UNDERSTANDING ANEMIA

GUIDANCE FOR CONDUCTING A LANDSCAPE ANALYSIS

SECOND EDITION

USAID
FROM THE AMERICAN PEOPLE

SPRING
Strengthening Partnerships, Results, and Innovations in Nutrition Globally

ABOUT SPRING

The Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING) project is a five-year USAID-funded cooperative agreement to strengthen global and country efforts to scale up high-impact nutrition practices and policies and improve maternal and child nutrition outcomes. The project is managed by JSI Research & Training Institute, Inc., with partners Helen Keller International, The Manoff Group, Save the Children, and the International Food Policy Research Institute.

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Contents

Acronym List

AGP	alpha-1-acid-glycoprotein
CFSVA	Comprehensive Food Security and Vulnerability Analysis
CRP	C-reactive protein
DDT	organochloride
DHIS2	District Health Information System2
DNA	deoxyribonucleic
ELISA	enzyme-linked immunosorbent assay
G6PD	glucose-6-phosphate deficiency
GAIN	Global Alliance for Improved Nutrition
HbS	sickle hemoglobin
HIV	human immunodeficiency virus
HPLC	high-performance liquid chromatography
IFA	iron-folic acid
IPTp	intermittent preventive treatment during pregnancy
IRS	indoor residual spraying
ITN	insecticide-treated bed nets
IYCF	infant and young child feeding
IZiNCG	International Zinc Nutrition Consultative Group
LLIN	long-lasting insecticide-treated bed net
SP	sulfadoxine-pyrimethamine
STH	soil-transmitted helminth

sTfR	serum transferrin receptors
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

Overview of the Landscape Analysis Guidance

Anemia is a major public health problem. It is characterized by low levels of hemoglobin, a protein that carries oxygen throughout the body. The effects of anemia include reduced cognitive and physical development in children, fatigue, and reduced physical stamina and productivity for people of all ages (Low et al. 2013; Lozoff 2007; Murray-Kolb 2013; Pasricha et al. 2014). During pregnancy, anemia increases the risk of preterm delivery, low birthweight, and maternal and neonatal mortality (Rahman et al. 2016).

Anemia disproportionately affects young children, pregnant women, and women of reproductive age. Globally, 43 percent of children under 5 years of age, 38 percent of pregnant women, and 29 percent of women of reproductive age are anemic (Kassebaum et al. 2014; Kassebaum and GBD 2013 Anemia Collaborators 2016). More information on the populations most affected by anemia is provided in the Step 1: Characterize Anemia Prevalence section of this guidance. Anemia is caused by multiple factors, with the main types of factors being infection, micronutrient deficiency, inflammation, and genetic blood variations. More information about the causes of anemia is provided in the Step 2: Establish Causes of Anemia section of this guidance. Recognizing the contributions from different sectors can better promote effective integration of anemia-related policies and programs. More information on the policies and interventions to reduce anemia can be found in the sections Step 3: Review Anemia Policies and Step 4: Assess Status of Anemia Interventions of this guidance.

WHAT IS A LANDSCAPE ANALYSIS?

Landscape analyses have been conducted in many different ways and they are closely related to a context assessment or situation analysis. For this guidance, we define a landscape analysis as a detailed assessment that uses primary and/or secondary data to describe a problem and the policies and interventions already in place to address this problem, in a given setting.

While the final format and output of a completed anemia landscape analysis will vary, your landscape analysis should include, at a minimum—

- introduction to the anemia situation in your country
- description of the methods used to conduct the landscape analysis, including how you gather information to include in the landscape analysis
- discussion of the risk factors for, or causes of, anemia that are present in your country
- overview of the policy situation in your country, as it relates to anemia
- discussion of the coverage and implementation of anemia prevention and reduction activities.

For country examples of anemia landscape analyses, please visit the Next Steps and Resources section.

WHY CONDUCT AN ANEMIA LANDSCAPE ANALYSIS?

Tackling the problem of anemia—a major endeavor—requires policymakers and implementers across a country to be committed and to show leadership. The United States Agency for International Development's (USAID) *Integrated Anemia Prevention and Control Toolkit* on the Knowledge for Health website (www.k4health.org/toolkits/anemia-prevention) identifies three key steps for developing a strategy for anemia prevention and control:

1. Know the problem.

2. Raise awareness and develop partnerships.

3. Identify interventions and implementation plans.

Conducting an anemia landscape analysis will help stakeholders "Know the problem." With this information, you can easily move on to the next two steps of strategy development. It is important to note that the three-step process can be circular. For example, participation in the process of "knowing the problem" may help raise awareness and develop partnerships with stakeholders not previously involved in anemia work.

WHO SHOULD USE THIS ANEMIA GUIDANCE AND TOOL?

The guidance is primarily directed at technical experts planning to carry out a landscape analysis; the guidance will also be of interest to anyone looking for a better understanding of anemia in their country: government staff in anemia-related ministries, nutrition program implementers, and planning staff in anemia-related sectors. The process of developing an anemia landscape analysis should include participation by multiple stakeholders working together to ensure all relevant and existing data are included and to build buy-in.

HOW DO YOU USE THE ANEMIA LANDSCAPE GUIDANCE DOCUMENT?

The *Guidance for Conducting a Landscape Analysis* and accompanying Excel-based *Anemia Landscape Analysis Tool* provide the reader with a guide and tool to develop an anemia landscape analysis that includes context-specific evidence, and it identifies areas that should be prioritized to guide anemia efforts in your country. You can also use this guidance document and/or the accompanying Excel-based tool to review an existing anemia landscape analysis.

This guidance leads you through the process of conducting a landscape analysis to understand the anemia situation in your country. **Box 1** explains the information included in the guidance document. Throughout the guidance, we offer suggestions about how to use the information and incorporate it into your landscape analysis.

WHO SHOULD BE INVOLVED IN DEVELOPING A LANDSCAPE ANALYSIS?

A variety of factors cause anemia and multiple sectors are involved in controlling and treating it, so this exercise will benefit from input from various sectors and stakeholder groups. Including multiple voices in this process, from the beginning, creates an awareness of the problem of anemia and ownership of the process of combating anemia. Conducting a landscape analysis should include staff from government, along with representatives of civil society, donors, academia, United Nations agencies, and the private sector who work in areas that include—

- health
- water and sanitation
- education
- agriculture
- gender and social welfare
- industry
- finance
- statistics.

Box 1: Navigating this Guidance Document

While the sections of this guidance are presented in order, you may want to explore them out of order, or return to completed sections as new information becomes available:

- Using the Anemia Landscape Analysis Tool: Provides an overview of the Excel-based tool for presenting information on your country's anemia situation.
- Gathering Information on Anemia: Outlines how to collect the prevalence, cause, policy, and intervention data you will need for your landscape analysis.
- Step 1: Characterize Anemia Prevalence: Helps you understand the burden of anemia in your country for various target groups, as well as additional details on how anemia is measured.
- Step 2: Establish the Causes of Anemia: Describes the multi-sectoral and multi-factoral nature of anemia, enabling you to explore the causes and risk factors of anemia and identify priority areas for intervention.
- Step 3: Review Anemia Policies: Explains how to gather data on the anemia policy environment. This will enable you to illustrate the policy landscape in which your country's anemia reduction interventions operate.
- Step 4: Assess Status of Anemia Interventions: Provides more information on the various solutions for addressing anemia. Use this information to identify areas that will improve the reach and efficiency of anemia prevention and reduction activities.
- Next Steps and Resources: Guides you to other resources and activities that will help translate your findings into action.

FOR MORE DETAIL

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Low, Michael, Ann Farrell, Beverley-Ann Biggs, and Sant-Rayn Pasricha. 2013. "Effects of Daily Iron Supplementation in Primary-School-Aged Children: Systematic Review and Meta-Analysis of Randomized Controlled Trials." *CMAJ: Canadian Medical Association Journal = Journal de l'Association Medicale Canadienne* 185 (17): E791-802. doi:10.1503/cmaj.130628.

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Using the Landscape Analysis Tool

The *Anemia Landscape Analysis Tool,* an Excel-based tool, allows you to present information on the anemia situation in your country in a format that can be shared with stakeholders. The Excel-based *Anemia Landscape Analysis Tool and User's Guide* can be downloaded at www.spring-nutrition.org/publications/series/understanding-anemia.

You can include the output of the tool in your landscape analysis or present it as a standalone document. You can complete this tool at any point in your landscape analysis process, but we recommend reviewing all the information in the guidance on how to conduct an anemia landscape analysis before downloading and using the tool.

Completing this tool is best done as a collaborative process. The Excel file is formatted so you can print the three questionnaires and complete them with colleagues before entering data into the tool.

- **Prevalence Questionnaire:** Captures information related to national anemia prevalence, as well as risk factors for anemia, including infection, inflammation, micronutrient deficiencies, and genetic red blood cell disorders. You can include up to two years of data for each indicator and disaggregate anemia prevalence by region.
- **Program Questionnaire:** Captures information on the current status of interventions for anemia reduction and control. Program data is often available from a variety of sources; an optional worksheet allows you to track different estimates. The questions are divided into the following topics: nutrition, disease control, water and sanitation, reproductive health, agriculture, and genetic counseling and management.
- **Strategy/Policy Questionnaire:** Captures information on which anemia-related policies or strategies are in place.

Data from questionnaires are compiled and summarized in two dashboards. The dashboards will automatically update to reflect new information as you add it to the questionnaires. You can print the dashboards to share with stakeholders or incorporate the tables and graphs into other materials.

- **Overview Dashboard:** Provides a "snapshot" of the situation of anemia at the regional and national levels, as well as the risk factors for anemia. The information is populated from the prevalence questionnaire.
- **Findings Dashboard:** Includes a summary of interventions to address anemia, summarized by topic area. Information is presented on policies and the existence of programs and their coverage. High impact interventions are presented graphically. The dashboard also highlights the various sectors that have to be involved in the integrated control of anemia.

Gathering Information on Anemia

While there are many different ways to conduct an anemia landscape analysis, a key piece is to assemble the data that will enable you to understand a situation as clearly as possible. Landscape analyses range from basic to complex, depending on your resources, data availability, audience, and goals. Generally, though, you will need to gather information from multiple sources and sectors. You will want to gather information on—

- anemia prevalence
- causes of anemia
- anemia policies
- status of anemia interventions.

Throughout this guidance, we ask you to review this information as a way to better understand the anemia situation in your country. Ideally you will have recent, high-quality, comprehensive, and disaggregated data that are representative of your population of interest. While it is helpful to have high-quality data to carry out a landscape analysis, this guidance will walk you through a process that is appropriate for any level of data you can gather. For more information see the Additional Data Sources section on page 8.

WHERE DO YOU GET THESE DATA?

Begin by investigating what sources are available in your country. Relevant information may be included in routine government reporting systems or regulatory monitoring systems. National alliances or working groups, or similar bodies that oversee health (e.g., nutrition, disease control, reproductive health, etc.), agriculture, or other relevant sectors, may have anemia-related information.

Routine data sources that may have relevant data include—

- **Routine health information collected through a national health monitoring information system.** Most countries collect routine data on health facility performance, prevalence of diseases (through treatment data), and coverage of preventive activities. These data are not always publically available, although ministries of health will often publish annual reports. While the chance of human error is high in many administrative reporting systems, countries with computer-based platforms that automate schedules and aggregation will probably have better reporting rates and data quality. More than 40 countries use the District Health Information System2 (DHIS2) platform to collect these data. For more information: www.dhis2.org or on country-specific DHIS2 websites.
- **Routine commodity tracking information may be available through a national logistics management and information system.** National agencies and development partners involved in health supply chain efforts maintain one or more tracking systems to oversee the movement of different classes of commodities. These data are not always publically available, but agencies that oversee the system may publish regular reports. Increasingly, these data are tracked through electronic systems that often have a public website. For more information: www.pmi.gov/docs/default-source/default-document-library/tools-curricula/elmis-selection-guide-electronically-managing-supply-chain-information.pdf?sfvrsn=6.

Periodically collected data sources that may have relevant data include—

- **Comprehensive food security and vulnerability analysis.** This survey assists in developing an understanding of the food security situation and household vulnerabilities in a given country. The survey aims to identify root causes of food insecurity; develop profiles of food insecure and vulnerable people; analyze markets; and analyze risks, such as natural disasters and their potential impact on the most vulnerable. For more information: www.wfp.org/food-security/assessments/comprehensive-food-security-vulnerability-analysis.
- **Demographic and Health Surveys.** These surveys are carried out in many countries on a regular schedule (usually every five years). They provide data on a wide range of indicators in the areas of population, health, and nutrition. Most surveys include estimates of anemia prevalence. The Demographic and Health Survey program also supports the Malaria Indicators Surveys—data on malaria treatment, prevention, and prevalence—and Service Provision Assessment surveys—data on health facility characteristics and provided services. For more information: www.dhsprogram.com.
- **Household Consumption and Expenditure Surveys.** This collective term refers to multipurpose household surveys that include data on the purchase and consumption of foods, as well as other socioeconomic indicators. While these surveys often report data at the household level and, therefore, do not allow for discussions of intra-household resource allocation, they are a tool for estimating nutrient intake patterns and possible prevalence of dietary inadequacy. For more information: www.spring-nutrition.org/about-us/activities/household-consumption-and-expenditure-surveys and in Fiedler et al. (2012).
- **Knowledge Practice and Coverage Survey.** This survey assesses the health situation at a local level, such as a program area or district, and then measures progress toward a result. The survey has seven modules, including sick child, malaria, immunization, maternal newborn care, family planning, breastfeeding infant and young child feeding, water and sanitation, and background. Each module contains questionnaires and indicators that help track improved health outcomes. For more information: www.mchip.net/node/788.
- **List-based food questionnaire.** List-based questionnaires rely on participant recall of food consumed during the prior defined period of time, often 24 hours. Although these questionnaires cannot describe diet quality for an individual, they are a population-level proxy indicator for micronutrient adequacy. For more information: www.fao.org/3/a-i5486e.pdf.
- **Multiple Indicator Cluster Survey.** The United Nations Children's Fund (UNICEF), carries out these surveys in many countries periodically with some countries having data collection as often as every three years. Results from these household surveys provide data on a wide range of health and socioeconomic indicators for women and children in low- and middle-income countries. For more information: www.mics.unicef.org.
- **National Micronutrient Survey**. This collective term refers to surveys that use biological markers to collect data on micronutrient deficiencies. While not available in most countries, these

surveys have been conducted in more countries in recent years in response to demands for greater detail on the prevalence of micronutrient deficiencies. In addition, national micronutrient surveys increasingly include factors beyond micronutrient status that are relevant to anemia, such as malaria, human immunodeficiency virus (HIV), and helminths. For more information: www.cdc.gov/immpact/index.html.

Global databases and repositories that may have relevant data include—

- **Global Burden of Disease study.** This comprehensive study includes data from 120 countries and covers a variety of health topics in its effort to measure global epidemiological levels and trends. For more information: www.healthdata.org/gbd.
- **Global database on the Implementation of Nutrition Action.** The World Health Organization (WHO) houses a database of country policies related to anemia. For more information: www.who.int/nutrition/gina/en/.
- **Nutrition Landscape Information System.** This information system, a web-based tool, presents country profiles that include a snapshot of nutrition, health, and development data from several available sources, at a national level. For more information: www.who.int/nutrition/nlis/en/.
- **Vitamin and Mineral Nutrition Information System.** This database provides up-to-date national, regional, and global assessments of vitamin and mineral deficiencies; summarizes data on the vitamin and mineral status of the population; tracks progress toward elimination of deficiencies; and offers tools and resources to support a nutritional status assessment. For more information: www.who.int/vmnis/en/.
- **e-Library of Evidence for Nutrition Actions.** This e-Library provides the latest evidence-informed nutrition guidelines, recommendations, and related information for nutrition interventions. While it is not a specific data source, it is a useful resource for scaling up nutrition interventions. For more information: www.who.int/elena/en/.

ADDITIONAL DATA SOURCES

Of course, the ideal data source is not always available. Even without information that fits the characteristics above, you can still conduct an anemia landscape analysis if you have information that provides a picture of the current situation. Additional data sources for your landscape analysis can include one-time or irregular survey data, subnational surveys, key informant interviews, or systematic reviews. After you identify possible data sources, selecting what to use is more of an art than a science. When deciding whether or not to use these data sources, consider their quality and representativeness with stakeholders, and ensure that you clearly state any limitations when sharing the findings. We included questions to ask as you consider using each data source. No clear guidelines govern what data is "too old" or "too small" to use for an anemia landscape analysis, but you can decide with your colleagues whether the data improves your understanding of the anemia situation in your country or provides helpful information to your landscape analysis audience.

- **Government websites.** Government websites—such as Ministry of Health and Sanitation and other sector website—can provide national data

reports and provide information on the status of current nutrition-related policies, interventions, and infrastructure.

  - How recent are the latest pieces of information?
  - Are resources missing that should be available?

- **One-time or irregular survey data.** Many research organizations or projects conduct surveys that represent the national, subnational, or project levels, at various points. Talk to implementers, or your national statistics body, to identify surveys that you can use.

  - Did the data collectors use appropriate methods for their outcomes of interest?
  - Are the findings recent enough to present an accurate picture of the current situation?
  - If not nationally representative: How does this population compare to your population of interest?

- **Subnational surveys or data collection.** To conserve resources, or focus on a specific target group, data are often collected that are not nationally representative. Talk to subnational implementers, subnational policymakers, or the national statistics body to identify data that may apply to your population of interest.

  - Why was this specific population chosen for the data collection?
  - What do you know about this group in relation to the rest of the country that may affect your findings?

- **Older data.** Data from sources that are not considered recent can still be informative if you believe the situation has not changed much in the intervening time. Most likely, you will not want to go back further than 10 years.

  - How has this situation changed in the time since the data were collected?
  - How often or quickly does this situation generally change?
  - Do you believe these data give an accurate description of the current situation?

- **Key informant interviews.** Many times, data are not available for the programs or issues you are interested in. In these situations, experts in the field may have enough experience to help you understand the general trends in this area or informal data from on-the-ground implementers. These qualitative or general data may be helpful in the early stages of a landscape analysis.

  - Where does their information come from and what do you know about those sources?
  - What should you keep in mind or consider regarding their understanding of the issue?
  - What preconceived notions or biases might this expert have when forming their opinion?

- **Conduct a systematic search for data on anemia and its risk factors.** If high-quality nationally representative data are not available, it only takes a few steps to identify additional data sources for your anemia landscape analysis. **Box 2** includes steps to follow in conducting a search and a list of relevant terms. You can build on these searches by specifying population groups of interest relevant for your context—women of reproductive age, pregnant women, adolescents, school-age children, young children, children, or infants. Remember, most findings are linked to specific geographic areas within a country,

or to a specific target group, and cannot be generalized to the whole country. Even so, these data can offer a gauge and range. You may need to conduct a systematic search to find data on risk factors for anemia; data on interventions are often more readily available.

Box 2: Steps for Conducting a Systematic Search for Anemia-related Data in your Country

1. Decide on the timeframe: How far in the past do you want to go in each of the databases you search? For the maximum number of results, start from their earliest available dates, but this will probably result in too much information. Because you want data that represent the current situation, consider limiting your results to the last 15 to 20 years. If you limit your options, track the timeline you use and be consistent across databases. In addition, track the dates when you run the search. Monitoring the dates (both start and end) will keep your landscape analysis up-to-date.
2. Identify databases: Some databases let you search their content for free, while others require payment. As with your search dates, track the databases you use. The following databases have anemia-related content:
    a. Ovid MEDLINE*: ospguides.ovid.com/OSPguides/medline.htm
    b. Cochrane Database of Systematic Reviews: onlinelibrary.wiley.com/cochranelibrary/search
    c. Cochrane Central Register of Controlled Trials: onlinelibrary.wiley.com/cochranelibrary/search?searchRow.searchOptions.searchProducts=clinicalTrialsDoi
    d. CAB Abstracts: www.cabi.org/publishing-products/online-information-resources/cab-abstracts/
    e. Global Health: www.ebscohost.com/academic/global-health
    f. Global Health Archive: www.ebscohost.com/archives/stm-database-archives/global-health-archive
    g. Google Scholar (scholar.google.com) and Web of Science (ipscience.thomsonreuters.com/product/web-of-science) are additional search options, but they will give you many more results; make your searches of these databases more specific and be prepared to screen many more results.
3. Choose your search terms: By carefully defining your search terms, you will identify the most appropriate results. See **Table 1** for an example of search terms used in an anemia landscape analysis search. Always include the relevant terms for your country, which may not be on this list. Note: A space is included for you to add your country at the end of both search term groups.
4. Conduct the search: To identify the most data sources, first search for each group of terms separately (i.e., run the search terms in #1, then run a separate search with the terms in #2). After you finish each search, remove any duplicate results.

*Note that Ovid MEDLINE includes results from PubMed (www.ncbi.nlm.nih.gov/pubmed), but with a three-month lag.

Table 1: Terms for Anemia-Related Data Systematic Search

Search Term Group	Search Terms
#1: Risk factors **(separate with "OR")**	**General terms:** Anemia, Nutrition, Nutritional Status, Nutritional Deficiency, Hypochromic, Macrocytic, Microcytic **Genetic Variations:** Sickle Cell, Thalassaemias, Hemoglobinopathies, Ovalocytosis, G6PD deficiency **Micronutrient deficiency:** Megaloblastic, Transferrin, Ferritin, Hepcidin, Zinc Protoporphyrin, Micronutrients, Iron-Deficiency, Fortification, Enrichment, Supplementation, Receptors, Vitamin B12, Vitamin B12 Deficiency, Cyanocobalamine, Vitamin A Deficiency, Night Blindness, Xerophthalmia, Folic Acid, Folic Acid Deficiency, Folate Deficiency, Neural Tube Defects, Zinc, Zinc Deficiency **Infection:** HIV-AIDS, Helminths, Nematode Infections, Ascariasis, Cestoda, Leishmaniasis, Trichuriasis, Trichuris, Helminthiasis, Ancylostomatoidea, Filariasis, Microfilaria, Fasciola Hepatica, Filarioidea, Wuchereria Bancrofti, Strongyloides, Enterobius, Necator, Schistosomiasis, Bilharzia, Round Worm, Hookworm, Tapeworm, Whipworm, Filarial, Malaria, Plasmodium **Inflammation:** Inflammation, obesity, anemia of chronic disease, anemia of chronic inflammation AND **YOUR COUNTRY NAME**
#2: Populations	Pregnancy OR Women of Reproductive Age OR Adolescent OR Women OR Children OR Infants AND **YOUR COUNTRY NAME**

HOW TO INCLUDE THIS INFORMATION IN YOUR LANDSCAPE ANALYSIS

Your landscape analysis report should include a description of the data you selected and explain why you selected it. Use the "Methodology" section of your report to describe the decision-making process and include details of the sources. While many sources for data relating to anemia causes and interventions are available, often important data are not regularly collected. In particular, National Micronutrient Surveys usually provide the most comprehensive picture of the anemia situation in a country. These surveys often include information on micronutrient status, but also the prevalence of other infections, as well as coverage of relevant interventions. These surveys are expensive, but they will provide the most comprehensive data on anemia-related issues.

As you start to use the findings from your landscape analysis, having recent and representative data can greatly aid the process of planning and targeting programs. If your country does not have up-to-date information on anemia prevalence, causes of anemia, anemia policies, and status of anemia interventions, note this in your landscape analysis and consider working with policymakers in your country to collect the relevant data. It is important to keep in mind that there is value to conducting a landscape analysis, even when you lack some of the "ideal" data—understanding the available data and gaps is necessary for planning future activities.

FOR MORE DETAIL

Fiedler, John L., Keith Lividini, Odilia Bermudez, and Marc Smitz. 2012. "Household Consumption and Expenditures Surveys (HCES): A Primer for Food and Nutrition Analysts."

Step 1: Characterize Anemia Prevalence

The prevalence and burden of anemia disproportionately affects children under 5 years of age, pregnant women, and non-pregnant women of reproductive age because of the increased nutrient needs and susceptibility to infections, as well as menstruation in non-pregnant women of reproductive age. Because of these biological factors, most data on anemia are collected for these three target groups. While men can suffer from anemia, women and children are most vulnerable and are the focus of most public health interventions.

HOW IS ANEMIA CATEGORIZED?

According to WHO, anemia is a severe public health problem when the anemia burden is higher than 40 percent; moderate, if between 20 and 39.9 percent; and mild, if between 5 and 19.9 percent (WHO 2011). **Table 2** presents the severity of the anemia public health problem, by prevalence.

Table 2: Severity of Anemia as a Public Health Problem

Public Health Problem	Prevalence
No	<5%
Mild	5–19.9%
Moderate	20–39.9%
Severe	≥40%

Source: WHO 2011

HOW IS ANEMIA MEASURED?

Measuring hemoglobin is the primary method for assessing anemia. Anemia is diagnosed if the amount of hemoglobin present in the bloodstream is below the set thresholds, based on age, sex, and physiological status.

The thresholds of hemoglobin in **Table 3** are the suggested cutoffs for anemia severity, with differences based on sex, age, and pregnancy status. Often, these different levels of anemia are presented as "any anemia" that combines those with mild, moderate, and severe anemia into one grouping.

The HemoCue system, commonly used in the field, includes a portable photometer, a microcuvette (for collecting blood), and dry hemoglobin conversion reagents. Measurements can also be done on blood samples in a lab.

WHERE CAN WE GET THESE DATA?

Surveys that collect hemoglobin measurements include—

- Demographic and Health Surveys
- Malaria Indicator Surveys
- National Micronutrient Surveys
- WHO Global Database on Anemia.

Many research and evaluation activities collect biomarker data related to anemia and its causes. Kassebaum et al. (2014) includes a list of available data from 150 countries in supplemental tables 1 and 2 of the online appendix. For more information: www.ncbi.nlm.nih.gov/pmc/articles/PMC3907750/bin/supp_123_5_615__index.html.

Table 3: Anemia Cutoffs in Hemoglobin (grams/liter) at Sea Level

Population	No Anemia	Mild Anemia	Moderate Anemia	Severe Anemia
Children 6–59 months of age	Equal to or above 110	100–109	70–99	Below 70
Children 5–11 years of age	Equal to or above 115	110–114	80–109	Below 80
Children 12–14 years of age	Equal to or above 120	110–119	80–109	Below 80
Non-pregnant women of reproductive age (15 years of age and above)	Equal to or above 120	110–119	80–109	Below 80
Pregnant women	Equal to or above 110	100–109	70–99	Below 70
Men (15 years of age and above)	Equal to or above 130	110–129	80–109	Below 80

Source: WHO 2011

Information related to anemia prevalence is rarely collected through routine data sources, but it may be available through the country's health monitoring information system. Consider the usage of health care services in your context when interpreting findings, because not all people suffering from anemia will seek services at a facility.

METHODOLOGICAL ISSUES

- Living above sea level and smoking increases hemoglobin concentrations, resulting in an underestimate of the prevalence of anemia. Applying adjustments to hemoglobin concentrations corrects this underestimation. Adjustments are applied by subtracting a set value from individuals' hemoglobin concentrations, depending on how many meters above sea level an individual resides (**Table 4**) and/or how frequently he/she smokes (**Table 5**). Make these adjustments before applying anemia cutoffs. If these factors are not properly adjusted, the results will underestimate anemia for populations at higher altitudes and for smokers. If you are using secondary data, many surveys may have made these adjustments. If they have not, and they include populations living 1,000 meters above sea level, or data are from a population of frequent smokers, include it as a weakness in your limitations.

Table 4: Hemoglobin Concentration Adjustments for Altitude

Altitude (meters above sea level)	Measured Hemoglobin Adjustment (g/l)
<1,000	0
1,000	-2
1,500	-5
2,000	-8
2,500	-13
3,000	-19
3,500	-27
4,000	-35
4,500	-45

Source: WHO 2011

Table 5: Hemoglobin Concentration Adjustments for Smoking Status

Smoking Status	Measured Hemoglobin Adjustment (g/l)
Non-smoker	0
Smoker (all)	-0.3
½ –1 packet/day	-0.3
1–2 packets/day	-0.5
≥ 2 packets/day	-0.7

Source: WHO 2011

- There is some indication that capillary blood has a slightly higher hemoglobin concentration than venous blood. Studies in the field in low- and middle-income countries report that hemoglobin measurement in capillary blood samples trend higher than from venous samples: 10 of 13 studies, with the difference ranging from 1 to 17 g/L. This trend is also seen in studies done in laboratory settings (Rappaport et al. 2017). Thus, when reviewing studies or reports, consider the blood collection methods when comparing results between surveys that used different techniques. An example of this is in Bangladesh in which the prevalence of anemia differed, despite being collected the same year; it was hypothesized this was the result of using capillary blood in one survey and venous blood in the other survey (see **Box 3**). If you find that surveys used different collection methods, include it as a weakness in your limitations.

DESCRIBE VARIATIONS IN ANEMIA BURDEN

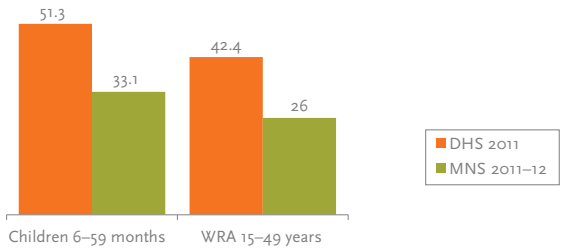
While national prevalence rates can help you understand the overall burden of anemia in your country, variations at the subnational level are common. These subnational variations are important for programmers and policymakers interested in targeting their interventions to the most affected populations. Reviewing disaggregated national anemia data can help identify areas or groups with an anemia burden higher than the national average. Patterns of anemia may vary

Box 3: Difference in Anemia Prevalence between Two Studies in Bangladesh

Example: Bangladesh conducted surveys using different methods in 2011/12. As seen in **Figure 1**, the Demographic and Health Survey data (capillary) showed higher levels of anemia than the national micronutrient survey results (venous) held in the same year.

Source: NIPORT, Mitra and Associates, and ICF International 2012; and icddr,b, UNICEF, GAIN and IPHN 2013.

Figure 1: Percentage of Population Suffering from Any Anemia (Bangladesh)



WRA - women reproductive age

DITS - Demographic Health Survey

MNS - micronutrient Survey

within countries because of many factors: the burden of anemia-related diseases and infections, functionality of supply chain and distribution networks, availability of micronutrient-rich foods for consumption, etc. Income inequality and women's empowerment are often reflected in anemia rates that vary with socioeconomic status and maternal education (Kassebaum et al. 2014).

Anemia prevalence varies over time and with populations. The anemia burden can shift from being more severe to less, or the opposite. Discuss with stakeholders the specific factors that could influence the anemia rates at the national and subnational levels. If data are available, review the anemia prevalence for your target groups by geographic area, income, education, or other similar factors to see if any populations are disproportionately affected by anemia. Disaggregation of data by additional indicators—such as sex, pregnancy status, age, education levels, and urban versus rural residence—may also reveal important information. You can prepare graphs of anemia prevalence by target group, or by various characteristics, to illustrate the variation in the anemia burden in your country. These types of basic data are often collected in surveys as part of a "Background" or "Household" characteristics section. For more details on these possible indicators, see **Table 6**.

Table 6: Possible Disaggregation Indicators for Anemia Prevalence

Indicator	Details
Socioeconomic status	Many surveys report a wealth index or percentiles. An example (based on wealth quintile) is poorest, poorer, middle, richer, and richest.
Sex	The prevalence of anemia often varies between females and males.
Age	Nutrient requirements vary across age groups. Examples of these groupings are— • infants and young children (months): 6–11, 12–23, and 24–59 • children (years): 5–11, 12–14 • adults (years): 15–24, 25–34, 35–44, 45–54, and 55+
Pregnancy status	Pregnant and lactating women have additional nutrient requirements; they can be reached through a different set of delivery platforms than the non-pregnant population.
Education levels	Often grouped by level of school completed. Examples include no formal schooling, some primary schooling, completed primary, completed some secondary schooling, completed secondary, and completed post-secondary education.
Residence	Urban and rural populations have different risk factors for anemia; they often do not have access to the same delivery platforms for anemia prevention and control programs.
Social groups	In many countries, anemia can vary significantly across social groups that may face different risk factors and have different access to anemia prevention and control programs. These can include ethnicity, case, religion, indigenous groups, etc.

FOR MORE DETAIL

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Step 2: Establish Causes of Anemia

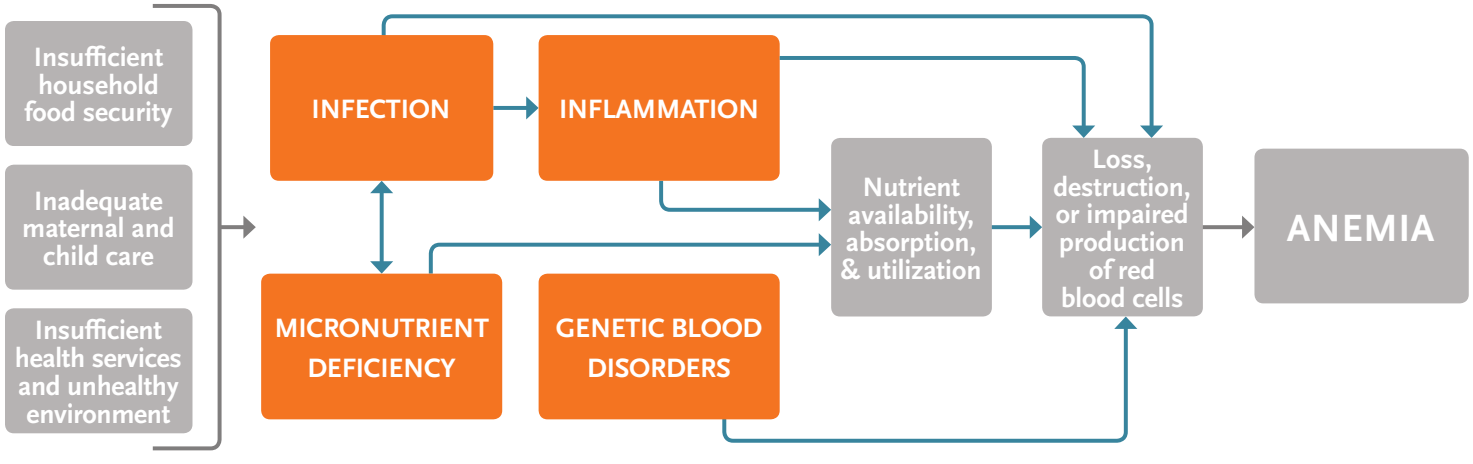
Anemia is a complex public health problem caused by multiple factors. **Figure 2** outlines the four main types of the immediate causes of anemia—infection, micronutrient deficiency, inflammation, and genetic red blood cell disorders—which affect the body's ability to access, absorb, and use important nutrients and undermine red blood cell production. Food security, inadequate maternal and child care, and health services and the environment are highlighted in the left-hand side of the figure to represent the main underlying causes of anemia. Knowing the causes that contribute to the anemia burden can help you identify which actions will be necessary to prevent and control the disease in your country.

HOW TO INCLUDE THIS INFORMATION IN YOUR LANDSCAPE ANALYSIS

To understand the relative importance of each cause, you must collect data that illustrate the role each cause plays in the burden of anemia. In your landscape analysis, explore which data are available for each cause of anemia, describe what is known about each potential cause, and use the information in this guidance to understand the relative importance of each cause in your context.

To illustrate the variations in your country, you can also include graphs of the prevalence of each cause by target group, or by various characteristics. Looking at these causes of anemia, over time, may help you identify whether their prevalence, and the resulting risk of anemia, has increased or decreased. Some causes may include a measure of the public health significance, which you can include in your landscape analysis. You do not need to do additional or complex analysis linking anemia to these risk factors unless your team has the epidemiological expertise. The rest of this section describes the four main types of causes of anemia and how to capture information about them in your landscape analysis. The subsequent sections of this guidance—Step 3: Review Anemia Policies and Step 4: Assess Status of Anemia Interventions—include more information on how to address anemia.

Figure 2: Anemia Causal Pathway



Adapted from the Biomarkers Reflecting Inflammation Nutritional Deficiencies (BRINDA) Project.

In the sections that follow, we included a number of methodological issues for each of the causes of anemia, which are important for you to understand. You should understand a number of common issues while reviewing data on the causes of anemia, and we discuss them here.

- Often, you can use more than one technique to estimate the prevalence of anemia causes (e.g., prevalence of malaria infection or iron deficiency). Data from different years or sources may use different techniques to calculate the same indicator. For each data point included in your landscape analysis, to ensure that the data are comparable and representative at the same level, note the sampling method, technique, and season when the data were gathered.
- When you interpret biomarkers, be sure to check that the biomarkers, techniques, units, and cutoff points used are consistent with the recommendations. In your report, include any differences from the current recommendations.
- In general, use population-based surveys to determine the prevalence of the causes of anemia. If not available, consider other types of surveillance data—for example, a country's health management information system—to estimate the prevalence of the causes of anemia. However, these sources will only capture confirmed cases or diagnoses that are reported through the health care system. As a result, they are likely to underestimate the extent of the cause's prevalence, especially because surveillance is often weakest in countries with high prevalence of the causes of anemia. The quality of data available through these data sources will vary depending on their design and the in-country capacity for monitoring.
- Many research or evaluation activities collect biomarker data. Kassebaum et al. (2014) includes a list of available data from 150 countries in supplemental tables 1 and 2 of the online appendix. For more information: www.ncbi.nlm.nih.gov/pmc/articles/PMC3907750/bin/supp_123_5_615__index.html.
- You may need to rely on research data to access information about the causes of anemia. A systematic search of electronic databases—for example, PubMed and the Cochrane libraries—may be helpful (see **Box 2** in Gathering Information on Anemia). Use specific keywords for the cause you are interested in, as well as the name of the country. You can limit the search by specifying population groups of interest—women of reproductive age, pregnant women, adolescents, school-age children, young children, children, or infants. Remember, it is important to state as a limitation in your landscape analysis that the findings are linked to specific geographic areas within a country, or to specific target groups, and cannot be generalized to the whole country. Even so, these data may offer a gauge and range of the prevalence of causes of anemia within your country.

Infection

Infection and anemia are directly and indirectly related through a number of mechanisms (Roberts 2016). Certain infections cause anemia directly by destroying red blood cells or by decreasing their production. Some infections can also cause anemia directly by blood loss, or indirectly through depletion of iron stores (see Iron Deficiency section). Anemia is also caused by several chronic conditions, including HIV and AIDS (Calis et al. 2008; Volberding et al. 2004), peptic ulcer disease, gastritis and duodenitis, chronic kidney disease, and uterine fibroids (Kassebaum et al. 2014). These chronic conditions go beyond the scope of this guidance, although some countries may want to address them in the context of anemia. The inflammation that accompanies acute infections and chronic conditions can also indirectly cause anemia (see Inflammation section).

WHICH KEY INFECTIONS CAN DIRECTLY CAUSE ANEMIA?

- malaria
- soil-transmitted helminths, particularly hookworm
- schistosomiasis.

INTERVENTIONS THAT ADDRESS THESE INFECTIONS

- case management of malaria
- deworming for schistosomiasis
- deworming for soil-transmitted helminths
- indoor residual spraying
- intermittent preventive treatment during pregnancy
- long-lasting insecticide-treated bed nets.

For more information about these interventions, go to Step 4: Assess Status of Anemia Interventions.

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Malaria

Malaria, a serious vector-borne illness, is transmitted to people when a mosquito infected with the protozoan parasite, *Plasmodium*, bites them. Four different species of *Plasmodium* cause malaria; *p. falciparum, p. malariae*, *p. ovale*, and *p. vivax,* with *p. falciparum* and *p. vivax* posing the greatest public health threat (WHO 2015a). The largest number of malaria deaths can be attributed to the *p. falciparum* parasite, which is most prevalent on the African continent. *P. vivax* is also present on the African continent, but its ability to survive higher altitudes and cooler climates means that it has a wider geographic distribution (WHO 2015a). Malaria causes anemia by destroying red blood cells; decreasing the production of new red blood cells, which also leads to iron deficiency (see Iron Deficiency section); and general inflammation (see Inflammation section) (Spottiswoode, Duffy, and Drakesmith 2014). Children under 5 years of age and pregnant women are at a much higher risk for contracting malaria and becoming seriously ill. School-age children are also increasingly recognized as an important population group because, as transmission of malaria among young children is successfully decreased, children fail to build immunity to malaria until later in life. This means that school-age children in previously endemic areas will most likely experience an increase of severe and uncomplicated malaria cases, because they are no longer building an immunity during early childhood (Nankabirwa et al. 2014).

HOW IS MALARIA CATEGORIZED?

The gold standard for measuring malaria transmission is entomological inoculation, but it is difficult to measure and lacks precision at low levels of transmission. Thus, communities are categorized as low, moderate, or high transmission areas, using the prevalence of malaria in children 2 to 9 years as a proxy, as defined in **Table 7** (WHO 2009). Malaria associated anemia is defined as hemoglobin <80 g/L, which is an indication of malaria morbidity and, thus, useful for tracking the impact of malaria interventions (Korenromp et al. 2004; Roll Back Malaria et al. 2009).

Table 7: Definition of Malaria Transmission Levels

Category of Infection	Prevalence in Children 2–9 Years
High transmission/ transmission intense except during dry season	>50%
Moderate transmission/ transmission occurs during regular season	11–50%
Low transmission/ transmission is intermittent	≤10% during most of the year

Source: WHO 2015b

HOW IS MALARIA MEASURED?

The gold standard measure of malaria prevalence is microscopy—blood smears are examined under a microscope to identify malaria parasites. However, rapid diagnostic tests, which can provide results in 15 minutes, can also be used to assess malaria prevalence. They are, generally, becoming the norm to obtain crude estimates of malaria prevalence. The most common rapid diagnostic tests look for antigens that occur with current or recent infection (Florey 2014).

WHERE CAN WE GET THESE DATA?

In malaria-endemic countries, surveys that collect malaria prevalence data include—

- Demographic and Health Surveys
- Malaria Indicator Surveys

- Multiple Indicator Cluster Survey
- National Micronutrient Surveys
- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

These surveys typically collect blood samples from children 6–59 months old and, sometimes, from women of reproductive age. Also, look for other surveys that may include school-age children.

Information related to malaria diagnosis is sometimes available through the country's health monitoring information system. Consider the usage of health care services in your context when interpreting findings, because not all people suffering from malaria will seek services at the facility. However, in Africa, care seeking for fever is generally high for children under 5 years of age.

METHODOLOGICAL ISSUES

- Look at the season when the data was collected. Malaria transmission is seasonal in most places, with peaks during and just after the rainy season. Thus, it is important to consider the season when comparing malaria prevalence data collected at different points in time.
- Look at the quality of the techniques used. For microscopy, the type of microscope, the quality of the blood smear, and the technician's expertise determine the quality of results (Florey 2014). Often, you will not have information on the quality of microscopy data collection unless you were directly involved in the data collection or have obtained this information from those that undertook the survey. If you have this information, include it in your report. For rapid diagnostic tests, the type and brand determine the accuracy of the test and should be reported on, if available (WHO 2015c).
- Look at the type of technique used. Generally, rapid diagnostic tests show higher malaria prevalence than microscopy, because the former test can show false positivity after the infection has been treated (Mappin et al. 2015). Adjustment approaches have been developed to compare malaria prevalence between rapid diagnostics and microscopy data using a regression approach (Mappin et al. 2015). Check to see if this adjustment approach was used when comparing malaria prevalence data collected at different points in time. If it was not used, note this in your limitations. If you have the raw data available, you can apply these adjustments yourself using instruction included in Mappin et al. (2015).
- When using health monitoring information system data, keep in mind that some countries include both clinical and confirmed malaria cases as a data point. Also, countries sometimes make a distinction between "confirmed" and "non-confirmed" malaria. Confirmed implies that some test (either a rapid diagnostic test or microscopy) was conducted for a parasitological-based diagnosis, whereas clinical malaria are cases that are diagnosed with malaria but do not have parasitological confirmation. Be sure to report the definition(s) used in your country's health monitoring information system.
- If you decide to directly link malaria and anemia in your analysis (e.g., regression), it is important to note that malaria-related anemia can persist after parasitemia has cleared. As a result, cross-sectional data may not capture the full extent of the anemia caused by malaria.

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Soil-Transmitted Helminths

Individuals are usually infected with soil-transmitted helminths (STH)—Ascaris, Trichuris, or hookworm—after eating or drinking food or liquids contaminated with parasitic worms or eggs. They can also become infected with hookworms if their skin comes in contact with soil that contains infective larvae of hookworm. Anemia from STH infections is caused by blood loss in the gastrointestinal system by interfering with the absorption of nutrients, suppressing appetite, and general inflammation (see Inflammation and Miconutrient Deficiency sections). Hookworm, due to the high levels of intestinal blood loss, is likely the main STH contributing to anemia. As a result of moderate to severe STH infections, children have an estimated loss of iron equal to twice the amount of their daily iron requirement (see Iron Deficiency section) (Stoltzfus et al. 1996; Smith and Brooker 2010). Young children, including school-age children, bear most of the infection burden (Albonjco et al. 1998), but pregnant women are also vulnerable to infection (Steketee 2003).

HOW IS STH INFECTION CATEGORIZED?

A community's risk for STH infection is categorized as high-risk or low-risk, depending on the prevalence. **Table 8** displays the cut-offs for high- and low-risk communities.

Table 8: STH Public Health Risk Based on Prevalence

Categories of Infection	Prevalence of Any STH Infection Among School-Age Children
High-risk community	≥50%
Low-risk community	≥20% and <50%

Source: Crompton and WHO 2006

HOW IS STH INFECTION MEASURED?

An analysis of stool samples is needed to detect the prevalence of STH. WHO recommends identifying parasitic eggs by microscopic laboratory process—permanent-stained fecal smears—to detect STH infection. Laboratory technicians can use many methods to prepare and examine samples, with varying levels of sensitivity, specificity, and cost (Nikolay, Brooker, and Pullan 2014). The Kato-Katz technique, useful for field surveys, estimates the intensity of the infection.

WHERE CAN WE GET THESE DATA?

Now that almost all countries have mapped neglected tropical diseases, data on STH is typically available through the Ministry of Health. Because school-age children are most at risk, and for logistical purposes, surveys are often done in schools. Some National Micronutrient Surveys also include this data for different populations at risk. In the coming years, data will be available through the WHO Regional Office for Africa portal (WHO 2016).

METHODOLOGICAL ISSUES

- WHO recommends the Kato-Katz technique in areas where the percentage of infected individuals is >20 percent, but use a more sensitive method in settings with a suspected lower prevalence (Speich et al. 2015). This is because when using the Kato-Katz technique with high infection intensity, there will be many eggs, so the infection will be easy to detect. But, with low infection intensity, there will be just a few eggs, so the infection may be missed. In general, the Kato-Katz technique will result in light infections not being diagnosed; keep this potential for underestimating STH infection in mind when interpreting data results.

- To determine hookworm levels, stool samples must be examined shortly after specimen collection, either on the spot or at a field laboratory, because trophozoites (active stage) disintegrate rapidly (Crompton and WHO 2006). You may not have adequate information on the extent to which samples were examined at the appropriate time unless you were directly involved in the data collection or obtained this information from someone directly involved in the survey. If you have this information, include it in your report.
- Consider the timing the data on STH prevalence was collected in relation to recent deworming campaigns. Data collected immediately after a mass deworming campaign will temporarily show a lower than normal rate of infection. Therefore, if the data were collected shortly after a deworming campaign, note this as a limitation. This will be especially problematic when comparing prevalence levels collected at two points in time, if one of the time points was collected much closer to the time of deworming campaign.

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Schistosomiasis

Schistosomiasis, a chronic disease, is caused by infection with schistosomes (a trematode parasite) from fresh water infected with specific fresh water snails (Colley et al. 2014). Fecal matter or urine from infected individuals pass eggs into the water; the parasites live in a snail host before releasing the larvae that cause the human infections. Unlike STH, schistosomes tend to be focally transmitted, because they need a specific freshwater host. The mechanisms by which schistosomiasis causes anemia likely involve a combination of effects, including blood loss, red blood cell destruction associated with sequestration in the spleen, immune mechanisms, iron deficiency as a result of blood loss/destruction, and general inflammation (Friedman, Kanzaria, and McGarvey 2005). Young children, as well as anyone in frequent contact with infested water, have the highest risk of being infected with schistosomiasis (Steketee 2003).

HOW IS SCHISTOSOMIASIS CATEGORIZED?

Blood in the urine is a morbidity indicator that can signal an intense infection. The number of schistosome eggs can be used to measure the intensity of infection which is categorized as light, moderate, or heavy, depending on the number of eggs per unit of sample (WHO 2002). Different species and infection types (i.e., bladder or intestinal) determine whether fecal or urine samples should be taken. **Table 9** displays the cut-offs for high-, moderate-, and low-risk communities.

Table 9: Schistosomiasis Public Health Risk Based on Prevalence

Category of Infection	Prevalence in School-Age Children
High-risk community	≥50% by parasitological methods (intestinal and urinary schistosomiasis) or ≥30 by questionnaire for visible haematuria (urinary schistosomiasis)
Moderate-risk community	≥10 but <50% by parasitological methods or <30% by questionnaire for visible haematuria
Low-risk community	<10% by parasitological methods

Source: Crompton and WHO 2006

HOW IS SCHISTOSOMIASIS MEASURED?

To detect the prevalence of intestinal schistosomiasis, an analysis of stool samples is needed. WHO recommends using a microscopic laboratory process to identify parasitic eggs—permanent-stained fecal smears—to detect schistosomiasis. Laboratory technicians can use many methods to prepare and examine samples, with varying levels of sensitivity, specificity, and cost (Nikolay, Brooker, and Pullan 2014). The Kato-Katz technique, useful for field surveys, also estimates the intensity of the infection.

Urine samples (analyzed through filtration) can be used to detect urinary schistosomiasis. When interventions have not taken place, questionnaires

that ask the target populations about the presence of blood in their urine can be used to identify urinary schistosomiasis, although this type of date is already collected. Questionnaires have also been used to identify intestinal schistosomiasis, but with less success (Chitsulo, Lengeler, and Jenkins 1995).

WHERE CAN WE GET THESE DATA?

With almost all countries now having mapped neglected tropical diseases, data on schistosomiasis is typically available through the Ministry of Health. As school-age children are most at risk, and for logistical purposes, surveys are often done in schools. Some National Micronutrient Surveys also include this data for different populations at risk. In the coming years, data will also be available through the WHO Regional Office for Africa portal (WHO 2016).

METHODOLOGICAL ISSUES

- WHO recommends the Kato-Katz technique in areas where the percentage of intestinal schistosomiasis is >10 percent—but use a more sensitive method in settings with a suspected lower prevalence (Speich et al. 2015) because the Kato-Katz technique, with high infection intensity, identifies many eggs, so the infection is easy to detect. But, with low infection intensity, there will only be few eggs, so the infection may be missed. In general, the Kato-Katz technique will result in light infections not being diagnosed; keep this potential for underestimating schistosomiasis in mind when interpreting results.
- Consider when the data on STH prevalence was collected in relation to recent deworming campaigns. Data collected immediately after a mass deworming campaign will temporarily show a lower than normal rate of infection. Therefore, if the data were collected shortly after a deworming campaign, note this as a limitation. This will be especially problematic when comparing prevalence levels collected at two time points, if one of the time points was collected much closer to the time of deworming campaign.
- Remember that schistosomes are focally transmitted, and the prevalence of schistosomiasis may vary widely across a country, depending on the access to and contamination of freshwater. Most findings are linked to specific geographic areas within a country, or to specific target groups, and cannot be generalized to the whole country. Even so, these data can offer a gauge of the level of schistosomiasis within the country and where to target interventions.

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Micronutrient Deficiencies

Nutritional deficiencies, resulting from an inadequate intake or absorption of micronutrients needed to produce and synthesize red blood cells, can lead to anemia. Low intake of dietary iron is a major contributor to anemia because iron is an integral part of the red blood cell and it plays a central role in transporting oxygen. Iron deficiency is the most common cause of anemia globally, but the leading causes of anemia vary widely by geography, age, and sex (Kassebaum et al. 2014). Other nutrients—vitamin A, folate, vitamin B12, and zinc—play specific roles in the production of red blood cells, or indirectly influence iron status. Deficiencies in these micronutrients can, therefore, contribute to anemia; however, they may coexist with anemia even if they are not the cause. Infants and young children, pregnant women, and women of reproductive age, including adolescents, have particularly high biological requirements for micronutrients and are especially vulnerable to micronutrient deficiencies.

WHICH MICRONUTRIENT DEFICIENCIES CAN CAUSE ANEMIA?

- iron
- vitamin A
- folate
- vitamin B12
- zinc.

INTERVENTIONS THAT ADDRESS MICRONUTRIENT DEFICIENCIES:

- biofortification
- delayed cord clamping
- dietary diversification
- dietary modification
- high-dose vitamin A supplementation for children
- industrial fortification
- iron-folic acid supplementation in women of reproductive age
- maternal, infant, and young child nutrition
- routine micronutrient interventions for children.

For more information about these interventions, go to the Assess Status of Anemia Interventions section.

FOR MORE DETAIL

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Iron Deficiency

Iron deficiency occurs when there is an insufficient intake of iron—primarily found in flesh foods and, to a lesser extent, dairy products and plant foods—as well as in fortified foods or supplements. Iron deficiency can also be caused by poor absorption and excessive loss of the mineral, including blood loss. The more severe stages of iron deficiency can result in anemia when there is not enough iron to produce adequate amounts of hemoglobin for red blood cells (WHO and CDC 2004). Iron deficiency is a major contributor to anemia, though the actual extent of overlap between iron deficiency and anemia is context-specific and varies by setting (Kassebaum and GBD 2013 Anemia Collaborators 2016). Specific groups at an increased risk of iron deficiency include children (due to rapid growth), pregnant women (due to expansion of the red blood cell mass and the need for more iron for the fetus), and women of reproductive age, including adolescent girls (due to blood loss during menstruation).

HOW IS IRON DEFICIENCY MEASURED?

Bone marrow aspirates are the gold standard for assessing iron deficiency, but this method is not practical for population-based measurements. Ferritin is the most commonly used biomarker for iron status; WHO recommends the use of ferritin to assess iron status in population-based surveys. Ferritin measures the amount of iron stores in the body; low levels reflect depleted iron stores. Serum transferrin receptors (sTfR), which reflect the need for iron at the cellular level, is also a biomarker used to assess iron status (WHO 2011).

Ferritin and sTfR levels can be determined using a venous or capillary blood sample and require maintaining a cold chain. Laboratory assessments commonly include enzyme-linked immunosorbent assay (ELISA), immunoturbidimetry, or others (WHO and CDC 2004).

HOW IS IRON DEFICIENCY CATEGORIZED?

A definition for what constitutes a public health problem for iron deficiency has not been established. **Table 10** describes the cut-offs for defining iron deficiency using ferritin, with differences based on age and pregnancy status.

WHERE CAN WE GET THESE DATA?

Iron deficiency is measured in population-based surveys and research studies, among women of reproductive age and children. Of the commonly administered population-based surveys, the National Micronutrient Survey is usually the only one that collects and analyzes information on the prevalence of iron deficiency.

Table 10: Iron Deficiency Cut-offs Based on Serum Ferritin Concentration

	Serum Ferritin (mcg/l)			
	Less than 5 years of age		Five years of age or older	
	Male	Female	Male	Female
Depleted iron stores	<12 (where infection and inflammation are not prevalent)	<12 (in areas where infection and inflammation are not prevalent)	<15	<15
Depleted iron stores in presence of infection	<30	<30	-	-
Severe risk of iron overload (adults)	-	-	>200	>150

Note: For sTFR, use cut-off values recommended by manufacturer or the assay.

Source: WHO 2011

METHODOLOGICAL ISSUES

- While the prevalence of anemia is sometimes used as a proxy indicator for iron deficiency, this poses many problems, because iron deficiency is only one of many causes that lead to anemia and, depending on the setting, may not even be a major contributor (Kassebaum et al. 2014). Additionally, mild and moderate levels of iron deficiency may not manifest as anemia, although they probably still result in functional impairment (WHO 2001).
- Infection and inflammation can increase ferritin concentrations, which can complicate the interpretation of iron status using ferritin concentrations. In addition to being a biomarker of iron status, ferritin concentrations are also a positive acute phase protein and they rise in response to inflammation. In other words, ferritin levels may be elevated in the presence of inflammation, irrespective of iron status, and may lead to an underestimation of the prevalence of iron deficiency.
- Approaches have been developed to adjust ferritin concentrations for inflammation using the inflammation biomarkers alpha-1-acid-glycoprotein and C-reactive protein. The four types of approaches currently proposed are to—

  1. Exclude individuals with elevated inflammation from calculations of iron status (WHO and CDC 2004).
  2. Raise the ferritin threshold to <30 mcg/l for those with elevated inflammation (WHO and CDC 2004).
  3. Use a categorical correction factor (Thurnham et al. 2010).
  4. Use a regression correction (Namaste et al. forthcoming).

Verify if any adjustment approach was used to determine iron deficiency when using ferritin concentrations. If it was not used, note this in your limitations and recognize that iron deficiency is probably a bigger problem than your data indicates. If you have the raw data available, apply these adjustments. Present both adjusted and unadjusted prevalence levels.

- As an alternate to using adjustment approaches, in areas with a high prevalence of inflammation, you can use the combination of ferritin and sTfR. This method may help you determine if iron deficiency is a problem in your setting by using the definition in **Table 11**.

Table 11: Interpretation of Serum Ferritin and Transferrin Receptor Concentrations in Population Surveys

Percentage of Serum Ferritin Values Below Threshold[a]	Percentage of Serum Transferrin Receptor Above Cut-Off Values[b]	Interpretation
<20[c]	<10	Iron deficiency not prevalent
<20[c]	≥10	Iron deficiency prevalent
≥20[d]	≥10	Inflammation prevalent
≥20[d]	<10	Iron deficiency prevalent

[a] Apply cut-off values by age group as described in table 3; [b] Apply cut-off values recommended by manufacturer of assay until an international reference standard is available; [c] less than 30% for pregnant women; [d] 30% or higher for pregnant women

Source: WHO 2011

FOR MORE DETAIL

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Vitamin A Deficiency

Vitamin A deficiency occurs when there is an insufficient intake of vitamin A—primarily found in milk and breastmilk, eggs, and liver—as well as yellow, orange, and dark green vegetables and fruits—and in fortified foods or supplements. Vitamin A deficiency can also be caused by poor absorption or excessive loss of the vitamin. The role of vitamin A deficiency in causing anemia has not been established with certainty, but it may involve a direct inhibition of red blood cell production. It may also cause anemia through indirect effects, such as increasing the risk of iron deficiency by decreasing the iron available to produce red blood cells or decreasing iron absorption or through increased risk and severity of infections (Balarajan et al. 2011; West, Gernand, and Sommer 2007). Vitamin A deficiency is most prevalent in Africa and South Asia, particularly in young children and pregnant women (Stevens et al. 2015). Vitamin A deficiency can also cause night blindness in pregnant women and children, is the leading cause of preventable blindness in children, and is associated with an increased risk of mortality in children (WHO 2016; Imdad et al. 2011).

HOW IS VITAMIN A DEFICIENCY MEASURED?

The gold standard for assessing vitamin A deficiency is to use isotope dilution testing to measure vitamin A stores in the liver, but because this method requires a liver biopsy, it is not viable for a population-based assessment. Alternatively, the modified relative dose response is an indirect measure of vitamin A stores in the liver. While some countries have used this biomarker to determine population-level vitamin A deficiency, it is not widely used, partly due to commercial availability (WHO 2012).

Circulating retinol is the most commonly used indicator for vitamin A status. It has been associated with functional outcomes of vitamin A deficiency, and generally reflects liver stores when they are depleted. Serum/plasma retinol levels can be determined using a venous blood sample and it requires maintaining a cold chain. Laboratory assessments include high-pressure liquid chromatography (the first choice, with high sensitivity and specificity), fluorescence, and ultraviolet spectrophotometry.

Recently, retinol-binding protein has also been used to measure vitamin A status and has, in some settings, produced similar results to serum retinol (Engle-Stone et al. 2011). Retinol-binding protein is easier to measure than serum retinol from a logistics standpoint, but it has not been validated to the same extent. Either capillary or venous samples can be used; it can be assessed using enzyme-linked immunosorbent assay, which is technically much easier than high-pressure liquid chromatography. Retinol-binding protein is also more stable and requires a lower sample volume that circulating retinol, but commercial assay kits have not been well standardized among manufacturers (WHO 2011).

Other less commonly measured biomarkers include night blindness, dark adoptometry, and breastmilk retinol concentrations. More information on these biomarkers can be found in the Biomarkers of Nutrition for Development- Vitamin A Review in the *Journal of Nutrition* (Tanumihardjo et al. 2016).

HOW IS VITAMIN A DEFICIENCY CATEGORIZED?

Vitamin A deficiency is considered to be a severe public health concern when the prevalence of low serum retinol concentrations is greater than 20 percent in a population. **Table 12** shows the cut-offs

to define a public health problem, which apply to most age groups, excluding infants under 6 months of age. Cut-offs for defining vitamin A deficiency using serum/plasma retinol are defined in **Table 12**.

Table 12: Severity of Vitamin A Deficiency As a Public Health Problem by Prevalence

	Mild	Moderate	Severe
Prevalence of low serum retinol (≤0.70 micromol/l or below)	2–9%	10–19%	20% or more

Source: WHO 2011

WHERE CAN WE GET THESE DATA?

Vitamin A deficiency is measured in population-based surveys and research studies, among women of reproductive age and children. Of the commonly administered population-based surveys, the National Micronutrient Survey is usually the only one that collects and analyzes information on the prevalence of vitamin A deficiency.

METHODOLOGICAL ISSUES

- Consider the season(s) that data were collected, as this may affect the availability of vitamin A–rich foods and result in small shifts in serum retinol concentrations (Balarajan et al. 2011).
- Using of dried blood spots to assess serum retinol is not reliable, despite this method still being used in some situations.
- Zinc plays a central role in the synthesis of vitamin A; a zinc deficiency may cause low levels of retinol in the blood, even if there are adequate stores in the liver.
- Depending on the prevalence of vitamin A deficiency in your country, one or multiple regular mass distribution campaigns for vitamin A supplementation may take place for children under 5 years of age. Collecting data immediately after a mass supplementation campaign might show a lower than normal rate of vitamin A deficiency. If you compare data across years, note the timing of data collection each year, and compare it to the vitamin A distribution campaigns. This will help you avoid identifying changes that are caused more by the vitamin A supplementation campaign than by any long-term change in vitamin A deficiency.
- Serum/plasma retinol is a common, but imperfect, indicator of vitamin A status. At marginal to sufficient vitamin A status, it is considered a poor indicator of the status of individuals because it is homeostatically controlled and does not reflect liver stores until vitamin A reserves drop to dangerously low levels or approach toxic levels. Circulating retinol can be affected by liver function, infection, and other nutritional deficiencies. Retinol declines during episodes of infection, as well as during protein and zinc deficiencies. Thus, assessing the vitamin A status of populations where infections or inflammation are common may overestimate the amount of "actual" vitamin A deficiency—as some low retinol may be ascribed to these other conditions.
- Approaches have been developed to adjust serum/plasma retinol and retinol-binding protein concentrations. A consensus has not been reached on the specific adjustment approach. The three types of approaches currently proposed are to—
    1. Exclude individuals with elevated inflammation from calculations of vitamin A deficiency (Bresnahan and Tanumihardjo 2014).
    2. Use a categorical correction factor (Thurnham et al. 2003).

3. Use a regression correction (Namaste et al. Forthcoming).

Verify if any adjustment approach was used to determine vitamin A deficiency when using serum/plasma retinol and retinol-binding protein concentrations. If it was not used, note this in your limitations and recognize that vitamin A deficiency is likely a smaller problem than your data indicates. If you have the raw data available, you must apply these adjustments. Present both adjusted and unadjusted prevalence levels.

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Folate Deficiency

Folate deficiency occurs when there is insufficient intake of folate—primarily found in green leafy vegetables and legumes or in fortified foods or supplements in the form called folic acid. Folate deficiency can also be caused by poor absorption or excessive loss of the vitamin. A severe deficiency in folate, which is required for the synthesis of red blood cells, results in megaloblastic anemia, characterized by oversized and malformed red blood cells (Balarajan et al. 2011). In addition, folate deficiency in women during conception and early embryologic development increases the risk for neural tube defects in babies, which occurs when fusion of the tissues around the spinal cord is incomplete during the initial formation of the spinal cord. These defects are often very serious and can result in fetal or infant death (Bailey et al. 2015). While folate deficiency may impact anemia minimally, it is the risk of neural tube defects that resulted in the push for fortification with folic acid. At-risk groups for folate deficiency include pregnant and lactating women, infants, young children, and the elderly (Benoist 2008). While many countries have successfully reduced the prevalence of folate deficiency through mandatory folic acid fortification programs, based on the limited data available, folate deficiency still appears be a public health problem in some settings, particularly for women (McLean, Benoist, and Allen 2008; Bailey et al. 2015).

HOW IS FOLATE DEFICIENCY MEASURED?

Serum/plasma folate and/or red blood cell folate levels are most commonly used to measure folate deficiency. The serum/plasma level of folate does not represent long-term status because it may be influenced by illness or recent ingestion of folate or folic acid; therefore, the red blood cell folate level is usually the preferred indicator to determine folate deficiency. A venous blood sample, which requires a cold chain, is the preferred way to measure serum/plasma folate and red blood cell folate levels. Several laboratory techniques can be used to assess folate status, including microbiological methods, protein-binding assays, and chromatography-based assays (WHO 2015b). The microbiological assay, using the folate-dependent microorganism *Locatobacillus rhamnosus*, is the most widely recommended (Bailey et al. 2015).

HOW IS FOLATE DEFICIENCY CATEGORIZED?

A definition for what constitutes a public health problem for folate deficiency is not established, although, generally, a prevalence below 5 percent does not represent a public health problem (Bailey et al. 2015). **Table 13** shows the cut-offs for defining folate deficiency using serum/plasma folate and red blood cell folate. Note that the cutoff for insufficiency to prevent neural tube defects are higher among non-pregnant women of reproductive age at the population level—red blood cell folate levels should exceed 400 ng/mL (WHO 2015a).

Table 13: Folate Deficiency Cutoffs in Serum/Plasma Folate of Red Blood Cell Folate (nanogram per milliliter or nanomole per liter)

Folate Indicator	Cutoff Value Indicating Folate Deficiency ng/mL (nmol/L)
Serum/plasma folate level	<4 (<10)
Red blood cell folate level	<151 (<340)

Source: WHO 2015b; Bailey et al. 2015

WHERE CAN WE GET THESE DATA?

Folate deficiency is measured in population-based surveys and research studies for women of reproductive age and, in rare cases, children. Of the commonly administered population-based surveys, the National Micronutrient Survey is usually the only one that collects and analyzes information on the prevalence of folate deficiency.

METHODOLOGICAL ISSUES

- It is useful to report the entire distribution of values, including the lower and upper tails, especially in fortification or supplementation programs.
- Cut-offs for pregnant women are not established, because folate status declines throughout pregnancy. However, for pregnant women, when red blood cell folate concentration fall below 1,000 nmol/L, the risk of neural tube defects begins to increase (Crider et al. 2014).

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Vitamin B12 Deficiency

Vitamin B12 deficiency usually occurs when the intake of vitamin B12 is insufficient—which is found only in animal source foods or in fortified foods or supplements. Vitamin B12 deficiency can also be caused by poor absorption or excessive loss of the vitamin. A severe deficiency of vitamin B12, which is required for the synthesis of red blood cells, results in megaloblastic anemia, characterized by oversized and malformed red blood cells (Balarajan et al. 2011). Vitamin B12 deficiency can also induce clinical and sub-clinical neurological and other disorders (Shipton and Thachil 2015). At-risk groups for vitamin B12 deficiency include pregnant and lactating women, infants, young children, and the elderly (Benoist 2008). Vitamin B12 deficiency is especially prevalent in populations that consume low quantities of animal-source foods, including not only strict vegetarians but also those with low access to or intake of animal source foods for economic or cultural reasons. The global burden of vitamin B12 deficiency is unknown, but available data suggest that it could be widespread in both developed and developing countries and across all ages and physiological groups (Allen et al. 2017).

HOW IS VITAMIN B12 DEFICIENCY MEASURED?

Vitamin B12 concentrations in serum/plasma provide the most useful and least expensive measure to determine the status of populations. Serum/plasma vitamin B12 levels can be determined using a venous blood sample, which requires a cold chain. Electrochemiluminescence immunoassay is the most widely recommended method for measuring vitamin B12 in serum/plasma.

Biomarkers of adequacy for metabolic function are also available, including plasma homocysteine and serum methylmalonic acid. Holotranscobalamin, a serum protein that transports vitamin B12, is also reduced in B12 deficiency. Recently, equations to combine two, three, or four vitamin B12 biomarkers into one diagnostic parameter called "combined indicator of vitamin B-12 status (cB-12)" have been reported. This indicator provides the best prediction for associated anemia and poorer cognitive function in the elderly (Fedosov et al. 2015).

Typically, biochemical assessment of functional metabolic markers of vitamin B12 status require more significant resources and are rarely conducted in low- and middle-income countries, except to meet specific research objectives.

HOW IS VITAMIN B12 DEFICIENCY CATEGORIZED?

A definition for what constitutes a public health problem for vitamin B12 deficiency has not been established. Cut-offs for defining vitamin B12 deficiency are described in **Table 14** and apply to all segments of the population, although they may not be as valid for pregnant women or infants because of physiological effects on the biomarkers (e.g., levels usually decline during pregnancy).

Table 14: Vitamin B12 Deficiency Cut-offs in Serum/Plasma B12 (picomole per liter)

Vitamin B12 Status	Cut-Off Value Indicating Vitamin B12 Deficiency
Low serum/plasma B12	<148 pmol/L
Marginal B12	148–221 pmol/L
Adequate B12	>221 pmol/L

Source: Allen et al. 2017

WHERE CAN WE GET THESE DATA?

Vitamin B12 deficiency is measured in population-based surveys and research studies, among women of reproductive age, children, and the elderly. Of the commonly administered population-based surveys, the National Micronutrient Survey is usually the only one that collects and analyzes information on the prevalence of B12 deficiency.

METHODOLOGICAL ISSUES

- Cut-offs for pregnant women are not established because of the physiological fluctuations in vitamin B12 biomarkers in the perinatal period.
- High folate status can detrimentally influence vitamin B12 status, especially in the lowest distribution of vitamin B12 status (Selhub et al. 2009; Brito et al. 2016).

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Zinc Deficiency

Zinc deficiency results from insufficient intake of zinc—primarily found in animal protein—as well as in whole-grain cereals, pulses, and legumes, especially if consumed with animal protein to reduce phytates negatively influencing absorption. Zinc deficiency can also be caused by poor absorption or excessive loss of the mineral. Because the human body cannot store zinc, a consistent supply of the mineral in the diet is necessary to fulfill zinc requirements (Lowe, Fekete, and Decsi 2009). Zinc is a catalyst for many enzymes that are needed for red blood cell production; as a result, zinc deficiency may be associated with anemia (Badham, Zimmermann, and Kraemer 2007). Available data suggest that zinc deficiency is widespread in low- and middle-income countries and is an important contributor to mortality and morbidity in children (Oruamabo 2015). For further information on zinc deficiency, visit the International Zinc Nutrition Consultative Group (IZiNCG) website: www.izincg.org.

HOW IS ZINC DEFICIENCY MEASURED?

Insufficient zinc intake results in low serum/plasma levels of the mineral. In the face of increasing demand or lower dietary intake, the body maintains a mechanism to keep the blood levels of zinc steady by increasing the efficiency of absorption or reducing the excretion through the skin, kidney, and intestines. The status of populations is best measured by the zinc concentrations in serum/plasma (Fischer Walker and Black 2007), which can be determined using a venous blood sample, and requires a cold chain. Based on availability, several instruments can be used to analyze zinc status, including flame atomic absorption spectrometry and inductively coupled plasma mass spectrometry (IZiNCG 2012).

In addition to direct measurement of serum/plasma zinc concentrations, inadequate zinc intake or stunting can be indirect indicators for the risk of zinc deficiency (Christine Hotz 2007; Fischer Walker and Black 2007). When using zinc intake to measure deficiency, also calculate phytate intake to estimate zinc absorption.

HOW IS ZINC DEFICIENCY CATEGORIZED?

Zinc deficiency is considered to be a public health concern when the prevalence of low serum/plasma zinc concentration is higher than 20 percent (IZiNCG 2007). Cut-offs for zinc deficiency are defined in **Table 15**; they depend on the age, sex, and fasting status of the study participant, as well as the time of day the blood was collected.

Table 15: Zinc Deficiency Cut-Offs Based on Zinc Concentration (microgram/deciliter)

Time of Day and Fasting Status	Suggested Lower Cut-Offs for Serum Zinc Concentration (mcg/dL)		
	<10 years	≥10 years	
	Males and females	Non-pregnant females	Males
Morning fasting	Not available	70	74
Morning non-fasting	65	66	70
Afternoon non-fasting	57	59	61

Source: IZiNCG 2012

WHERE CAN WE GET THESE DATA?

Zinc deficiency is measured in population-based surveys and research studies conducted among children and, sometimes, women of reproductive age. Of the commonly administered population-based surveys, the National Micronutrient Survey

is usually the only one that collects and analyzes information on the prevalence of zinc deficiency.

METHODOLOGICAL ISSUES

- Serum/plasma zinc status relies on age, sex, fasting status, and time of day of blood collection, and thus to calculate the relevant cut-offs, studies must collect all this information (Hess et al. 2007). If these data are not collected, then the results of the study may not accurately reflect the population zinc status and it should be noted as a limitation.
- Look at the quality of data collection. Because zinc is found in serum/plasma in trace amounts, the sample's risk of contamination with external zinc is very high, and is a major source of measurement error (IZiNCG 2012). Often, you will not have information on the quality of data collection unless you were directly involved in the data collection or have obtained this information from those that undertook the survey. If you have this information, include it in your report.
- Serum/plasma zinc it is not a reliable indicator of deficiency at the individual level (IZiNCG 2012).

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Inflammation

Anemia associated with inflammation commonly occurs with chronic states of exposure to infection or trauma. Several chronic conditions, including obesity, can also cause inflammation. The consequences of this phenomenon, commonly termed *anemia of inflammation*, include a reduction in the absorption of micronutrients, and/or temporarily isolating the micronutrients, which prevents the body from using them (see Micronutrient Deficiency section). In the short term, any detrimental changes will probably be minimal, but it will become a problem when exposure to infection/inflammatory stimuli is prolonged. An example of such a state is a condition called environmental enteropathy— a poorly defined state of intestinal inflammation, without obvious diarrhea, that occurs in individuals exposed to long-term poor sanitation and hygiene. They are repeatedly exposed to environmental pathogens, resulting in a chronic state of inflammation (Ngure et al. 2014; Petri, Naylor, and Haque 2014).

HOW IS INFLAMMATION MEASURED?

The two acute-phase-proteins C-reactive protein (CRP) and alpha-1-acid glycoprotein (AGP) are the most commonly used biomarkers to identify the presence of inflammation in nutrition surveys. CRP is a positive acute-phase protein that helps detect inflammation in its early stages. In the first six to eight hours of an inflammatory response, CRP levels increase rapidly, peaking within 24–48 hours (WHO 2014). AGP, also a positive acute-phase protein, is useful in detecting the later stages of inflammation, because it rises more slowly and takes three to five days to stabilize (Thurnham and McCabe 2012). A venous or capillary blood sample can measure CRP and AGP levels and a cold chain is required. Several laboratory techniques can be used; the most common is ELISA. Other methods, such as immunoturbidimetry or antibody-based nephelometric assays, are also used (WHO 2014).

HOW IS INFLAMMATION CATEGORIZED?

A definition for what constitutes a public health problem for inflammation has not been established. Using both CRP and AGP, you can distinguish between different stages of the inflammatory process: incubation (measured by elevated CRP concentrations, >5 mg/L), early convalescence (measured by elevated CRP and AGP concentrations, >1g/L), and late convalescence (measured by elevated AGP only) (Thurnham and McCabe 2012).

WHERE CAN WE GET THESE DATA?

CRP and AGP are measured in population-based surveys and research studies conducted with women of reproductive age and children. Of the commonly administered population-based surveys, the National Micronutrient Survey is usually the only one that collects and analyzes information on the prevalence of inflammation.

METHODOLOGICAL ISSUES

- As explained in the Iron Deficiency and Vitamin A Deficiency sections, determining the prevalence of inflammation by measuring AGP and CRP, and subsequently using these results to adjust the values of iron and vitamin A biomarkers, is a key step to obtaining a more accurate prevalence of micronutrient deficiencies.
- In women, the acute phase proteins may be higher in the late stages of pregnancy and early postnatally. A specific cut-off has not been developed for this population (WHO 2014).

INTERVENTIONS THAT ADDRESS INFLAMMATION

- case management of malaria
- clean play spaces
- deworming for schistosomiasis
- deworming for STHs
- handwashing
- IRS
- IPTp
- LLINs
- promotion of food safety
- use of basic and safely managed sanitation facilities
- use of safely managed drinking water services
- water treatment.

For more information about these interventions, go to the Assess Status of Anemia Interventions section.

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Genetic Red Blood Cell Disorders

Genetic red blood cell disorders—resulting in abnormalities in the function, structure, or production of red blood cells—can cause anemia. Worldwide, approximately 11 percent of anemia is attributable to genetic red blood cell disorders, including the thalassemias and thalassemia trait, sickle cell disorders and sickle cell trait, glucose-6-phosphate deficiency (G6PD), other hemoglobinopathies and hemolytic anemias (Kassebaum and GBD 2013 Anemia Collaborators 2016), and Krüppel-like factor 1 variants (Perkins et al. 2016). All populations have genetic red blood cell disorders, but their contribution to the prevalence of anemia varies greatly both between and within different countries, even across small geographical distances (Kassebaum et al. 2014; Williams and Weatherall 2012). The highest instances are found in populations in or originating from Africa, the Middle East, and Asia. By different mechanisms, sickle cell disease, hemolytic anemias, and G6PD deficiency increase the destruction of red blood cells; while the thalassemias produce ineffective red blood cells, as well as a shorter red blood cell lifespan (Beutler 1996; WHO 2011).

Genetic red blood cell disorders are non-modifiable risk factors for anemia, but progress toward prevention and management of the thalassemias is reasonably well advanced in several countries in Asia (Fucharoen and Weatherall 2016). In many countries, the expertise and facilities for the control of genetic red blood cell disorders are extremely limited, but partnerships are being developed to improve control and treatment (Weatherall 2008; Fucharoen and Weatherall 2016).

HOW ARE GENETIC RED BLOOD CELL DISORDERS CATEGORIZED?

Criteria for what constitutes a public health problem for genetic red blood cell disorders have not been established.

HOW ARE GENETIC RED BLOOD CELL DISORDERS MEASURED?

A deoxyribonucleic (DNA) analysis is used to diagnosis genetic red blood cell disorders, but the current expense of DNA sequencing limits the use of this approach in population surveys (Perkins et al. 2016). At present, most population studies of genetic red blood cell disorders rely on phenotypic screening. For the thalassemias, the most common methods use identification of individuals with unusual red blood cell indices, followed by further analysis of abnormal samples by hemoglobin electrophoresis or high-performance liquid chromatography (HPLC) (Weatherall et al. 2006). Osmotic fragility testing is a low-cost way to screen for the beta thalassemia trait, but it must be used with caution because the sensitivity may be limited by interactions with the carrier states for alpha thalassaemia, G6PD deficiency, and Southeast Asian Ovalocytosis (Penman, Gupta, and Weatherall 2014). Many hemoglobinopathies, including sickle hemoglobin (Hb S) disorders, Hb E, Hb C, and others, can also be identified by hemoglobin electrophoresis or HPLC. Enzyme testing is typically used to diagnose G6DP deficiency; a G6PD rapid diagnostic test is also available for use in the field (Espino et al. 2016).

WHERE CAN YOU GET THESE DATA?

Most commonly administered population-based surveys do not collect or analyze information

related to screening or diagnosing genetic red blood cell disorders. In recent years, however, the National Micronutrient Survey has started collecting information related to genetic red blood cell disorders, specifically in countries where these conditions are thought to be common.

Other resources are also available: The Gene database engine from the National Library of Medicine (www.ncbi.nlm.nih.gov/gene) provides detailed information about all the disorders, including genetic basis, clinical condition, and prevalence in various populations. The International Genome Sample Resource (www.internationalgenome.org), previously the 1000 Genomes Project, is an important source for data on variations in populations; the Ensembl genome browser (useast.ensembl.org/index.html) can be used to search for genetic variation data; or the Frequency of Inherited Disorders database (www.findbase.org) has information on the frequency of genetic variations across the world. However, you may need the services of a genetic epidemiologist to understand some of these data.

METHODOLOGICAL ISSUES

- Quantifying the contribution of genetic variants to anemia remains a challenge within the realm of public health because genes are expressed in many ways, and the expression can be modified by other factors like environment and diet.
- More information on the contribution of genetic red blood cell disorders to anemia may be helpful when setting targets to reduce anemia.

INTERVENTIONS THAT ADDRESS GENETIC RED BLOOD CELL DISORDERS

- Counseling and management of genetic blood disorders.

For more information about this intervention, go to the Assessing Status of Anemia Interventions section.

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Step 3: Review Anemia Policies

Effective anemia prevention and control activities require a strong policy environment. When policies do not exist, or are not used for programming, it can be difficult to create broad-based stakeholder support for long-term implementation. Conducting a review of anemia-related policies in your country will enable you to identify gaps in the anemia-related policies and will highlight key areas for stakeholder action. Keep the policy lifecycle in your country in mind so you can determine whether new policies, strategies, or implementation plans should be developed or existing ones updated. Sometimes, a country does not have a policy, but they do have a strategy or implementation plan, so identify these, as well.

You may want to go beyond simply identifying existing policies, strategies, or implementation plans. Outlining the content of these documents can help you understand how your country is implementing or intending to implement interventions. For example, when reviewing documents, identify the target groups, type of treatment (including dose and duration), clinical guidelines, and delivery platforms. Also, sometimes, you can examine progress reports on implementation plans.

Your country may not have a specific anemia-related policy, but look for policies that address anemia causes, prevention activities, and control measures. Remember that anemia-related policies are often found within larger policy documents; for instance, a national agriculture policy document may include a policy on biofortification. While the following list is not exhaustive, it is a place to start:

- agriculture and food security policy/strategy
- anemia policy/strategy
- biofortification
- delayed cord clamping
- deworming for children and/or pregnant women
- dietary diversity and/or modification
- family planning
- food safety
- IRS
- infant and young child feeding
- industrial fortification legislation
- iron-folic acid for pregnant women and/or women of reproductive age, including adolescents
- IPTp
- LLINs for household use
- malaria diagnosis and treatment
- micronutrient supplementation
- nutrition policy/strategy
- screening, counseling, and/or management of genetic disorders
- water, sanitation, and hygiene national policy/strategy.

Outlined here are three options for reviewing anemia-related policies. Depending on the resources available for this work, you may only be able to complete one or two types of policy review. The key is to have a picture of the policy landscape—you and your colleagues can continue to fill in the details and learn more as you put the findings from this landscape analysis into practice.

1. **Conduct key informant interviews with anemia stakeholders**. Reaching out to policymakers and implementers can help identify relevant policies, even those that are not available online. This step is particularly useful in countries where government documents are not readily available online. Informants can identify relevant documents, but consider including these prompts in your questionnaire:

    a. What policy documents do you consult when considering anemia-related programs?

    b. What policies do your colleagues consult when developing anemia-related programs?

    c. What policies are still needed to improve the support for anemia-related programming?

    d. If a policy is in place, is it being implemented?

    e. What are the challenges/constraints to implementing the existing policies?

    f. [For policies you identified as missing:] Why isn't [POLICY] a policy in this country?

    g. Can you share a copy of the [POLICY]?

2. **Consult the websites of relevant government agencies**. Many ministries or departments have policy sections on their websites where you can download relevant documents. Start by searching the Ministry of Health (or similar) website; focus on ministry-wide policy pages, as well as anemia-related units, if they have their own pages. Expand your search to include other anemia-relevant ministries or sectors, such as agriculture, education, gender, etc. Finally, look for government-wide policy documents relevant to nutrition. They may be available through websites for the Office of the Prime Minister or President, and any national development bodies or the Ministry of Finance.

3. **Search for relevant policies on online databases**.

    a. WHO's Global database on the Implementation of Nutrition Actions collects a variety of standardized data about nutrition actions across the globe, including policy data. You can search for policies by country—extranet.who.int/nutrition/gina/en/policies/summary—to see what is available for your country. Most policy pages include information on the timeline, adoption status, goals, monitoring and evaluation indicators, and links to full-text versions of the policy. Note that this database relies on registered users to submit data. Even if a policy is not included in this database, it may exist; it may be new enough that no one has uploaded it to the site.

    b. The Scaling Up Nutrition (SUN) website aggregates a significant amount of information on member states. If your country is a member of SUN, visit the "Coherent Policy and Legal Framework" section of the country page—www.scalingupnutrition.org/sun-countries—for a list of key documents from a range of nutrition-related sectors. This section lists

responsible bodies for policy documents and often includes a short description of the policy or legislation. When available, a link will let you download the document. Because the WHO website documents may not be available immediately, check the "Last updated" data on the page.

HOW TO INCLUDE THIS INFORMATION IN YOUR LANDSCAPE ANALYSIS

In the methods section of your landscape analysis, document the search methods you used to identify policies. If you conducted interviews, include a list of respondents as an appendix to your final report. Include the full list of identified policies, with a discussion of any gaps your review uncovers. If possible, include the presence or absence of a supportive policy in your discussion of interventions.

Step 4: Assess Status of Anemia Interventions

Many different sectors have programs that address anemia; they rely on a variety of delivery mechanisms and platforms to reach their intended recipients. This guidance includes information on interventions to address both the immediate and underlying causes of anemia. Given the specifics of the anemia prevalence in your country and the burden of the various causes, you may identify certain interventions as a higher priority than others. It is important to remember that implementing effective interventions depends partly on the policy context in your country (see Step 3: Review Anemia Policies).

The interventions listed in **Table 16** are described in more detail on the following pages including information on collecting and analyzing data related to the intervention. We recommend that you explore the data that are available to you on each intervention, including its delivery platform. The information will help you understand the current strength of your country's anemia prevention and control programs. Knowing the poorly performing interventions, you can help you identify actions to improve your country's anemia outcomes. Data on interventions are often available through surveys (to understand coverage or use), routine data collection (to understand provision or supply), or other ad hoc data collection mechanisms.

Table 16: Anemia Interventions, Organized by Sector

NUTRITION

- Dietary diversification
- Dietary modification
- High-dose vitamin A supplementation for children
- Industrial fortification
- Iron-folic acid supplementation in women of reproductive age
- Maternal, infant, and young child nutrition
- Routine micronutrient interventions for children.

DISEASE CONTROL

- Case management of malaria
- Deworming for schistosomiasis
- Deworming for soil-transmitted helminths
- Indoor residual spraying
- Intermittent preventive treatment during pegnancy
- Long-lasting insecticide treated bed nets.

WASH

- Clean play spaces
- Handwashing
- Use of basic and safely managed sanitation facilities
- Use of safely managed drinking water sources
- Water treatment.

REPRODUCTIVE HEALTH

- Delayed cord clamping
- Family planning.

AGRICULTURE

- Biofortification
- Increased production of nutrient-rich foods
- Promotion of food safety.

GENETICS

- Counseling and management of genetic blood disorders.

HOW TO INCLUDE THIS INFORMATION IN YOUR LANDSCAPE ANALYSIS

Your landscape analysis should include information on the interventions that have the potential to reduce anemia. Document which interventions are being planned or already exist. For the existing interventions, include information on the coverage of the intervention. Coverage—the measure of an intervention's success—calculates the percentage of eligible individuals who received the service. To illustrate the variations in your country, you can also include graphs of the coverage for each intervention by target group, or by various characteristics. Looking at the coverage of these interventions, over time, may help you determine if any trends are related to reductions in the prevalence of anemia.

In the sections that follow, we include a number of methodological issues that are important for each of the interventions. However, there a number of considerations for reviewing anemia intervention data, which we discuss here.

- Carefully note the dates of your data sources. Routine population-based surveys like Demographic and Health Surveys or Multiple Indicator Cluster Surveys are widely available data sources, but they are only collected every five or more years and may not accurately reflect the current coverage rates. Similarly, reporting rates for administrative data may be slow and may only be available during multiple reporting periods, after the data were collected.
- Coverage is difficult to estimate if you rely on administrative data for the numerator (number of people reached) or denominator (number of eligible people in the population).
  - Administrative data used to estimate coverage are often based on tally sheets or other handwritten records, frequently relying on the summation of totals by hand. These data sources are, therefore, subject to human error and may also have incomplete or delayed reporting.
  - Accurate denominator estimates (i.e., number of infants 6–11 months of age or pregnant women) can be difficult to access, which will influence coverage estimates. Inaccurate population estimates will lead to inaccurate coverage estimates. Therefore, if you are calculating coverage based on estimated denominators, make sure the basis for the denominator is documented and reported.
- Coverage estimates based on the health monitoring information system, or other routine data, will only capture individuals who sought or received treatment through the public health care system. As a result, these data may underestimate coverage. You may consider highlighting populations that you think may have been left out of the estimates. While intervention coverage can also be collected through administrative data, representative, population-based surveys are probably the most reliable source of data.
- Information available through the country's health monitoring information system can be useful, although its quality will vary, depending on the robustness of the design of the health monitoring information system and the in-country capacity for monitoring.
- Interventions that rely on campaign-based distribution, such as high-dose vitamin A supplementation or antihelminth treatment, may use administrative data or post-event coverage

surveys to estimate coverage, often relying on comparisons between the two to identify any over- or underestimation.

  - To estimate coverage, you can compare administrative data collected during the distribution campaign against the total target population. Human error in the collection and summation of administrative data, and reliance on population estimates, mean that administrative data can result in significant overestimation of program coverage and it should be validated, when possible, with population-based survey data (Nyhus Dhillon et al. 2013).
  - Post-event coverage surveys take place within a month of the last distribution round and they collect recall data on receipt of supplements or medications during a specific period—timed to coincide with the latest distribution campaign. These surveys can be expensive, but they can be useful to assess coverage estimates from administrative data. Although the surveys face the challenge of recall bias when compared with administrative data, changes to the questions asked—such as showing pictures or asking about other services provided in mass campaigns—can improve the respondents recall (Ouédraogo et al. 2016). Post-event coverage survey data may also be available for parts of the country; Lot Quality Assurance Sampling methodology can reduce costs and highlight performance against a target (The Global Alliance for Vitamin A 2016).

- Supply chain issues can have a dramatic effect on intervention performance. Including data on supply system performance will be just as important for many of these interventions as information on coverage. Health management information systems, Service Provision Assessments, or other facility-based assessments may collect data on anemia-related supplies (e.g., deworming medication, micronutrient supplements, bed nets), including stockouts or other supply-related issues that may affect their distribution. Reviewing logistics management information systems may also be useful in gauging the availability of anemia-related supplies at distribution points, forecasting necessary supplies, and identifying formulations or specifications of each product provided in your country.

- A number of anemia-related interventions use common delivery platforms to reach eligible populations, such as antenatal care for iron-folic acid supplementation and intermittent preventive treatment during pregnancy, or Child Health Days for deworming and high-dose vitamin A supplementation. Understanding how well these platforms work will help you better understand the performance of each intervention. Therefore, your data collection should include indicators like attendance at antenatal care clinics or number of children reached by Child Health Says, when relevant. Sometimes, improving the performance of an intervention may require changes to the delivery platform, in addition to modifying the services.

- Implementing anemia-related interventions is often the endpoint of a long chain of events. Improvement of an intervention may rely on reviewing supply processes, strengthening a delivery platform, or improving provider training. While indicators of these integral issues are not included in the discussion below, you should

keep these issues in mind when conducting your landscape analysis.

FOR MORE DETAIL

Nyhus Dhillon, Christina, Hamsa Subramaniam, Generose Mulokozi, Zo Rambeloson, and Rolf Klemm. 2013. "Overestimation of Vitamin a Supplementation Coverage from District Tally Sheets Demonstrates Importance of Population-Based Surveys for Program Improvement: Lessons from Tanzania." *PloS One* 8 (3): e58629. doi:10.1371/journal.pone.0058629.

Ouédraogo, Césaire T., Elodie Becquey, Shelby E. Wilson, Lea Prince, Amadou Ouédraogo, Noël Rouamba, Jean-Bosco Ouédraogo, Stephen A. Vosti, Kenneth H. Brown, and Sonja Y. Hess. 2016. "Factors Affecting the Validity of Coverage Survey Reports of Receipt of Vitamin A Supplements During Child Health Days in Southwestern Burkina Faso." *Food and Nutrition Bulletin* 37 (4): 529–43. doi:10.1177/0379572116666167.

The Global Alliance for Vitamin A. 2016. "Vitamin A Supplementation Regional Symposium Report." Dakar, Senegal. http://www.vas2016symposium.org/index.php.

Case Management of Malaria

Strategies for case management of malaria are usually an integral part of the national malaria control program in countries where malaria is endemic (WHO 2015). Malaria can quickly escalate in severity and, if untreated, lead to severe anemia and death. Early diagnosis should be followed by prompt, effective treatment within 24–48 hours of the onset of symptoms. For the malaria species *Plasmodium falciparum*, the recommended first line treatment for uncomplicated malaria is a fixed-dose artemisinin-base combination therapy, although pregnant women in the first trimester and other special risk groups may require different treatments or dosing regimens. Treatment of complicated malaria should start with intravenous or intramuscular injections of artesunate until the patient can tolerate oral therapy with artemisinin-base combination therapy.

Infection by other species may require different treatments, depending on antimalarial resistance in the area.[1] Antimalarial drug resistance—a growing concern—has led to increases in malaria cases and treatment failures in Asia (Tilley et al. 2016).

MEASUREMENT AND DATA SOURCES

Population-based surveys typically report the percentage of children under age 5 who have experienced fever in the two weeks preceding data collection. For those children, the survey collects information on the percentage for whom advice or treatment was sought, who had blood taken from a finger or heel for testing, and who took any artemisinin-base combination therapy.

Surveys that collect information related to coverage of malaria case management include—

- Demographic and Health Surveys
- Malaria Indicator Surveys
- Multiple Indicator Cluster Surveys
- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

Information related to malaria treatment is sometimes available through the country's health monitoring information system. Consider the usage of health care services in your context when interpreting findings, because not all people suffering from malaria will seek services at the facility. However, in Africa, careseeking for fever is generally high for children under 5 years of age.

METHODOLOGICAL ISSUES

- Always consider seasonality when interpreting malaria data, especially for population-based surveys. Generally, survey reports indicate when the survey was conducted so that data are interpreted appropriately. Malaria transmission rates—and the resulting stock flows—at the time of data collection will affect the comparability of these estimates over time and across studies. For instance, Demographic and Health Surveys often avoid the rainy season, given the difficulties inherent with data collection at this time, while Malaria Indicator Surveys are deliberately scheduled during the rainy season to capture indicators during a season of high malaria transmission.

1 Primaquine is used to treat the relapsing stage of *Plasmodium vivax* or *Plasmodium ovale*, but care must be taken to avoid hemolytic toxicity in subjects who are glucose-6-phosphate dehydrogenase (G6PD) deficient (Baird 2015).

FOR MORE DETAIL

Roberts, David J. 2016. "Hematologic Changes Associated with Specific Infections in the Tropics." *Hematology/Oncology Clinics of North America* 30 (2): 395–415. doi:10.1016/j.hoc.2015.11.007.

Tilley, Leann, Judith Straimer, Nina F. Gnädig, Stuart A. Ralph, and David A. Fidock. 2016. "Artemisinin Action and Resistance in Plasmodium Falciparum." *Trends in Parasitology* 32 (9): 682–96. doi:10.1016/j.pt.2016.05.010.

Ukpe, I. S., D. Moonasar, J. Raman, K. I. Barnes, L. Baker, and L. Blumberg. 2013. "Case Management of Malaria: Treatment and Chemoprophylaxis." *South African Medical Journal* 103 (10): 793. doi:10.7196/SAMJ.7443.

World Health Organization. 2009. "Malaria Case Management Operations Manual." Geneva, Switzerland: WHO.

———. 2015. "Guidelines for the Treatment of Malaria." Geneva: WHO. http://www.who.int/malaria/publications/atoz/9789241549127/en/.

Deworming for Schistosomiasis

WHO recommends that all at-risk groups receive anthelminthic treatment for schistosomiasis with praziquantel—a safe and low-cost medicine—in areas of endemic schistosomiasis infection. While it is still possible to become infected, the treatment minimizes the progression of the disease (WHO 2016). At-risk groups include preschool-age children, starting at 12 months of age; and school-age children and adults, including pregnant and lactating women. In addition, individuals—such as fishermen and farmers—who must work near or in infested water are at an increased risk of schistosomiasis.

According to WHO, treatment should be given periodically, based on the level of infection, and as often as once a year in areas with high transmission. In highly endemic areas, anthelminthic treatment is recommended for the entire community, including pregnant women (WHO 2016). WHO's prevalence categories are used to recommend the frequency of deworming; prevalence is based on school-age children because data for this population group is most often available, but treatment applies to all populations (see **Table 17**).

Many countries with endemic schistosomiasis, at certain intervals, administer praziquantel in schools. They have also integrated schistosomiasis treatment into broader deworming efforts for hookworm, onchocerciasis, and other initiatives (King 2011). The medicines, widely administered to everyone in the high-risk groups, can be given without prior diagnosis and, often, by non-medical personnel.

Table 17: Prevalence Levels for Treatment of Schistosomiasis

Prevalence in School-Age Children	Treatment
≥50% by parasitological methods (intestinal and urinary schistosomiasis) or ≥30 by questionnaire for visible haematuria (urinary schistosomiasis)	Blanket treatment once per year for school-age children. Also, treat adults considered to be at high risk (from special groups to entire communities living in endemic areas).
≥10 but <50% by parasitological methods or <30% by questionnaire for visible haematuria	Blanket treatment once every 2 years for school-age children. Also, treat adults considered to be at risk.
<10% by parasitological methods	Blanket treatment twice during primary schooling age for school-age children. Praziquantel should be available in dispensaries and clinics for treatment of suspected cases.

Source: Crompton and WHO 2006

MEASUREMENT AND DATA SOURCES

Population-based surveys typically report the percentage of children 6–59 months who were given deworming medication in the six months preceding the survey, as well as the percentage of women with a live birth in the two to five years before the survey who were given deworming medication during their most recent pregnancy. In post-event coverage surveys, coverage is the percentage of the eligible population who received deworming medication during the last campaign. These surveys usually take place within a few weeks of the campaign, and interviewers will show participants the provided medications to ensure accurate recall.

Surveys that collect information related to deworming coverage include—

- Demographic and Health Surveys
- Multiple Indicator Cluster Surveys
- National Micronutrient Surveys
- Post-event coverage surveys
- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

In addition, health monitoring information systems may include coverage estimates of deworming activities, both from mass treatment events, as well as routine treatment. In the case of campaign-based distribution, these data often come from tally sheets completed during mass drug administration, which are compared against the total target population to obtain coverage estimates.

Most implementers who conduct deworming campaigns for schistosomiasis—often the government or specific organizations—will have detailed reports on distribution. You may be able to access up-to-date coverage information from these sources and use this information to cross-reference survey data.

METHODOLOGICAL ISSUES

- Generally, tally sheets and other administrative data may overestimate deworming coverage compared to post-event coverage survey data; therefore, it is preferable to use post-event coverage data.
- Recall bias in these routine population-based surveys may result in lower coverage estimates compared to post-event surveys.
- Consider the regularity of deworming campaigns, as well as the timing of data collection, to assess coverage in population-based surveys and other sources, including health monitoring information systems and post-event coverage surveys. Discrepancies may be noted between these sources, based on whether information was collected prior to or following a deworming campaign. In other words, coverage estimates from population-based surveys may be affected by the time interval between the survey and the mass antihelminthic treatment, especially when estimates are compared between years.
- While WHO recommends anthelminthic treatment for children starting at 12 months, many population-based surveys collect information about deworming coverage in children younger than 12 months. It is best to exclude these younger children in the overall assessment of deworming coverage, especially if a country policy is aligned with WHO's recommendation of starting deworming at 12 months.

- While looking for information on this topic, remember that most data on deworming refers to both treatment for schistosomiasis and soil-transmitted helminths.

FOR MORE DETAIL

Crompton, D. W. T, and World Health Organization. 2006. *Preventive Chemotherapy in Human Helminthiasis Coordinated Use of Anthelminthic Drugs in Control Interventions: A Manual for Health Professionals and Programme Managers.* Geneva, Swizterland: World Health Organization. http://site.ebrary.com/id/10161463.

King, Charles H. 2011. "Schistosomiasis: Challenges and Opportunities." In *The Causes and Impacts of Neglected Tropical and Zoonotic Diseases: Opportunities for Integrated Intervention Strategies*, A12. Washington, D.C.: National Academies Press (US). http://www.ncbi.nlm.nih.gov/books/NBK62510/.

World Health Organization. 2016. "Fact Sheet: Schistosomiasis." February. http://www.who.int/mediacentre/factsheets/fs115/en/.

Deworming for Soil-Transmitted Helminths

WHO recommends fighting soil-transmitted infections by giving all at-risk population groups periodic anthelminthic treatment with one of two safe, effective, and low-cost medicines: albendazole (400 mg) or mebendazole (500 mg) in areas with endemic infection levels (WHO 2002). At-risk groups include preschool-age children, starting at 12 months of age; school-age children and women of reproductive age, particularly pregnant women after the first trimester; and lactating women.

According to WHO, treatment should be given once a year in areas with an infection burden higher than 20 percent and twice a year in areas with prevalence higher than 50 percent (WHO 2016). WHO prevalence categories are used to recommend the frequency of deworming; prevalence is based on school-age children because this population group has available data most often, but treatment applies to all populations (see **Table 18**).

In many countries where soil-transmitted helminths are endemic, administration of anthelmintic medication is combined with other routine health

Table 18: Prevalence Levels for Treatment of Soil-Transmitted Helminth Infection

Prevalence of Any Soil-Transmitted Helminth Infection Among School-Age Children	Treatment
≥50%	Blanket treatment: 2 times per year for school-age children. Also treat: • Preschool children • Women of childbearing age, including pregnant women in 2nd and 3rd trimester and lactating women • Adults at high risk in certain occupations (e.g., tea pickers and miners)
≥20% and <50%	Blanket treatment once per year for school-age children. Also, treat— • Preschool children • Women of childbearing age, including pregnant women in 2nd and 3rd trimester and lactating women • Adults at high risk in certain occupations (e.g. tea pickers and miners)

Source: Crompton and WHO 2006

events: Child Health Days, school health programs, and others. Anthelmintic medication is also administered as part of routine primary health care and routine antenatal care for high-risk groups. The medicines, widely administered to everyone in the high-risk groups, can be given without prior diagnosis and, often, by non-medical personnel.

MEASUREMENT AND DATA SOURCES

Population-based surveys typically report the percentage of children 6–59 months who were given deworming medication in the six months preceding the survey, as well as the percentage of women with a live birth in the two to five years before the survey who were given deworming medication during their most recent pregnancy. In post-event coverage surveys, coverage is the percentage of the eligible population who received deworming medication during the last campaign. These surveys usually take place within a few weeks of the campaign, and interviewers will show the participants the medications to ensure accurate recall.

Surveys that collect information related to deworming coverage include—

- Demographic and Health Surveys
- Multiple Indicator Cluster Surveys
- National Micronutrient Surveys
- post-event coverage surveys
- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

In addition, health monitoring information systems may include coverage estimates of deworming activities, both from mass treatment events, as well as routine treatment. In the case of campaign-based distribution, these data often come from tally sheets completed at the time of mass drug administration, which are compared against the total target population to obtain coverage estimates.

METHODOLOGICAL ISSUES

- Generally, tally sheets and other administrative data may overestimate deworming coverage compared to post-event coverage survey data, so it is preferable to use post-event coverage data.
- Recall bias in these routine population-based surveys may result in lower coverage estimates compared to post-event surveys.
- Consider the regularity of deworming campaigns, as well as the timing of data collection in relation to a deworming campaign. Discrepancies may be noted between different data sources, based on whether information was collected prior to or following a deworming campaign. In other words, coverage estimates from Demographic and Health Surveys, Multiple Indicator Cluster Surveys, or National Micronutrient Surveys may be affected by the time interval between the survey and the mass antihelminthic treatment, especially when estimates are compared between years.
- While WHO recommends anthelminthic treatment for children starting at 12 months, many population-based surveys collect information about deworming coverage in children younger than 12 months. It is best to exclude these younger children in the overall assessment of deworming coverage, especially if a country policy is aligned with WHO recommendations of starting deworming at 12 months.

- While looking for information on this topic, remember that most data on deworming refers to both treatment for schistosomiasis and soil-transmitted helminths.
- Understanding antenatal care visits is helpful for interpreting data regarding deworming for pregnant women. Many countries, however, do not consistently record or report these data, complicating efforts to explain coverage of antenatal care services (Dwivedi et al. 2014).

FOR MORE DETAIL

Brooker, Simon, Peter J. Hotez, and Donald A. P. Bundy. 2008. "Hookworm-Related Anaemia among Pregnant Women: A Systematic Review." *PLoS Neglected Tropical Diseases*. doi:10.1371/journal.pntd.0000291.

Crompton, D. W. T, and World Health Organization. 2006. *Preventive Chemotherapy in Human Helminthiasis Coordinated Use of Anthelminthic Drugs in Control Interventions: A Manual for Health Professionals and Programme Managers.* Geneva, Swizterland: World Health Organization. http://site.ebrary.com/id/10161463.

Dwivedi, Vikas, Mary Drake, Barbara Rawlins, Molly Strachan, Tanvi Monga, and Kirsten Unfried. 2014. "A Review of the Maternal and Newborn Health Content of National Health Management Information Systems in 13 Countries in Sub-Saharan Africa and South Asia." Washington, DC: Maternal and Child Survival Program.

Gulani, Anjana, Jitender Nagpal, Clive Osmond, and H. P. S. Sachdev. 2007. "Effect of Administration of Intestinal Anthelmintic Drugs on Haemoglobin: Systematic Review of Randomised Controlled Trials." *BMJ* 334: 1095. doi:10.1136/bmj.39150.510475.AE.

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Taylor-Robinson, D. C., N. Maayan, K. Soares-Weiser, S. Donegan, and P. Garner. 2012. "Deworming Drugs for Soil-Transmitted Intestinal Worms in Children: Effects on Nutritional Indicators, Haemoglobin and School Performance." *Cochrane Database of Systematic Reviews* 7: CD000371.

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———. 2016. "Fact Sheet: Soil-Transmitted Helminth Infections." *WHO*. March. http://www.who.int/mediacentre/factsheets/fs366/en/.

Indoor Residual Spraying

Indoor residual spraying (IRS) includes applying residual insecticides to indoor surfaces—walls, ceilings, and others—where it is likely to come in contact with and repel and/or kill adult mosquitoes. IRS also kills mosquitoes that rest on indoor surfaces after feeding on humans, preventing them from biting again and possibly transmitting malaria (WHO 2015). To a lesser degree, IRS also reduces the number of mosquitos that enter the household.

Correct insecticide application can reduce mosquito populations, curbing malaria transmission and the contribution of malaria to anemia. In target areas, IRS coverage of 80 percent or more leads to the maximum protection for the population and can interrupt transmission in the immediate area (WHO 2016). WHO recommends 12 insecticides for IRS, classified as pyrethroids, organochlorines, organophosphates, and carbamates. Most are effective for three to six months after they are applied (WHO 2015). Based on cost, availability, hazard classification, insecticide resistance, and length of effect per spray, one or multiple types of insecticides may be appropriate. Despite previous concerns over safety, the organochlorine—known as DDT—is still recommended for IRS because it is effective for an extended period of time (6–12 months); provides the best protection in many malaria endemic areas; and, if used in very small quantities, is not toxic to humans or the environment. Apply DDT under strict controls and regulations (WHO 2011).

IRS spray campaigns take place at least yearly, with up to two rounds per year in areas with high transmission (WHO 2015).

Often, campaigns are not done at a national level, but are targeted to high-risk areas or those with increasing epidemics, and are often closely linked to external funding.

Insecticide resistance is a growing concern that threatens the success of malaria vector control in the future. With the widespread use of IRS in recent years, more than 60 countries with endemic malaria transmission have reported resistance to one or multiple insecticides, mainly pyrethroids, although DDT resistance is also prevalent; the poor, ad-hoc monitoring in most affected countries makes it more difficult to address the problem (Roll Back Malaria and WHO 2012). You may want to include any locally relevant information on insecticide resistance in your landscape analysis.

MEASUREMENT AND DATA SOURCES

Population-based surveys typically report IRS information bundled with coverage of insecticide-treated bed nets (ITN), and they assess the percentage of individuals, or the percentage of households, covered by both intervention (IRS and ITNs). These surveys typically assess the percentage of residences sprayed with IRS in the 12 months before the survey, the percentage of households with at least one ITN for every two people, and the percentage of individuals who slept under an ITN prior to the survey.

Surveys that collect information related to coverage of IRS include—

- Demographic and Health Surveys
- Malaria Indicator Surveys
- Multiple Indicator Cluster Surveys
- Other research or evaluation activities.

Most implementers who administer IRS, often the government or specific organizations, will have detailed reports on spray campaigns, all the way to the household level and often with global positioning system data. Information is often collected by the number (or percentage) of rooms and structures sprayed and the number (or percentage) of people protected by the structures or houses sprayed. Households will also often be given record cards to track participation in each spray round, which can be used to facilitate recall. In addition to survey or administrative data regarding coverage, you can use WHO cone bioassays or field-collected susceptible *anophelines* to measure the quality of spray application.

You may also be able to access information on coverage of IRS from the President's Malaria Initiative, which includes country profiles and other data available on its website: www.pmi.gov.

METHODOLOGICAL ISSUES

- Always consider seasonality when interpreting malaria-related data, especially for population-based surveys. Generally, survey reports indicate when the survey was conducted to ensure that data is interpreted appropriately. Malaria transmission rates—and, therefore, the implementation of prevention activities—at the time of data collection will affect comparability of these estimates over time and across studies. For instance, Demographic and Health Surveys often avoid the rainy season, given the difficulties inherent with data collection during this time, while Malaria Indicator Surveys are deliberately scheduled at this time to capture indicators during a season of high malaria transmission.
- The effectiveness of IRS programs relies on the effectiveness of the specific insecticide against the local vector populations. In addition to routine data regarding coverage and quality of the program, annual susceptibility testing should take place to ensure the insecticide used is still effective. In addition, regular collection of entomological performance indicators is necessary to track program effectiveness and plan for future spray rounds.

FOR MORE DETAIL

Roll Back Malaria, and World Health Organization. 2012. *Global Plan for Insecticide Resistance Management in Malaria Vectors*. Geneva: World Health Organization.

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———. 2016. "Fact Sheet: Malaria." http://www.who.int/mediacentre/factsheets/fs094/en/.

Intermittent Preventive Treatment during Pregnancy

In areas with moderate to high malaria transmission, WHO recommends intermittent preventive treatment during pregnancy (IPTp) with *sulfadoxine-pyrimethamine (SP)*. IPTp reduces the adverse consequences of malaria on maternal and fetal outcomes, including the reduction of maternal malaria episodes, maternal and fetal anemia, and low birthweight (Radeva-Petrova et al. 2014). With IPTp, individual doses of SP are given to pregnant women during antenatal care visits, regardless of malaria status, to clear existing parasites and prevent new infections. Pregnant women should be given at least three tablets of SP, each containing 500 mg/25 mg SP, ideally as directly observed therapy (WHO 2015). IPTp should start as early as possible in the second trimester, with doses given at each scheduled antenatal care visit until delivery, with the doses at least one month apart. The three or more doses of IPTp are associated with greater benefits than taking only one or two doses, including higher mean birth weight and fewer low birth weight births than with two doses (WHO 2013; Kayentao et al. 2013).

IPTp should be provided as part of an antenatal care package that includes other services, such as deworming for soil-transmitted helminths and deworming for schistosomiasis, and iron-folic acid supplementation (WHO 2016). Doses of folic acid equal to 5,000 mcg or above have been shown to counteract the efficacy of the antimalarial SP. Therefore, the folic acid dose given in iron-folic acid supplementation should be 400 mcg, which can be used safely with SP (Roll Back Malaria Partnership 2015; Maternal and Child Survival Program 2015).

MEASUREMENT AND DATA SOURCES

Population-based surveys typically report whether women received IPTp if they had a live birth in the two to five years preceding the survey. Survey questions typically include whether drugs were taken to prevent malaria, which drugs were taken, and how many times the drugs were taken. Surveys report IPTp coverage as the percentage of women who received any IPTp; two or more doses of IPTp (minimum WHO requirement); or, in more recent surveys, three or more doses of IPTp.

Surveys that collect information related to coverage of IPTp include—

- Demographic and Health Surveys
- Malaria Indicator Surveys
- Multiple Indicator Cluster Surveys
- National Micronutrient Surveys
- other research or evaluation activities.

In addition, health monitoring information systems may gather data on the coverage of IPTp.

METHODOLOGICAL ISSUES

- Although many population-based surveys only assess the percentage of women who received any IPTp and those who received two or more doses of IPTp, remember that WHO recommends three or more doses, because that dosage is associated with higher benefits.
- Administrative data may not allow you to track multiple doses given to women during the same pregnancy.

- Understanding antenatal care visits is helpful for interpreting data regarding deworming for pregnant women. Many countries, however, do not consistently record or report these data, complicating efforts to explain coverage of antenatal care services (Dwivedi et al. 2014).

FOR MORE DETAIL

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Long-Lasting Insecticide-Treated Bed Nets

Long-lasting insecticide-treated bed nets (LLINs) are an effective way to curb malaria transmission in an endemic population. WHO currently recommends free distribution of LLINs, which are factory-treated to remain effective for a minimum of three years and 20 washes (WHO 2007). WHO encourages full coverage for all people at risk of malaria in areas targeted for malaria prevention with LLINs, especially children under 5 and pregnant women (WHO 2015). In malaria-endemic areas, all at-risk population groups should be covered with LLINs, especially children under 5 and pregnant women (WHO 2016).

LLINs can be provided through a combination of mass free distributions and continuous distribution through multiple channels, with mass campaigns repeated at an interval of no more than three years and with continuous distribution channels functioning before, during, and after any mass campaign (WHO 2013). Campaigns are often not carried out on a national level, but rather are targeted to high-risk areas, or those with increasing epidemics, and are often closely linked to external funding. Appropriate social and behavior change communication messaging on the proper use and maintenance of LLINs is crucial; you should ensure it is always part of malaria prevention interventions.

Insecticide resistance is a growing concern that threatens the success of malaria vector control in the future. More than 60 countries with endemic malaria transmission have reported resistance to one or multiple insecticides; the poor, ad-hoc monitoring in most affected countries makes it more difficult to address the problem (Roll Back Malaria and WHO 2012). Consider including locally relevant information on insecticide resistance in your landscape analysis.

MEASUREMENT AND DATA SOURCES

Population-based surveys typically report household ownership and the use of bed nets during a certain period of time preceding the survey. Surveys report bed net ownership as the percentage of households with at least one mosquito bed net or at least one bed net for every two persons who stayed in the household the night before the survey. Surveys report bed net use as the percentage of the population that slept under a bed net the night before the survey.

Surveys that collect information related to coverage of LLINs include—

- Demographic and Health Surveys
- Malaria Indicator Surveys
- Multiple Indicator Cluster Surveys
- National Micronutrient Surveys
- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

Health monitoring information systems may also record information about the distribution of LLINs or other bed nets to pregnant women or young children, especially if the country includes this service as part of the antenatal care platform or well-child visits.

METHODOLOGICAL ISSUES

- While WHO recommends that governments procure and distribute only LLINs, many other types of bed nets are still in use throughout the world; therefore, indicators of bed net ownership and usage often report results in

categories of any bed net, ITN, or LLIN. While the LLIN indicators provide the best picture of optimal protection against malaria, consider the discrepancies in coverage between the other types of bed nets.

- Always consider seasonality when interpreting malaria-related data, especially population-based surveys. Generally, survey reports indicate when the survey was conducted to ensure that data are interpreted appropriately. Malaria transmission rates—and, therefore, the implementation of prevention activities—at the time of data collection will affect comparability of these estimates over time and across studies. For instance, Demographic and Health Surveys often avoid the rainy season, given the difficulties inherent with data collection at this time, while Malaria Indicator Surveys are deliberately scheduled at this time to capture indicators during a season of high malaria transmission.
- Most population-based surveys ask about the use of a bed net the night before data collection and, subsequently, use that information as a proxy for consistent use throughout the year. Therefore, actual, regular use of LLINs or other bed nets is likely to be lower than reported in surveys.
- The hot, humid seasons often coincide with high malaria transmission. Bed nets, in general, reduce airflow and can be uncomfortable for the user, especially during the hot, humid months of the year, so usage may be particularly low during these months (von Seidlein et al. 2012).
- Distribution data do not reflect proper use by individuals, especially if the data do not track indicators of social and behavior change strategies. When administrative data is used to estimate coverage, WHO recommends using a correction factor of 1.6 users per ITN to estimate population access to ITNs, rather than assuming each ITN covers two users (WHO 2014).[2]

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2 Note that this is different than the quantification number used to estimate procurement of ITNs, which remains at 1.8 users per ITN.

Dietary Diversification

Dietary diversification interventions are interventions that change food consumption at the household level, such as increasing the consumption of animal-source foods (Gibson and Anderson 2009; Gibson, Perlas, and Hotz 2006). In most resource-poor settings, starch-based diets with limited access to meats, dairy, fruits, or vegetables, are the dominant diets. The objective in changing household diet is to increase the variety and quantity of micronutrient-rich foods to decrease micronutrient deficiencies, including animal-source foods (Nair, Augustine, and Konapur 2016; Gibson 2014). This objective is generally achieved through social and behavior change activities, but can also include increased production of nutrient-rich foods and improved access to diverse foods.

MEASUREMENT AND DATA SOURCES

While measuring energy and nutrient intake would ideally rely on observed and weighed food records, such data collection is expensive, may be impractical, and may change the behavior of people being observed. Instead, most information reflects recall of diet intake (at the individual level) or recall of purchasing patterns (at the household level). Diet data collection methods vary and include—

- Repeat 24-hour diet recall, in which the food groups that a household or an individual has consumed are calculated for the preceding 24 hours. This method requires at least two 24-hour recalls from each person, on nonconsecutive days, to report individual-level data.
- List-based diet recall, in which the respondent recalls foods consumed in the past 24 hours, based on a list provided by the interviewer (Kennedy et al. 2011).
- Food frequency questionnaire, in which a respondent is asked questions about foods and beverages consumed over a specified period of time (longer than 24 hours).
- Emerging tools, such as Optifood (FANTA 2016) collects data on food consumption patterns.
- Ethnographic studies explore nutrition practices in various contexts and may include details on dietary intake (Tumilowicz, Neufeld, and Pelto 2015; Pelto et al. 2015).
- Questionnaires, such as those used in Household Consumption and Expenditure Surveys, provide information at the household level on consumption of food groups for approximately 125 predefined food items (Fiedler et al. 2012).

To help aggregate diet data collected through one of the methods above, many population-based surveys will report the types of food consumed, average numbers of predefined food groups included in the diet, and diet diversity scores. At the household level, diet diversity scores represent the economic ability of a household to access a variety of foods, while individual diet diversity scores aim to reflect nutrient adequacy. If inadequate food is consumed, it is unlikely that adequate quality can be met. These scores are most commonly reported for women and children:

- **Minimum dietary diversity for women** is the percentage of women 15–49 years of age who consumed at least 5 of 10 identified food groups in the last 24 hours (FAO and FHI 360 2016).
- **Minimum dietary diversity for children** is the percentage of children who consumed at least 4 of 10 identified food groups in the last 24 hours

(WHO 2010). When paired with data regarding meal frequency, diet diversity can be used to calculate the minimum acceptable diet for children 6–23 months of age.[3]

Surveys that collect information related to diet include—

- Demographic and Health Surveys
- household consumption and expenditure surveys
- Multiple Indicator Cluster Surveys
- National Micronutrient Surveys
- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

METHODOLOGICAL ISSUES

- Repeat 24-hour dietary recall assessments are difficult to conduct and data may be unreliable unless managed by trained specialists who are familiar with local dishes and implements, as well as interviewing techniques that can assess the portions consumed by the individual versus the rest of the family.
- Depending on the survey tool, country context, population group (i.e., women or children), and indicators, food groups used in data collection and analysis can vary.
- Population-based surveys that use list-based food questionnaires generally rely on a 24-hour recall period, which is not a good measure of habitual diet; but, the longer recall periods used in some surveys, such as 7 or 14 days, can increase recall bias.
- If consumption patterns are measured during atypical consumption days, for example during harvest seasons, diet indicators may not accurately represent the population studied.

3 The calculation for minimum dietary diversity slightly differs when done for inclusion in the composite minimum acceptable diet indicator, because diet diversity for non-breastfed children in this indicator is calculated without a dairy food group and requires at least two milk feedings. For more detail see Section D: Instructions for calculating indicator values in (WHO 2010).

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Dietary Modification

Dietary modifications are changes made during food preparation, processing, and consumption to increase the bioavailability of micronutrients—and reduce micronutrient deficiencies—in food at the commercial or individual/household level (Beck and Heath 2013). One example of dietary modification is the simultaneous consumption of iron-rich foods with ascorbic acid (vitamin C) (Gibson 2014), which increases the amount of iron absorbed by the body. Decreasing the amount of coffee and tea consumed with meals containing iron-rich foods is another example of dietary modification, because coffee and tea inhibit iron absorption.

Other strategies to increase bioavailability include (1) using germinated cereal flours containing amylase to increase the energy and nutrient density of cereal-based porridges; and (2) using processes like germination, fermentation, and soaking to reduce the phytate content, which can interfere with iron and zinc absorption. These practices improve the intake and absorption of micronutrients, thus reducing anemia.

MEASUREMENT AND DATA SOURCES

Data on the commercial or individual/household-level dietary modification are not easily available. Currently, tools or indices to assess dietary modification practices are not developed. Still, the consumption of specific foods that enhance or inhibit the absorption of micronutrients can be measured. Population-based surveys that measure household, or individual-level food consumption, may list specific foods and processing practices that enhance or inhibit the absorption of micronutrients. National Micronutrient Surveys, the Optifood tool (FANTA 2016), and other population-based surveys with dietary intake modules, collect information about coffee and tea consumption, which can decrease iron absorption when consumed with meals containing iron-rich foods. Other dietary modification practices—using germinated cereal flours in cereal-based porridges or germination, fermentation, and soaking practices in cooking to reduce the phytate content—may be available from individual research studies (Hotz and Gibson 2001; Hotz, Gibson, and Temple 2001; Hotz and Gibson 2005). It's important to note that these dietary modification practices may vary by geographic location within a country, or by cultural or ethnic groups.

METHODOLOGICAL ISSUES

- Dietary modification practices, including processing and cooking methods, may vary significantly within a country. This makes findings difficult to generalize to national populations.

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High-dose Vitamin A Supplementation for Children

In settings where vitamin A deficiency is a public health problem, WHO recommends a high-dose vitamin A supplement every six months for children 6–59 months to reduce child morbidity and mortality. The recommended dose for children 6–11 months old is 100 000 International Units (IU), and for children 12–59 months, it is 200 000 IU. Because vitamin A is fat soluble, the liver can effectively absorb and store a high dose of vitamin A and use it over an extended period of time. High-dose vitamin A supplementation improves vitamin A status for up to three months only in children who have low dietary intake. It is insufficient for preventing vitamin A deficiency because it does not address the underlying cause of the deficiency.[4]

Many countries have integrated universal distribution of high-dose vitamin A supplementation into campaign events—such as Child Health or Immunization Days—while others are beginning to use routine fixed facility and outreach health services. When high-dose vitamin A supplementation is available through multiple channels (i.e., campaigns and routine services), tracking receipt becomes an important activity to minimize the risk of providing too many doses to young children within a short time span (Klemm et al. 2016).

MEASUREMENT AND DATA SOURCES

Population-based surveys typically report the percentage of children 6–59 months who were given vitamin A supplementation in the six months preceding the survey. In post-event coverage surveys, coverage is the percentage of the eligible population that received vitamin A supplementation during the last campaign. These surveys usually take place within a few weeks of the campaign. The target coverage for an effective high-dose vitamin A supplementation program provided through immunization programs is at least 90 percent in 80 percent of districts to achieve mortality reduction (WHO 2013).

Surveys that collect information related to high-dose vitamin A supplementation coverage include—

- Demographic and Health Surveys
- Multiple Indicator Cluster Surveys
- National Micronutrient Surveys
- post-event coverage surveys
- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

In addition, health monitoring information systems may include coverage estimates of vitamin A supplementation—both from mass treatment events, as well as routine treatment. For campaign-based distribution, these data often come from tally sheets completed at the time of mass supplementation, which are compared against the total target population to obtain coverage estimates. In this context, high-dose vitamin A supplementation coverage refers to the percentage of children who received an age-appropriate dose of vitamin A within a semester and within both semesters in a year (semester 1 is usually January–June; semester 2 is usually July–December).

4 Often misunderstood, twice yearly vitamin A supplementation implementation is intended to improve child survival through its immune benefits, and not to reduce vitamin A deficiency (even though this is the criteria for initiating the intervention). On its own, twice yearly high-dose vitamin A is not likely to reduce vitamin A deficiency over the long term, but it may be able to do so in conjunction with other interventions providing vitamin A (e.g., biofortification, dietary diversification, and micronutrient powders).

Administrative data are sometimes accessible through the Expanded Programme on Immunization, Ministry of Health nutrition units, or donors of the high-dose vitamin A supplementation program (e.g., Helen Keller International, Micronutrient Initiative, and UNICEF).

METHODOLOGICAL ISSUES

- Generally, tally sheets and other administrative data may overestimate vitamin A supplementation coverage compared to post-event coverage survey data, so it is preferable to use post-event coverage data.
- Recall bias in routine population-based surveys may result in lower coverage estimates compared to post-event surveys. For instance, vitamin A supplementation coverage from Demographic and Health Surveys usually underestimates true coverage, because the timing of the survey in relation to the vitamin A supplementation distribution impact maternal recall (Hodges et al. 2013; Dhillon et al. 2013).
- Consider the regularity of high-dose vitamin A supplementation campaigns, as well as the timing of data collection, in relation to a deworming campaign. Discrepancies may be noted between different data sources, based on whether information was collected prior to or following a supplementation campaign. In other words, coverage estimates from Demographic and Health Surveys, Multiple Indicator Cluster Surveys, or National Micronutrient Surveys may be affected by the time interval between the survey and the mass supplementation, especially when estimates are compared between years.

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Industrial Food Fortification

Food fortification is the addition of one or more essential nutrients to a foodstuff—food, food product, ingredient, or condiment—to prevent micronutrient deficiencies of one or more nutrients at the population level (Allen et al. 2006). Industrial food fortification refers to adding micronutrients and minerals to industrially processed and widely consumed edible products (Allen et al. 2006). Common fortified foods, for example, include salt; wheat and maize flours; edible oils; and sugar, but can also include bouillon cubes or soy sauce. Foods fortified with iron will likely have the highest impact on anemia, although foods fortified with other nutrients, such as vitamin A and folic acid, may also be important. One advantage of industrial food fortification is that it requires limited changes in consumer behavior compared to other micronutrient interventions.

You should consider the quality and coverage of industrial food fortification in the population, and whether it is reaching those who need it the most. Young children may not consume sufficient quantities of industrially fortified foods to meet their micronutrient needs and, thus, additional micronutrient interventions may be needed for this population. In addition, industrial food fortification may not reach populations who do not have access to markets; therefore, you should consider the reach of products to communities in rural or hard-to-reach areas. Small-scale fortification—for example, hammer mills to grind small batches of maize in East Africa—may, theoretically, fall under fortification legislation, but feasibility, compliance, and enforcement may be very limited.

MEASUREMENT AND DATA SOURCES

Key indicators for food fortification programs include having fortification policies at the national level, levels and type of fortificants available in fortified foods, availability of fortified foods, and consumption of fortified foods. Depending on the fortification interventions in your country, these indicators may or may not be relevant for all food vehicles.

To understand the policy environment for industrially fortified foods, review the legislation governing the fortification of food in the country to determine if it is mandatory, voluntary, or neither. If a law mandates fortification, or if fortification is voluntary, then the industries fortifying foods must ensure that their food meets the fortification standards. Fortification standards establish the levels (or ranges) of micronutrients expected to be found in the final packaged foods.

Do not assume that all industries comply with the standards—even if mandatory. Look for additional data from a governmental regulatory agency on external quality control results to establish, for example, the number of metric tons of adequately fortified wheat flour in the last year. The website or annual reports of the ministry governing the program may post summary data on how adequate the fortification of foods is at the production and retail levels.

Standardized methods can be used to verify the level of micronutrients in fortified foods—qualitative, semi-quantitative, and quantitative methods for determining the amount of iron, vitamin A, and other micronutrients in fortifiable

foods. Qualitative methods add reagents that indicate the presence of micronutrients by forming a colored compound (e.g., blue color with trifluoroacetic acid when vitamin A is present in oil or sugar). Quantitative methods use procedures like spectrophotometry for iron in wheat flour; high-performance liquid chromatography for vitamin A in flour, sugar, and oil, and water soluble vitamins (thiamin, riboflavin, niacin and folic acid) in foods; and, microbiological assays for folic acid and vitamin B12 in fortified foods. This information may be available from industry, governments' monitoring data, or population-based surveys.

A fortification rapid assessment tool is often conducted before a fortification program is implemented; it can be used with complementary monitoring data to understand reach and potential dietary impact of implementation. Once a fortification program is underway, you need to quantify the contributions of micronutrients from the different fortified foods to the diets of the population. The Global Alliance for Improved Nutrition (GAIN) developed the Fortification Assessment Coverage Tool to evaluate the potential dietary intake from fortified foods because of large-scale food fortification programs (GAIN 2016). The tool is used in population-based surveys to assess the coverage of fortifiable and fortified foods purchased or consumed at the household and individual level, and to test household food samples for their nutrient content.

Household-level consumption of a particular fortified food may also be found through consumer expenditure surveys, or other nationally or regionally representative datasets. These datasets vary from country to country, but it is often possible to add fortification-relevant questions to existing surveys or survey collection systems to understand the functioning of a food fortification program. Household surveys like Demographic and Health Surveys, Multiple Indicator Cluster Surveys, and household consumption and expenditure surveys may also collect information on the purchase or consumption of fortified and fortifiable foods.

The Food Fortification Initiative is a comprehensive source of data on fortification policies, fortification practices, industry information, and nutrient deficiencies across most countries (www.ffinetwork.org), with a focus on maize flour, wheat flour, and rice. In addition, GAIN maintains information on food fortification programs on its website (www.gainhealth.org). The Iodine Global Network (www.ign.org) highlights some instances of fortification of salt with other nutrients.

METHODOLOGICAL ISSUES

- In countries where fortification is not mandated by law and the food industry does it voluntarily, it may be difficult to access data on monitoring at the production level. These data may only be available directly from the industries fortifying the foods, if at all. Because of market competition, most industries do not share their production data.
- In most countries where industrial food fortification is being implemented, a regulatory mechanism ensures that the foods being fortified meet the standards set within the country. The quality of the data from these regulatory agencies can vary, based on the resources they have to carry out production-level monitoring.
- Most countries with fortification programs do not have nationally representative data on the consumption of fortified foods. The coverage of these programs for the population at high risk

of micronutrient deficiencies—children under 2, adolescent girls, and pregnant women—is often unknown. We rely on food consumption data, both fortified and non-fortified, as a proxy for their dietary micronutrient intake.

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Iron-Folic Acid Supplementation in Women of Reproductive Age

Iron-folic acid (IFA) supplementation during or before pregnancy can effectively reduce the risk of iron deficiency and anemia and improve gestational outcomes (Peña-Rosas and Viteri 2009).

Pre-conception: IFA supplementation before pregnancy can improve birth outcomes, increasing the iron and folic acid status in women pre-pregnancy, while addressing the iron deficiency that affects some menstruating women and adolescents (WHO 2009; WHO 2016a). Women of reproductive age (including adolescents) can be given oral IFA supplementation for three consecutive months, either daily or weekly, depending on the anemia prevalence rates in the setting (**Table 19**). Always consider the intervention in the context of other interventions to avoid exceeding daily iron requirements (e.g., mass fortification of staple foods) (WHO 2009).

Table 19: IFA Supplementation Recommendations for Women of Reproductive Age

Anemia Prevalence among Women of Reproductive Age	Recommendation
20–40%	120 mg iron + 2,800 mcg folic acid weekly
>40%	30-60 mg iron + 400 mcg folic acid daily for three consecutive months

Source: WHO 2009; WHO 2016a

Pregnancy: Women face increased iron requirements during pregnancy, and folic acid is necessary for the healthy development of the fetus. In the antenatal care package in most countries, daily IFA supplementation is a key intervention. WHO recommends daily oral IFA supplementation in areas where anemia prevalence rates are above 20 percent and weekly IFA supplementation in areas where anemia is 20 or below (see **Table 20**).

Table 20: IFA Supplementation Recommendations for Pregnant Women

Anemia Prevalence among Pregnant Women	Recommendation
<20%	120 mg iron + 2,800 mcg folic acid weekly
20-40%	30-60 mg iron + 40 mcg folic acid daily
>40%	60 mg iron + 40 mcg folic acid daily

Source: WHO 2016b

IFA supplementation should begin as early as possible in a pregnancy and continue throughout. If a woman is diagnosed with anemia during her pregnancy, her iron dose should be increased to 120 mg daily until her hemoglobin concentration is normal (110 g/L or higher).

Low doses of folic acid—40 mcg daily or 2,800 mcg weekly—combined with iron can be given in combination with *sulfadoxine-pyrimethamine* to prevent malaria during pregnancy (see Intermittent Preventive Treatment during Pregnancy section) (Roll Back Malaria Partnership 2015; Maternal and Child Survival Program 2015). It is important to note that when providing IFA supplementation in settings with endemic infections, such as malaria and hookworm, measures to prevent and treat these infections should be implemented (WHO 2016b).

Many countries provide IFA supplementation to pregnant women through facility-based antenatal care, but in several countries, especially where antenatal care coverage is low, IFA supplements may be provided through community-based programs (MCHIP 2011). IFA supplementation for women of reproductive age (including adolescents) often relies on a community-based or other non-facility-based distribution model.

A barrier analyses on IFA supplementation consumption, while usually not nationally representative, can provide important insight into a program's strengths and weaknesses, such as difficulties with the supply chain or poor distributor counseling skills (Sununtnasuk, D'Agostino, and Fiedler 2015). Quality of interpersonal counseling, and how side effects are addressed by health care providers, can also affect the implementation and effectiveness of an IFA supplementation intervention. Concerns about side effects are one main reason for non-compliance with IFA supplements among pregnant women; this may point to possible programmatic solutions, such as increasing women's and communities' awareness of the importance of supplements (Sadore, Gebretsadik, and Hussen 2015).

MEASUREMENT AND DATA SOURCES

Population-based surveys typically report the percentage of women with a live birth in the two to five years before the survey who received and took IFA supplementation during their most recent pregnancy. Surveys usually report means and medians, in addition to categorizing responses by the number of supplements consumed: any IFA supplements, less than 60, 60–89, or more than 90. Because antenatal care is typically the main platform for IFA supplement distribution for pregnant women, survey questions on antenatal care attendance and timing of the first antenatal care visit can provide information on the use of this platform to deliver IFA supplementation. Also, some surveys now ask women of reproductive age about their consumption of IFA supplements.

Surveys that collect information related to coverage of IFA supplementation include—

- Demographic and Health Surveys
- Multiple Indicator Cluster Surveys
- National Micronutrient Surveys
- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

Health monitoring information systems usually include information about the distribution of IFA supplements to pregnant women, because they are one service that is supposed to be provided during antenatal care (Dwivedi et al. 2014).

METHODOLOGICAL ISSUES

- Coverage of IFA supplementation is not the same as adherence—and adherence to the correct dosing regimen is necessary to reach the intended impact. Most data sources report on IFA distribution, but women may not adhere to the dosage recommendations after they receive the supplements. Adherence intake is a challenge to measure and it may not be easily captured by the data outside year-end reports or research studies aimed at assessing coverage and adherence.
- Pregnant women are supposed to take the supplement daily, beginning early in the pregnancy, but it can be difficult to find information on timing. Usually, timing of the first antenatal care visit is used as a proxy

for beginning IFA supplementation, but this assumes that women do not have access to IFA supplementation earlier in the pregnancy.

- Current routine data systems probably only capture IFA supplementation for pregnant women, while most systems do not collect data on supplementation for women of reproductive age, including adolescents.
- Understanding antenatal care visits is helpful for interpreting data regarding IFA supplementation for pregnant women. Many countries, however, do not consistently record or report these data, complicating efforts to explain coverage of antenatal care services (Dwivedi et al. 2014).

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Maternal, Infant, and Young Child Nutrition

Improved nutrition during pregnancy, lactation, and early childhood are important ways to avoid micronutrient deficiencies, for both mothers and children.

Good maternal nutrition during pregnancy improves the birth outcomes of children and reduces the risk of pregnancy-related health complications (Black et al. 2013; Abu-Saad and Fraser 2010). Providing nutrition education and counseling during pregnancy is one way to improve maternal nutrition practices (WHO 2016), although good practices need to continue through lactation.

Infant and young child feeding (IYCF) is a critical component of the 1,000 days approach to improve child health. WHO recommends early initiation of breastfeeding (within the first hour), exclusive breastfeeding for the first six months of life, and timely and appropriate complementary feeding, with continued breastfeeding up to two years or beyond (WHO and UNICEF 2003). Exclusive breastfeeding reduces infant morbidity and mortality from common infections, such as diarrhea or pneumonia; and it indirectly reduces anemia by preventing the inhibitory effects of inflammation on iron absorption, mobilization, and, consequently, red blood cell production.

Complementary feeding starts at 6 months of age when breastmilk alone cannot meet the nutritional requirements of an infant, and other foods and liquids are needed with the breastmilk. The guiding principles of complementary feeding include (1) giving amounts of food that increase with the age of the child; (2) ensuring the food has the right consistency, nutrient, and energy density; and (3) ensuring the caregiver practices responsive feeding (WHO 2005; K. Dewey 2003). Ensuring dietary diversity in these early months of life when growth is rapid helps avoid micronutrient deficiency. Additionally, fluid intake should meet the daily requirements, micronutrient fortified foods should be used when available, and food and fluid should not be restricted during or after illness.

MEASUREMENT AND DATA SOURCES

WHO defines a list of core and optional indicators to assess IYCF practices, which include (WHO 2010)—

Core breastfeeding indicators—

- early initiation of breastfeeding (percentage of children born in the last 24 months who were put to the breast within one hour of birth)
- exclusive breastfeeding (percentage of infants 0–5 months of age who are fed exclusively with breastmilk)
- continued breastfeeding at 1 year (percentage of children 12–15 months of age who are fed breastmilk).

Core complementary feeding indicators—

- introducing solid, semi-solid, or soft foods (percentage of infants 6–8 months of age who receive solid, semi-solid, or soft foods)
- minimum dietary diversity (percentage of children 6–23 months of age who receive foods from four or more food groups)
- minimum meal frequency (percentage of breastfed and non-breastfed children 6–23 months of age who receive solid, semi-solid, or soft foods—but also including milk feeds for non-breastfed children—the minimum number of times or more)

- minimum acceptable diet (percentage of children 6–23 months of age who receive minimum diet diversity and meal frequency).

Optional indicators—

- children ever breastfed (percentage of children born in the last 24 months who were ever breastfed)
- continued breastfeeding at 2 years (percentage of children 20–23 months of age who are fed breastmilk)
- age-appropriate breastfeeding (percentage of children 0–23 months of age who are appropriately breastfed)
- predominant breastfeeding under 6 months (percentage of infants 0–5 months of age who receive only water and water-based drinks, fruit juice, ritual fluids, oral rehydration salts, or drops or syrups—vitamins, minerals, medicines—in addition to breastmilk)
- bottle feeding (percentage of children 0–23 months of age who are fed with a bottle)
- duration of breastfeeding (median duration of breastfeeding among children less than 36 months of age (WHO 2010).

WHO created a comprehensive tool for assessing national practices, policies, and programs for IYCF; although, in the context of anemia, the indicators above are sufficient (WHO and LINKAGES Project 2005).

While less commonly collected in household surveys, minimum dietary diversity and minimal meal frequency for postpartum women can be calculated from surveys that include a section on postpartum dietary intake (USAID 2015). Similarly, questions on knowledge and practice of maternal nutrition messages and counseling may be available.

Surveys that sometimes collect information related to IYCF practice (and sometimes counseling or message delivery) include—

- Demographic and Health Surveys
- Multiple Indicator Cluster Surveys
- National Micronutrient Survey
- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

Health monitoring information systems may include information relevant to maternal, infant, and young child nutrition programs, including early initiation of breastfeeding, breastfeeding status, or providing nutrition counseling. They may also capture and aggregate data on the nutritional status of children and mothers. This data may be collected during antenatal care visits (for maternal nutrition), at birth, during well-child/immunization visits, or during other interactions with health-care providers.

METHODOLOGICAL ISSUES

- Age is an important factor in calculating these indicators. Most of the standardized national surveys have processes in place that ensure the child's age is correct. If the indicator data is from a household survey, review the survey methods to ensure that the age data were properly calculated. Remember, some of the IYCF indicators depend on mothers' recall to calculate the value.
- In the face of intensive behavior change and communication messages about IYCF, data collected through recall may be overestimated, because respondents will often be aware of ideal

behaviors and may want to provide the "right" answer, even if they do not use the practice themselves.

- Children 0–5 months can be given oral rehydration salts and vitamin and/or mineral supplements, and still be considered exclusively breastfed.

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Routine Micronutrient Interventions for Children

Children can be routinely given micronutrient interventions, which contain one or more micronutrients, to ensure they meet their daily micronutrient requirements. These interventions can include iron supplements, micronutrient powders, and small-quantity lipid nutrient supplements. Each of these interventions should be considered in the context of other interventions to avoid exceeding daily micronutrient requirements. Give either iron supplements, micronutrient powders, or lipid nutrient supplements, but not more than one at a time. High-dose vitamin A supplementation, a non-routine intervention to address morbidity and mortality in children, is addressed in the High-dose Vitamin A Supplementation for Children section.

Iron supplementation during childhood can effectively reduce the risk of iron deficiency and anemia. See **Table 21** for the WHO recommendations for iron supplementation.

Micronutrient powders, a mixture of vitamins and minerals, are enclosed in single-dose sachets, that are stirred into a child's portion of food immediately before consumption; they have been shown to reduce anemia and iron deficiency. Micronutrient powders are sometimes called "Sprinkles," and the process of adding them to complementary foods is often referred to as home fortification or point-of-use fortification. Micronutrient powders contain at least 10 to 12.5 mg iron, 300 mcg retinol (see vitamin A deficiency), and 5 mg zinc (see zinc deficiency), but often contain up to 22 micronutrients. WHO recommends iron-containing micronutrient powders for children age 6–23 months in areas where anemia rates for children under 2 or children under 5 are above 20 percent, and for children age 2–12 years when anemia prevalence among school-age children is 20 percent or higher (WHO 2016b). Programs should target 90 sachets or doses over a six-month period.

Using small-quantity lipid-based nutrient supplements adds micronutrients, essential fatty

Table 21: Iron Supplementation for Children

Anemia	Recommendation for Children Age 6–23 Months	Recommendation for Children Age 24–59 Months	Recommendation for Children Age 5–12 Years
20-40%	-	25 mg iron once per week Given throughout calendar year or three months on, three months off	45 mg iron once per week Given throughout calendar year or three months on, three months off
>40%	10–12.5mg daily	30 mg daily	30–60 mg daily

Source: WHO 2016a

acids, and a small amount of protein to the diets of young children. While larger quantities are often used to treat severe and moderate acute malnutrition, rations of about 20 grams (around 110 kcal) per day are used to prevent malnutrition and to promote growth and development. While it is usually available in 20 gram sachets, some research studies suggest that 10 gram sachets provided twice daily may improve adherence, especially in younger children who may have trouble consuming the entire packet at one time; as well as preventing the consumption of partial sachets that can attract pathogens when left open (FANTA 2016).

In addition to the interventions described above, to improve the micronutrient and macronutrient intake of young children (de Pee and Bloem 2009), fortified blended foods, or fortified commercial infant cereals, can also be used. While these interventions can be costly, experience in Latin America suggests that these programs can be effective and they demonstrate a role for the public and private sectors in promoting these fortified foods (Lutter and Rivera 20.

In malaria-endemic settings, the provision of iron through iron supplements, micronutrient powder, or small-quantity lipid nutrient supplements should occur in conjunction with appropriate efforts to prevent, diagnose, and treat malaria (WHO 2011, 2016a, 2016b; Neuberger et a. 2016).

MEASUREMENT AND DATA SOURCES

Population-based surveys typically report the percentage of children (usually 6–59 months) who received iron tablets, syrups, or micronutrient powders (i.e., Sprinkles) in the seven days preceding the survey. However, some surveys will provide additional details on the types and timing of iron supplementation, as well as micronutrient powder or lipid nutrient supplements intake. Coverage of these interventions for children 6 months and older in the previous seven days can be disaggregated by age and gender.

Surveys that collect information related to the micronutrient interventions coverage include—

- Demographic and Health Surveys
- Multiple Indicator Cluster Surveys
- National Micronutrient Surveys
- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

Health monitoring information systems may include coverage estimates of micronutrient interventions, usually from distribution activities, which are compared against the total target population to obtain coverage estimates. Most implementers who conduct micronutrient interventions, often the government or specific organizations, will have detailed reports on distribution. In addition to these routine sources, the Home Fortification Technical Advisory Group website (www.hftag.org) provides information on micronutrient powder and lipid nutrient supplements intervention measurement and data collection, as well as a database of interventions, by country.

METHODOLOGICAL ISSUES

- Coverage of these interventions is not the same as adherence—and adherence to the correct dosing regimen is necessary to have the intended impact. Children may receive the appropriate supply, but may not adhere to the minimum dosage. Adherence intake is a challenge and may

not easily be captured by the data in other than year-end reports or research studies aimed at assessing coverage and adherence.

- Routine micronutrient interventions for children are often not included as part of administrative data collection, such as the country's health monitoring information system.

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Clean Play Spaces

Fecal pathogens (bacteria, protozoa, and viruses), soil-transmitted helminths, and other ie., contaminants can enter the human body in multiple ways, causing intestinal infections, inflammation of the gut, or micronutrient deficiencies through reduced micronutrient absorption. The predominant and primary sources of fecal contamination include broken sewerage systems, open defecation, inadequate child feces disposal, and free-range livestock and poultry. Humans and animals walk on feces in open yards and, subsequently, introduce contamination to the household environment. Children spend a lot of time playing on the ground, often exploring their surroundings with multiple senses, including touch and taste. When children interact with their environment, they directly ingest contaminants like animal feces and soil from dirty fingers, toys, or other objects (Ngure et al. 2013), as well as human feces in the environment, as a result of poor sanitation. Clean play spaces can stop or minimize these modes of transmission (Mbuya and Humphrey 2016).

Even when children do not appear to be infected, their continued exposure to fecal contamination can affect growth and overall health through gut inflammation (Humphrey 2009; Ngure et al. 2014). While it is still unknown how important this contamination pathway is for child health and anemia reduction, research is ongoing.

Clean play spaces separate children from contaminated soil, animals, animal feces, and human feces within the immediate household physical environment. While completely separating children from their environment might prevent them from ingesting fecal contaminants, it will also keep them from interacting with their surroundings—an important part of their developmental process. Therefore, interventions that improve hygiene in the spaces where children live and play should not block their developmental need to explore the environment (Mbuya et al. 2015; SPRING Project 2015).

MEASUREMENT AND DATA SOURCES

Ideally, structured observations of household hygiene practices and microbiological assays would be used to collect information on clean play spaces. Indicators for this intervention have not been adopted for regular data collection, and research surveys provide most of the available data. Programs that examine the relationship between environmental hygiene and stunting have used the following indicators, but carefully consider each one before including it in a monitoring or evaluation plan:

- percentage of households maintaining a clean environment (no standardized definition available) for children under 2
- percentage of households with children under 2 where human feces is not present inside the household compound
- percentage of households where animal feces are not present inside the household compound
- percentage of households where animals and children sleep in the same room or building, an indicator associated with higher stunting in Ethiopian households (Headey and Hirvonen 2015).

Other possible indicators include spot checks for—

- presence and number of free range poultry and livestock

- presence type and density of animal feces within the courtyard/household environment
- visibly dirty caregiver's hands
- visibly dirty child's hands.

In situations where a specific product, such as a mat or playpen, are introduced as part of clean play spaces interventions, you could collect data on sales/distribution, coverage, and use of the product.

METHODOLOGICAL ISSUES

- The lack of common indicators means there is no consensus on how to measure clean play spaces.
- Collecting data by observing household hygiene practices and conducting microbiological assays is expensive, can be impractical, and may change the behavior of the people being observed.
- Given the myriad cultural practices around childrearing and the expectations of children's activity at an early age, different contexts will require different versions of an intervention to ensure children have clean feeding and play spaces. This variability may make it difficult for you to routinely collect data and to compare it across time and place.

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Handwashing

Fecal pathogens can enter the human body in multiple ways, causing intestinal infections, inflammation of the gut, or micronutrient deficiencies through reduced micronutrient absorption. An important way to stop the transmission of pathogens is to reduce the risk of accidentally ingesting soil and waterborne pathogens. Handwashing for all household members at key times can eliminate, or greatly reduce, the risk of ingesting pathogens from the physical environment; it has been shown to reduce diarrheal disease and respiratory illness (Ejemot et al. 2008; Ejemot-Nwadiaro et al. 2015; WHO and UNICEF 2013; Luby et al. 2011). It is important to note, however, that very young children do not practice handwashing very often. When young children practice handwashing, it may be an opportunity for soil or other contaminants to stick on the hands if they are left to air dry (Ngure et al. 2013).

Critical handwashing times are—

- before preparing food or cooking
- after cooking
- before eating food or feeding a child
- after cleaning a child's bottom
- after defecating
- after sweeping and/or contact with animal feces.

Among these critical times, Luby et al. (2011) identified handwashing before food preparation as the best time to reduce childhood diarrhea. Hands should be washed with running water (preferably warm) and soap. If soap is not available, other cleansing agents, like ash or alcohol-based cleansers, can be used.

MEASUREMENT AND DATA SOURCES

Ideally, structured observations of handwashing practices at all critical time points would be used to collect information on household handwashing, but most available data rely on observing if appropriate handwashing facilities are available. In addition to rapid observations, surveys can ask respondents to self-report their handwashing practices, request a skills demonstration, conduct microbiological measures of hand contamination, carry out structured observations, or use sensors (Ram 2013).

Surveys usually report the percentage of households observed with a designated place for handwashing, dividing the indicator further if water and cleansing agents (e.g., soap) are available and/or its location within the household. The new Sustainable Development Goals include a target indicator (sanitation target 6.2.1) for the percentage of the population using safely managed sanitation services, including a handwashing facility with soap and water (UN Statistical Commission 2016). Luby et al. (2011) found that allowing hands to air dry, and the presence of water where respondents usually wash hands, were independently associated with fewer respiratory infections and could be important indicators to include in handwashing assessments.

Surveys that collect information related to the presence of handwashing facilities include—

- Demographic and Health Surveys
- Multiple Indicator Cluster Surveys
- National Micronutrient Surveys
- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

The WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation maintains a database

of information on the coverage of water, sanitation, and hygiene programs (www.wssinfo.org).

METHODOLOGICAL ISSUES

- It can be expensive to collect data by observing household hygiene practices, may be impractical, and may change the behavior of the people being observed.
- Having a place for handwashing does not mean that proper handwashing practices are followed, nor does it identify who uses the handwashing facility, water quality used, or what the triggers are. However, this indicator has been found to be a good proxy for handwashing practice (Ram et al. 2014). Further questions or observation will usually be necessary to better understand how the facilities are used.

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Use of Basic and Safely Managed Sanitation Facilities

Fecal pathogens can be ingested via multiple pathways and cause diarrhea, intestinal infections, inflammation of the gut, or micronutrient deficiencies through reduced micronutrient absorption. Using basic and safely managed sanitation facilities is an important way to stop the transmission by removing fecal matter from the environment, which prevents pathogens from entering waterways, household courtyard soil, and contaminating surfaces. Access to basic and safely managed sanitation infrastructure should be accompanied by effective behavior change strategies to address social and cultural barriers for use; ensure sustained use; and ensure the adequate disposal of adult, infant, and animal feces.

Using "basic and safely managed" sanitation facilities for regular waste disposal removes the waste from human contact and controls flies. While various types of facilities fall into this category, the main focus is to ensure that the way waste is collected and stored does not allow pathogens to easily contaminate the surrounding environment.

Basic sanitation facilities include the following (UN-Water 2016):

- flush toilet
- piped sewer system
- septic tank
- flush/pour flush to pit latrine
- ventilated improved pit latrine
- pit latrine with slab
- composting toilet.

Note that these "basic" sources used to be known as "improved" sources.

Safely managed services include sanitation facilities that are not shared, where excreta is safely disposed of in situ or treated off-site, and where handwashing facilities with soap and water are available. Sanitation facilities are often seen as a ladder, with households progressing from open defecation (the lowest rung), to unimproved facilities, to use of basic facilities by all households in a community, to—finally—all households having and using basic and safely managed facilities.

MEASUREMENT AND DATA SOURCES

Ideally, collecting information on the use of basic and safely managed sanitation facilities would be through structured observations of facility use, but most available data rely on observing the presence or reported use of sanitation facilities.

Surveys generally report the percentage of households that have access to a basic, unshared toilet facility. Respondents usually show or are asked to describe the type of facility their household has access to or uses, with answers categorized into various options that are relevant for the target population (see the basic sanitation facility options in the list above). The indicator can be disaggregated by service level: no or unimproved services, basic (or improved) services, and safely managed services.

Surveys that collect information on the use of basic and safely managed sanitation facilities include—

- Demographic and Health Surveys
- Multiple Indicator Cluster Surveys
- National Micronutrient Surveys

- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

The WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation maintains a database of information on the coverage of water, sanitation, and hygiene programs (www.wssinfo.org)

Additional data sources for the use of basic facilities may be available, including from businesses that sell latrines.

METHODOLOGICAL ISSUES

- Collecting data by observing household hygiene practices is expensive, can be impractical, and may change the behavior of the people being observed.
- The definition of "basic" is generally understood, but classification of facilities could vary slightly between survey instruments, so make sure you understand what is included under "basic."
- "Safely managed" does not include households sharing facilities, but some surveys may differ on how the final results are reported for the survey.

FOR MORE DETAIL

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Use of Safely Managed Drinking Water Services

Fecal pathogens in the environment easily and often contaminate water. When this contaminated water is used for drinking, food preparation, or other household uses, it can cause intestinal infections, inflammation of the gut, or micronutrient deficiencies by reducing micronutrient absorption. Safely managed services include basic water sources located on the premises, available when needed, and free of fecal and priority chemical contamination.

Use of these basic (previously known as "improved") drinking water sources can reduce the risk of acquiring waterborne infections. While many types of sources fall into this category, the main focus is ensuring that the water comes from a known, uncontaminated origin, and is transported to the household in a way that ensures it is always safe and available.

Safely managed drinking water sources include the following (UN-Water 2016):

- piped water into dwelling, yard, or plot
- boreholes or tubewells
- protected dug wells
- protected springs
- rainwater.

MEASUREMENT AND DATA SOURCES

Data collectors usually observe—although some surveys may rely on respondents' descriptions—the water source the household can access or use.

Surveys usually report the percentage of the population using a basic (or improved) drinking water source. The new Sustainable Development Goals include a target indicator (sanitation target 6.1.1) for the percentage of the population using safely managed drinking water services (UN Statistical Commission 2016). This builds on the Millennium Development Goal indicator that measured the percentage of the population using an improved drinking water source.

Surveys that collect information related to the use of safely managed drinking water services include—

- Demographic and Health Surveys
- Multiple Indicator Cluster Surveys
- National Micronutrient Surveys
- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

The WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation maintains a database of information on the coverage of water, sanitation, and hygiene programs (www.wssinfo.org).

METHODOLOGICAL ISSUES

- Classification of water sources can vary slightly between survey instruments; make sure you understand how the indicator is defined.
- Categorization of a source as "safely managed" is a proxy indicator of safe drinking water, because it includes testing water quality—therefore, including water quality testing for fecal contamination and priority chemicals is needed to confirm drinking water quality (UN-Water 2016).

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Water Treatment

Fecal pathogens in the environment can contaminate water through multiple pathways, including fingers, flies, fomites, and drainage. When anyone drinks contaminated water or uses it to prepare food or complete other household tasks, it can cause intestinal infections, inflammation of the gut, or micronutrient deficiencies by reducing micronutrient absorption. While using a safely managed source of drinking water makes contamination less likely, the type of infrastructure used as a water source and the water's microbiological safety do not correlate perfectly. Unless the drinking water source is under an effective water quality surveillance and regulatory regime, the water may need additional treatment measures to make it microbiologically safe for consumption. Water quality typically declines from the source to consumption, due to multiple opportunities for contamination during collection, transport, storage, and use in the household. Therefore, consider the entire chain of water quality—from source to safe storage. Contamination of water is likely during transport, handling, and storage within households, and it calls for point-of-use water treatment.

Evidence-based drinking water treatment options include—

- filtration through a certified filter (ceramic, membrane, or biosand) that has been tested for pathogen removal efficiency; filters will clarify turbid water but, typically, do not remove 100 percent of the pathogens, which requires a second step of disinfection—usually filtration plus chlorination—to ensure safe drinking water
- chemical disinfection—typically with chlorine or iodine
- boiling to disinfect, combined with a strong behavioral component to prevent recontamination of the treated water
- thermal treatment with solar radiation
- solar treatment by ultraviolet and thermal effects
- lamps to disinfect
- alum and iron coagulation
- charcoal and activated carbon adsorption
- iron exchange to disinfect
- combination of flocculation and disinfection (e.g., P&G Purifier of Water) (Agrawal and Bhalwar 2009).

The best treatment option depends on the cultural context, organoleptic (taste and smell) expectations, as well as the efficacy; but all of them also require safe management, including safe storage in a narrow-mouthed container with a lid and a tap to prevent recontamination.

MEASUREMENT AND DATA SOURCES

Multiple options are available for measuring water treatment (WHO 2012), including reported use of a treatment option, observation of the correct use of the treatment method in the household, or conducting water quality tests to compare treated and untreated water—by looking at reductions in bacteria—or to test for the presence of chlorine.

Surveys generally report the percentage of households (or household members) using an appropriate treatment method; some surveys specify that the treatment must take place prior to drinking. Generally, households participating in a survey or data collection activity are asked to describe what they do to make their water safe to

drink. "Appropriate method" in standard survey reports includes boiling, adding bleach or chlorine, filtering, and solar disinfecting.

Surveys that collect information related to water treatment methods include—

- Demographic and Health Surveys
- Multiple Indicator Cluster Surveys
- National Micronutrient Surveys
- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

The WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation maintains a database of information on coverage of water, sanitation, and hygiene programs (www.wssinfo.org).

METHODOLOGICAL ISSUES

- Collecting data by observing household treatment practices, or conducting water quality tests, is expensive, may be impractical, and may change the behavior of the people being observed.
- Some reports or surveys may restrict questions or findings on water treatment to households that do not report using a basic water source; verify which populations are included in the data you collect.
- Some surveys include options that do not have an evidence base for reducing diarrhea in children under 5, for example "filtering water through a cloth." Ensure that any analysis includes only the evidence-based treatment methods listed above.

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Delayed Cord Clamping

Delayed cord clamping is the practice of waiting at least one minute, and up to three minutes, after delivery to clamp and cut the umbilical cord. Because circulation between the placenta and infant continues for a few minutes after birth, delaying the cord clamping allows more blood to flow to the newborn (WHO 2014). Evidence shows that the additional blood increases the newborn's iron stores for approximately the first six months of life, which decreases the risk of infants developing iron deficiency (McDonald et al. 1996; Berglund and Domellöf 2014). Delayed cord clamping provides similar benefits for both preterm and term deliveries, but preterm births have additional benefits, including a reduction in common complications of preterm birth (e.g., intraventricular hemorrhage and necrotizing enterocolitis). Delayed cord clamping should not be practiced if the newborn requires resuscitation in a country where national policy does not support resuscitation of the newborn with the cord intact at the mother's side.

MEASUREMENT AND DATA SOURCES

It is important to determine if delayed cord clamping is done and how widely it is practiced in your country (e.g., private versus public facilities, trainings, supervision checks). If a policy is in place for delayed cord clamping, check to see if documents to support implementation are available, such as protocols, guidelines, provider job aids, and strategies for rollout.

Research and evaluation studies may assess the percentage of births in a specific health care facility where delayed cord clamping was practiced. Outside these studies, quantitative data on the scale of the practice may not be available. Also, identify and review the quality of maternal and neonatal health care surveys or assessments, which may sometimes include data on delayed cord clamping through direct observation of childbirth and other methods. If you can, conduct key informant interviews with the Ministry of Health staff and/or health care providers to determine how widely delayed cord clamping is practiced in your country. Because many routine hospital surveys do not collect information on delayed cord clamping, it may be useful to advocate for including that data in scheduled maternal and neonatal health and nutrition surveys (e.g., interviews with providers, review of records, etc.). Adding a column in the delivery room register is one option for collecting routine data on delayed cord clamping.

METHODOLOGICAL ISSUES

- It's unlikely that you will find quantitative data that can be generalized to all the maternity facilities in the whole country.
- Qualitative studies and reports from a specific country region may help shed light on reported practice, obstacles, and facilitators of delayed cord clamping to inform implementation strategies in a specific region. However, information from research studies, key informant interviews, quality of care documents, and other sources may not be nationally representative.

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Family Planning

Family planning interventions include using modern contraceptive methods and counseling to space births or to limit the number of children. For many less invasive methods of family planning—pills, condoms, lactational amenorrhea method, and injectables—community health workers and others without a clinical background may be able to provide services. Other methods may require that health care providers have additional training to provide the service, such as implants, intrauterine devices, or sterilization. Delayed pregnancy improves birth outcomes, decreases pregnancy-related anemia risk, and allows women time to build up and maintain stores of iron and other micronutrients to prevent micronutrient deficiencies. (Dewey and Cohen 2007; Conde-Agudelo et al. 2012).

MEASUREMENT AND DATA SOURCES

Information related to family planning in surveys typically assesses the percentage of women who are—or whose partners are—using modern or traditional contraception for family planning. Many surveys also collect and analyze information on the unmet need for family planning, distinguishing between women with unmet needs for spacing births and for limiting births, disaggregated by age group.

Surveys that collect information related to family planning include—

- Demographic and Health Surveys
- Multiple Indicator Cluster Surveys
- National Micronutrient Surveys
- Knowledge, Practice, and Coverage Surveys
- other research or evaluation activities.

Health monitoring information systems may include information on the use of contraceptive methods. Although counseling on family planning is part of the services that are supposed to be provided during antenatal care, routine data collection and reporting on the provision of this service is generally lacking (Dwivedi et al. 2014).

METHODOLOGICAL ISSUES

- In some countries, questions around family planning pertain only to married or in-union women, which does not address the contraceptive needs of sexually active women who are not in these categories. Surveys that do not include all women of reproductive age may incorrectly estimate the need for family planning—and the unmet need—for unmarried or non-partnered women. When data are available, compare the rates of unmet need for women in both groups.
- Teenagers, age 15–19 years, often report high levels of unmet need and, also, are often hard to reach through health care services; you may want to report data disaggregated by age.

FOR MORE DETAIL

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Biofortification

Biofortification is "the process by which the nutritional quality of food crops is improved through agronomic practices, conventional plant breeding, or modern biotechnology" without sacrificing important culinary characteristics and key agronomic traits, such as pest resistance, drought resistance, and yield (WHO 2016). These modalities of biofortification can be combined. Crops biofortified with iron (e.g., high-iron pearl millet, high-iron beans) or biofortified with vitamin A (e.g., orange-fleshed sweet potato and pro-vitamin A maize and cassava) can reduce iron deficiency and vitamin A deficiency, respectively (Haas et al. 2011).

A variety of factors that impact the effectiveness of a biofortification program include—

- Bioavailability (e.g., the increment by which the micronutrient level increases over baseline, levels of the micronutrient in the crop, genotype-by-environment—to ensure stability of mineral accumulation—and micronutrient retention during storage and cooking)
- Viability (e.g., the planting material's acceptability to farmers; drought, pest, and disease resistance; yield potential)
- Potential reach (e.g., acceptability to consumers, including appearance, flavor, and cooking time; quantities grown versus saved for home consumption).

MEASUREMENT AND DATA SOURCES

A country's National Agricultural Research System—the national institution with the mandate to breed, test, and release new crop varieties in-country—should maintain data on whether a crop is available, where it is available, as well as estimates of micronutrient content in the locally adapted variety. It is important to identify which, if any, biofortified varieties have been released, the prevalent forms of preparation, and the levels of consumption for each variety in your country.

Income expenditure surveys or market surveys may provide details about value chains or specific food items—information that can help establish to what extent and where the particular crop—biofortified or not—is available in a local area and whether households are buying it. Intakes of biofortified crops may be available via household surveys conducted by organizations working to promote biofortification.

Some household diet questionnaires may include specific information about consumption of biofortified crops, often using visual aids to help respondent recall. Surveys that include a food frequency, or list-based food questionnaire, may include questions on consumption of biofortified varieties.

To understand whether biofortification will effectively reduce micronutrient deficiencies, you should know the levels of each micronutrient in the locally adapted variety (raw and cooked) and use that information to estimate the intake by the target population. Outside the context of a program, consumption data may not be available, but knowing if and which biofortified crops are present, is an important first step.

HarvestPlus maintains a map that shows which countries have released or are testing biofortified crops (www.harvestplus.org/what-we-do/crops), as well as other publications related to biofortification (harvestplus.org/knowledge-market/publications).

METHODOLOGICAL ISSUES

- Where biofortified crops are available, rollout takes time—particularly for roots, tubers, and other crops that reproduce vegetatively—and in those areas where no effective seed distribution system is available.
- Nutritional impact is ultimately related to the local market share occupied by the biofortified crops and the average daily consumption of the locally produced biofortified staple. Therefore, with the exception of orange-fleshed sweet potato, new programs are unlikely to widely impact a population's micronutrient status for several years.
- Many steps lie between biofortification and anemia reduction, including bioavailability and other factors—absorption may be higher for those who are deficient.

FOR MORE DETAIL

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Increased Production of Nutrient-Rich Foods

Supporting the production of foods rich in iron and other micronutrients to prevent micronutrient deficiencies is an indirect intervention that can lead to improvements in anemia (Flores-Martinez et al. 2016; Olney, et al. 2015; Dewey 2007; Christian et al. 2015). Farmers can be supported to grow nutrient-rich food crops via agriculture extension services and farmer field schools. Home garden and animal husbandry projects can increase the production of vegetables and animal-source foods.

MEASUREMENT AND DATA SOURCES

Production of micronutrient-rich foods is typically measured by the crops and animal-sourced foods produced (and/or imported, exported) at the country level, in metric tons. These data can be used to estimate the average per capita availability of a given food item.

See the Food and Agriculture Organization's FAOSTAT database (www.fao.org/faostat) for information on the production of micronutrient-rich foods. This type of data is then fed into analyses like the Comprehensive Food Security and Vulnerability Analysis (CFSVA). The CFSVA describes a current food security situation and includes data on factors--such as months of adequate food provisioning--that will ultimately impact families' ability to obtain nutrient-rich diets (WFP 2016).

Field projects may use emerging tools, such as Optifoods (FANTA 2016) and Cost-of-the-Diet (Save the Children UK 2009), both of which rely on local data similar to the data in FAOSTAT; or they may collect data on farmers' gross margin per hectare, animal, or cage. It is becoming more common to collect data on the number of farmers cultivating, or the number of hectares of nutrient-rich commodities being cultivated. It may be worth looking for year-end reports from individual projects in your country.

METHODOLOGICAL ISSUES

- National-level data on production and trade will not provide specificity on the variety of crops (e.g., a given breed of bean) and estimates on per capita availability provide only crude estimates of food intake. This is because availability does not reflect accessibility—low income groups access the available food differently than higher income groups—or intra-household distribution of food.

FOR MORE DETAIL

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Promotion of Food Safety

Consuming unsafe foods exposes humans to viruses, bacteria, parasites, and fungi that can cause infections, inflammation, or micronutrient deficiency by reducing the micronutrient absorption; they can all contribute to anemia. Governments may regulate the processes of production, processing, and selling foods to decrease these risks. Within the home, consumers can practice WHO's five key steps for safer food to further decrease the risk of foodborne illness or disease:

1. Keep clean.
2. Separate raw and cooked foods.
3. Cook thoroughly.
4. Keep food at safe temperatures.
5. Use safe water and safe raw materials.

Meat, eggs, milk, fish, and fresh fruits and vegetables, often produced by smallholder farmers and sold in informal markets, are high-risk products for consumers (Grace et al. 2015). Crops, such as maize and peanuts, harbor mycotoxins, which compromise immune responses (Turner 2013). Parasites acquired from eating raw fish are associated with anemia (Villazanakretzer et al. 2016); uncooked milk may transmit listeria (Grace et al. 2015); and feces-contaminated food or water often transmit E. coli bacteria that can result in severe and bloody diarrhea—followed by nutrient and blood loss (Betz et al. 2016). Salmonella and hepatitis E infections, caused by consuming contaminated food and water, are also a problem (Odey, Okomo, and Oyo-Ita 2015).

MEASUREMENT AND DATA SOURCES

WHO's *Five Keys to Safer Food* series recommends safe food production and marketing, including keeping fishpond sites clean, protecting fields from fecal contamination, treating fecal waste when using it as fertilizer, managing water quality and irrigation water risks, and using clean equipment for harvesting. Any monitoring data on those indicators would also be useful. Additionally, data on the following government policies and guidelines for food safety, if available, can provide important information on how well this intervention is being implemented.

These data can be difficult to identify. Proxy indicators that measure rates of food safety issues may identify when these efforts are not taking place. At the production level, these could include a prevalence of outbreaks of foodborne illnesses in animals, or levels of aflatoxin and other mycotoxins in crops. At the consumption level, data on outbreaks of salmonella, hepatitis E, and other illnesses from consuming high-risk products may also be maintained.

The Ministry of Health, or the ministry responsible for food industry regulation, may have data on foodborne illness outbreaks and preventive practices. WHO has estimates of the global burden of foodborne diseases, but they are global rather than country specific (Foodborne Disease Burden Epidemiology Reference Group 2007-2015 2015) and they may track some of the food safety indicators mentioned above (Foodborne 2015).

METHODOLOGICAL ISSUES

- Little information is available about foodborne illnesses. But, given their ubiquity and their impact on food producers and food consumers alike, they are an important area to consider.

FOR MORE DETAIL

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Counseling and Management of Genetic Blood Disorders

Depending on the prevalence of genetic blood disorders in a specific setting, and the available country resources, the health care system may include newborn screening services for early identification and better management of genetic blood disorders; genetic counseling to test and educate individuals on their status; and case management to provide adequate health services for people living with genetic blood disorders. Two of the most common genetic red blood cell disorders are sickle cell disease and the thalassemias. Effective treatment for both conditions is available, but a stem cell transplant from a genetically matched donor offers the only cure.

Concern is increasing that (a) with reduced child mortality, many more children with these genetic diseases will survive and present for clinical treatment, and (b) countries may be unable to cope with the increased number of clinical cases (Williams and Weatherall 2012). Some countries include the prevention and treatment of genetic red blood cell disorders in their national anemia strategies. Prevention and treatment for these conditions is done in clinical settings, with programs for newborn screening, genetic counseling, and case management.

A person with sickle cell disease is typically anemic and is more susceptible to common infections.

Care of patients with sickle cell disease includes—

- health maintenance, such as neonatal screening followed by prophylactic vaccination and antibiotics or transcranial Doppler screening for stroke prevention
- management of painful vaso-occlusive crises, of a variety of acute crises (e.g., stroke, splenic sequestration, and acute chest syndrome), and of chronic complications (e.g., pulmonary hypertension and chronic renal disease)
- selective use of hydroxyurea therapy and red blood cell transfusions.

Individuals with the sickle cell trait have minor blood abnormalities and require no specific treatment.

The thalassemias are genetic disorders characterized by defects in the production of either the alpha-like (alpha-thalassaemia) or the beta-like (beta-thalassaemia) globin chains that may cause anemia and other complications. Management of patients with the most severe forms of thalassemia (thalassemia major) requires regular red blood cell transfusions and iron-chelating therapy to prevent complications of the associated iron overload, such as liver disease, endocrine dysfunction, and cardiomyopathy. Patients with thalassemia intermedia may not require chronic red blood cell transfusions, but they may develop iron overload from excessive gastrointestinal iron absorption and may need iron-chelating therapy. Individuals with the thalassemia trait have minor blood abnormalities and require no specific treatment.

MEASUREMENT AND DATA SOURCES

It is important to determine if neonatal screening, counseling, and/or managing genetic blood disorders is done, and how widely these services are available in your country. It is unlikely that most countries will have a national/public program; therefore, data sources, such as health monitoring information system, are unlikely to provide relevant information. Depending on the prevalence of

genetic blood disorders in-country, specialized hospitals or programs may provide newborn screening, counseling, and management services. They will probably keep routine records for the number of individuals receiving services. Research and evaluation studies may assess the need—met and unmet—of newborn screening counseling and management services in-country.

METHODOLOGICAL ISSUES

- Quantitative data that you can generalize to the whole country is probably not available for this topic. Information from research studies and programs may only reflect the situation in a specific setting.

FOR MORE DETAIL

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Next Steps and Resources

USAID's *Integrated Anemia Prevention and Control Toolkit* on the Knowledge for Health website (https://www.k4health.org/toolkits/anemia-prevention) provides a three-step process to address anemia in your country:

1. **Know the problem**. Encourage colleagues to participate by downloading and sharing the Anemia Landscape Analysis Guidance (www.spring-nutrition.org/publications/series/understanding-anemia).
2. **Raise awareness and develop partnerships**. Share with key stakeholders the landscape analysis you developed while following this guidance and the summary dashboard of the Excel-based Anemia Landscape Analysis Tool (www.spring-nutrition.org/publications/series/understanding-anemia) to help them understand the anemia situation. SPRING's website has examples of anemia landscape analyses (www.spring-nutrition.org/technical-areas/anemia/multi-sectoral-coordination) that you can use as examples of how to organize a landscape analysis and it suggests additional information for you to include.
3. **Identify interventions and implementation plans**. Use your data on anemia causes and programs to inform planning discussions around anticipated results, interventions, and implementation. SPRING's website has examples of country anemia strategies (www.spring-nutrition.org/technical-areas/anemia/multi-sectoral-coordination) that may help you plan a multi-sectoral anemia prevention and control strategy.

OTHER TOOLS AND RESOURCES FROM SPRING

Explore anemia data. See if one of SPRING's anemia profiles (www.spring-nutrition.org/publications/series/national-anemia-profiles) has information on the anemia situation in several countries.

Go into more detail. Use SPRING's DATA tool to conduct a review of the anemia burden and programming at the subnational level (www.spring-nutrition.org/publications/tools/district-assessment-tool-anemia-data).

Establish a national anemia working group. Use one of SPRING's national anemia platform case studies (www.spring-nutrition.org/about-us/activities/multi-sectoral-anemia-platforms-strengthening-maps-strengthening-anemia) to bring stakeholders together.

Join the Accelerated Reduction Effort on Anemia Community of Practice (www.knowledge-gateway.org/area) to interact with a network of global anemia experts and implementers.

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