Food and nutrition surveillance systems

A manual for policy-makers and programme managers

World Health Organization

Regional Office for the Eastern Mediterranean

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Preface

Food and nutrition policies and programmes that improve the health and nutritional status of the population require a strong evidence base and capacity to measure outcomes. To fulfil these issues there is a strong need for an ongoing food and nutrition surveillance system. The objective of this system is to measure and monitor food and nutrient intakes, food security, nutritional status, nutrition-related health outcomes, as well as knowledge, attitudes and practices on healthy food and other lifestyle factors such as physical activity and a healthy environment. This information must be linked to data on demographics, determinants of health, and factors affecting access to safe, affordable nutritious foods.

A food and nutrition surveillance system is an essential instrument for the detection of nutrition and nutrition-related health problems and to follow up on policy implementation for both developmental and emergency programmes. A food and nutrition surveillance system is defined as the regular and timely collection, analysis and reporting of data on nutrition risk factors, nutritional status and nutrition-related diseases in the population. The activity is undertaken to provide information useful in supporting, improving and guiding decisions regarding the need for nutrition interventions and the extent and distribution of nutrition problems in the population.

The objectives of nutrition surveillance are: to describe the population's nutritional status, with particular reference to at-risk subgroups; to explain causal relationships to permit selection of preventive measures; to promote government decisions that will meet the needs of both normal national development and emergencies; to consolidate the most important indicators relevant to food and nutrition and health priorities; to predict the evolution of nutritional problems based on an assessment of current trends; and to monitor nutrition programmes and evaluate their effectiveness.

Prior to implementing a nutrition surveillance system, an initial assessment should be conducted to determine the type, extent and timing of the nutritional problems; to identify and describe groups at risk; to assess the reasons for the presence of malnutrition; and to identify existing data sources that could be useful to the system. This information can be based on data from similar countries, spot surveys, community studies, hospital reports and routinely collected data.

While the use of health indicators such as mortality and morbidity data to monitor the health situation of a country is now common practice, food and nutrition surveillance is not yet established practice in most developing countries. However, a number of countries in the WHO Eastern Mediterranean Region are seriously considering the need for such a system as a prerequisite for a national food and nutrition policy.

Despite WHO's regional efforts since 1980 to encourage Member States to develop nutrition surveillance systems, only a few countries have responded positively and initiated such systems; these are still at a primary stage and need enforcement. Surveillance systems in Kuwait, Morocco, Oman and the occupied Palestinian territory are progressing very well, as is the surveillance system in Darfur, Sudan under emergency operations. The most successful system, not only in the Region but also globally, has been established for Somalia by a United Nations country team in Nairobi. However, this is not sustainable as it has been funded and run by the Food Security and Nutrition Analysis Unit, managed by the Food and Agriculture Organization of the United Nations. Nevertheless, the centre could be a good investment and provide training for other Member States.

As indicated in WHO's regional strategy on nutrition 2010–2019 and plan of action,[1] nutrition data in the Region are not up to date. Most countries in the Region do not have a functional surveillance system that is able to analyse the nutrition situation and its possible evolution and trends in response to current policies and programmes. In addition, over the past three decades the Region as a whole has witnessed significant social, economic, demographic and political changes that have highly influenced the nature, scope and magnitude of health, nutrition problems, the burden of disease and related risk factors in most of its Member States.

This manual is designed to be a user reference manual for policy-makers and programme managers for the development of a food and nutrition surveillance system, with the focus on application. It provides a model for developing a surveillance system and provides a general overview of the basic principles, as well as the essential steps and issues involved in the different activities to be undertaken.

[1] Regional strategy on nutrition 2010–2019 and plan of action. Cairo, WHO Regional Office for the Eastern Mediterranean, 2011.

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Introduction

Although improvements in nutrition have taken place as a result of economic growth and as a natural outcome of health sector development and services, an overview of nutrition programmes in the WHO Eastern Mediterranean Region indicates that the greater burden of malnutrition is associated with inadequate dietary intake and disease. This burden is increasing in many countries. Other countries are experiencing overnutrition due to changing food consumption patterns and lifestyles, resulting in increasing overweight, obesity and noncommunicable diseases.

The nutrition and health problems of today are quite different from those of 20–30 years ago. In some countries, sudden climatic changes have occurred at irregular intervals leading to drought, flooding and famine, while other countries have suffered as a result of war or sudden changes in the world economy on which they depend. Obviously, such factors cannot be eliminated. Food and nutrition surveillance is intended to provide all the necessary information, periodically at varying intervals in time according to the needs in each particular case. The establishment of a surveillance system will enhance the monitoring of both population-specific and Region-specific trends in nutrition-related risk factors and conditions.

The present use of the term "food and nutrition surveillance" started with the recommendation by the World Food Conference, 1974. At the regional level, the first initiative, a WHO/Food and Agriculture Organization of the United Nations (FAO) intercountry meeting on nutrition surveillance, was held in Islamabad, Pakistan in 1988. In September 2009, it was followed by a WHO regional meeting held in the Syrian Arab Republic, with active participation from the Centers for Disease Control and Prevention, FAO, International Council for the Control of Iodine Deficiency Disorders, Johns Hopkins University, United Nations Children's Fund (UNICEF), the World Food Programme and representatives from Member States.

A food and nutrition surveillance system is an instrument for the formulation, modification and application of the food and nutrition policy of a country. Such surveillance is intended to provide information on the basis of which decisions are made. The principles of a food and nutrition policy exist in every country and occasionally these are formulated as an official policy. Since such a policy affects several different sectors, a food and nutrition surveillance system has to collect information from these various sectors and analyse and interpret it as a whole. A surveillance system is only meaningful if it supplies information upon which decisions concerning nutrition can be based. It is essentially a practical part of the machinery by which a government may safeguard the nutritional status of its population and is not intended purely for research or academic purposes.

Adequate nutrition, a prerequisite for good health, depends on many factors that intervene in the relationship between food and health. Accurate and relevant information is generated from the periodic and systematic measurement of some of these factors. In conjunction with data on population nutrition and health status assessment, this will provide a good foundation for understanding trends in health and nutrition and for taking appropriate action to promote the well-being of populations.

Information is also needed to provide early warning of impending nutritional emergencies and for on-going programme management. In order to be utilized efficiently, the information must be:

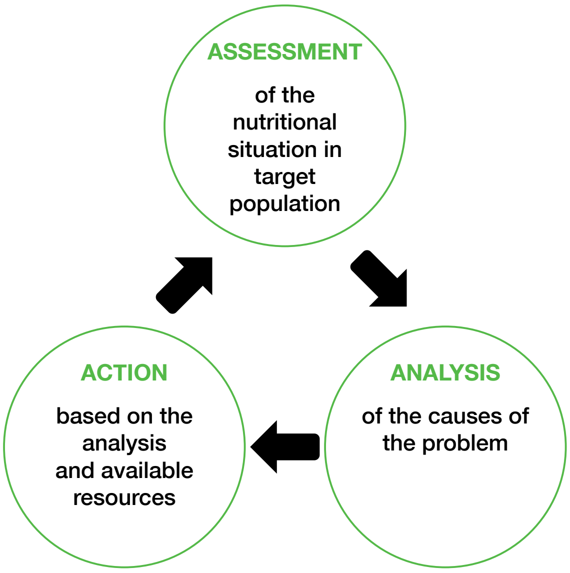
- timely;
- relevant to the decision-makers;
- communicated effectively at the appropriate levels.

WHO at a global level, and involved institutions at the regional level, are focusing on the following elements, to be considered throughout the ongoing programme:

- updating the concepts and improving the methods of global nutrition surveillance;
- conducting surveillance during conflict and crises;
- improving the coverage of food and nutrition surveillance systems;
- providing technical support to conduct food and nutrition surveys;
- improving the quality and use of collected data;
- implementing the WHO Child Growth Standards (2006 revision) throughout the world;
- encouraging the integration of the growth standards and references into health programmes.

Finally, a food and nutrition surveillance system is based on the regular collection of data. These data are analysed to define indicators of present or future change of nutritional status. The types of information from which indicators can be devised cover a broad range. Information and classifications used in this manual are intended to be miscellaneous, so that Member States have the flexibility to select the most suitable indicators, as they differ in their requirements for planning, their needs for information and their sources of data. Although a single design for all surveillance systems is neither feasible nor desirable, some principles, examples and characteristics of systems are presented in this manual based on available resources and phases of implementation. The WHO Regional Office for the Eastern Mediterranean is committed to providing constant support and the required tools to its Member States to help scale up nutrition and food security, in line with the regional nutrition strategy.

A food and nutrition surveillance system covers a broad range of nutrition-related problems, purposes and settings. Users of information obtained by the surveillance system include governments, bilateral and multilateral international donors, nongovernmental organizations and communities. The data can be applied to problems of overnutrition and undernutrition and can help policy and programme decision-makers to identify the most effective and efficient solutions for a specific area. Food and nutrition surveillance systems can monitor agricultural activities, dietary intakes of individuals, households or populations, mortality and morbidity or related topics such as socioeconomic indicators, demographic changes (including migration) and housing patterns. Data can be established at the national, regional or community level, or based at an institution. In order to define the nutritional problem it is necessary to measure the nutritional status of the targeted population. Nutritional status assessments enable determination of whether the individual is well nourished or undernourished by measuring anthropometric, biochemical or physiological characteristics. This information, combined with the analysis of underlying causes, will provide the understanding needed to select the appropriate intervention. This strategy is illustrated in Figure 1.



Source: (*1*)

Figure 1. The triple-A cycle diagram for addressing nutrition-related problems

This manual is designed to be a user reference manual for policy-makers and programme managers for the development of a food and nutrition surveillance system, with the focus on application. It provides a model for developing a surveillance system and provides a general overview of the basic principles, as well as the essential steps and issues involved in the different activities to be undertaken. The information is presented in a brief, direct and easy to read format. It aims to provide the basic elements and framework for establishing a functional surveillance system for those who do not have such a system in place. It will also help in upgrading the surveillance system output to help strengthen the impact of nutrition programmes through targeting and timeliness.

WHO's Member States have endorsed global targets for improving maternal, infant and young child nutrition by 2025 and are committed to monitoring progress.

1. 40% reduction in the number of children under 5 who are stunted
2. 50% reduction of anaemia in women reproductive age
3. 30% reduction in low birth weight
4. No increase in childhood overweight
5. Increase the rate of exclusive breastfeeding in the first 6 months up to at least 50%
6. Reduce and maintain childhood wasting to less than 5%

Module 1. The food and nutrition surveillance system: concept and principles

1. Learning objectives

- Understand the objectives of a food and nutrition surveillance system.
- Be aware of the main sources of nutrition information.
- Be aware of the variety of indicators and their appropriateness in different contexts.
- Understand where and what to look for, to ensure reliable and high-quality nutrition information.

2. Introduction

This module highlights the ways that a good food and nutrition surveillance system can assist managers, workers and other potential users throughout the health system to make better decisions concerning nutritional problems and take more timely action by describing:

- the principles of a food and nutrition surveillance system;
- food and nutrition surveillance system impamentation steps;
- ways to strengthen a food and nutrition surveillance system.

This section covers the definition of a food and nutrition surveillance system, its scope, functions and objectives in relation to improving the health and nutritional status of the population, as well as its links to the different users.

3. Principles of a food and nutrition surveillance system

A food and nutrition surveillance system is a mechanism by which food and nutrition data are transferred to action through formulation, modification and application of the food and nutrition policies of a country. A food and nutrition surveillance system is used to collect, analyse, interpret and report information about the nutritional status of populations. Most important of all, the system is used to create appropriate response strategies. Nutritional status is a recognized outcome of human well-being; therefore, by closely monitoring the indicators that measure nutritional status, it is possible to understand better the evolving situation of a vulnerable population.

The World Food Conference 1974 defined the function of a food and nutrition surveillance system as “monitoring the food and nutrition conditions of the reference groups of the population at risk, and [providing] a method of rapid and permanent assessment of all factors that influence food consumption patterns and nutritional status”.

The application of the system, as in the case of disease surveillance, is to facilitate decisions that will lead to improvement and prevent deterioration of the nutritional status of populations. The nutritional status of populations is affected by many factors, including social and economic factors, as well as health, the environment and availability of food. Therefore, decisions that may be influenced by nutrition surveillance activities may be related to many different areas of government.

A nutrition surveillance system does not need to be complex or to require routine collection of a large range of data. The amount of information required will depend on the nature of the problem and the range of policy alternatives and available resources. An efficient system design will ensure the maximum use of all relevant existing sources of data.

3.1 Objectives

The immediate objectives of a food and nutrition surveillance system are:

- To describe the nutritional status of the population, with particular reference to defined subgroups that are identified as being at risk. This will permit the description of the character and magnitude of the nutrition problem and possible changes in these features.
- To provide information that contributes to the analysis of causes and associated factors and therefore permits a selection of preventive measures, which may or may not be nutritional.
- To promote decisions by governments concerning priorities and the disposal of resources to meet the needs of both "normal development" and emergencies.
- To enable predictions to be made on the basis of current trends in order to indicate the probable evolution of nutritional problems. Considered in conjunction with existing and potential measures and resources, these predictions will assist in the formulation of policy.
- To monitor nutritional programmes and to evaluate their effectiveness.

In emergency settings, the objectives specifically focus on:

- A warning system. This is used as a means of highlighting an evolving crisis.
- Identification of appropriate response strategies. These may include non-food as well as food assistance to address the underlying causes of malnutrition.
- Triggering a response. Nutrition surveillance systems provide a trend analysis focusing on the magnitude of change. This may trigger an in-depth assessment, which in turn may lead to a response.
- Targeting. Nutrition information can help target areas that are more at risk or in greater need of assistance.
- Identification of malnourished children. Some forms of surveillance can identify acutely malnourished children.

3.2 Challenges *(2)*

The most important aspect of a food and nutrition surveillance system is to ensure effective links between information and action. However, the reliability of data, timeliness of reporting, efficient action management and sustainability are challenging. A further challenge is the interpretation of findings. Similar levels of acute malnutrition have different significance, depending on the context. Unless the underlying causes of nutritional disorders are understood, an appropriate response may not be provided.

Sustainability

One of the biggest challenges is ensuring effective continuity of the system. One of the main reasons for the failure of surveillance systems in the past was that national or local governments were unable to provide the resources needed to maintain them. When establishing a surveillance system, it is essential to consider and plan for long-term sustainability, especially in areas where there is a high probability of prolonged crisis. Ideally, if a system proves to be effective and sensitive in monitoring change over time, there should be no difficulty in justifying long-term resource provision. An accurate early-warning mechanism that triggers a response is far more cost effective than having to support a full-scale humanitarian response to a nutritional emergency.

Institutionalization

Institutionalization, including the accommodation of the systems and links with existing early-warning or health information systems, can also be problematic. A risk for many information systems is relying on a range of information sources that cut across several government ministries, including health, agriculture and education. This means that no specific ministry takes responsibility for the management of the system and over time it may be uncontrolled.

Linking information to action

Linking information to action is very important. Collection of data that is not linked to action is meaningless. A surveillance system should be designed to maximize the probability of response, if one is needed. This requires an analysis of ideal institutional locations for the system, as well as consideration of the dissemination channels for information and the setting in which the analysis will be presented. The involvement of decision-makers in the design and development of an analytical framework for using the information will strengthen the credibility of the system and, as a result, the probability of response where necessary.

3.3 Essential actions for conducting a surveillance survey

The essential actions for conducting a food and nutrition surveillance survey are summarized in Table 1.

Table 1. Essential actions for conducting a food and nutrition surveillance survey

Identify nutritional indicators	Identify population groups at risk using standard case definitions. This information may be used by integrated food and nutrition surveillance systems to identify priority nutritional disorders, nutrition-related diseases and conditions
Analyse and interpret data	Compile the data and analyse for trends. Compare information with previous periods and summarize the results
Report	Report malnourished cases or conditions to the next level. If this is a disease targeted at elimination or eradication, investigate and respond immediately
Respond	Mobilize resources and personnel to implement the appropriate nutritional or public health response
Provide feedback	Encourage future cooperation by communicating with levels that reported the problems regarding the investigation outcome and the success of response efforts
Evaluate and improve the system	Assess the effectiveness of the surveillance system in terms of timeliness, quality of information, preparedness, thresholds, case management and overall performance. Take action to correct problems and make improvements

Source: (*3*)

3.4 Methods (*2*)

The following are the main methods used for surveillance:

- large-scale national surveys;
- repeated small-scale surveys;
- clinic-based monitoring;
- sentinel site surveillance;
- school census data.

In an emergency setting, additional sources of data can be obtained from:

- rapid nutrition assessments;
- rapid screening based on mid-upper arm circumference.

Normal situations

Under normal conditions, the following common methods are recommended for establishing a national food and nutrition surveillance system.

Large-scale food and nutrition surveys

The surveillance system should make an inventory of all large national surveys related to health, food and nutrition that could act as a basis and provide data at subregional, district and village levels. In particular, frequent surveys such as the Demographic Health Survey, National Nutrition Survey or National Food Security Surveys should be considered. Try to include selected nutritional indicators.

Repeated small-scale surveys

Repeated small-scale surveys are population-based surveys that use standard methodologies to collect quantitative and qualitative data. They assess the type, severity and extent of malnutrition and its causes among a representative sample of the population (children and/or adults). The purpose is to support policy-makers and managers to design strategies and prioritize geographical areas at risk and specific types of interventions. Repeated small-scale surveys include surveys that are periodically conducted at national level and surveys carried out at local level to gather nutrition information at a suitable time.

Sentinel site surveillance

These involve surveillance in a limited number of sites to detect trends in the overall well-being of the population. The sites may be specific population groups or villages that cover populations at risk. Trends are monitored for various indicators, including nutritional status, morbidity, dietary issues, coping strategies and food security. Data can be collated and analysed centrally (centrally based sentinel site surveillance) or by trained members of the community (community-based sentinel site surveillance).

School census data

Nutritional assessment is occasionally undertaken in schools, where first-grade children are measured through censuses every two to three years. The objective is to identify high-risk children with poor health, malnutrition and low socioeconomic status. Results can be used to target school feeding programmes and to support policy-making in food-based strategies. The need for monitoring obesity among school-aged children becomes more and more important. These data, supported by information on specific food consumption patterns, marketing of healthy food and information on physical activity levels, are very important to underline the main causes of obesity.

Growth monitoring

Growth monitoring is a continuous monitoring of growth in children. Its aim is to identify slowing of growth or growth faltering at the individual level, which helps to correct the problem promptly. In former times, growth was usually measured as weight for age once per month. It is now recommended to use the WHO new growth curve (weight/height or length). Growth monitoring can be conducted by health professionals at maternal and child health clinics (clinic-based growth monitoring) or by trained members of the community in villages (community-based growth monitoring).

Emergency situations

Data on the situation of at-risk populations and groups are needed rapidly. The Joint United Nations Nutritional Cluster Surveys therefore offer preferred methods.

Sentinel site monitoring is particularly useful for early-warning purposes and can pick up trends quickly. These trends can then be the triggers for conducting nutritional surveys to determine more accurate levels of malnutrition.

In an emergency setting, additional sources of data can be obtained from:

- rapid nutrition assessments;
- rapid screening based on mid-upper arm circumference.

There is no single prescribed method for establishing nutrition surveillance systems in emergencies. Often a variety of nutrition information sources is used, depending on the context and what is appropriate, available and feasible. The best method is to use representative data collected from the population.

3.5 Uses and users of surveillance information (*4*)

As there are many factors leading to malnutrition and there is a close relationship with socioeconomic status, potential users of nutrition surveillance information are found in various sectors. Although it is unrealistic to expect nutrition to play a leading part in decisions on overall resource allocations, nutrition surveillance can be used to analyse policies for nutritional consequences, to suggest alternative policy options and eventually to assess their nutritional effects. There is an advocacy role for long-term nutrition surveillance to reinforce other similar methods trying to detect the fundamental causes of malnutrition. However, surveillance probably has the most potential for bringing about policy changes favourable to nutrition with reference to specific, selected issues. These issues may often be less fundamentally related to the basic causes of malnutrition, such as the inequitable distribution of resources, but in reality decisions on them have a better chance of influencing nutritional status.

Four areas are reviewed here: agricultural and rural development planning; the health sector; large-scale nutrition and social welfare programmes; and the private sector.

Agricultural and rural development planning

Agricultural planning ministries have the major responsibility for the supply and consumption of food. They thus have the potential to affect the nutrition of vulnerable groups.

Health sector

The potential users of nutrition surveillance data in the health system include those who make decisions about the distribution and effective use of resources, ranging from the Minister of Health to primary health workers in isolated rural health posts. These decisions usually relate to the planning of services or the management and evaluation of existing programmes.

At the national level, decisions are made regarding the introduction or expansion of primary health care, the position of health centres, the number of staff assigned to them and the services provided. Knowing the number and location of malnourished individuals is crucial in making these decisions.

In local clinics, nutrition surveillance data can be used to identify pockets of malnutrition so that appropriate interventions can be planned. These data, along with disease surveillance and administrative data, could also be used to justify requests for additional personnel, training programmes or supplies required to meet identified needs.

As nutrition surveillance has many similarities to health information systems, it should not be developed in isolation from them. Depending on the state of development of the available health information system, nutrition surveillance for health could be part of a broader information system or, in some cases, provide data for the health information system. The principles and indicators used are similar in both areas; for example, nutritional status is one of the main indicators proposed for health monitoring.

3.6 Stakeholders of food and nutrition surveillance data (*5*)

Table 2 summarizes the important stakeholders of food and nutrition surveillance data.

Table 2. Stakeholders of food and nutrition surveillance data

Stakeholder	Purpose
Government	Nutrition: national food and nutrition guidelines, nutrient reference values, nutrition goals and targets, nutrition strategies (e.g. Healthy Eating – Healthy Action), purchasing services Health: health strategies (e.g. chronic disease, inequalities, population subgroups), purchasing services, health promotion, advice for higher health authority Food: development, monitoring and enforcement of food regulations and standards (e.g. food safety, composition and labelling), international food standards (Codex), advice for Food Safety Authority
Health sector	Programmes (e.g. nutrition education, health promotion, food safety) and services, patient advice and education
Nongovernmental organizations	Policies and programmes, health promotion
Academic institutions	Teaching, research direction, data for research
Food industry	Food labelling, food marketing
General public	Information, advice, education

3.7 Sources of data

Sources of food and nutrition surveillance data can be primary or secondary. Primary data are collected through surveys specifically designed to monitor food and nutrition. National nutrition surveys are the major source of primary data. They provide detailed and specific information on food and nutrient intakes, nutritional status and nutrition-related health status. Ideally, food and nutrition surveillance data should be collected continuously. However, this is not a practical option for most countries, as nutrition surveys are expensive to undertake. Most countries undertake national nutrition surveys on a periodic basis, approximately from every three to five years up to 10 years, which is considered sufficient to keep up with changes in dietary patterns and new food technologies.

Secondary data are derived from data collected for purposes other than food and nutrition surveillance. Potential sources of secondary data include routinely collected health statistics, household budget surveys, market research surveys, industry surveys and research studies. Issues to be considered when evaluating the value of secondary data sources include the:

- periodicity of data collection (ad hoc, periodic, continuous);
- frequency of data collection (weekly, monthly, yearly);
- level of aggregation (individual, household, national);
- sample size and sampling strategy;
- format in which the data are stored (computer, paper);
- availability and cost of data.

The potential sources of data for each food and nutrition surveillance element are described below and summarized in Table 3.

Table 3. Food and nutrition monitoring domains and data sources

Sector	Data source	Comments
Food supply	Health economic survey (household) Food balance sheet (national)	Includes national and household food supply
Food consumption	Adult and child nutrition surveys Limited data on selected food groups (e.g. vegetables and fruit) from health surveys	All foods and beverages, including fortified or functional foods, dietary supplements and breast milk
Dietary patterns	Nutrition survey data	Factor analysis or diet quality score (e.g. Healthy Eating Index)
Nutrient intake	Derived from nutrition surveys using food composition tables	Requires maintenance of up-to-date food composition database
Nutritional status	Adult and child nutrition and health surveys	Includes anthropometric and biochemical measurements
Nutrition-related health status	Health and nutrition surveys	Includes incidence and prevalence of ischaemic heart disease, diabetes, obesity, blood pressure, blood lipid profile
Food security	Nutrition surveys Healthy food basket pricing Food bank surveys Benefit statistics	Includes various dimensions of household food security
Food culture	Nutrition surveys Survey of foods consumed away from home Surveys of advertising and marketing	Includes food preferences, food preparation practices, social settings for eating, portion sizes, consumer knowledge, attitudes and behaviours, marketing and advertising practices
Stage of change	Nutrition surveys	Includes intention and attempts to change diet; perceived barriers or facilitators of dietary change
Links to other risk or protective factors	Health and health behaviour survey	Includes drug use (especially alcohol and tobacco), physical activity, infant care practices (i.e. breastfeeding)

Source: Adapted from (*5*)

Food supply

Monitoring various trends in the food supply is important as food availability influences food consumption patterns and therefore the nutritional and health status of a population. Food supply monitoring can occur at the national or household level.

At the national level, food supply monitoring is undertaken to determine the total available food supply, the per capita food and nutrient availability, and the nutritional adequacy of the available food. National food supply data are the most useful way to monitor long-term trends in food availability.

At the household level, food supply monitoring is undertaken to detect changes in household food use and expenditure patterns, including the use of foods or meals prepared outside of the home. Patterns and trends in the consumption of foods prepared away from home, including the setting (e.g. restaurant, take-away, preprepared) and portion size, are important dimensions of:

- food and nutrition monitoring in the country;
- food balance sheets, which are the most common means of collating comprehensive data on the food supply at the national level. FAO sets out specific guidelines for food balance sheets, which ensure that data are collected consistently over time and between countries. This allows long-term trends to be assessed within countries and comparisons to be made between countries.

The amount of total food available for consumption is calculated by totalling all food produced, adding the amount of imported food and the change in stocks held over a specified period, and subtracting the amount of food exported, wasted, used for non-food purposes (e.g. seed and stock feed) or used in the manufacture of a different type of food. The supply per capita is then calculated by dividing the total food available for consumption by the population size.

For selected nutrients (e.g. energy, protein and fat), the nutrient availability per capita is calculated using food composition data. However, it is important to note that food balance sheet data only provide an estimate of the food and nutrient availability per capita, i.e. apparent consumption, rather than a concrete measurement of actual food and nutrient consumption.

Furthermore, food balance sheets cannot account for the fact that foods are not available equally to all members of the population, or consumed equally by them.

Industry surveys

Various agricultural and horticultural organizations collect data that could be used to monitor the food supply at a national level. These data could be useful for monitoring national trends in the consumption of meals prepared away from home.

Household socioeconomic survey

The Household socioeconomic survey is a statistics survey that collects data on the income and expenditure patterns of private households throughout the country. This kind of survey involves a representative sample of households and consists of data collection spread over a 12-month period to enable seasonal variation to be ascertained. It provides data on food expenditure, recalls major purchases made, and provides income and employment information. Expenditure on food is classified into different reference categories. Food items are reviewed annually and new food items added as appropriate.

Data can be linked to socioeconomic factors as well as to age, sex and various subgroups and administrative levels (e.g. national, district, community, etc.).

Food and nutrient intake

The core component of food and nutrition surveillance is the collection of primary data on food and nutrient intake at an individual level. The food and nutrient intake covers all foods and beverages, including functional or fortified foods, dietary supplements and breast milk.

Food consumption data are essential for assessing the quality of the diet in comparison to food-based dietary guidelines. For example, food consumption data are used to determine the proportion of people consuming the recommended number of servings of fruit and vegetables. Food consumption data can also be used to examine relationships between diet and nutritional status or nutrition-related health status. The analysis of food consumption data as dietary patterns provides an additional dimension for examining the relationship between diet and health, with the focus on the entire diet rather than on single foods or nutrients.

Nutrient intake is calculated by combining data on the amounts and types of foods consumed by individuals with data on the nutrient composition of these foods. Reliable estimates of nutrient intake are essential for assessing the nutritional adequacy of the diet in comparison to nutrient reference values and dietary targets. Nutrient intake data can also be used to examine relationships between particular nutrients and nutritional status or nutrition-related health status (e.g. saturated fat intake and prevalence of high blood cholesterol). Another aspect of nutrient intake that is becoming increasingly important is the contribution of dietary supplements, fortified foods and functional foods to overall nutrient intake.

National nutrition surveys

National nutrition surveys are the main source of data on nutritional status. They are the cornerstone of food and nutrition surveillance systems and the only means of collecting reliable and specific data on the food and nutrient intake at an individual level. Food and nutrient intake data are collected via one or more of the following methods:

- 24-hour dietary recall;
- food frequency questionnaire or food diary.

National nutrition surveys are difficult and expensive to undertake and put a considerable burden on the respondent. Therefore, most countries undertake such surveys approximately every 5–10 years, which is considered sufficient to keep up with changes in dietary patterns and new food technologies.

Breastfeeding data

For infants, food consumption includes breast milk. Breastfeeding data provide information on the proportion of babies fully breastfed at 5–6 weeks, at 3 months and at 4–6 months, and fully or partially breastfed at 6–12 months.

Research studies

Nutritional data collected by academic institutions and nongovernment organizations provide a potential source of secondary data on food and nutrient intake. The main limitation of such data is that they are often not representative of the national population. However, the main advantage of these studies is that they often focus on particular populations subgroups (e.g. pregnant and breastfeeding women, infants and young children) that are not adequately covered in national nutrition surveys. Research studies may also use measures of food and nutrient intake that are not practical for national surveys (e.g. 24-hour urinary sodium excretion, which is the most reliable indicator of total salt intake).

Nutrition and health status

The measurement of nutritional status is another core component of food and nutrition surveillance. Nutritional status can be assessed by anthropometric, biochemical or clinical measures. In large population surveys, height and weight are the most common anthropometric measures of nutritional status because they are easy to measure reliably and can be used to calculate body mass index (BMI), the most widely accepted indicator of overweight and obesity. Other simple anthropometric measures, such as waist and hip circumference, can be used to estimate body fat distribution. Biochemical indicators of nutritional status can be used as biomarkers of dietary intake, to determine the prevalence of nutrient deficiencies (e.g. iron deficiency anaemia) and nutrition-related health problems (e.g. high blood cholesterol). Information on nutritional status or nutrition-related health status, such as the prevalence of hypertension, diabetes and cardiovascular disease, can be determined clinically or obtained by questionnaires (self-reports). Ideally, the information on health status should be obtained from the same people that provide the dietary and anthropometric data so that links between diet, nutritional status and health status can be assessed.

National health surveys

National health surveys are the main source of data on nutrition-related health status. Information on health status is collected by questionnaires: the Self-report Household Health Survey collects data from adults on some nutrition-related risk factors and health outcomes (e.g. high blood pressure and prevalence of diagnosed diabetes). It also gathers data on specific risk factors relevant to nutrition-related health status, including physical activity levels, alcohol consumption and cigarette smoking.

Health statistics

The Health Information Service collates national data on all hospitalizations, morbidity and mortality. These data are useful for monitoring trends concerning undernutrition and nutrition-related diseases such as marasmus, kwashiorkor, ischaemic heart disease, stroke, diabetes and some cancers. Trends in disease incidence and mortality can be related to trends in dietary intake; for example, the decline in ischaemic heart disease mortality has coincided with a decrease in total and saturated fat intake. Hospitalization data are also used to monitor the prevalence of low birth weight (under 2500 g), an indicator of intrauterine nutrition.

Food composition

Information on the nutrient composition of foods is essential for calculating reliable estimates of nutrient intakes from food consumption data. Food composition data are also essential for calculating per capita nutrient availability (apparent consumption) from food supply data. To keep the database up to date, new foods should be identified and analysed for their nutrient composition (in the form in which they are eaten) on an ongoing basis. To complement this database, data on food fortification practices and the nutrient content of dietary supplements are also required. Ideally, a comprehensive food composition database should be established that includes all major foods available for consumption in a country.

4. Food and nutrition surveillance system implementation steps

This section highlights the following steps to develop and implement a successful food and nutrition surveillance system:

- organization
- setting an activity
- practical steps to be undertaken.

The decision to establish a surveillance system has to be based on clearly defined objectives, considering the availability of resources, staff capacity, sustainability, environmental factors and capacity to respond to emerging nutritional and nutrition-related health problems.

Once the decision has been made to establish a surveillance system, the first step is to establish a central nutrition surveillance unit, which will organize all the activities of the nutrition surveillance implementation processes.

4.1 Organization of the surveillance system

Institutional framework

To implement sustainable surveillance system activities, a well-organized qualified structure is required. Qualified structures often already exist, although these may be incomplete or inefficient (e.g. health information system, agriculture information system, central bureau of statistics, economic analysis unit, etc.) and there is often a need to introduce surveillance activity in these institutions. The solution is to have minimum institutionalization of surveillance activities by setting up a central surveillance unit, which is responsible for data collection, analysis and interpretation. This unit would serve as a reference and support unit for other national institutions engaged in surveillance.

The central nutrition surveillance unit

The main function of the central nutrition surveillance unit, which can either be an individual or a small group, is to coordinate, and provide and explain information. Existing data are continuously pooled and supplementary data collection can be organized when required. The objectives of the central unit are:

- short-term operational objectives aimed at satisfying users' needs (e.g. information requirements, training, guidance, proposing alternative strategies or intervention programmes and research);
- enhancement of the quality of information, reduction of surveillance costs, development of analysis and communication potential, and the sustainability of surveillance.

Central unit users also have other objectives related to the different fields of application of surveillance such as:

- formulation of policies or programmes, evaluation, justification, creation of "awareness", consolidation of information systems;
- investigation of the causality of nutritional problems.

5. Setting food and nutrition surveillance system activities (*6, 7*)

Surveillance functions, resources, needs and the degree of support cover a wide range; therefore no single, universal model is applicable. Food and nutrition surveillance can be organized at different levels: national, regional or community. It may cover specific geographical zones or population groups. It may also focus on specific types of malnutrition, for example surveillance of disorders due to iodine or vitamin A deficiency or on chronic noncommunicable diseases associated with nutrition, such as obesity, diabetes, hypertension, dyslipidaemia and some cancers. Consequently, this section is limited to general principles.

Four principal phases of a nutrition surveillance activity can be distinguished:

- preparatory or presurveillance
- conceptualization
- implementation
- evaluation.

5.1 Presurveillance

When a decision to implement a surveillance system has been made, a series of preparatory activities will be necessary. These arrangements will vary depending on the specific situation but will generally include the following:

- Answering questions such as: Who is making the decision to set up nutrition surveillance? Why? What is expected of surveillance? What do we already know?
- Identifying the levels of nutrition surveillance (national, regional or local).
- Preliminary identification of potential users and their probable needs.
- General identification of types and modes of information that are likely to be required.
- Identification of “stakeholders” as well as selection and definition of the responsibilities of “nutritional coordinators”. Preliminary decisions on the opportunity to conduct a baseline survey.
- General planning of nutrition surveillance activity.

At what level will surveillance be established: national, regional or community? Which groups will be covered? Is it for certain problems?

From a practical point of view, once the levels of utilization have been determined, two simple questions should be asked: "Who wants to know what?" and "For what purpose"? The preliminary response to these questions increases the relevance of the information that will be provided and consequently the probability that the data will be used. Furthermore, the preliminary response reduces the operational cost, which enhances the efficiency of data collection on the condition that the following process of data selection is controlled. Finally, this “exercise” should also provide some idea of the sustainability of surveillance activities.

Who are the potential users of the information? What are their expectations?

The list of surveillance initiators does not necessarily include all future end-users and potential users may also be found in other categories, not yet identified. At this stage, it is only a matter of identifying expected users.

What types of information will most probably be required? What are the main trends? In which areas? Comparing groups or regions? For which possible decisions?

At this stage, only very rough ideas need to be written down. More detailed information will be provided during later steps.

What types of stakeholders will be involved?

Four types of players can be identified:

- the surveillance coordinator (whether an individual or a group, it is important to define the exact responsibilities of the coordinator at an early stage);
- the information users;
- the data providers;
- the supporters (who are usually also the financiers of the surveillance system).

Define the role of each category of player in each of the phases: presurveillance; construction of the conceptual model; choice of required information; data selection, collection, and analysis and interpretation. Several stakeholders will be involved in each of these phases.

Another important parameter that should be considered before starting the surveillance activity is the different levels and forms of staff training.

Is it necessary to establish a baseline reference?

It is preferable to conduct baseline surveys after identifying different roles, defining principal objectives and selecting preliminary indicators.

This first phase of nutrition surveillance is generally concluded with collaborative decisions and the elaboration of the preliminary plan for the implementation of surveillance, which particularly refers to the planning of the conceptualization design phase. The duration, extent of validation and order of events do not follow any strict, preset rule, other than that of flexibility.

Summary

The presurveillance phase provides an opportunity for preliminary, well-structured but flexible discussions aimed at assessing a series of options and assuring a relevant and sustainable activity. Many surveillance programmes have failed because they did not try to answer the questions mentioned above in a well-defined presurveillance phase.

5.2 Conceptualization *(6)*

Conceptualization is a participatory process in the form of a workshop, in which all potential future stakeholders in the surveillance activity participate on an equal basis.

The steps to follow in the conceptualization phase are:

1. Construction of a causal model of the nutritional problem. Using the definition of surveillance and the causal model as a reference will ensure the relevance of the answers obtained. Similarly, the model designed in the presurveillance phase should be used to obtain a nutritional diagnosis.
2. Precise identification of future users of the surveillance, their information requirements and the predicted fields of application of surveillance.

3. Choice of data to collect and definition of indicators using the causal model. This type of data selection should simultaneously consider user requirements, cost, feasibility and the likelihood of obtaining data in a sustainable manner. Above all, the prospective and retrospective data that will be required should be identified using a highly selective process.
4. The determination of modalities for data analysis. This should be based on standardized methodologies, stable in time (raw data analysis, analysis of trends, validation of certain hypothesis from the initial model, etc.). In addition, the flow of data and information should be taken into account (i.e. to whom, via which routes, at what frequency?).
5. The detailed planning of the nutrition surveillance activity and operations itself should provide answers to a series of standard questions: Who? What? Where? When? How? With whom? The activity planning requires appropriate tools and different methods for each country or even for each sector (including calendar, budget/action plans).
6. Conceptualization of an evaluation strategy for nutrition surveillance. Although such assessments only take place after programme implementation, they should be clearly planned during the preliminary phase of conceptualization.
7. An analysis of conceptual consistency. This final step of the conceptualization phase involves ensuring that the surveillance decisions are clear, that the relevance of information is guaranteed and that all precautions have been taken to ensure sustainability. What is needed is a final complete check prior to the initiation of any surveillance activity.

Consider how the information from the surveillance system will link to action or response. Information is meaningless unless it is used appropriately.

5.3 Implementation (*7*)

The following steps are recommended to implement a surveillance system:

1. Review the existing system.
2. Define the data needs of relevant units within the health system.
3. Determine the most appropriate and effective data flow.
4. Design the data collection and reporting tools.
5. Develop the procedures and mechanisms for data processing.
6. Develop and implement a training programme for data providers and data users.
7. Pretest and, if necessary, redesign the system for data collection, data flow, data processing and data utilization.
8. Monitor the developing steps/implementation.
9. Develop effective data dissemination and feedback mechanisms.
10. Enhance the surveillance system.

Reviewing the existing system

Principle

Review the existing nutrition information sources (e.g. indicators collected, frequency of collection, target population) to prevent duplication and ensure appropriate linkage or integration with the relevant existing information systems. Do not destroy existing systems, but build on the strengths and learn from the weaknesses of what already exists.

Steps

1. Make a list of the forms, log books and other tools used to record and summarize data at different levels.
2. Assess the quality of the data being collected using the existing forms at different levels. Among the aspects to be included in the assessment are accuracy, completeness, adequacy and timeliness.
3. Determine the problems encountered with the current system of data collection at different levels, including the timing and flow of information.
4. Determine the current status of the other components of the food and nutrition surveillance system, such as:
   - data processing, analysis and dissemination;
   - supply and logistics;
   - staff development;
   - coordination, cooperation and communication within and between different units in the Ministry of Health, as well as with related agencies outside of the Ministry.
5. Identify any aspects of the system that need to be modified or stopped.
6. Summarize the results of the assessment in a formal report.
7. Discuss the results of the assessment with the proper authorities.

Challenges/risks

The following challenges should be addressed:

- identification of the authorities to make the assessment;
- availability of technical expertise and resources to do the assessment;
- cooperation among the different units in the assessment process and involvement of end-users at all levels;
- formation of a body (ideally an interdepartmental committee) responsible for planning, monitoring and managing all phases of the development of the surveillance system, from the baseline assessment to the evaluation phase.

Defining data needs

Principle

Define a minimum set of core indicators that both refer to nutritional status and also provide an understanding of the underlying causes of malnutrition. Different administrative levels in the health system have different roles and therefore have different data needs. Not all data needs should be generated through the routine system of data collection. Data that are not frequently needed or are required only for certain subsets of the population can be generated through special studies and sample surveys.

Steps

1. Define the different roles/functions of each level, for each of the major programmes. The following programmes are strongly recommended for establishing the surveillance system:
   - a mother and child health programme for infants and mothers;
   - an Integrated Management of Child Health (IMCI) programme for children below 5 years old;
   - a school health programme for schoolchildren;
   - a community-based health programme;
   - emergency/relief specific operation.

The data will be collected at different levels (community, health facility, district, regional and national, Table 4).

2. Identify the indicators needed by each level to perform its functions. Note that some levels, especially at higher administrative levels, need data from other ministries or departments related to the health and nutrition sector.
3. Develop calculation formulae and identify the variables or data elements needed in order to compute the indicators.
4. Determine the sources of the different data needed for both the numerator and denominator of each indicator. The major sources can be:
    - routine data generated from the nutrition and health management information system of the Ministry of Health;
    - special studies and surveys conducted by the Ministry of Health;
    - nutrition-related information systems under the responsibility of other agencies or institutions (e.g. the vital registration system, usually under the Department of Justice or the National Statistics Office, and the nutrition data collected by the Ministry or Department of Agriculture, etc.).

Table 4. Levels of food and nutrition surveillance systems

Community	Represented by basic nutrition educators, mayor/leader of the village, health workers or similar care providers at the village level
Health facility	Defined by each country. For surveillance purposes, the health facility may include institutions with outpatient and inpatient facilities
District, regional or provincial	Intermediate administrative units. Countries may have two intermediate levels, such as district and provincial
National	In many countries this is the federal level where policies are set and resources are allocated. This level usually compiles information and gives data to several programmes
Regional	At this level, nutrition surveillance data are reported to WHO or other agencies

Source: (*7*)

Challenges/risks

The following challenges should be addressed:

- roles and functions of different units with respect to data generation and utilization are not well defined;
- defining minimum basic data needs;
- differentiating data that should be included in the routine data collection system from data that are best generated through special studies and sample surveys;
- inability of staff at different levels to identify data needs (e.g. their understanding of indicators is often lacking).

Determining the data flow

Principle

Not all data collected at a certain level needs to be submitted to higher levels. The most detailed data should be kept at the source and reporting requirements to higher levels should be kept to a minimum.

Steps

1. Determine what data will be submitted to whom. This involves the:
   - identification of variables/indicators that need to be submitted to higher levels;
   - identification of the most appropriate units and persons to whom summaries will be submitted.

   A major determining factor for this step is the function of the office and/or the person to whom the data is submitted in relation to the generation and utilization of information.
2. Determine how frequently data should be submitted to each level, considering the following factors:
   - needs of each level;
   - how a common phenomenon is observed (reports on infrequent events or ones that are not often needed, e.g. the number of immunization campaigns conducted in a village, can be submitted on a quarterly or semi-annual basis, instead of monthly).
3. Determine in what form data will be submitted to each level:
   - raw data versus summaries;
   - hard copies versus electronic files.
4. Make a flow chart that shows the flow of information from the peripheral to the highest level.

Challenges/risks

The following challenges should be addressed:

- lack of understanding concerning the data collection purpose;
- inability to distinguish between data needed for service delivery and data essential for programme management and monitoring;
- inability of lower administrative levels to generate summaries of raw data collected due to:
  - lack of technical expertise of staff, including computer skills;
  - lack of data processing facilities (e.g. calculators, computers, etc.);
- lack of storage facilities for raw data at lower administrative levels;
- data retrieval issues, inability to generate any information (e.g. because of computer breakdown).

Designing the data collection and reporting tools

Principle

When designing forms, the ability of the staff to fill them in must be considered. Think about contextual issues when interpreting the data, such as seasonality, population movement, morbidity patterns and historical trends in nutritional status. The most effective data collection and reporting tools are simple and short.

Steps

1. Develop the first draft of each required form, taking as a guide the list of indicators to be used for the programme. This step entails either the modification of existing forms or the development of new ones.
2. Compare the first draft with the list of indicators to ensure that all data needs can be generated from the form.

3. Present the first draft of the form to relevant staff members and discuss the following aspects of the new form:
   - How does it compare with the old forms?
   - What are the advantages and disadvantages of the new form?
   - What modifications are needed to enhance the new form's advantages and minimize its disadvantages?
   - For countries that have a number of dialects, is it necessary to translate the forms into the major dialects used in the different regions of the country?
4. Prepare a draft of an instruction manual on how to fill in the new forms.
5. Pretest the use of the new forms as well as the instruction manual.
6. Assess the results of the pretest.
7. Modify the forms and the instruction manual, based on the results of the pretest.

Challenges/risks

The following challenges should be addressed:

- technical expertise/capability of data providers is not consistent with the level of complexity needed for data collection tools to meet the data expectations of users;
- designing the pretesting activity and ensuring the comparability of conditions with actual implementation. Where? Who will be involved? For how long?

Developing procedures for data processing

Principle

The way the surveillance system data are processed should be consistent with the objectives for data collection and the plans for analysis and utilization.

Steps

1. Assess the advantages and disadvantages of manually processing data compared with using computers, by considering the following factors:
   - cost;
   - availability of personnel with the proper level of technical expertise to run a computerized system; in particular, the software skills of the staff at the lowest computer-provision level should be checked;
   - availability of technical support in case of hardware breakdown.
2. If a computerized system is to be implemented, decide on the lowest level where computers will be used to process data. One of the important considerations in choosing this level is the presence of staff trained in system maintenance.
3. Define the specifications for software development, in consultation with different levels of data users. Among the important aspects to be decided are:
   - summary reports to be routinely generated;
   - data quality control mechanisms/checks to be incorporated in the software;
   - data analysis requirements of the data users.
4. Develop the software needed to process the data at each level where computers will be used, based on the required specifications. It may also be possible that software designed to generate outputs similar to those of the surveillance system has already been developed and requires only minor modifications to customize it. In this situation, resources to acquire and customize the software should be determined. A final decision needs to be made as to whether to develop new software or acquire and modify an existing programme.

5. Pretest the software, paying attention to:
   - identification of viruses;
   - ability of software to generate the expected data;
   - ability of staff to use it.
6. Develop and pretest the user's manual for the software.
7. Design a training programme to train relevant staff on the use of the software.

Challenges/risks

The following challenges should be addressed:

- capability of existing hardware to incorporate the software as well as its ability to store all the data (especially at the lower levels);
- compatibility of the developed software with the existing software (future interaction);
- basic system maintenance procedures;
- the security system.

Developing the training programme

Principle

The training programme should be designed according to the needs and level of the target groups.

Steps

1. Conduct a training needs assessment for data providers and data users. Four types of trainings are usually conducted. These are:
   - training of trainers;
   - training of data providers at the peripheral levels on how to fill out forms;
   - training of computer operators on the use of the software and hardware;
   - training of staff at different levels on data utilization.

   A separate training needs assessment should be conducted for each type of training. Among the variables to be collected for the training needs assessment are:
   - basic functions of each staff member related to the surveillance system;
   - extent of previous training received on the performance of such functions;
   - when training was received;
   - adequacy of previous training to enable staff to perform expected functions;
   - desired training areas.
2. Develop the curriculum/agenda for each type of training, based on the results of the training needs assessment. The following aspects should be covered:
   - Target group (for whom)?
   - Content (what)?
   - Strategies (how)?
   - Duration (how long)? This refers to the total duration of the training programme, as well as the time allocated for each topic included in the training. The output of this step is a course syllabus/curriculum for each training programme to be conducted.
3. Develop the training materials (see Table 5 for suggested materials). The participants of the training of trainers course should be provided with a copy of a data dictionary manual for data providers and a manual for data users.
4. Generate the training materials. Since there is a chance that some modifications in the format, structure and content of the training materials will be made, based on the evaluation results, the number of copies at this stage should be limited.

5. Design the evaluation strategy for the training programme. It is important to determine the methods prior to the training activities, since most evaluation designs require the collection of a baseline or pretraining level of knowledge among the participants.
6. Identify the most appropriate participants for each type of training, based on their duties and responsibilities related to data generation, management and utilization. An efficient strategy is to identify and train exclusive staff who can act as trainers for the neighbouring areas. If this strategy is adopted, it is important to consider the geographic distribution of participants for the training of trainers course.
7. Conduct the training of data providers.
8. Conduct the training of data users. This is usually conducted after sufficient data from the food and nutrition surveillance system has been collected to use as examples during the training.
9. Evaluate the training programme, including the training materials used.
10. Modify the training materials and the training programme, based on the results of the evaluation. This should be done prior to another series of training activities.

Table 5. Suggested training materials

Type of training	Manual	Contents
Training for data providers	Data dictionary manual for data providers (separate manual for each level)	List of indicators, formulas, definitions, data sources Instructions on how to fill in the forms
Training for data users	Manual for data users (separate manual for each level)	Data analysis, interpretation and utilization
Training for computer operators	Computer software user's manual	Detailed instructions (with examples) on how to use the software; troubleshooting
Training of trainers	Trainer's manual	Instructions on how to implement the training programme for data providers and data users; teaching strategies; guidelines on the use of the manual for data users and the manual for data providers

Source: (7)

Challenges/risks

The following challenges should be addressed:

- selection of appropriate participants for the different training programmes;
- backgrounds of staff identified to enter data and generate reports using the software developed for the surveillance system (e.g. are they very different?);
- language/dialects to be used for training materials;
- extent of dissemination of training materials and manuals;
- preparation of adequate facilities to conduct training.

Pretesting the system

Principle

The system should be pretested in conditions that as much as possible reflect the conditions prevailing during its implementation.

Steps

1. Prepare the guidelines for pretesting the system, addressing the following questions:
   - Where? Selection of the place(s) where pretesting will be conducted. There is a need to develop criteria for selecting pretesting sites. These can include technical factors such as the level of expertise or qualifications of the staff in the area, and practical considerations like the proximity of the area, the availability of infrastructure support or the level of cooperation of the staff.
   - Who? Who will participate in pretesting? How many people? It is important to include the different types of data providers and data users in pretesting.
   - What? What are the specific objectives of pretesting? Specifically, what aspects of the surveillance system will be pretested? What are the different activities to be undertaken to achieve these objectives?
   - How? What modes and tools for data collection will be utilized to systematically collect the data required for efficient pretesting of the forms?
   - How long? For how long will pretesting be conducted?
2. Instruct the staff involved in pretesting:
   - inform them on the objectives of and procedures for pretesting;
   - train data users and data providers in the different pretest areas on the new system.
3. Implement the pretesting activities.
4. Write a report on the results of the pretesting.
5. Formulate recommendations, based on the results of the pretesting and correct the food and nutrition surveillance system according to the recommendations.

Challenges/risks

The following challenges should be addressed:

- implementing a systematic and proactive monitoring mechanism during the pretesting phase;
- systematic updating of the software in all units where it has been installed;
- ensuring that all elements and staff are ready for the pretesting phase.

Monitoring the developing steps/implementation

Principle

The goal of monitoring and evaluation is not to focus on what is wrong and to condemn it, but rather to highlight the positive aspects of the system as well as to identify improvement opportunities and establish triggers to determine when more detailed nutrition assessments are necessary.

Steps

1. Develop a plan for the systematic monitoring and evaluation of the system:
   - What will be monitored and evaluated?
   - How will it be done?
   - Who will do it?
   - How frequently will it be conducted?
   - How will the results be systematically disseminated?
   - How will actions resulting from the evaluation results be generated?
2. Identify the resources needed to implement the monitoring and evaluation plan.

3. Prioritize the activities, based on availability of resources and need.
4. Implement the monitoring and evaluation plan.
5. Document and disseminate the results of monitoring and evaluation activities.
6. Make recommendations based on the results of monitoring and evaluation activities.

Challenges/risks

The following challenges should be addressed:

- institutionalizing monitoring and evaluation to ensure that it becomes a regular activity and will be allocated the corresponding resources;
- ensuring availability of technical expertise and other resources for monitoring and evaluation.

Developing data dissemination and feedback mechanisms

Principle

Constant feedback (positive and negative) on the status of the produced data is essential for the motivation of data producers and for a valuable, high-quality data outcome.

Steps

1. Determine the most effective and efficient way of disseminating the data generated from the surveillance system by considering the following factors:
   - Who is the target for dissemination? The needs of target groups have to be considered.
   - What should be disseminated? This should include not only the outputs of the surveillance system, but also feedback of its users and the way they are using it.
   - How often should data be disseminated to the different target groups?
   - In what form should data be disseminated to the different target groups? The whole range of forms and venues for data dissemination should be considered.
2. Identify the human, financial and all other resources needed to implement the data dissemination plan.
3. Prioritize the different modes of data dissemination to be adopted, based on the necessity and availability of resources.
4. Implement the data dissemination activities.
5. Develop and implement a system for monitoring and evaluating the data dissemination and feedback activities conducted. Among the factors to be considered are:
   - Coverage – to what extent is the material reaching the target audience?
   - Effect of the feedback system on the staff.
   - Degree of utilization by the target audience – are they actually using the data presented in the different materials?

Challenges/risks

The following challenges should be addressed:

- preparing a management report;
- limited financial resources for dissemination;
- ensuring that dissemination activities reach the target group;
- consistency between the data disseminated by the surveillance system and similar data published by other units within the Ministry, especially those of vertical programmes (e.g. Expanded Programme on Immunization (EPI), Integrated Management of Child Health (IMCI)).

Enhancing the food and nutrition surveillance system

Principle

The development of a food and nutrition surveillance system is always a work in progress. It is a dynamic project where managers and workers struggle for constant improvement.

Steps

1. Review the results of monitoring and evaluation activities conducted on the surveillance system in recent years and include the necessary changes for improvement identified in the previous phases.
2. Identify aspects of the system that need to be developed further to facilitate its functioning. The basic question to be answered is: What aspects should be emphasized next? Among the possible aspects that need further investigation may be:
   - enhancing and institutionalizing procedures to assure data quality control;
   - developing capacity to conduct special studies and sample surveys;
   - defining coordination mechanisms for the horizontal use of data generated from vertical programmes;
   - developing strategies to keep the staff interested at different levels to use the data for programme planning, management and evaluation;
   - establishing inter- and intrasectoral links among units involved in different aspects of the system;
   - unifying and coordinating initiatives of sectors and funding agencies related to the system.
3. Identify resources needed to implement the different options for the enhancement of the system. This should include specific types of resources for each planned expansion activity, the budgetary requirements (if any), and the desired source of support for each type of resource needed.
4. Prioritize the different options according to degree and urgency of need, and availability of resources for its proper implementation.
5. Prepare a timetable for the implementation of the different activities for the expansion of the system.
6. Conduct the different activities needed to implement the desired enhancement of the system.
7. Monitor and evaluate the effect of newly implemented aspects of the system.

Challenges/risks

The following challenges should be addressed:

- sustaining interest among different stakeholders for the continuous development of the surveillance system;
- generating resources to support the different activities for enhancement of the surveillance system;
- coordinating the activities of the different agencies in order to minimize the production of data collection forms and the duplication of efforts in areas related to the development of the surveillance system;
- ensuring the continued existence of a body or committee to control the surveillance system after the pilot-testing phase.

5.4 Evaluation (*7*)

For information on evaluating a food and nutrition surveillance system, both during the process of implementation and after completion, see Module 5.

6. How to strengthen a food and nutrition surveillance system

This section highlights how a functioning, effective surveillance system assists nutrition and nutrition-related programme managers, workers and other stakeholders throughout the health system to make better decisions and take timely action.

Nutrition surveillance is not only to collect data, but also to interpret data and communicate the information so that it can be used in decision-making. A surveillance system is an action-based system that consists of a set of activities that allow you to collect, analyse and interpret data and to communicate your findings and conclusions so that appropriate actions can be taken.

Before discussing steps to strengthen a surveillance system we have to know the characteristics of a good surveillance system.

6.1 Characteristics of a good surveillance system (*7*)

The following are characteristics of a good surveillance system:

- *Capacity to act on information.* First and foremost, the system must be able to act on information produced, whether in terms of a well-organized response to the rising nutrition problem or of managers using the information to make better medium- and long-term decisions.
- *Standard case definitions and reporting protocols.* These allow correct and timely documentation and reporting.
- *Basic and sound investigation methods.* These use appropriate analysis and interpretation techniques.
- *Adequate laboratory support.* Appropriate actions require accurate detection. Cases detected in the field may require more sophisticated laboratories for confirmation of the diagnosis.
- *Efficient communication systems.* Information and feedback must be passed on quickly.
- *Cost-effective resource use.* The system must focus on priorities to keep nutritional problems under control and also, where appropriate, on cooperation to save duplication of effort.
- *A network of interested people.* The surveillance system is only as good as the people who operate it.

6.2 Principles for transforming a weak or non-functioning surveillance system into a stronger one (*8*)

To turn a weak surveillance system into a stronger one:

- make the appropriate systemic improvements, including the aspects of improvement identified in the evaluation phase;
- build ownership for all improvements at every level;
- train personnel in order to develop skilled workers;
- ensure availability of resources.

Transformation by definition means change. If no change is made, the surveillance system will continue to function poorly, with the associated nutrition and health risks and detrimental effect on the economy. The transformation or the improvement has to be sustainable. There are many factors influencing the sustainability of a surveillance system, for example local capability and resource availability.

To enable sustainability of an improved surveillance system, capacity, motivation and resources are essential. If transformations are made but not sustained, improvements will be lost and the system will either revert to its prior state or perhaps get worse or even collapse. Therefore, the focus should be on building ownership through empowerment in order to sustain the improvements.

National ownership motivates stakeholders to maintain the improvements over time. Ownership should:

- result when people know and care enough about their surveillance system to fund interventions to implement improvements;
- be built at each level of the system: national, regional and local;
- be built by all parties: data recorders, data analysers and decision-makers.

Building ownership should be ongoing, helping to increase commitment and strengthen capacity to improve the surveillance system at each step of the process.

6.3 Practical steps to transform a weak surveillance system into a stronger one (*8*)

The following practical steps can be taken to improve a surveillance system:

1. *Assess the current food and nutrition surveillance activities.* The first step is to look at the current nutrition surveillance activities and how they are being performed.
2. *Determine specific conditions.* In what context is the food and nutrition surveillance system working?
3. *Identify strengths, interactions, opportunities, weaknesses and gaps.* Is there an overlap with other interventions/activities? What are the challenges?
4. *Develop a plan of action.* Set out the priorities, strategies and time schedule for the implementation of various action steps to transform the system into a better one.
5. *Implement the plan of action.* The best plan of action needs monitoring over time.

Assessing the current surveillance activities

Assessment of the current surveillance activities includes asking several questions about the system and its performance (what exists and how well it is used) such as:

- Are there guidelines for identifying nutrition problems?
- Are there protocols for actions?
- What are the norms and expectations for communication?

Improving surveillance means examining the whole system and its components. The following key partners should be involved in the assessment:

- Ministry of Health nutrition surveillance and action personnel – those who collect data and those who respond to trends identified through the nutrition surveillance;
- managers of vertical programmes such as the Expanded Programme on Immunization (EPI), Integrated Management of Child Health (IMCI), the Stop TB Strategy, etc.;
- staff of laboratories involved in nutrient and nutrition problem analysis;
- special project personnel, such as sentinel surveillance or limited geographic surveillance;
- nutrition-related sectors, government, academia, nongovernmental organizations, etc.

Determining specific conditions

The next step after collecting the required information is the analysis and interpretation of the data.

Identifying the strengths and opportunities for collaboration

Where are the gaps in performance? Listening to feedback from partners and involving them in the process of interpretation helps to identify problems and find solutions.

In the analysis and interpretation of the nutrition information, the main focus should be on:

- *What works well and what does not?* Identify successful actions to build the plan of action on existing capacity and strength. Communication with people who work in the system will provide this information.
- *What type of activities can we build on?* Where can we find collaborations? Are there common elements in the activities of surveillance survey that can be consolidated, for example standard setting, training, supervision, communications or resource management? Are there opportunities to share resources such as personnel, equipment (e.g. computers) or transport?
- *What are the gaps in the system?* Is there capacity to act?
- *What support is available?* Is there an effective communication system? Are resources being used well? Are people being trained to operate the system?

Developing a plan of action

After reviewing the current food and nutrition surveillance survey and identifying opportunities to build on and strengthen existing measures, a plan of action has to be developed. The building of ownership necessitates empowering key personnel to incorporate the existing, successful components and the information from the assessment into a new plan of action.

Essential components of the plan of action include:

- *Building on existing strengths* and focusing on strengthening essential core and support activities.
- *Considering short- and long-term needs.* The surveillance system is not just a quick response to an emerging nutritional problem, it is also important for medium- and long-term goals of identifying nutritional status as well as risk trends and modifying programmes and policies.
- *Setting priorities and realistic goals.* It is not possible to do everything and trying to do so weakens performance, so focus instead on major health concerns such as:
    - concerns of public health importance such as morbidity, mortality, WHO policy (e.g. eradication, elimination);
    - concerns with established actions (e.g. vaccination, prevention measures, education campaigns);
    - concerns where laboratory, health facility, environmental or other relevant data are available;
    - concerns for which a food and nutrition surveillance system is worth the effort.

Developing a plan of action is just the beginning. For improvements in the surveillance system to be effective, they must be implemented and sustained. Sustainable improvements require the commitment to build ownership of the system.

Implementing the plan of action

To encourage support and commitment for improving the surveillance system you should:

1. *Communicate the plan of action.* Meet partners and participants in the assessment phase and share the draft of the plan of action with them for feedback. Also use this opportunity to share the draft with other key players to whom you may not yet have talked.
2. *Encourage interaction of stakeholders in the plan of action.* Consider this a draft plan of action and let key stakeholders have the time and opportunity to make comments and suggestions. Accommodate their suggestions where feasible or explain why their suggestions cannot be included.
3. *Secure commitments of leadership, resources and action.* Be specific about who is responsible for each part of the plan of action, who is funding each action and in what timeframe the implementation will proceed.
4. *Establish partnerships* and plan future action together.
5. *Establish monitoring* to measure and control the implementation phase.
6. *Implement the plan.*
7. *Monitor progress and results.* Collect data to find out if the implementation is proceeding as planned and if the “improvements” are making any difference.
8. *Adapt as needed.* Use the monitoring information to provide feedback to users and stakeholders of the system and make changes and modifications if required.

Getting the right team is very important for ensuring the technical appropriateness of the results and the feasibility and sustainability of the recommendations. Two types of teams will be involved: an assessment team, which collects and analyses data, and an oversight team, which provides guidance to the assessment team.

Assessment team members should:

- be knowledgeable (i.e. can determine what data are needed);
- be respected (i.e. others will hear what they have to say);
- be objective (i.e. not biased by fixed ideas).

Oversight team members should:

- have seniority and decision-making authority;
- be respected and influential leaders (i.e. others listen to them);
- be representative of the important stakeholders in the surveillance system.

To build ownership of the assessment, local officials should:

- understand the benefits of an improved surveillance system and take part in the assessment;
- be encouraged to be open (i.e. to give accurate information about the strengths and weakness of the current system to allow the assessment team to make appropriate, effective recommendations).

To build ownership of surveillance improvements, respondents should:

- welcome changes to the system and be committed to implementing improvements;
- feel empowered that their comments and suggestions will be noted and considered.

In the final stage of data analysis and the development of recommendations, there are additional ways of building ownership for an improved surveillance system. Respondents need to feel that their input is recognized as a valuable and worthwhile contribution to the improvement process, therefore:

- look for worthy ideas provided by respondents during the assessment, incorporate these into the analysis and recommendations, and acknowledge their source;
- identify opportunities for improving the system and, in order to continue building ownership of improvements, pick the most suitable strategies and recommendations that will show visible improvements;
- start with small successes in areas where there is support for the improvement and avoid debated recommendations at the onset of change.

Initially, it is important to focus on a limited number of priorities, instead of trying to tackle every problem and weakness at once. Prioritizing allows your team to concentrate its efforts and increase the likelihood of early success, which can be used to mobilize further support. Without priorities, you risk either taking no action because the project seems too overwhelming and costly, or taking action that wastes effort because it is not the most important. To ensure success, the priorities should represent a consensus of stakeholders' concerns.

Over time the surveillance system should begin to change as implementation progresses. To maintain this change there is a need to maintain a base of support by checking the following:

- *Are the right people involved?* As implementation occurs, are key stakeholders still working towards implementation? Have new stakeholders gained importance in the process? Who are they? Are they being involved?
- *Are you communicating with supporters?* Do they know the status of the surveillance system improvements and the successes and weaknesses? Sustaining ownership depends on effective communication with supporters.
- *If improvements are not working as planned, what can be done?* Involve supporters in modifying the approach to change. Use supporters to advocate for change.
- *What happens to actions that were not selected as priorities?* Many are important and still need to be addressed. Some of your partners may support issues that were not priorities. Ask for their assistance in moving implementing these recommendations.

Module 2. Malnutrition: causes, forms and the relationship between nutrition, food security and health

1. Learning objectives

- Get a basic understanding of malnutrition and its different types, including overnutrition.
- Know about the major causes of malnutrition.
- Identify persons at risk.
- Know about the links between malnutrition, food security and health.
- Acquire the knowledge about health and food security assessment and the main indicators.

2. Introduction

This module provides information on malnutrition, focusing on types (e.g. undernutrition of macronutrients and micronutrients as well as overnutrition), causes of malnutrition and the link between nutrition, food security and health.

The nutritional status of a population is affected by a number of variables such as:

- food production and availability
- purchasing power
- dietary practices and intake
- disease patterns
- other related factors.

These factors can be arranged in a causal sequence or model as follows:

1. Nutritional status depends on, apart from disease, dietary intake of food.
2. The dietary intake or food consumption of a family or a person depends on the food available to the family and on nutrition awareness in the family.
3. Food availability depends on:
   - the relation between food prices and earning, in a market economy;
   - on the food harvests, in subsistence households;
   - on both the price–wage relationship and on production, in mixed market and subsistence households (the exact relationships between these and food availability in a mixed household economy are not usually known and are difficult to determine).
4. The relation between food prices and earnings is largely influenced by imports and, in some cases, food aid.
5. Local food production is influenced by the weather as well as a host of other interrelated factors, both inside and outside the country.
6. Food utilization depends on the physiological status of the human body, which in turn is influenced by the environment, access to safe water and the morbidity status, which itself results from inadequacies in the environment, water and sanitation situations.

Models that concentrate on other aspects of the complex network of factors affecting nutritional status could similarly be developed; for instance, the interactions between malnutrition and infections, sanitation or water supply. However, for the purpose of planning a surveillance system, the simplified list given above should be sufficient.

3. Relationship between nutrition, food security, agriculture, health and socioeconomic sectors

3.1 Food security

According to FAO, food security is "a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life". (*9*) It includes both physical and economic access to food.

This multidimensional concept:

- covers the whole food chain from production to biological use;
- applies at the national as well as the household and individual levels;
- aims at permanent security, combining stability with non-dependence on external factors;
- is dynamic, as food security is a relative and not an absolute goal;
- is centred on the material and economic attributes of food. (*10*)

The United States Agency for International Development has proposed three basic components of food security: (*11,12*)

- *Availability.* Sufficient quantities of appropriate food are available from domestic production, commercial imports or food assistance on a consistent base.
- *Access.* Adequate income or other resources are available to access appropriate food through home production, buying, exchange, gifts, borrowing or food aid.
- *Utilization.* Food is properly used through appropriate food processing and storage practices, adequate knowledge and application of nutrition and child care, and adequate health and sanitation services.

In addition, other determinants of food security are:

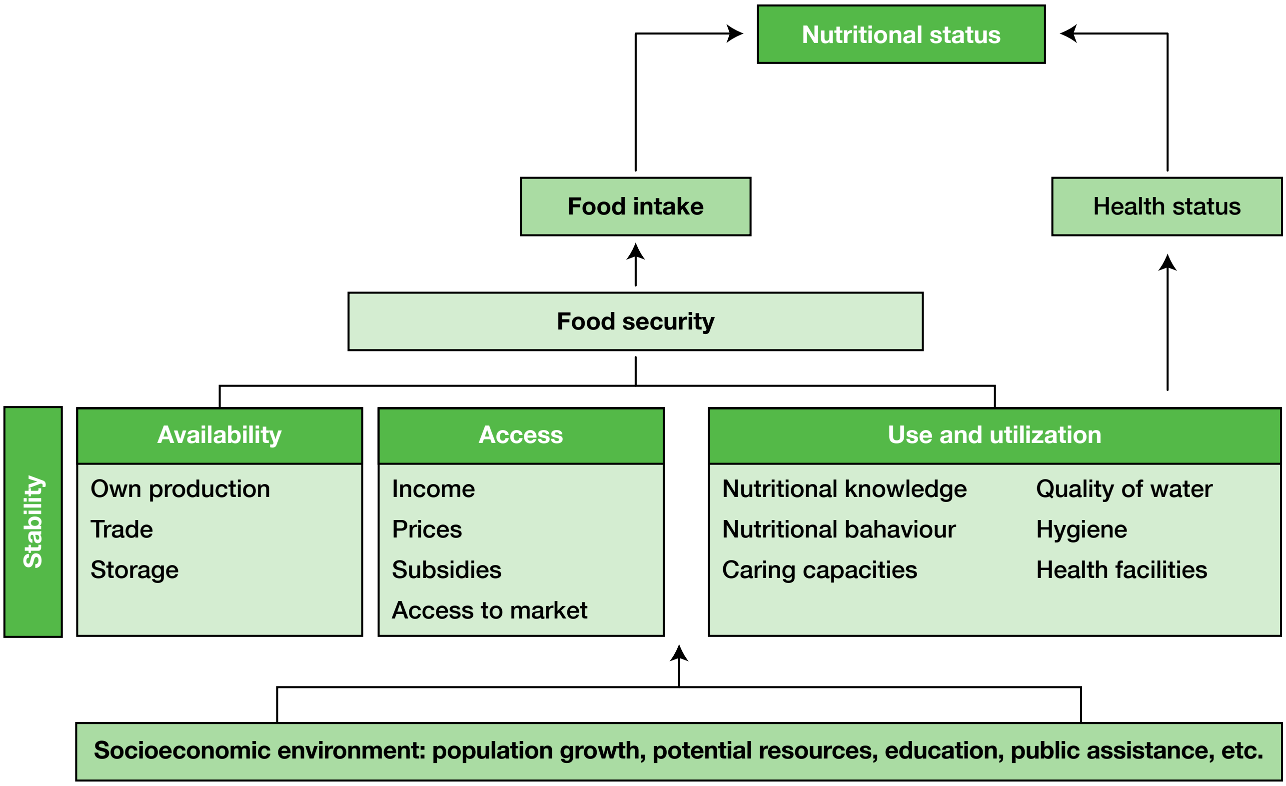
- the distribution of food within households and communities; (*12*)
- food stability.(*13*)

The importance of food stability is implied in the indication that adequate food must be obtainable at all times. It has to be warranted that access and availability of food is not curtailed by acute or recurring emergencies (e.g. sudden crises or seasonal shortages). Stability thus concerns both availability and access.

Food insecurity is one of the three underlying causes of malnutrition as conceptualized in the model shown in Figure 1. Insufficient access to food leads to inadequate dietary intake, which in turn can lead to malnutrition. Although food insecurity is rarely the only cause of malnutrition, which in most cases is accompanied by high disease rates, it has nevertheless a great impact, especially in emergency situations with deteriorating care practices, health, hygiene and sanitation.

Emergency food security assessment is therefore essential when planning interventions to protect food security and prevent potential malnutrition. Interventions include the distribution of food aid or cash and agricultural and economic support and should be adapted to the specific problems of afflicted households. (*12*)

In addition to its close relationship with health through malnutrition, food security also plays a central role in sustainable development, both being influenced by and influencing economic development, environment and trade.



Source: adapted from (*1*)

Figure 1. Food security as a determinant of nutritional status

No consensus has yet been reached on whether:

- adequate nutrition is a matter of distribution rather than the quantity of food in the world;
- current food production can cope with future requirements;
- global trade may render national food security dispensable;
- food insecurity and poverty in rural communities may be maintained and aggravated by globalization. (*14*)

Food and nutrition security is a major focus of a food and nutrition surveillance system and may serve as a common aim for policies and the different sectors involved.

A more detailed presentation of some key sectors (10) is given in the following sections.

Agricultural sector

Considering the eminent role of domestic availability of staple foods for the satisfaction of a population's food requirements, food security is tightly linked to agriculture; therefore, agriculture plays an important role in food and nutrition surveillance systems. Not only is the production of crops a determining factor of food security but the existing agricultural structure, food policies and market situation are also factors. The latter in particular has great implications for the choice of crops for production.

Agricultural policies must suit the needs of the target population. Policies concerning food production and distribution can impact strongly on the food security of vulnerable groups. At the national level, a country's food security is also affected by international agriculture and trade agreements. Trade liberalization has been considered to be a potential threat for food security in developing countries, by diminishing agricultural employment and changing food prices. Better export conditions may reduce the availability of food products within a country. In most developing countries, agriculture is still the largest employment sector. Lower domestic crop prices would therefore worsen the economic situation and hence impair food access of vulnerable households. However, this pessimistic view is not shared by all experts and liberalization may also offer benefits to developing countries.(*15*)

Generally, food production and domestic commercialization should be surveyed by the agricultural sector, keeping in mind the degree of food insecurity among various population groups.

Health sector

The health sector is more concerned with the results of socioeconomic and food insecurity, and health and nutrition surveillance can therefore show indicators of upstream problems in the food chain, albeit in an unspecific manner, disclosing regional and demographic differences.

Group feeding, health and nutrition education, and environmental sanitation are examples of interventions in this sector aimed at curing or alleviating negative consequences of food insecurity that need monitoring within the surveillance framework.

Social and economic policy sectors

As outlined above, social and economic factors have a great impact on food and nutrition security, being determinants of access to food. Purchasing power, food prices, employment, earnings, social policies, etc. all influence food consumption.

4. Understanding malnutrition

Malnutrition is caused by an inadequate supply of food and essential nutrients. It includes both undernutrition, when not getting enough, resulting in underweight, wasting and, in children, stunting, and overnutrition, when getting too much, which mostly manifests in overweight and obesity. Moreover, deficiencies of a single or a number of nutrients are also forms of malnutrition.

Poverty is an important cause of undernutrition thus this often afflicts low-income populations in developing countries. However, overnutrition becomes an increasing problem in many developing countries, where it frequently coexists with undernutrition. This issue is known as the double burden of malnutrition.

Overnourishment is as much a problem as undernutrition and leads to overweight and possible obesity, which are associated with noncommunicable diseases such as hypertension, diabetes, cardiovascular diseases and certain types of cancer.

Generally, energy and nutrients are needed for:

- the maintenance of body functions such as breathing, digestion and temperature regulation;
- repair of the body and functioning of the immune system;
- growth;
- physical activities.

Nutrients are classified as:

- macronutrients, such as protein, carbohydrate and fat, which are needed in large amounts;
- micronutrients (vitamins and minerals), which are needed in lower amounts.

Individual nutritional requirements vary with age, sex, physical and health status, level of physical activity and environmental factors (especially temperature). Special needs arise from pregnancy and breastfeeding or disease.

5. Undernutrition

FAO estimates that there are close to 1 billion malnourished people globally.

5.1 Contributing factors and at-risk groups

Factors favouring undernutrition

Factors affecting undernutrition include:

- bad eating habits and food choices
- insufficient knowledge about nutrition
- poverty
- dental problems
- sensory losses
- age-related changes, including the previous two factors
- diseases and infections
- social isolation
- psychological disturbances (e.g. depression, eating disorders).

Who is at risk?

Those at risk of malnutrition include:

- financially deprived persons;
- infants and children who do not get the right type or amount of energy and nutrients;
- older adults;
- those taking medicines that decrease appetite or affect the digestion and nutrient absorption;
- those with eating disorders;
- those suffering from diseases such as cystic fibrosis, coeliac disease, liver disease, kidney disease and cancer;
- pregnant women;
- people with substance use disorders.

Infants and children as well as pregnant and lactating women have increased nutrient requirements. Fulfilling the special food, care and health needs of young children is a prerequisite for adequate growth and development. While breastfeeding usually prevents malnutrition in the first 6 months, the need for complementary food exposes older children to a particular risk of inadequate nutrition. Children aged between 6 and 24 months are most threatened by impaired growth. Additional health risks arise from contaminated food and water. Growth deficiencies caused by early malnutrition are not recovered later in life.

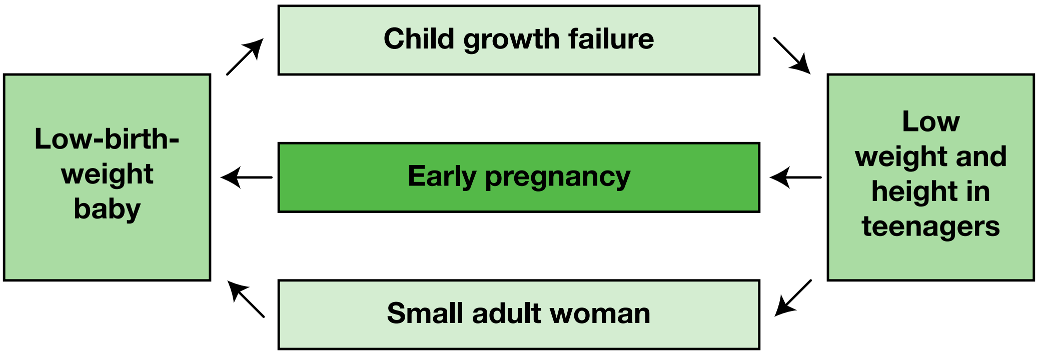
Children under the age of 5 years are particularly vulnerable to malnutrition. WHO estimates that at least half of the approximately 10 million deaths per year of children under the age of 5 years can be attributed to malnutrition. The majority of these deaths are due to the higher susceptibility of malnourished children to infections and this is already seen with moderate malnutrition. Moreover, malnutrition may entail permanent physical and mental damage in young children with consequences for their later life. (*16–18*)

Adequate energy and nutrient supply is also crucial for foetal development and lactation. Undernourished pregnant women have a high risk of having a child with a low birth weight. This is known as the cycle of malnutrition (Box 1, Figure 2). Furthermore, optimal nutrition during pregnancy enables the accumulation of stores to be used during the ensuing lactation. Thus, breast milk has the necessary quality to ensure optimal growth of the infant.

Box 1. The cycle of malnutrition

As illustrated in Figure 2, malnutrition can be passed on from mother to child. Infants born to small women tend to have low birth weight, predisposing them for small stature in later life. This risk is further increased by the fact that breast milk from malnourished women has a lower nutrient content. Thus, in low-income countries, small body stature is to a higher degree due to previous and current malnutrition rather than genetically determined. Adequate nutrition of girls and women is therefore crucial for the reduction of malnutrition in the long term, as well-fed women give birth to larger, healthier infants.

Weight at birth not only allows assumptions about a mother's nutrition and health status but is also an indicator of her child's chances of survival, growth, long-term health and psychosocial development. Low birth weight (< 2.5 kg) is associated with a number of serious health risks for infants. Undernourishment during pregnancy increases infant mortality, as it impairs immune function and hence susceptibility to disease. Surviving children are also affected and tend to remain undernourished during adulthood. Moreover, catch-up growth in re-fed children disposes them to diabetes and cardiovascular diseases in later life. Cognitive development may also be impaired in children born with a low birth weight; thus they may perform less well in school and have fewer job opportunities as adults.



Source: (*19*)

Figure 2. Nutrition throughout the life cycle

Decreased appetite and digestive problems are another cause of inadequate energy and nutrient intake leading to undernutrition. Elderly and/or disabled persons or those taking certain medications or suffering from certain diseases are particularly affected and the latter may also have higher nutrition requirements. Food intake is impaired by difficulties in chewing and swallowing. Disabled persons may experience difficulties in accessing food.

5.2 Forms of undernutrition

Chronic or long-term malnutrition is the most common form of malnutrition and impairs growth in children leading to stunting, i.e. low body height. It is an irreversible condition.

Acute malnutrition or "wasting" can be reversed. However, when severe, it readily leads to death, especially in children. Therefore, it is of particular concern during emergencies.

Table 1. Clinical features of severe acute malnutrition

Marasmus	Kwashiorkor
Extremely emaciated	Bilateral pitting oedema, beginning in the lower legs and feet, can become more generalized (hands and arms, "moon face")
Fat and muscle tissue grossly reduced	Reduced fat and muscle tissue, which may be masked by oedema
Thin, flaccid skin, hanging in loose folds; "old man's appearance"	Skin lesions, atrophy, cracked and peeling; patchy and fragile, prone to infection
Normal hair	Hair changes colour (yellow/reddish) and becomes sparse, dry and brittle, can be pulled out easily leaving bald patches
Frequent infections with minimal signs	Frequent infections
Electrolyte imbalance	Electrolyte imbalance
Frequent association with dehydration	Frequent association with dehydration, which may be masked by oedema
Alert and irritable	Generally apathetic, lethargic and miserable when left alone; irritable when handled

Source: (*19*)

Two clinical forms of severe acute malnutrition are distinguished: marasmus and kwashiorkor. Marasmus is caused by a general deficiency of food, including most nutrients, and is characterized by severe wasting. Kwashiorkor is due to an inadequate supply of protein while energy intake is generally sufficient. Its predominant symptom is bilateral oedema (Table 1). Mixed forms also exist.

5.3 Signs and consequences

Undernutrition usually develops gradually over a long time period and only becomes apparent in later stages. The early signs and symptoms include:

- weight loss
- irritability and fatigue
- growth faltering or arrest in children.

Later signs and symptoms of malnutrition may include:

- pain in bones or joints, muscle weakness
- oedema (bloated, swollen abdomen and extremities)
- anaemia
- orthostatic hypotension
- alterations of skin and hair (such as change of colour)
- brittle and spooned nails
- dry, scaly skin
- hair loss
- loss of appetite
- impaired immune function, slow wound healing, higher susceptibility to infections
- sunken temples (due to dehydration and loss of muscle)
- decreased thyroid function (associated with impaired regulation of body temperature)
- cognitive dysfunction
- increased risk of hip fracture.

In general, malnutrition (especially undernourishment and micronutrient deficiencies) reduces body strength and impairs immune functions and wound healing, leading to a higher infection risk. Severe malnutrition can even entail heart, kidney and respiratory problems. Electrolyte balance in the blood may be disturbed. Untreated, severe malnutrition eventually leads to death.

6. Micronutrient deficiency

Micronutrient deficiencies are caused by an inadequate intake of essential micronutrients, i.e. vitamins and minerals that the body needs in only very small amounts. However, these small quantities are very important for various functions and deficiencies can cause serious health problems. Micronutrient deficiencies are particularly common in developing countries and affect more than 2 billion people. Being less known and not so often reported in the media, they are often termed “hidden hunger”; however, they affect more individuals than starvation. They are often less apparent than starvation as they can occur even when energy and macronutrient intake is sufficient and affected individuals, especially with subclinical deficiencies, may appear well nourished. Nevertheless, the consequences of micronutrient deficiencies are detrimental.

6.1 Effects of micronutrient deficiency

Micronutrients are essential for life and a wide range of body functions. Vitamins are classified as water soluble (e.g. the B vitamins and vitamin C) or fat soluble (e.g. vitamins A, D, E and K). A great number of minerals are essential, including iron, iodine, zinc and calcium.

Individual requirements for various micronutrients depend on age and sex. They increase during special key periods such as pregnancy and lactation, early infancy and childhood due to growth, and with certain diseases.

Micronutrient deficiencies cause a number of harmful effects, increasing morbidity (illness) and mortality (death) risk, and impeding growth and mental development. Serious deficiency of certain micronutrients manifests in specific clinical symptoms that are referred to as micronutrient deficiency disease. Many well-known nutritional diseases such as scurvy, beriberi and pellagra are examples of micronutrient deficiency disease. Depending on the manifestations of deficiency, micronutrients can be classified as type 1 or type 2 (Box 2).

Box 2. Classification of micronutrients

Depending on the manifestations of deficiency, micronutrients are categorized as either type 1 or type 2 nutrients.(*20*)

Type 1 nutrient deficiencies are associated with characteristic deficiency diseases, as they are needed for specific body functions. Before these symptoms appear, metabolism and immune competence are impaired while growth is generally only affected in later stages of deficiency. Most type 1 nutrients are stored in certain organs or tissues of the body. Vitamins A, B1, B2, niacin, B6, B12, C, D and folic acid, as well as iron, calcium, copper, iodine and selenium are in this category of nutrients.

Type 2 nutrient deficiencies do not show specific clinical signs. They affect general metabolic processes causing growth failure, wasting, oedema and immune deficiency. The effects of deficiency are quite similar for all nutrients in this category, rendering diagnosis difficult. There are no specific stores in the body apart from the normal amounts in various tissues. Sulfur, potassium, sodium, magnesium, zinc, phosphorus, water, essential amino acids and nitrogen belong to this category of nutrients.

6.2 The critical three

Worldwide, the supply of three micronutrients in particular is critical: vitamin A, iron and iodine (Table 2).

Vitamin A deficiency is still a major cause of blindness and impaired vision, with about 33% of preschool childrenn in developing countries suffering from subclinical deficiency.

Iodine deficiency is common in mountainous areas that are remote from the sea where it leads to endemic goitre. In children, it also impairs growth and physical development, the most extreme form being cretinism. Goitre from iodine deficiency affects about 16% of the general population worldwide.

Iron deficiency shows a high worldwide prevalence and also affects industrialized countries. Its predominant symptom is anaemia, which is caused by a decrease in haemoglobin, which contains iron. It manifests in breathlessness and fatigue.

Emerging deficiencies include calcium, zinc, folic acid and vitamin D.

Table 2. The three critical micronutrients: main functions, deficiency symptoms and at-risk groups

Micronutrient	Deficiency symptoms	At-risk groups
Vitamin A Vitamin A is a fat-soluble vitamin required for the normal functioning of the visual system, growth and development, maintenance of epithelial cell integrity, immune function and reproduction	Vitamin A deficiency results in xerophthalmia, which affects the eyes Vitamin A deficiency in children is also associated with an increased risk and severity of morbidity and increased risk of mortality	Children suffering from measles, diarrhoea, respiratory infections, chickenpox and other severe infections are at increased risk of vitamin A deficiency
Iron Iron has three major roles in the body. First, it is necessary for the synthesis of haemoglobin, which carries oxygen to the body's cells and transports carbon dioxide from the tissues to the lungs. Second, it is a component of myoglobin (a muscle protein). Third, it is required for the functioning of many enzymes	Lack of iron eventually results in iron deficiency anaemia, which manifests with tiredness and breathlessness Women with severe anaemia carry a high risk of complications during childbirth Economic productivity and educational achievement is reduced by iron deficiency anaemia	At risk groups are: • women of child-bearing age • pregnant and breastfeeding women • babies given cow's milk • weaning-age children • regions where malaria and intestinal parasitic infestation are prevalent
Iodine Iodine is an essential constituent of hormones produced by the thyroid gland in the neck. In the foetus, iodine is necessary for the development of the nervous system	Iodine deficiency causes a range of abnormalities, including goitre and cretinism, which occurs in the offspring of women with severe deficiency	Goitre is endemic in many mountainous areas of Europe, Asia, the Americas and Africa where there is limited access to seafood The prevalence of goitre increases with age and reaches a peak during adolescence Goitre tends to affect girls more than boys and women more than men because of increased activity of the thyroid gland during pregnancy

6.3 Causes

The amounts of micronutrients vary in different foods. Some micronutrients are widely available from a range of food sources whereas others, such as vitamin D, are only contained in certain types of food. The risk of deficiency is higher for micronutrients for which there are few food sources, especially when these foods are not easily available to the whole population.

In many developing countries, diets are based on a few staple foods with high starch content but low amounts of micronutrients. Fresh vegetables and fruit that are particularly rich in many micronutrients are often unavailable or too expensive. This is also the case with animal foods, especially meat and fish, which are important sources of iron and vitamin D, respectively.

However, inadequate micronutrient intake is not restricted to low-income countries. With the increasing use of processed foods, they are also becoming an issue in industrialized countries as high processing of foods entails losses in micronutrients. Diets in industrialized countries are rich in fats, especially saturated fats, and sugars but poor in micronutrients.

Micronutrient deficiencies may also be a consequence of diseases or injuries. Heavy or regular bleeding leads to iron loss and promotes iron deficiency anaemia; diarrhoea and frequent vomiting can cause electrolyte depletion; and gastrointestinal diseases such as coeliac disease and inflammatory bowel diseases are associated with malabsorption.

6.4 Monitoring micronutrient malnutrition

Generally, micronutrient deficiencies are the major nutritional problem. However, some micronutrients are also harmful when taken in too high amounts and become toxic; for example, high doses of vitamin A are particularly detrimental to the foetus and excessive intake presents a high risk in pregnant women.

Considering the threat micronutrient deficiencies pose to public health, effective monitoring should be part of health surveillance. Assessment can be done using direct or indirect approaches; however, the latter are less accurate.

In direct assessment, clinical signs and symptoms and biochemical testing are used to diagnose clinical or subclinical deficiency at the individual level. Combined with survey methods, the prevalence of micronutrient deficiency diseases can then be estimated at the population level.

In indirect assessment, the risk and prevalence of micronutrient deficiencies are extrapolated from the estimated nutrient intakes at the population level. This necessitates assessing the dietary intake of a given population and the availability of reference data for requirements such as the reference nutrient intakes published by WHO and FAO. Information is also needed regarding the demographic characteristics of the population, their overall health status, activity level and energy requirements, the bioavailability of nutrients from the diet, and environmental influences.

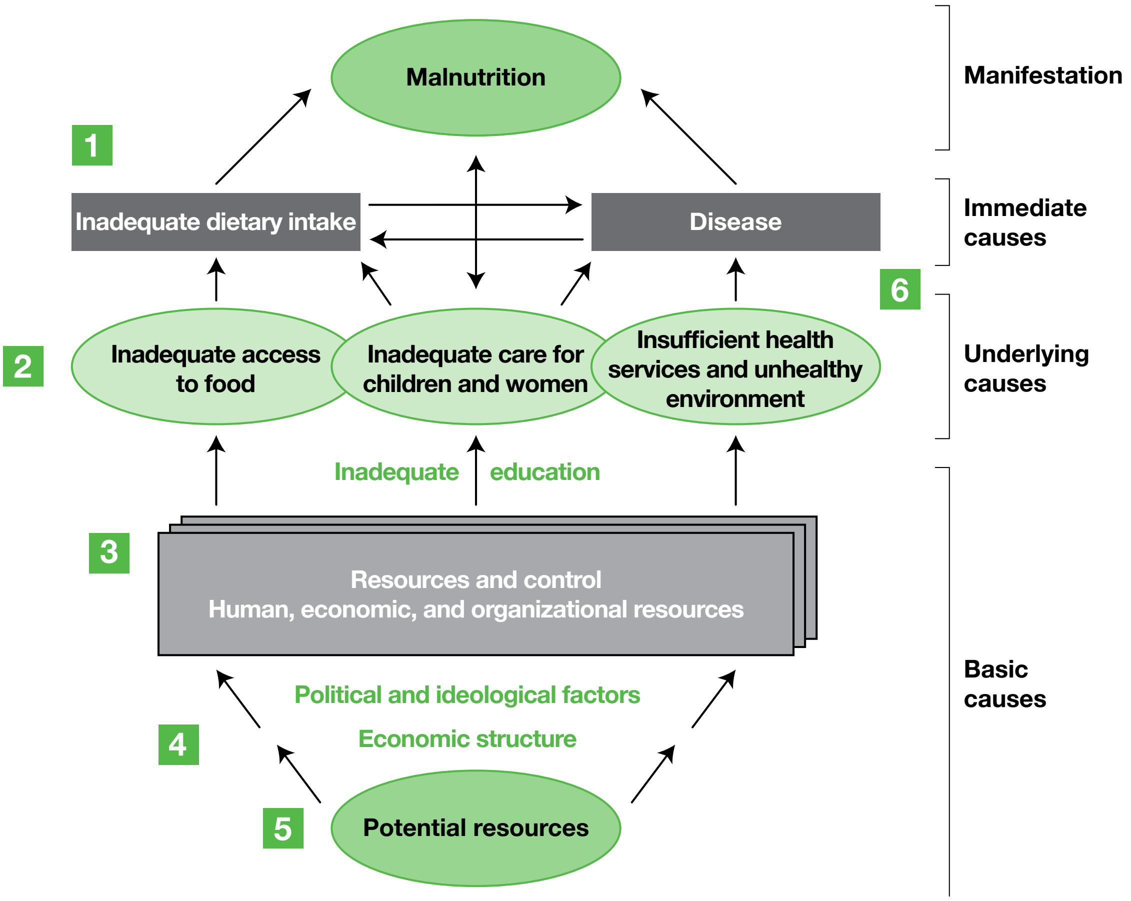
Information on actual or potential micronutrient malnutrition should always be cross-checked against other available data to obtain the most accurate picture of what is happening.

7. Causes of undernutrition: the UNICEF conceptual framework

Before solutions to malnutrition can be found, the causes of the problem have to be known so that available resources can be used most efficiently. Frequently, the focus is more on assessment of its prevalence than on the causal factors.

Undernutrition cannot always be reduced to a mere lack of food. Besides inadequate energy and nutrient intake, it is also caused by altered requirements of the body. These can be the result of diseases that influence energy and/or nutrient requirements or modify their utilization by interfering with digestion and absorption. Deficiencies of micronutrients are also a possible consequence of diarrhoea or high blood loss.

UNICEF has proposed a conceptual framework to illustrate the complex relationship of different causes for malnutrition; this mainly applies to undernutrition (Figure 3). (*1*)



1 Nutritional status depends on the dietary intake of food and nutrients apart as well as disease.
2 The dietary intake or food consumption of a family or a person depends on the food available to the family and on the nutrition awareness in the family.
3 Food availability depends on: a) the relation between food prices and earnings in a market economy; b) the food harvests in subsistence households; and c) both the price–wage relationship and on production in mixed market and subsistence households (the exact relationships between these factors and food availability in a mixed household economy are not usually known and are difficult to determine).
4 The relation between food prices and earnings is largely influenced by imports or food aid.
5 Local food production is influenced by many interrelated factors, both inside and outside the country (e.g. the weather).
6 Food utilization depends on the physiological status of the human body which, in turn, is influenced by the environment, accessibility to safe water, and morbidity status, which itself results from inadequacies in the environment and water and sanitation situations.

Source: adapted from (*1*)

Figure 3. The conceptual framework of malnutrition

This conceptual framework for malnutrition is a useful tool for understanding the causes of malnutrition; however, it has to be adapted to the respective situation. It describes three levels of causality: immediate, underlying and basic. Immediate causes have an effect directly on individuals and are generally inadequate food intake and disease, while underlying causes work at the level of households and communities. Basic causes act at society level.

The Inter-Agency Standing Committee Global Nutrition Cluster's harmonized training package gives a detailed view of these causes. (*21*)

7.1 Immediate causes: the malnutrition and infection cycle

Immediate causes of malnutrition are due to an imbalance between the amount of nutrients absorbed by the body and the amount of nutrients required by the body. This happens as a consequence of consuming too little food or having an infection that either increases the body's requirements for nutrients or prevents the body from absorbing food consumed.

In practice, malnutrition and infection often occur at the same time because one can lead to another and this creates a vicious cycle of infection and malnutrition. A malnourished child, whose resistance to illness is poor, falls ill and becomes more malnourished, which reduces his or her capacity to fight against illness and so on. This infection–malnutrition cycle is illustrated in Figure 4.

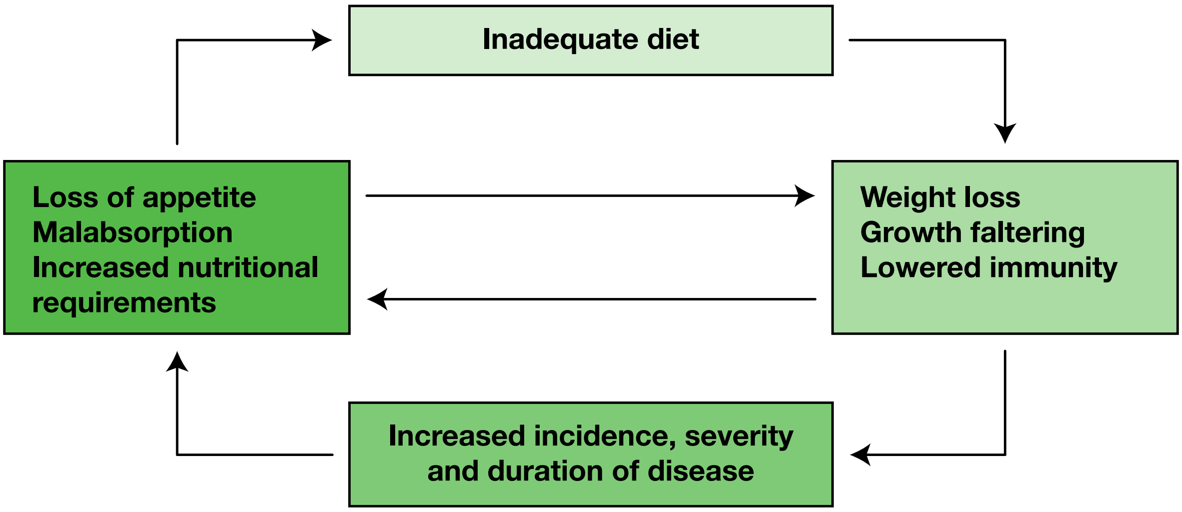


Figure 4. The infection–malnutrition cycle

7.2 Underlying causes (*21*)

According to the framework, there are three major underlying factors: food access, care practices and health conditions; however, these factors are related to each other. All are necessary prerequisites for adequate nutrition.

Food

Household food security is defined as sustainable access to safe food of sufficient quality and quantity to ensure adequate intake and healthy nutrition for all family members. Household food security depends on access to food as well as its availability and utilization by each person. It applies to foods available in a particular geographical area through local food production systems: agriculture; fisheries; livestock rearing; and foods from hunting and foraging in the wild. It also includes the food imported and exported into the region and a consideration of seasonal variations in food availability. Food security does not stop at availability; it also needs to include food access by different households with different livelihoods (i.e. means of making a living) and incomes.

Poverty limits access to food not only through a lack of financial means but often also through limited access to land for food cultivation. Vulnerable groups such as women and children may be even more disadvantaged in deprived households.

The disruption of food production or distribution is another major cause of hunger and malnutrition. Natural disasters, such as droughts, floods or tornados, may halt or disrupt food production, shipping or marketing and result in food shortages. Man-made disasters, including war, often limit food accessibility because they disrupt regular movement and distribution of food. During conflicts, food can be used as a weapon; withholding food from civilian populations intentionally causes starvation. (*22*)

Care

Caring practices are the way community members, including vulnerable members such as children, the elderly and the sick, are fed, nurtured, taught and guided. These practices are the responsibility of the family and the community. Cultural factors and resources such as income, time and knowledge determine caring practices. The values of the society strongly influence the priority given to the care of children, women and the elderly. Attitudes to modern health services, water supplies and sanitation also affect caring practices. The care of children and other vulnerable groups is particularly linked with the status, roles and responsibilities of women, which may be culturally dependent.

Caring for and supporting vulnerable groups

Children, the disabled, the chronically ill, the elderly and those in hospitals or prisons all deserve special care. Different cultural norms and economic situations will determine how these caring practices are carried out. Both formal and informal systems of care exist through institutional care and family networks.

Child feeding behaviour

While breastfeeding provides the best nourishment and protects children from infection, a child must have complementary foods at six months to ensure optimal growth. The foods first introduced are often determined by a family's financial situation as well as cultural norms and therefore vary greatly. Changing the diet of infants from one based on milk to one coming from the family plate is time consuming and requires extra care around hygiene practices related to the preparation and provision of food.

Health protection behaviour

In order for children to thrive they require essential health care, especially immunizations. Cultural norms and the quality of health information and services available influence the way families seek appropriate and timely health care for their children.

Caring for and supporting mothers

The unequal division of labour and resources in families and communities that favours men jeopardizes the well-being of both children and women. The elements of care most critical for women during pregnancy and breastfeeding include extra quantities of good-quality food, release from onerous labour, adequate time for rest, and skilled pre- and postnatal health care from trained practitioners.

Health

Health refers to a range of factors linked to access to health care, safe water and sanitation. An essential element of good health is access to affordable, good-quality health services and a healthy environment. Limited access to a safe water supply, proper sanitation systems and hygienic conditions in and around homes all influence the spread of infectious diseases. A poor health environment can lead to an increased incidence (new cases) of disease. This reduces the capacity of adults to work and increases the time they spend caring for sick members of the family.

Access to basic health services determines the extent to which infection can be prevented or treated. Effective treatment should reduce the duration and the severity of infection. Access to health services is determined by physical distance and cost. Costs can include transport costs and medical costs for treatment as well as time costs for family member having to attend the clinic and leave other tasks undone. Poor-quality health services are a disincentive for uptake for many households, who may often wait until health has deteriorated to serious levels before going for treatment.

As with food security, seasonal factors affect diseases spread by mosquitoes, such as malaria, dengue and yellow fever. Diarrhoea incidence also has a marked seasonal dimension, increasing in the rainy season.

8. Overnutrition

As with undernourishment, excessive food intake has negative health effects leading to overweight and obesity.

Overweight and obesity designate a state of excessive body weight, mostly due to an increase in fat mass. While overweight comes from extra muscle, bone, fat and water, obese persons always have a high proportion of extra body fat.

The most frequently used indicator of overweight and obesity is the body mass index (BMI). BMI is based on the relationship between weight and height:

$$\text{BMI} = \frac{\text{body weight [kg]}}{(\text{body height [m]})^2} \text{ in kg/m}^2$$

where BMI = body mass index

BMI correlates with the amount of body fat. For the assessment of body weight, BMI is used for categorization. There are slight variations in cut-off points that are partly due to ethnic differences. WHO defines overweight as a BMI greater than 25 kg/m^2 and obesity as a BMI greater than 30 kg/m^2, and indicates that the risk for some chronic diseases may begin to rise at a BMI of 21 kg/m^2 (Table 3).

Table 3. International classification of adult underweight, overweight and obesity according to body mass index (BMI)

Weight	BMI (kg/m^2)
Underweight	**< 18.5**
Severe underweight	< 16.0
Moderate underweight	16.0–16.99
Mild underweight	17.0–18.49
Normal range	**18.5–24.99**
Overweight	**≥ 25**
Pre-obese	25.0–29.99
Obese	**≥ 30**
Obese class I	30–34.99
Obese class II	35–39.99
Obese class III	≥ 40

Source: (*23*)

Different classifications are used for children and adolescents, to account for growth and sex-related difference in maturation.

The BMIs of children and adolescents are compared with age- and sex-specific reference charts represented as percentile curves showing the age-specific distribution. This BMI for age allows comparing an individual's BMI with the values of other children of the same age.

Waist circumference can also be used as an indicator for possible health risks related to overweight and obesity in adults. It allows estimation of abdominal fat mass (localized around the waist, as opposed to peripheral fat on hips and extremities or subcutaneous fat). A large waist circumference is a sign of abdominal obesity. A waist circumference more than 88 cm for women and more than 102 cm for men is associated with an increased risk for coronary heart disease and type 2 diabetes. This is also described as having an "apple" shape.

8.1 Obesity and noncommunicable diseases

Overweight and obesity

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health.

BMI provides the most useful population-level measure of overweight and obesity as it is the same for both sexes and for all ages of adults. However, it should be considered a rough guide because it may not correspond to the same degree of body fatness among different individuals.

What causes obesity and overweight?

The fundamental cause of obesity and overweight is an energy imbalance calories consumed and calories expended. Globally, there has been an increased intake of energy-dense foods that are high in fat, and an increase in physical inactivity due to the increasingly sedentary nature of many forms of work, changing modes of transportation, and increasing urbanization.

Changes in dietary and physical activity patterns are often the result of environmental and societal changes associated with development and lack of supportive policies in sectors such as health, agriculture, transport, urban planning, environment, food processing, distribution, marketing and education.

What are the common health consequences of overweight and obesity?

Raised BMI is a major risk factor for noncommunicable diseases such as:

- Cardiovascular diseases (mainly heart disease and stroke)
- Diabetes
- Musculosketetal disorders (especially osteoarthritis – a highly disabling degenerative disease of the joints)
- Some cancers (endometrial, breast, and colon).

The risk for these noncommunicable diseases increases with the increase in BMI.

Childhood obesity is associated with a higher chance of obesity, premature death and disability in adulthood. But in addition to increased future risks, obese children experience breathing difficulties, increased risk of fractures, hypertension, early markers of cardiovascular disease, insulin resistance and psychological effects.

How can overweight and obesity be reduced?

Overweight and obesity, as well as their related noncommunicable diseases, are largely preventable. Supportive environments and communities are fundamental in shaping people's choices, making the healthier choice of foods and regular physical activity the easiest choice (accessible, available and affordable), and therefore preventing obesity.

At the individual level, people can:

- Limit energy intake from total fats and sugars
- Increase consumption of fruit and vegetables, as well as legumes, whole grains and nuts
- Engage in regular physical activity (60 minutes a day for children and 150 minutes per week for adults).

Individual responsibility can only have its full effect where people have access to a healthy lifestyle. Therefore, at the societal level it is important to:

- Support individuals in following the recommendations above, through sustained political commitment and the collaboration of many public and private stakeholders;
- Make regular physical activity and healthier dietary choices available, affordable and easily accessible to all – especially the poorest individuals.

The food industry can play a significant role in promoting healthy diets by:

- Reducing the fat, sugar and salt content of processed foods
- Ensuring that healthy and nutritious choices are available and affordable to all consumers
- Practicing responsible marketing especially those aimed at children and teenagers
- Ensuring the availability of healthy food choices and supporting regular physical acativity practice in the workplace.

Cardiovascular diseases

Cardiovascular diseases are a group of disorders of the heart and blood vessels and they include:

- Coronary heart disease – disease of the blood vessels supplying the heart muscle
- Cerebrovascular disease – disease of the blood vessels supplying the brain

- Peripheral arterial disease – disease of blood vessels supplying the arms and legs
- Rheumatic heart disease – damage to the heart muscle and heart valves from rheumatic fever, caused by streptococcal bacteria
- Congenital heart disease – malformations of heart structure existing at birth
- Deep vein thrombosis and pulmonary embolism – blood clots in the leg veins, which can dislodge and move to the heart and lungs.

Heart attacks and strokes are usually acute events and are mainly caused by a blockage that prevents blood from flowing to the heart or brain. The most common reason for this is a build-up of fatty deposits on the inner walls of the blood vessels that supply the heart or brain. Strokes can also be caused by bleeding from a blood vessel in the brain or from blood clots.

What are the risk factors for cardiovascular disease?

The most important behavioural risk factors of heart disease and stroke are unhealthy diet, physical inactivity, tobacco use and harmful use of alcohol. Behavioural risk factors are responsible for about 80% of coronary heart disease and cerebrovascular disease.

The effects of unhealthy diet and physical inactivity may show up in individuals as raised blood pressure, raised blood glucose, raised blood lipids, and overweight and obesity. These "intermediate risks factors" can be measured in primary care facilities and indicate an increased risk of developing a heart attack, stroke, heart failure and other complications.

Cessation of tobacco use, reduction of salt in the diet, consuming fruits and vegetables, regular physical activity and avoiding harmful use of alcohol have been shown to reduce the risk of cardiovascular disease. The cardiovascular risk can also be reduced by preventing or treating hypertension, diabetes and raised blood lipids.

Policies that create conductive environments for making healthy choices affordable and available are essential for motivating people to adopt and sustain healthy behaviour.

There are also a number of underlying determinants of cardiovascular diseases, or "the causes of the causes". These are a reflection of the major forces driving social, economic and cultural change – globalization, urbanization, and population ageing. Other determinants of cardiovascular disease include poverty, stress and hereditary factors.

Diabetes

Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood sugar. Hyperglycaemia, or raised blood sugar, is a common effect of uncontrolled diabetes and overtime leads to serious damage to many of the body's systems, especially the nerves and blood vessels.

Type 1 diabetes

Type 1 diabetes (previously known as insulin-dependent, juvenile or childhood-onset) is characterized by deficient insulin production and requires daily administration of insulin. The cause of type 1 diabetes is not known and it is not preventable with current knowledge.

Symptoms include excessive excretion of urine (polyuria), thirst (polydipsia), constant hunger, weight loss, vision changes and fatigue. These symptoms may occur suddenly.

Type 2 diabetes

Type 2 diabetes (formerly called non-insulin-dependent or adult-onset) results from the body's ineffective use of insulin. Type 2 diabetes comprises 90% of people with diabetes around the world, and is largely the result of excess body weight and physical inactivity.

Symptoms may be similar to those of Type 1 diabetes, but are often less marked. As a result, the disease may be diagnosed several years after onset, once complications have already arisen.

Until recently, this type of diabetes was seen only in adults but it is now also occurring in children.

Gestational diabetes

Gestational diabetes is hyperglycaemia with onset or first recognition during pregnancy.

Symptoms of gestational diabetes are similar to Type 2 diabetes. Gestational diabetes is most often diagnosed through prenatal screening, rather than reported symptoms.

Impaired glucose tolerance and impaired fasting glycaemia

Impaired glucose tolerance (IGT) and impaired fasting glycaemia (IFG) are intermediate conditions in the transition between normality and diabetes. People with IGT or IFG are at high risk of progressing to type 2 diabetes, although this is not inevitable.

What are the common consequences of diabetes?

Over time, diabetes can damage the heart, blood vessels, eyes, kidneys and nerves.

- Diabetes increases the risk of heart disease and stroke. 50% of people with diabetes die of cardiovascular disease (primarily heart disease and stroke).
- Combined with reduced blood flow, neuropathy (nerve damage) in the feet increases the chance of foot ulcers, infection and eventual need for limb amputation.
- Diabetic retinopathy is an important cause of blindness, and occurs as a result of long-term accumulated damage to the small blood vessels in the retina. One per cent of global blindness can be attributed to diabetes.
- Diabetes is among the leading causes of kidney failure.
- The overall risk of dying among people with diabetes is at least double the risk of their peers without diabetes.

How can the burden of diabetes be reduced?

Simple lifestyle measures have been shown to be effective in preventing or delaying the onset of type 2 diabetes. To help prevent type 2 diabetes and its complications, people should:

- Achieve and maintain healthy body weight
- Be physically active – at least 30 minutes of regular, moderate-intensity activity on most days. More activity is required for weight control
- Eat a healthy diet of between three and five servings of fruit and vegetables a day and reduce sugar and saturated fat intake
- Avoid tobacco use – smoking increases the risk of cardiovascular diseases.

Cancer

Cancer arises from one single cell. The transformation from a normal cell into a tumour cell is a multistage process, typically a progression from a pre-cancerous lesion to malignant tumours. These changes are the result of the interaction between a person's genetic factors and three categories of external agents.

- Physical carcinogens, such as ultraviolet and ionizing radiation
- Chemical carcinogens, such as asbestos, components of tobacco smoke, aflatoxin (a food contaminant) and arsenic (a drinking-water contaminant)
- Biological carcinogens, such as infections from certain viruses, bacteria or parasites.

WHO, through its cancer research agency, International Agency for Research on Cancer (IARC), maintains a classification of cancer-causing agents.

Ageing is another fundamental factor for the development of cancer. The incidence of cancer rises dramatically with age, most likely due to a build-up of risks for specific cancers that increase with age. The overall risk accumulation is combined with the tendency for cellular repair mechanisms to be less effective as a person grows older.

Risk factors for cancers

Tobacco use, alcohol use, unhealthy diet and physical inactivity are the main cancer risk factors worldwide. Chronic infections from hepatitis B, hepatitis C virus and some types of human papillomavirus (HPV) are leading risk factors for cancer in low- and middle-income countries. Cervical cancer, which is caused by HPV, is a leading cause of cancer death among women in low-income countries.

How can the burden of cancer be reduced?

Knowledge about the causes of cancer, and interventions to prevent and manage the disease is extensive. Cancer can be reduced and controlled by implementing evidence-based strategies for cancer prevention, early detection of cancer and management of patients with cancer. Many cancers have a high chance of cure if detected early and treated adequately.

Modifying and avoiding risk factors

More than 30% of cancer deaths could be prevented by modifying or avoiding key risk factors, including:

- Tobacco use
- Being overweight or obese
- Unhealthy diet with low fruit and vegetable intake
- Lack of physical activity
- Alcohol use
- Sexually transmitted HPV infection
- Urban air pollution
- Indoor smoke from household use of solid fuels.

Tobacco use is the single most important risk factor for cancer causing 22% of global cancer deaths and 71% of global lung cancer deaths. In many low-income countries, up to 20% of cancer deaths are due to infection by hepatitis B virus and HPV.

Prevention strategies:

- Increase avoidance of the risk factors listed above
- Vaccinate against human papillomavirus (HPV) and hepatitis B virus
- Control occupational hazards
- Reduce exposure to sunlight

Noncommunicable diseases can be significantly reduced with millions of lives saved through reduction risk factors, early detection and timely treatment.

In 2012 the 59th session of the Regional Committee for Eastern Mediterranean issued a resolution (EM/RC59/R.2) on The Political Declaration of the United Nations General Assembly on the Prevention and Control of Non-Communicable Diseases: commitments of Member States and the way forward. In the resolution, the Committee recognized the rising burden of noncommunicable diseases and risk factors in the Region and the need to invest in prevention and control as imperative for sustainable development. It also endorsed a regional framework for action on implementing the Political Declaration and urged Member States to implement the core set of interventions in the regional framework and to strengthen surveillance for noncommunicable diseases and their risk factors by implementing the WHO surveillance framework covering monitoring of exposures (risk factors), outcomes (morbidity and mortality) and health system performance (capacity and interventions). The strategic interventions to address the nutrition-related risk factors are summarized below.

Strategic intervention	WHO existing tools
• Implement the WHO recommendations on marketing of foods and non-alcoholic beverages to children	• Global status report on noncommunicable diseases 2010
• Implement interventions to reduce salt intake	• Recommendations on the marketing of foods and non-alcoholic beverages to children (WHA63.14, 2010)
• Conduct media campaigns on diet and physical activity	• Global recommendations on physical activity for health
• Replace trans-fats with polyunsaturated fats	• 2008–2013 Action plan for the global strategy for the prevention and control of noncommunicable diseases
• Promote breastfeeding and implement the International Code of Marketing of Breast-Milk Substitutes	• Existing national tools

8.2 Causes

In most cases, overnutrition is caused by an unequal energy balance. Energy balance means the energy supplied by food and drink corresponds to the energy spent for basal functions such as breathing, digesting food and physical activity. Unbalanced energy intake is the most frequent cause of overweight and obesity. Over time, both have to be the same to keep a healthy weight; however, this is not necessary every day. If the input repeatedly exceeds the output, weight gain is likely to result. On the contrary, using more energy than the amount supplied will lead to weight loss.

Factors causing or contributing to an unequal energy balance are:

- *Overeating.* Overeating means consuming more food than needed over a longer period of time, resulting in weight gain. This is especially the case when products rich in fat and/

or sugar are chosen. There are many underlying causes for overeating, both physical and psychological.

- *A sedentary lifestyle.* A lack of physical activity means that less energy is used by the body, resulting in weight gain if intake is not reduced accordingly. However, physical activity has other beneficial effects on health beyond energy consumption. Modern technologies have reduced the physical demands for work and transportation. Sedentary leisure activities, such as television viewing, further reduce physical activity. Regularly spending more than two hours a day in front of the television has been shown to increase the risk for overweight and obesity.
- *Environment.* Several aspects of modern living conditions promote overweight and obesity such as:
  - *Lack of neighbourhood sidewalks and safe places for recreation.* Not having parks, sidewalks or affordable sports clubs makes it difficult for people to be physically active.
  - *Work schedules.* People often say that they do not have time to be physically active because of long work hours and time spent commuting.
  - *Lack of sleep.* There is some evidence that sleeping five or fewer hours per night increases the risk of being overweight compared with sleeping seven to eight hours. This may be due to the secretion of hormones during sleep that regulate appetite and energy use.
  - *Oversized food portions.* The size of food portions has been increasing, especially in restaurants.
  - *Limited access to healthy foods.* Healthy foods, such as fresh fruits and vegetables or low-fat alternatives, are not always available and are often too expensive for low-income groups.
  - *Food advertising.* The majority of food advertising is for fat- and/or sugar-rich energy-dense products, for example snacks and sweetened drinks.
- *Genes and family history.* A genetic predisposition for overweight has been shown in twins. Children of overweight parents are prone to excessive body weight. Food habits may also play a certain role.
- *Age.* Physiological changes in body composition (loss of metabolically active muscle mass) and metabolism entail a decrease of the body's energy requirements. Moreover, older persons are often less physically active. Menopause has an influence in women. If energy intake is not reduced, this leads to weight gain.
- *Pregnancy.* Weight gain during pregnancy is a normal consequence of the child's growth. However, some women overestimate their energy needs and eat too much and the weight thus gained can be difficult to lose after delivery.
- *Health conditions and medicines.* Certain hormonally determined diseases such as hypothyroidism, Cushing's disease and polycystic ovarian syndrome are associated with weight gain. Furthermore, some medicines such as corticosteroids, antidepressants and treatments for seizure may also contribute to weight gain, either by increasing appetite or by slowing the metabolic rate.
- *Emotional factors.* Stress, boredom or emotional hardship may stimulate food intake in some persons.

High salt consumption is an important determinant of high blood pressure and cardiovascular risk. High consumption of saturated fats and trans-fatty acids is linked to heart disease. The prevalence of unhealthy diets is rising in lower-resource settings. Available data indicate that fat intake has been rising rapidly in lower-middle income countries since the 1980s.

Interventions to prevent noncommunicable diseases on a population-wide basis are not only achievable but also cost-effective. Low-cost solutions can work anywhere to reduce the major risk factors for noncommunicable diseases. While many interventions may be cost effective, some are considered “best buys” – actions that should be undertaken immediately to produce accelerated results in terms of lives saved, diseases prevented and heavy costs avoided.

Best buys include:

- protecting people from tobacco smoke and banning smoking in public places
- warning about the dangers of tobacco use
- enforcing bans on tobacco advertising, promotion and sponsorship
- raising taxes on tobacco
- restricting access to retail alcohol
- enforcing bans on alcohol advertising
- raising taxes on alcohol
- reducing salt intake and salt content of food
- replacing trans-fat in food with polyunsaturated fat
- promoting public awareness about diet and physical activity, including through mass media.

Who is at risk?

Overweight and obesity affect all ages, sexes, racial/ethnic groups and educational levels.

9. Health assessment and its significance for nutrition surveillance *(25)*

Malnutrition and disease are linked in a vicious cycle, resulting in lack of appetite, reduced immunity and greater susceptibility to infections. Childhood diseases can cause malnutrition, while malnutrition leaves a child more prone to diseases and infections.

The UNICEF conceptual framework of malnutrition was developed to illustrate the multiple causes of malnutrition (see Figure 3). This is a useful starting point for a health assessment as it highlights that malnutrition is not simply due to lack of food but is also closely linked to the presence of diseases resulting from an unhealthy environment, inadequate health services and a poor social care environment.

Health refers to a range of factors linked to access to health care, safe water and sanitation. An essential element of good health is access to affordable, good-quality health services and a healthy environment. Limited access to a safe water supply, proper sanitation systems and hygienic conditions in and around the home all influence the spread of infectious diseases. A poor health environment can lead to an increased incidence (new cases) of disease. This reduces the capacity of adults to work and increases the amount of time they spend caring for sick members of the family.

Access to basic health services determines the extent to which infection can be prevented or treated. Effective treatment should reduce the duration and the severity of infection. Access to health services is determined by physical distance and costs, including transport costs, medical costs for treatment as well as time costs for the family member having to attend the clinic and leave other tasks undone. Poor-quality health services are a disincentive for uptake for many households who may often wait until health has deteriorated to serious levels before seeking treatment.

In population situation assessments there is a need to consider both nutritional status and overall health status and how the situation will impact on health and nutritional status. For example, if measles vaccination coverage is low and the cold chain is not working there is an increased risk of both an outbreak of measles and malnutrition, as malnourished children are vulnerable to the complications of measles and measles can result in malnutrition. It is therefore critical to jointly assess health and nutrition in order to plan and implement appropriate interventions.

9.1 Why is a health assessment important?

A health assessment is a vital component of initiating, planning and implementing a surveillance system. It is essential to know whether there are any health problems, the risk of an increase in mortality (death) and morbidity (illness), health needs and how best to prioritize an intervention. An assessment should be based on the situation and the stage of implementation.

If the health and nutritional status is deteriorating, rapid assessment is crucial in order to identify the magnitude of the problem, secure the resources and intervene at the right time.

There are two approaches to health assessment: population based and health facility based.

Objectives of a health assessment

Health assessments may have a number of objectives (Box 3).

Box 3. Objectives of a health assessment

- To identify whether there is a nutrition- and health-related problem, the magnitude or impact of the problem and the cause – both immediate and underlying.
- To predict the likely evolution of the situation and future trends.
- To assess the magnitude and impact of the problem on the health and nutritional status of the population.
- To understand the overall context of the situation – political, social and economic.
- To assess the condition of the population, including vulnerable groups, and morbidity and mortality rates.
- To consider what usually happens in a similar situation, based on experiences and circumstances.
- To identify priority gaps and needs – some needs may be pre-existing but may be made worse by the arising problem, such as high incidence (new cases) of diarrhoeal diseases due to water, sanitation and lack of hygiene.
- To establish what the government and other agencies are doing and what their future plans are.
- To formulate the most appropriate recommendations for an immediate intervention.
- To gather baseline information in order to monitor change.
- To provide information for government, donors and the media, to mobilize resources for appropriate intervention.
- To map health facilities and services provided and staff and qualification levels.
- To identify the general and specific resources available (e.g. numbers of functioning, staffed, supervised health facilities and community services).
- To identify essential health and nutrition surveillance needs, such as on-going monitoring of morbidity and mortality.

9.2 Different types of health assessment

Assessing health risks and status

The health status of a population is a key indicator of the severity of the overall situation of the population.

The five major causes of morbidity and mortality for children under 5 years of age are acute respiratory infections, diarrhoeal diseases, malaria (where prevalent), measles and malnutrition. Because malnutrition and disease are closely linked, there is likely to be an increase in the incidence of infectious diseases, especially among vulnerable groups such as young children, when nutritional status worsens. These diseases can further contribute to deterioration in nutritional status.

Assessing morbidity

There are two groups of diseases that need to be assessed as they can result in increased levels of malnutrition:

- *Epidemic diseases.* These involve outbreaks of infections that spread rapidly and have the potential to affect many people, such as measles, meningitis and cholera. They also include diseases of public health importance, such as diarrhoea, respiratory infections and malaria. During an assessment, it is important to identify pre-existing health problems, local diseases that could become epidemic and/or are endemic (i.e. peculiar to a specific region or population group).
- *Micronutrient deficiency diseases.* These should be considered in assessments as they are frequently linked to a variety of health problems; for example, malaria causes anaemia and this makes individuals more susceptible to other diseases and malnutrition.

Measles is an important and preventable communicable disease. It is critical to assess the measles vaccination coverage rate, cold chain and provision of equipment for vaccinations. Children with measles lose their appetite and have diarrhoea and are therefore more vulnerable to malnutrition. Malnourished children who are not vaccinated are more vulnerable to measles.

During an assessment it is important to calculate the morbidity incidence rates and disaggregate the data. For example, data for children below 5 years of age should be reported separately from data of children aged 5 years and older, as children under 5 years of age are particularly vulnerable to infectious diseases.

Changes in morbidity should be noted through indicators such as the number of consultations, vaccination coverage and the nutrition and health information system.

Table 4 illustrates the most common diseases and their contributing factors. These diseases are all connected with malnutrition and should be prioritized by the assessment team, even if no qualified clinician is available. It is useful to keep the contributing factors in mind when conducting an assessment and to consider not only the current situation but also the likelihood of development of health problems. For example, there may be a risk of a measles outbreak if children are not vaccinated.

Table 4. Common diseases that may increase in a deteriorating environment

Disease	Major contributing factors	Preventive measures
Diarrhoeal diseases	Overcrowding Contaminated water and food Lack of hygiene	Adequate living space Public health education Distribution of soap Good personal and food hygiene Safe water supply and sanitation
Measles	Overcrowding Low vaccination coverage	Minimum living space standards Immunization of children with distribution of vitamin A. Immunization from 6 months up to 15 years (rather than the more usual 5 years) is recommended because of the increased risks from living conditions
Acute respiratory infections	Poor housing Lack of blankets and clothing Smoke in living area	Minimum living space standards and proper shelter Adequate clothing, sufficient blankets
Malaria	New environment with a strain to which refugees are not immune Stagnant water	Destruction of mosquito breeding places, larvae and adult mosquitoes by spraying Provision of mosquito nets Drug prophylaxis (e.g. pregnant women and young children according to national protocols)

Source: adapted from (*26*)

Assessing mortality

Assessing the mortality rate is a critical part of an assessment, as measuring the number of deaths will demonstrate the scale of the situation and the general health status of the population. If there is widespread malnutrition, mortality rates will be high. However, mortality is referred to as a "late indicator" since conditions have to be bad for it to increase.

The mortality rate should be monitored over time to assess trends. It is important to estimate the mortality rate at the start in order to establish a baseline rate and intervene accordingly.

During an assessment, it is important to gather mortality data as accurately as possible and preferably to express these data as a rate, rather than simple numbers, since this aids comparisons between areas and over time.

Estimating the crude mortality rate

The crude mortality rate is the rate of death in the entire population, including both sexes and all ages. It is also sometimes referred to as the crude death rate. The crude mortality rate can be expressed with different standard population denominators and for different time periods, for example deaths per 1000 population per month or deaths per 1000 population per year.

The formula used is deaths per 10 000 population per day. This is calculated by starting with the total number of deaths in a specific time period, dividing by the total population, multiplying by 10 000 and dividing by the number of days in the time period:

$$\text{CMR} = \frac{\text{Total no. of deaths during time period}}{\text{Total population}} \times \frac{10\ 000}{\text{No. of days in time period}}$$

where CMR = crude mortality rate.

Mortality rate in children under 5 years of age is the rate of death among children under 5 years of age in the population. This is calculated by totalling the number of deaths in children under 5 years of age, dividing by the total number of children under 5 years of age, multiplying by 10 000 and dividing by the number of days in the time period:

$$< 5MR = \frac{\text{Total no. of deaths in children} <5 \text{ years during time period}}{\text{Total no. of children} <5 \text{ years}} \times \frac{10\,000}{\text{No. of days in time period}}$$

where < 5MR = under-5 mortality rate

Interpretation of mortality rate

It is also important to assess the cause of deaths. Data should be analysed to establish who is dying, where they are dying and why. For example, a contributing factor may be lack of water and sanitation causing high rates of diarrhoea, leading to deaths or wasting. While mortality is a late indicator, it is important to include it in an initial assessment and interpret the findings in relation to other data such as measles vaccination rate, food availability and the water and sanitation situation. All data collected during an assessment should be recorded so that the information can be used as baseline data to monitor trends.

Practical challenges in assessing mortality rate

There are a number of practical challenges when assessing mortality rates. First, it is necessary to know the total population to calculate the denominator. Second, deaths may be underreported in areas where there is no functional vital statistics information system. It is therefore very important to triangulate the data, using a variety of sources.

Assessing health service delivery

Health services are needed to provide treatment and promote health activities. In some countries in the Region, the health care system is unable to deliver affordable, high-quality care to all who need it. Access to good health services is often limited and the capacity to deliver is poor owing to lack of resources and management problems. Frequently, the worst services are found in the poorest, most remote parts of the country.

Health facilities that provide care for mothers and children are particularly important. Mothers require antenatal care and somewhere clean and safe to deliver with trained support. In some countries in the Region, antenatal and postnatal services are weak. Breastfeeding may not be adequately promoted and supported. The result is high maternal and neonatal (infants less than 1 month old) mortality figures, even during normal circumstances.

The role of the traditional birth attendant, who has adequate training, can be critical and save lives. A pregnant woman who is malnourished is likely to have a baby with a low birth weight who risks becoming malnourished in the future.

When high levels of malnutrition occur, trained and supervised medical staff play a crucial role in diagnosing and treating malnutrition.

There are several factors that influence access to health services, including geographical access (e.g. long distance to health facilities, with poor or unaffordable transport), and lack of time and finance. Assessments need to consider the rates of use of health facilities and the obstacles faced by the population in accessing health care.

An important aspect to assess is the effectiveness of the health care system in delivering the services it is designed to do. A primary health care approach needs to address the major health problems in the community and provide promotive, preventive, curative and rehabilitative services. This includes:

- education about health problems and the methods of preventing and controlling them;
- promotion of food supply and proper nutrition;
- an adequate supply of safe water and basic sanitation;
- maternal and child health care, including family planning;
- immunization against the major infectious diseases;
- prevention and control of locally endemic diseases;
- appropriate treatment of common diseases and injuries;
- provision of essential drugs. (*27*)

WHO has recently produced a framework for action, calling for more investment in health services, in order to strengthen health systems. Points to assess in relation to health services are service delivery, the health workforce, information (surveillance systems), medical products and commodities, financing and leadership or governance.

The capacity of the Ministry of Health to cope with an emerging health situation also needs to be assessed. Does it have adequate resources, what are the risks and what are the requirements? Health services are not always provided by the government and some services may be provided by faith-based organizations, community-based nongovernmental organizations and other civil society groups, thus it is also important to obtain information about these.

A health assessment frequently involves visiting a selection of health units, observing the general state of the facility, whether it is clean, who is using it and how supplies and drugs are stocked and recorded. It is useful to talk to health staff and observe record-keeping. Observing how patients are assessed and treated will show whether standardized case definitions and protocols are being followed and whether tools such as the Integrated Management of Child Health (IMCI) are being used. There needs to be a system of referral, supervision and support, not only between clinics and hospitals for further treatment but also between community health services and clinics.

All information gathered from health units should be supported with qualitative data from the community. Focus group discussions and participatory mapping (involving the community in practical discussions with maps and/or drawings) with groups of women are likely to reveal much about health-seeking behaviour and how the health service is accessed.

Community health workers and traditional birth attendants often provide an invaluable service to the community. However, they require support and supervision and this becomes even more critical in an emergency response when they can be central to assisting with basic health provision and preventive activities at community level.

An assessment should monitor whether there is a programme for preparedness and an outbreak response plan in place and functioning. Likewise, there should be an effective, reliable and accurate health information system in place. In some countries, skilled human resources and diagnostic capacity are often scarce. Disease control systems, such as tuberculosis control programmes, are important in identifying at-risk populations.

General information

As part of a health and nutrition assessment, it is important to gather some general information about the overall context. This includes:

- an overall description of the affected and host population (e.g. urban/rural, livelihoods, level of literacy, especially among women);
- demographic information, which is essential for calculating mortality rates and requirements for interventions, should be shown in terms of numbers disaggregated by age and sex (e.g. children under 5 years of age and under 1 year of age, women of reproductive age, female-headed households, average family size, unaccompanied children, etc.);
- past experience of the population in terms of coping with similar health problems;
- cultural background of the target population;
- factors that may affect the design of potential interventions (e.g. women's role in the community, gender-based violence, security, accessibility to certain communities, etc.).

It is also important to gather information on other technical sectors that may have an impact on health and nutritional status, including agricultural information, food security (i.e. access to food), water and sanitation.

Maternal, neonatal and child care

Maternal and child care is essential for good health and nutrition. However, maternal and child health services are weak in many countries. Important areas to consider are safe motherhood programming, reproductive health care, practices in relation to breastfeeding and the introduction of complementary foods. Unsafe practices, such as the distribution of infant formula, should be addressed.

Methods and sources of information

The key criteria for any assessment are given below. It is important that all assessments meet some general criteria.

Criteria for good assessment practice

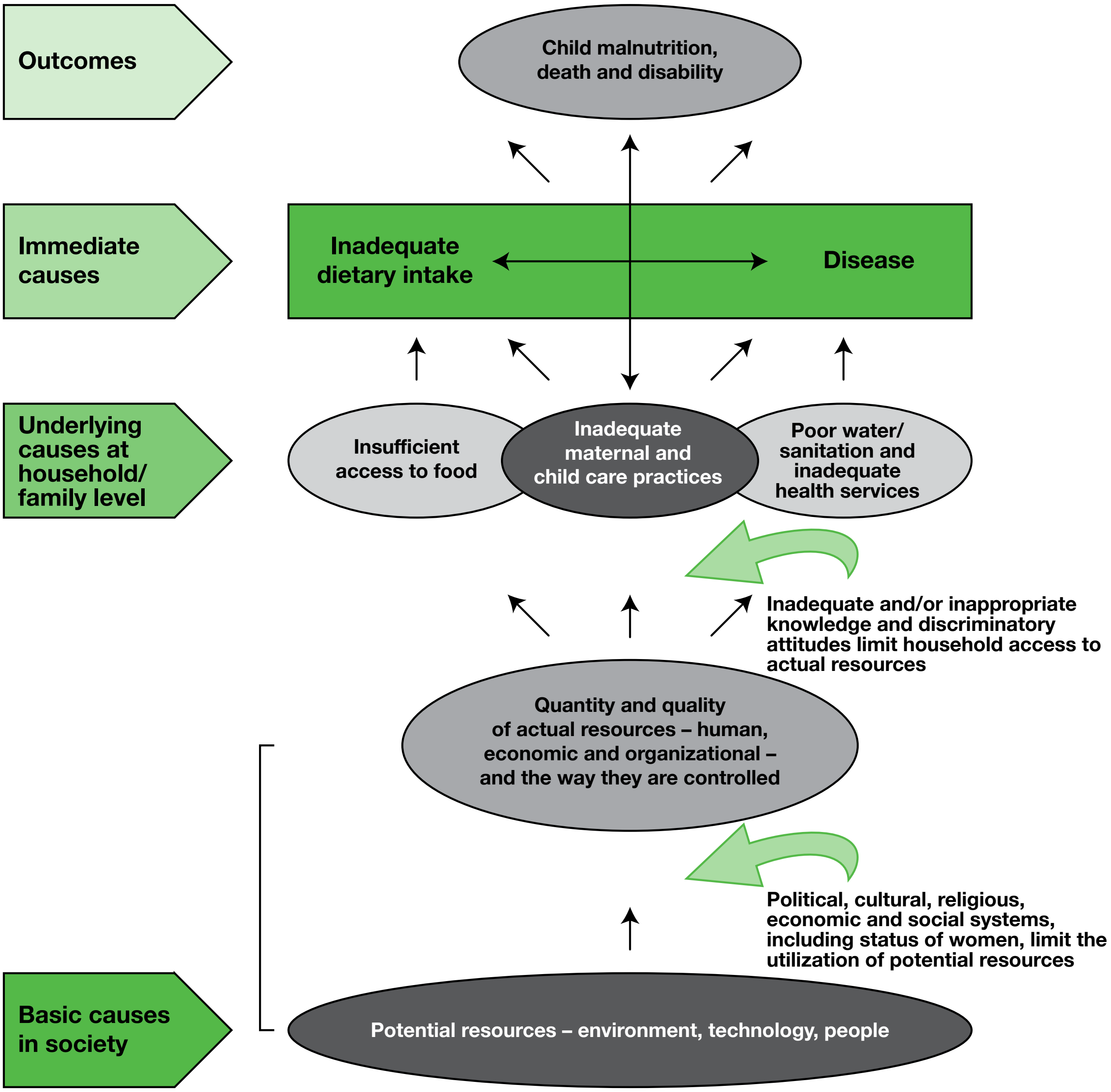
- *Timeliness.* Information and analysis are provided in time to inform key decisions about response.
- *Relevance.* The information and analysis provided are the most relevant to decision-making and are in a form that is accessible to decision-makers.
- *Coverage.* The scope of assessment is adequate for the scale and nature of the problem and the decisions to be taken.
- *Validity.* Methods used can be expected to lead to sound conclusions.
- *Continuity.* Relevant information is provided throughout the course of the problem.
- *Transparency.* The assumptions made, methods used and information relied on to reach conclusions are made explicit, as are the limits of accuracy of the data relied on.

In addition, good assessment practice involves effective coordination with others, sharing of data and analysis, and communication of significant results.

10. Food security assessment *(28)*

There is no single standard method for carrying out a food security assessment. Different agencies have developed their own unique approaches and there is broad variation in the indicators collected, the methods used to collect and analyse information and the degree to which nutrition data are incorporated.

Food security assessments are generally concerned with processes. They aim to provide an in-depth analysis of a situation and to relate this to current and future needs. Their strengths are that they can provide an early indication of deterioration and predict what is going to happen, given different scenarios. Unlike outcomes such as mortality or malnutrition, which can be encompassed in a single indicator, there is no single measure of food security status. Rather, there is a need to use multiple measures to assess food availability, accessibility and utilization (Figure 5).



Source: (*29*)

Figure 5. Conceptual framework for analysing the causes of malnutrition

10.1 Approaches

There is no standard method of collecting and analysing data in emergency food security assessment. Different agencies have developed different approaches to suit their individual needs. There are at least 10 different agency approaches to assessing food security. For the purposes of this module, these have been classified into three groups:

- early-warning and surveillance approaches;
- economic and livelihood approaches;
- nutritional status approaches.

Early-warning and surveillance approaches

Early warning has been described as “a process of information gathering and policy analysis to allow the prediction of developing crises and action to prevent them or contain their effects”. This form of assessment depends on continuous collection and interpretation of information rather than on one-off assessments. Early warning is related to preparedness and contingency planning on the one hand and preventive intervention on the other. It is most commonly used to predict crises rather than to assess need. Most food security monitoring systems collate data from the following four sources:

- agricultural production such as crop production and livestock farming;
- markets such as domestic and international trade (import/export), prices of key staples and livestock;
- vulnerable groups such as monitoring poverty;
- nutrition and health status of populations.

Early-warning systems rely heavily on secondary data (i.e. information already collected by another agency), which come primarily from national government statistics on rainfall, crop production, prices, imports/exports and satellite imagery. Such systems have generally been successful in predicting impending food crises, although not so good at pinpointing exactly when a crisis is likely to occur and who will be affected. Failures of timely and appropriate response have sometimes been blamed on poor early-warning systems but may also be attributable to failures by governments and donors to respond to the available evidence.

Economic and livelihood approaches

Economic approaches

The starting point of a number of food security assessment approaches is that food security must be understood within a broad economic context. This is the basis of approaches such as the household economy approach.

The household economy approach is one of the most methodologically well-defined approaches to food security assessment. Household economy surveys are carried out at one point in time and collect primary data (i.e. first-hand data). This approach recognizes that the economy of a population depends on household income (both cash and food production), household expenditure (both food and non-food) and other factors, including savings, livestock and other assets, availability of wild foods, and access to and use of markets. The great advantage of the household economy approach is that it provides quantitative estimates of household food deficits and provides a projection of deficits in the future. For this reason, it has been used widely by the World Food Programme to calculate food aid needs.

Livelihoods approaches

Livelihoods approaches have evolved out of a need to understand and address poverty. Food security is viewed as one subset of objectives of poor households while food is considered as only one of a whole range of factors that determine why the poor take decisions and spread risk, and how they finely balance competing interests in order to subsist in the short and longer term. People may choose to go hungry to preserve their assets and future livelihoods. Thus, food security is dependent on wider livelihood considerations.

Nutritional status approaches

The nutrition causal analysis approach based on the UNICEF conceptual framework has been adopted where areas of intervention are nutrition, food security, medical assistance, and water and sanitation. These fit within the UNICEF model as they all relate to the underlying causes of malnutrition.

10.2 Implementation

There are a number of steps that many approaches typically follow and can be applied to most situations. The steps outlined below, based on UNICEF (1997), (29) give a broad idea of the process of food security assessment but do not provide specific guidelines on methods.

Step 1: Preparation

1. Develop hypotheses on the effects of the crisis on food security and nutrition to guide information requirements and most appropriate assessment approach.
2. Formulate clear objectives.
3. Select the assessment team and draft terms of reference based on the objectives, time and resources available.
4. Define the assessment area. This will ensure that appropriate secondary information can be collated and help to decide which locations should be visited to collect primary information (see Appendix 1).
5. Find out what other organizations are doing assessments, where and why and make sure the assessment design is complementary and does not duplicate.
6. Organize logistics and finances. This includes a travel plan, field equipment, transport, translators, etc.
7. Inform authorities and obtain authorization to visit assessment areas.
8. Train the team on the assessment methodology and ensure the team is sensitized to cultural issues.

Step 2: Secondary information collection

1. Identify sources of secondary information from national, capital, provincial and district town level. The most common sources are government officials, local authorities, nongovernmental organizations and United Nations agencies.
2. Collect and analyse secondary information (data collected from a secondary source rather than directly from the affected area) (see Appendix 2).

Step 3: Primary information collection

1. Collect and analyse primary information (data collected directly from the affected area).
2. Identify which food security indicators will be collected (Table 5). Food security, unlike malnutrition, cannot be measured through a single indicator. Instead, multiple measures have to be used.
3. Identify what methods of data collection are appropriate and viable. These may include:
   - *Questionnaires.* Technical expertise is required to develop a good questionnaire. An alternative is to develop a checklist that includes areas to cover.
   - *Measurement.* Assessment of malnutrition through measurement may be done at the same time.
   - *Observation.* Observation of the environment can help verify or triangulate information collected using other methods. Information that can be obtained through observation includes the condition of livestock, crops, infrastructure, the environment, the population, mills, marketplaces and shops.
   - *Interviews.* Interviews are usually semi-structured, for example they include some structured and some "open-ended" questions. Interviews can be with households and/or individuals (key informants). Household interviews can provide information about the household economy. Key informant interviews are carried out with people who have specific knowledge about certain aspects of the community, such as traders, school teachers, religious leaders or local government officials.
   - *Focus group discussions.* These involve 6–12 people discussing a subject of common interest and usually include those from similar backgrounds, such as people from the same livelihood group. Focus groups are useful when investigating an issue in detail from a particular perspective.
4. Identify which tools or techniques are appropriate and viable.

Table 5. Indicators of food security

Food availability	Rainfall Crop production Livestock holdings and status
Food access	Income and food sources Essential expenditure Assets Livelihood strategies Market prices of key staples and assets Coping strategies (see Table 6) Intrahousehold food sharing
Food utilization	Nutritional status Health status Feeding practices Food consumption

Table 6. Dietary intake and coping strategies indices

Dietary intake	Individual dietary diversity score Household dietary diversity score Food consumption score Cornell–Radimer hunger scale Household food insecurity access scale
Coping strategies	Coping strategies index

Step 4: Analysis

1. Analyse the data collected during the assessment. This helps to identify what information should be collected next, what might be missing or what may not be making sense. All analyses should include:
   - problem identification
   - causes of the problem
   - future risks.
2. Include an analysis of the political, economic, social, institutional, security (conflict where appropriate) and environmental conditions.
3. Develop scenarios as a way of forecasting the future: what is likely to happen given a range of different events/factors?
4. Identify and analyse response options: interventions should be guided by an assessment of their feasibility and appropriateness.

Step 5: Report writing and dissemination of results

1. Produce a succinct report and disseminate findings. This may be for a range of audiences including:
   - government, donors and other humanitarian actors for programming, resource mobilization and advocacy purposes;
   - managers, who require reliable and transparent information to make sound decisions about the scale and scope of a crisis;
   - programmers, who rely on food security reports for designing interventions that are appropriate and operationally feasible.
2. Disseminate a summary report with key findings within a few days of completing the assessment.
3. Disseminate the final report, which should be clear and concise, avoiding language that could be ambiguous or misunderstood, such as jargon and excessive use of acronyms.
4. Show the findings to all those involved in the fieldwork, including the affected community and local authorities.

10.3 Linking food security with nutrition information

There is no direct link between food insecurity and malnutrition. Rather, food insecurity can exist without any malnutrition while malnutrition rates can rise in food secure environments (e.g. due to epidemics). However, linking food security and nutrition information can help to interpret food security assessment findings.

Nutrition surveys and food security assessments are usually carried out independently of one another. This is partly because different sampling procedures are employed so that it may be difficult to conduct the assessments simultaneously, and partly because individuals and agencies tend to have expertise and experience in either one area, or if in both, they are situated in different units. Furthermore, food security or livelihoods assessments need more time spent with each household as in-depth information is required. Interviewees can get “survey fatigue” if required to participate in too many activities at one time. As the two types of assessments are usually separated and conducted on different samples, statistical correlation is rarely possible. However, this separation has major disadvantages.

Appendix 1. Key points on health services and infrastructure *(30)*

Access

- Access by the affected population to local, pre-existing health services (may be affected by finance, geographical distance, cultural or security issues).
- Ability of local health services to absorb the influx of people affected by the emergency.

Facilities

- Numbers, names and types of health facilities available (e.g. clinics, hospitals, feeding centres and laboratories) and what services are provided (e.g. reproductive health, surgery, immunization, X-rays, mental health, community health, HIV/AIDS prevention and treatment, nutrition services).
- Level of support from Ministry of Health, nongovernmental organizations or faith-based institutions.
- Level of functioning.
- Level of damage (or facilities rendered non-operational).
- Number of beds, including maternity beds (total and occupied currently).
- Average number of outpatients seen per day (six months ago and current).
- Average number of deliveries during one week (six months ago and current).
- Availability of operating theatres.
- Numbers, type, size and capacity of health facilities set up for the displaced population if separate (e.g. tent, local material).
- Adequacy of water supply, vaccine cold chain (freezers and refrigerators), generators or town electricity, toilets and waste disposal facilities and food for patients or the malnourished.

Health personnel

- Per health facility, types and numbers of health personnel and relevant skills and experience present in the hosting area – six months ago and current (different emergencies will have different implications for staffing; in a refugee situation, there may be qualified staff within the refugee population).
- Health care staff also affected by disasters and thus either partly incapacitated (family deaths, loss of housing and other assets) or died in the disaster; those in action are often totally exhausted when international agencies arrive to assess the situation and set up programmes.
- Health workers present among the displaced population, including traditional healers, traditional midwives/traditional birth attendants, doctors and nurses, laboratory technicians, and water and sanitation engineers.
- Availability of interpreters.

Medicines and vaccine supplies

- Availability of essential medicines and medical supplies, considering the most common diseases seen in disasters.
- Availability of the Interagency Emergency Health Kit (IEHK 2006), which contains antibiotics and other medicines and medical supplies for 10 000 people for approximately 3 months (although it may not have enough drugs for chronic diseases).
- Availability of functioning cold chain, essential vaccines and vaccination equipment (e.g. measles vaccines, antitetanus sera, tetanus toxoid and injection material).
- Assess expiry dates of medicines.

Appendix 2. Sample checklist of secondary data *(31)*

Secondary data	Type of information
Demographic profile, including the number of people in the area, the presence of refugees or internally displaced persons and their number	Impression of how many people are affected by food insecurity
Maps with political/administrative boundaries, roads, railways, rivers, villages and water points	Information on where people are, how to access them, potential obstacles, under whose authority they fall
Overview of the various social groups by ethnicity, wealth and/or religion and their physical location	Information on how people are related socially and how best to approach them (e.g. through religious leaders)
Social and political structures/policies affecting food security, including government policies affecting production, rationing and subsidies, transport bans, fuel prices and groups prone to social discrimination by government/local authorities	Impression of the possible constraints and opportunities of the social structure
Maps of infrastructure facilities, including health facilities, schools, mosques and churches	Information on social gathering points to be able to find key informants and find out who are the most influential people
Livelihood profile economy zones, including information on how people make their living and the main categories (e.g. labour, agricultural production, livestock, trading)	Information on living patterns and levels of vulnerability to various crises
Market analysis, including market locations, access and days, market prices (baseline trends) of major food and cash crops by region, season and availability	Information about normal and current market situation, food access and availability
Nutritional status and seasonality; anthropometry and micronutrient deficiencies	Impression of nutritional vulnerability of population
Disease patterns and seasonality, including prevalence of HIV/AIDS, malaria, tuberculosis, measles, diarrhoea and meningitis	Information of the timing and severity of important diseases and increased risks and needs
Previous emergencies and humanitarian aid patterns of assistance	Information on how the past has influenced current vulnerability to food insecurity status, trends in aid provision and lessons learned
Existing disaster preparedness or response contingency plans	Impression on the capacity for response
Overview of where and what other organizations are focusing on	Information on location of possible key informants and organizations, and identification of what assistance is being provided to whom
Security information including natural hazards, landmines, possible areas of fighting and check points	Security overview to predict population movement and access to them
Existing food taboos	To understand people's food choices and consider them when planning food aid
Seasonal calendars to understand food production cycles, migration patterns, water access, disease	Information to identify times of increased need and self sufficiency
Rainfall patterns for normal years	To help predict effects of current situation on food security
Access to water in normal situations for livestock, agriculture and human consumption	Identification of possible increased risk of disease, loss of livestock and potential conflict
Livestock and land ownership	Impression of asset ownership and distribution

Module 3. Indicators for food and nutrition surveillance systems

This module gives an overview of indicators for food and nutrition surveillance systems, presenting different types and their characteristics, as well as criteria for their selection and use.

1. Learning objectives

- To know about different types of indicators and their characteristics.
- To be able to identify and select indicators for food and nutrition surveillance.

2. Introduction

When assessing the nutritional situation of an individual, a group or a total population, nutritional indicators are essential tools to gain information about the general health and nutritional status as well as selected nutrients. Moreover, they also allow monitoring the effects of interventions aimed at improving the nutritional situation.

Indicators are means to describe and possibly quantify a situation or status that cannot be easily determined directly. However, especially in the case of complex issues, they may only cover certain aspects. A more complete view can therefore only be gained through a range of indicators, both qualitative and quantitative, which have to be adapted to specific requirements.

Nutritional indicators are used to measure the nutritional determinants or consequences at:

- individual level, as in patient diagnosis, screening and monitoring;
- population level for setting policy, in programme evaluation and nutrition surveillance.

To set priorities for action, it is crucial to know:

- Who is suffering from malnutrition (e.g. in terms of age, sex, residency, etc.)?
- What is the type of malnutrition (e.g. undernutrition, overnutrition, micronutrient deficiencies)?
- How severe is the situation?
- When is it occurring (e.g. temporary, seasonal or annual; recurring or not; chronic)?
- Where are the afflicted individuals located (e.g. zones or administrative areas most at risk: districts, regions, etc.)?
- The general setting (e.g. emergency, normal situation). (*32*)

Considering the broad field of application, it is clear that there is a wide variety of nutritional indicators that are more or less specific for assessment of a certain aspect of nutrition. Generally, no single indicator can be classified as the best, as suitability is not only dependent on the purpose and context of the assessment but also on the target population. To get the most satisfactory results, the choice of indicators is therefore very important.

This is particularly important in light of the limited financial, human and time resources. Besides the suitability and validity of an indicator, the way the necessary data are obtained and analysed influences their choice.

Indicators are used at all stages of the surveillance system. They are needed to characterize the nutritional status of a population, to reveal deficiencies and the underlying causes, and to monitor the effects and outcomes of interventions aimed at improving the situation.

3. Types of indicators *(32)*

Three types of indicators can be distinguished: outcome, process and context indicators.

Outcome (impact) indicators

Outcome indicators are used to measure changes in the health and nutritional status at population level, mirroring the immediate causes and consequences of malnutrition such as low birth weight or stunting. The following indicators are included in this category.

Indicators of nutritional status

Information on the nutritional status of a population is a prerequisite for taking action to prevent or combat malnutrition. Indicators of nutritional status describe the type and severity of the nutritional problem and, combined with other population data (demographic, economic, etc.), allow an estimation of its distribution. Measurement indices first have to be collected at individual level (Box 1).

From a methodological point of view, nutritional indicators are traditionally classified as:
- biochemical
- clinical
- anthropometric
- dietary.

However, status indicators by themselves do not provide information about the underlying causes on which a strategy to improve nutritional inadequacies must be focused to be effective.

Indicators of causes

According to the UNICEF conceptual framework, (*1*) nutritional status is immediately influenced by food intake and health, which in turn are determined by the availability of, and access to, food, care, health services and a healthy environment. The latter factors are dependent upon other factors, for example socioeconomic, educational and organizational structures. This wide range of determinants requires a variety of indicators.

Process indicators

Process indicators are used to assess how inputs are transformed into outputs, focusing on programme-related activities such as coverage, quality and targeting. These are important for evaluating and monitoring.

Box 1. Measurement indices

Measurement indices first have to be collected at the individual level (e.g. weight, height, arm circumference, haemoglobin level, etc.). From this information prevalence rates at the level of the population group concerned can be extrapolated. These are expressed as percentages of individuals who are well nourished or malnourished compared with the cut-off values chosen (percentage of children under 5 years of age with a weight for age index of less than –3 Z-scores or less than –2 Z-scores or percentage of adults having a BMI <18.5 kg/m2 or <16.0 kg/m2, etc.).

Context indicators

Context indicators refer to the basal setting, i.e. the context of the programme focusing on the general situation. They are often not directly related to nutrition, but are underlying influencing factors such as education level or quality and coverage of health services.

4. Characteristics of indicators (*32*)

Independently of the classification above, indicators can be also be direct or indirect measures of the factors of interest.

To facilitate the choice of indicators, certain characteristics are used to assess their usefulness for the intended purpose. Depending on the indicator and the circumstances, these characteristics have to be given different priorities.

Basic characteristics

- *Validity.* A valid indicator is one that truly measures what it is meant to measure and does so as directly as possible. This is considered the most important property.
- *Reproducibility (reliability).* Reproducibility refers to the comparability of results when an indicator is measured repeatedly under standardized conditions and to its independence from the person or the instruments involved. This is particularly important in monitoring.
- *Sensitivity and specificity.* Sensitivity designates the capability to correctly identify the cases searched for (positive answers). In turn, specificity is a measure of how well negative cases (e.g. individuals not affected by a condition) are identified. In other words, a specific indicator only measures actual cases. Its assessment generally needs a reference method for comparison ("gold standard").

Operational characteristics

Operational characteristics are related to the applicability of indicators:

- *Availability.* Availability refers to the possibility of obtaining (collecting) the data necessary for an indicator. As only available data can actually be collected, this must be considered before all other operational characteristics. However, some nutritional indicators may already have been gathered during recently established nutrition programmes.
- *Dependability.* Dependability is determined by the accuracy and representativeness of the data and the quality of data sources. It expresses the trust that can be put in the data.
- *Representativeness.* Representativeness describes how well an indicator reflects the population(s) and phenomenon to be assessed.
- *Simplicity.* Simplicity is another important factor to consider for data collection as it has significant impacts on the time and effort needed and the frequency of collection achievable.
- *Cost.* Cost may also play a role if data are not routinely and centrally collected, but it is difficult to assess.

5. Usefulness of indicators for different objectives

Habicht and Pelletier (*33*) suggest classifying nutritional indicators according to the information they provide on:

- prevalence of nutritional problems or risk of these
- risk of future malnutrition and its consequences
- harm caused by past malnutrition
- benefit from an intervention
- response to that intervention (Table 1).

Indicators differ with regards to their usefulness to meet these objectives even though some may apply to more than one aim. Thus, nutritional status indicators are better suited to identifying current malnutrition. For prevention of future risks, nutritional status indicators may not change early enough and measures of predisposing socioeconomic and dietary factors are more suited. If there is to be an intervention, indicators also have to be predictive of their effects (e.g. mothers' thinness or socioeconomic status as predictors of their infants' growth following supplementation).

To evaluate the effects of an intervention or a treatment, outcome indicators must show a response that is measurable with good statistical power. Inadequate nutrient supply can be assessed through nutrient content or stores in the body (indicators of nutritional status in the narrow sense) or by looking at negative consequences of malnutrition (functional parameters). Underlying determinants of nutritional status, such as dietary intake or infections, are nutritional indicators but not indicators of nutritional status.

Table 1. Informational content of indicators to meet objectives

	Informational content				
Objective	Indicate risk[1]	Indicate harm[2]	Predict benefit from intervention	Responsiveness to intervention or determinant	Indicate normalcy
Prevent malnutration	x		x		
Treat malnutration		x	x		
Treat consequences		x			
Evaluate treatment				x	
Research (used as an outcome variable)				x	
Promote equity					x
Nutrition education	x				x

1) Refers to the risk of future malnutrition and its consequences

2) Refers to harm caused by past malnutrition

Source: (*33*)

6. Selection of indicators

6.1 Main elements to guide selection

A reference conceptual framework

As outlined above, the factors determining and surrounding a nutritional situation have to be taken into account. This is facilitated by a conceptual framework connecting immediate and underlying causes of malnutrition and its consequences. The widely used UNICEF model has already been presented and others have also been developed, focusing on different aspects. However, any framework will have to be adapted to the local and temporal context.

Required characteristics of indicators

Some characteristics of indicators have particular relevance and are described below.

Validity

The importance of validity has been mentioned above. In the case that the most valid indicator cannot be used, any replacement has to be evaluated with regards to its validity. Validation may be done in cooperation with specialized research groups. More details are given in Chung et al. (*34*)

Comparability

Comparability also matters. Comparisons between data from different periods and locations would require using the same indicators everywhere and always. However, concepts on indicators are subject to change owing to scientific progress and new insights. Therefore, especially for monitoring purposes, indicators should ideally provide information that is basically similar to other relevant data.

Dynamic

Indicators should preferably be dynamic rather than static so that changes can be adequately identified. This has special importance for monitoring.

Simplicity and low cost

Finally, operational qualities, particularly simplicity and low cost of collection, have a strong influence on choice.

Availability of reference data

Data that are to be used as an indicator have to be compared to a reference or cut-off value. Ideally, such values are defined based on an international consensus (e.g. by WHO). However, such references are not available for many indicators, so that previously collected data of the same type have to serve for comparison. Deriving a baseline from these data requires a good knowledge of the circumstances of these earlier samplings. The availability of previous repeated measurements of an indicator facilitates the identification of trends and thus is a determinant of choice among several indicators. Sometimes, present levels of different indicators have to be established through a preliminary survey. Many countries base their surveillance system on previous national surveys on the nutritional situation.

6.2 Criteria for selection: the SMART concept

To facilitate the choice of indicators, various criteria have been established. A very widely used concept is SMART, originally developed by Roche, (*35*) which has been adapted to the purposes of different programmes. A version from UNICEF uses the following definition:

- specific
- measurable (and also reliable, comparable and contextually appropriate)
- achievable (and also cost-effective)
- relevant
- time-bound (and also sensitive).

Specific

Indicators are specific when they measure what they claim to measure and are not confounded by other factors. This is also referred to as “validity”. The problem of different meanings occurs when establishing qualitative scales of measurement. It is also an issue when designing data collection tools for indicators as even words such as “family”, “household” and “child” are culturally and contextually biased.

Measurable

Indicators must be precisely defined so that their measurement is unambiguous. This generally means quantitative (percentage, ratio, number), but can also mean qualitative. They should be:

- *Reliable.* The results should be the same regardless of who collects the data or when the measure is repeated; this is also referred to as “verifiability”. For example, weight for height measures are reliable measures of nutritional status, while mid-upper arm circumference measures are more difficult to repeat reliably.
- *Comparable.* Indicators must allow comparison over time and from one location to another (essential where the indicators help to prioritize the level of need). Usually, if the indicator is reliable or verifiable, it is comparable. However, this is usually most challenging with qualitative indicators.
- *Contextually appropriate.* The measurements used must be culturally, socially and politically acceptable to the population under study, otherwise the population may seek to misrepresent information, under- or overreporting events, or undermining “true” measures. For example, direct questioning about household income and assets is often considered intrusive and will yield under- or overreporting, depending on the context.

Achievable/feasible

Achievability/feasibility means that the required data can actually be measured and collected. Feasibility should also be examined in terms of institutional capacity. Are the agencies, organizations and staff to be involved in data collection able and willing to do so? If indicators are part of a monitoring system, can they be integrated easily into the programme staff’s ongoing work? Examples include the ease of sample selection, availability of specialized personnel, availability of transport.

Data collection, for example capital costs, recurring costs and personnel, should also be cost effective, i.e. affordable and worthwhile.

Relevant

Indicators must provide information useful to the programme objectives and help guide the key users' decisions. Indicators are not relevant if they are chosen without reference to decision-makers' needs.

Time-bound

Indicators should describe when change is expected. An indicator needs to be collected and reported at the right time. For example, an indicator that can tell you only at the end of a project whether you succeeded in meeting certain objectives cannot influence the decision-making process.

Can data be collected in a timely manner? Indicators quickly reflect changes in the situation. They must correspond with the frequency of information required for decision-making; for example, maternal mortality measures are not sufficiently sensitive for programme decisions, so process indicators are used as proxy measures.

6.3 Criteria for selection: the SPICED concept

When change is to be measured, other properties of indicators become more important and call for different criteria. This is taken into account by the SPICED concept, (*35*) where criteria relate to the process of defining and measuring indicators for change:

- subjective
- participatory
- interpreted and communicable
- cross-checked and compared
- empowering
- diverse and disaggregated.

Subjective

Informants have a special position or experience that gives them unique insights that may yield a very high return on the investigator's time. These data may thus be seen as critical because of their source value.

Participatory

Indicators should be developed along with those best placed to assess them. This not only means involving the project's primary stakeholders, but also can mean involving local staff and other stakeholders.

Interpreted and communicable

Locally defined indicators may not mean much to other stakeholders and often may need to be explained.

Cross-checked and compared

The validity of the assessment needs to be cross-checked by comparing progress with different indicators and by using different informants, methods and researchers.

Empowering

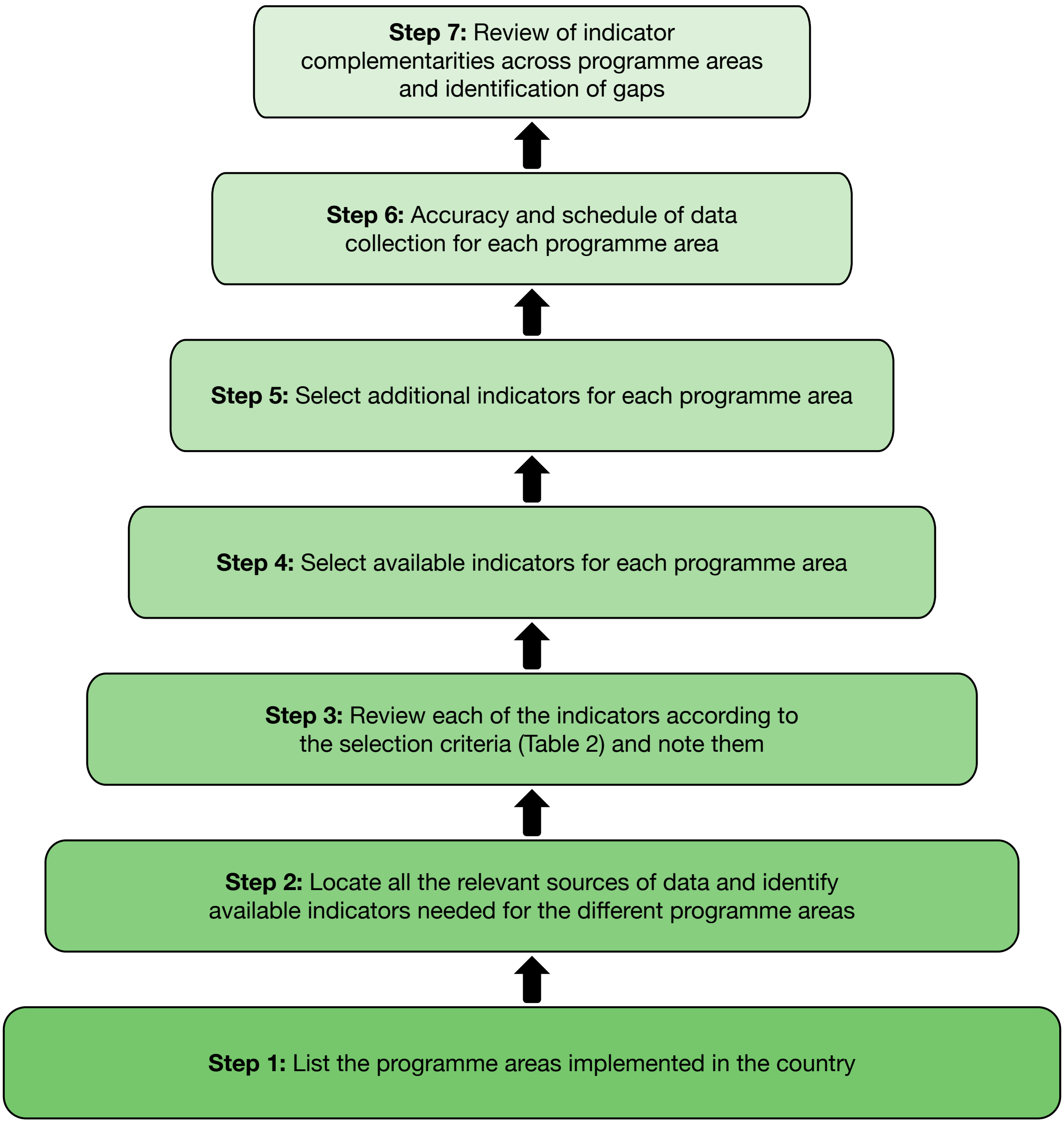
The process of setting and assessing indicators should be empowering and should allow individuals and groups to reflect critically on their changing situation.

Diverse and disaggregated

There should be a deliberate effort to seek out different indicators from a diverse range of groups, especially men and women. The information needs to be recorded in such a way that any differences can be assessed over time.

6.4 Steps in identifying and selecting indicators (*36*)

Indicators for food and nutrition surveillance systems should be selected according to the steps shown in Figure 1.



Source: (*36*)

Figure 1. Steps in identifying and selecting indicators for food and nutrition surveillance systems

Step 1: List the programme areas implemented in the country

1. Make a list of programmes covered by the current national food and nutrition surveillance system.
2. Indicate whether each programme area is operational.
3. Comment on the comprehensiveness of each programme area; for example, target population, scope and length of time that each programme has been operational.

Step 2: Locate all the relevant data sources and identify available indicators needed for the different programme areas

1. Collect copies of all relevant report summaries currently in use.
2. Review all sources of information and relevant data collection and reporting points.
3. Identify any periodic sources, particularly those collecting community- or population-based information (e.g. household surveys that could providing figures for the denominator of key indicators such as the number of women of reproductive age in a district).
4. Identify the indicators available from these different sources that are relevant to the surveillance system.
5. List these according to their source.

Step 3: Review each of the indicators

Review each of the indicators according to the following selection criteria (Table 2) and note them:

- useful
- accessible
- ethical
- robust
- representative
- understandable.

Step 4: Select available indicators for each programme area

1. List all indicators, using one form for each programme area.
2. For each indicator, note whether criteria were met.
3. Decide whether all criteria are equally important and how many must be met before an indicator is selected.
4. It is important that the persons involved in this step feel responsible for, and competent in, the approach adopted so that they can explain and justify it in following consultations.

Table 2. Criteria for selection of indicators

Which indicators are accessible?	An accessible indicator is one that is readily available in a usable format and at appropriate time intervals. The criteria of accessibility will reflect closely the source of data. However, routinely collected data do have drawbacks, sometimes related to representativeness (see criteria below) and sometimes the data are not aggregated or summarized to a point where indicators can be produced
Which indicators are ethical?	An ethical indicator is one for which the gathering, processing and presentation of the data it requires are ethical in terms of the rights of the individual to confidentiality, freedom of choice in supplying data, and informed consent regarding the nature and implications of the data required
Which indicators are robust (strong)?	Robustness reflects the scientific qualities of an indicator in terms of whether it is valid, specific, sensitive and reliable. A robust indicator is one that actually measures the issue or factor it is supposed to measure
Which indicators are representative?	A representative indicator is one that adequately includes all the issues or population groups it is expected to cover; for example, the indicator "percentage of health facilities providing growth monitoring" is a representative indicator, since it reflects the situation across all facilities. The indicator "prevalence of severe anaemia in pregnant women" would not be representative unless all pregnant women had their blood tested during pregnancy. One of the biggest drawbacks to using routinely gathered information from health facilities in order to generate indicators is selection bias. In situations where services are not accessible, affordable and acceptable to particular groups of the population, routine data will not reflect their health problems or needs and it is easy to see how these groups can become essentially invisible. This is one of the reasons why it is important to have some data from community-based sources, such as surveys, and to have an estimate of the total population of the district since this should form the denominator of any population-based indicators
Which indicators are understandable?	An understandable indicator is one that you would find easy to define and describe its meaning, and is easy to interpret

Source: (*36*)

Step 5: Select additional indicators for each programme area

At this stage, the group should spend some time reflecting on the list of indicators identified. The following should be considered.

1. All of these indicators are, by definition, available from existing sources.
2. It is possible that the same sources can be used to generate additional indicators that meet all the selection criteria.
3. These indicators may be preferable to those selected so far and fill gaps in the information available to planners.
4. Write down these new indicators and consider whether they meet the selection criteria mentioned in step 3.
5. Then apply the same approach as previously and decide whether to select or reject them.

Step 6: Accuracy and time schedule of data collection

1. Having selected the indicators, the group should assess to what extent the data collection system currently in place enables these indicators to be generated accurately and reported on time.
2. This will involve cooperation with several related sections of the health administration and may lead to proposals to change the system and introduce new data and/or methods, such as the use of community-based data for selected key indicators.
3. Summarize the definition and data requirements of each selected indicator, together with the implications for the health information system.

Step 7: Review of indicator complementarities across programme areas and identification of gaps

1. The final step should involve an appraisal of the balance in the indicators selected, both within and across programme areas in the country:
   - Which aspects of the nutrition problems are well covered by the indicators identified?
   - For which aspects of the nutrition problems are there insufficient indicators?
2. Determine if any imbalance in the indicator distribution is justifiable (e.g. a much larger number of indicators for a certain nutritional problem than for others).
3. Some indicators may be selected for use in more than one programme area. In this case, it would be efficient to pool the effort involved in data collection and analysis across programme areas. This approach will also highlight those programme activities for which there is currently a serious lack of indicators.
4. Consider how these gaps could be filled; perhaps form a small working group to look at the gaps and suggest relevant solutions.

7. Levels of assessment

Indicators for food and nutrition surveillance systems can be implemented at three levels according to the available resources, objectives and nutrition profile of the country as demonstrated in the regional nutrition strategy and plan of action. Appropriate indicators were suggested for the three levels of assessment. (*37*)

The first two levels (minimal and intermediate) correspond to data required to identify problems and to plan programmes and direct resources, respectively, because data for programme and policy evaluation must be tailored for specific situations. The suggested components for the third level, comprehensive level assessment, were included as an example of the type of assessment that could be done if resources were not limited.

The core indicators within each level of comprehensiveness were suggested with the aim that they would be used as a unit. Data on determinants, indices and consequences of all of the nutritional concerns should be collected to avoid the possible misinterpretation that could result from collection of insufficient data.

Instruments have been developed to assess the sociodemographic, economic, capability and dependency, community food insecurity, general state of health, health care and other measurements that provide information on determinants of nutritional state. Similarly, consequences associated with nutritional state (hunger, growth impairment, impaired performance, and diseases or conditions) can be detected by various methods.

Minimal

Core indicators for minimal-level assessment are listed in Table 3. Understanding of causal or contributing factors (determinants) is not possible with minimal-level assessment and is not necessary for problem identification. Assessment of consequences is not needed at this level.

Intermediate

Core indicators for intermediate-level assessment are listed in Table 4. The indices needed for intermediate-level assessment require methodologies that, in general, are more invasive, technically more complex and more costly than those needed for minimal-level assessment.

Comprehensive

Core indicators for comprehensive-level assessment listed in Table 5. These indicators are included as an example of indicators of nutritional state that would be preferred if time, cost and other constraints of operations were not a consideration. (*37*)

Table 3. Indicators for minimal-level assessment

Indicator	Determinants	Indices
All nutritional issues	Demographic and socioeconomic status (information about age, gender, geographic location, income)	
Malnutrition		
Undernutrition		Height Weight for height Weight change Skin folds Body circumferences Oedema
Overweight and obesity		Weight for length Weight for height
Micronutrients		
Iron status		Haemoglobin levels
Vitamin A status		Signs and symptoms of eye diseases
Noncommunicable diseases		
Diabetes mellitus		Number and percentage of persons with hyperglycaemia (fasting blood glucose $\geq$110 mg/dL of whole blood)
Hypercholesterolaemia		Serum total cholesterol
Hypertension		Blood pressure
Health	Choose relevant indicator from Appendix 1	
Caring		
Pregnant woman		
Food insecurity		Food consumption Patterns over time Types of foods Frequency of consumption Variety of foods Self-reports of: • food sufficiency • constraints to obtaining • food • sources of food

Source: (*37*)

Table 4. Indicators for intermediate-level assessment

Indicator	Determinants	Indices	Consequences
All nutritional issues	Demographic status (extensive data) Socioeconomic status (extensive data) Information about medical history	Food consumption patterns over time Types of foods Quantities of foods Frequency of consumption Variety of foods Nutrient supplement use Special weight reduction diets	
Malnutrition Undernutrition	Physical activity level	Height Weight for height Weight change Skin folds Body circumferences Oedema	Hunger Impaired performance Low birth weight Growth depression Infection Depression/demoralization
Overweight and obesity	Physical activity/ fitness Measures of capability and dependency Physical disability Diet	Weight for length Weight for height Skin folds Body circumferences and their ratios	Coronary heart disease Cardiovascular disease Hypertension Diabetes mellitus Depression/demoralization Impaired performance
Micronutrients Iron status	Blood loss Pregnancy Parity Reproductive history Recent infections or immunizations	Complete blood count Serum ferritin Serum iron Total iron-binding capacity Transferrin saturation Erythrocyte protoporphyrin Acute phase reactants	Microcytic, hypochromic anaemia Depression/demoralization Impaired performance
Vitamin A status	Acute infection Hormone use Alcoholism Hyperlipidaemia	Serum retinol Relative dark adaptation test Eye lesions	Night blindness Epithelial tissue changes Infection
Iodine status		Total goitre rate (or of different stages of goitre) in the population or in groups at risk	
Folate status	Pregnancy Parity Reproductive history Hormone use Medication use Alcohol use	Percentage of pregnant women receiving folate	Macrocytic anaemia Depression/demoralization Impaired performance

Table 4. Indicators for intermediate-level assessment (*concluded*)

Indicator	Determinants	Indices	Consequences
Noncommunicable diseases Diabetes mellitus		Number and percentage of persons with hyperglycaemia (fasting blood glucose ≥110 mg/dL of whole blood)	
Hyper-cholesterolaemia	Obesity Alcohol use Tobacco use Physical activity Diet (salt intake) Hormone use Medicines use	Serum total cholesterol High density lipoprotein cholesterol	Coronary heart disease Arteriosclerosis Cardiovascular disease Impaired performance
Hypertension	Obesity Alcohol use Tobacco use Physical activity Diet (salt intake) Hormone use Medicines use	Blood pressure	Coronary heart disease Arteriosclerosis Cardiovascular disease Depression/demoralization Impaired performance
Health	Choose relevant indicator from Appendix 1		
Caring			
Pregnant woman			
Food insecurity	Community food security Availability Affordability Accessibility Housing quality (food preparation and storage facilities) Measures of capability and dependency Physical disability	Food consumption Patterns over time Types of foods Quantities of foods Frequency of consumption Variety of foods Self-reports of: • food sufficiency • constraints to obtaining food • sources of food	Hunger Low birth weight Infection Depression/ demoralization Impaired performance

Source: (*37*)

Table 5. Indicators for comprehensive-level assessment

Indicator	Determinants	Indices	Consequences
All nutritional issues	Demographic status (extensive data) Socioeconomic status (extensive data) Information about medical history	Food consumption patterns over time Types of foods Quantities of foods Frequency of consumption Variety of foods Nutrient supplement use Special weight reduction diets	
Malnutrition Undernutrition		Height Weight for height Weight change Skin folds Body circumferences Oedema Serum proteins	Hunger Impaired performance Low birth weight Growth depression Infection Depression/demoralization
Overweight and obesity	Physical activity/ fitness Measures of capability and dependency Physical disability Diet	Weight for length Weight for height Skin folds Body circumferences and their ratios	Coronary heart disease Cardiovascular disease Hypertension Diabetes mellitus Depression/demoralization Impaired performance
Malnutrition (micronutrient) Iron status	Blood loss Pregnancy Parity Reproductive history Recent infections or immunizations	Complete blood count Serum ferritin Serum iron Total iron-binding capacity Transferrin saturation Erythrocyte protoporphyrin Acute phase reactants Red cell volume distributions Folate status indicators	Microcytic, hypochromic anaemia Depression/demoralization Impaired performance
Vitamin A status	Acute infection Hormone use Alcohol use Hyperlipidaemia	Serum retinol Serum carotenoids Relative dark adaptation test Eye lesions Serum retinyl esters Protein status measurements	Night blindness Epithelial tissue changes Infection
Iodine status		Total goitre rate (or of different stages of goitre) in the population or in groups at risk Percentage of individuals with a low urinary iodine level	
Folate status	Pregnancy Parity Reproductive history Hormone use Medication use	Serum and red blood cell folate concentrations Neutrophil hypersegmentation Iron status indicators Vitamin B12 status indicators	Macrocytic anaemia Depression/demoralization Impaired performance

Table 5. Indicators for comprehensive-level assessment (*concluded*)

Indicator	Determinants	Indices	Consequences
Noncommunicable diseases Diabetes mellitus		Number and % of persons with hyperglycaemia (fasting blood glucose ≥110 mg/dL of whole blood)	
Hyper-cholesterolaemia	Alcohol use Tobacco use Body weight Diet Hormone use Medicine use Physical activity	Serum total cholesterol High density lipoprotein cholesterol Apo-lipoproteins A and B	Coronary heart disease Arteriosclerosis Cardiovascular disease Impaired performance
Hypertension	Obesity Alcohol use Salt intake Tobacco use Hormone use Medicine use	Blood pressure Urinary sodium/potassium and sodium/calcium ratios Serum ionized calcium Left ventricular mass	Coronary heart disease Arteriosclerosis Cardiovascular disease Depression/demoralization Impaired performance
Health	Choose relevant indicator from Appendix 1		
Caring			
Pregnant woman			
Food insecurity	Community food security Availability Affordability Accessibility Housing quality (food preparation and storage facilities) Measures of capability and dependency Physical disability	Food consumption patterns over time Types of foods Quantities of foods Frequency of consumption Variety of foods Self-reports of: • food sufficiency • constraints to obtaining food • sources of food	Hunger Low birth weight Infection Depression/demoralization Impaired performance

Source: adapted from (*37*)

Comprehensive implementation plan on infant and young child nutrition

In May 2010, the World Health Assembly adopted resolution WHA63.23 on infant and young child nutrition. The Health Assembly requested the Director-General to develop a comprehensive implementation plan on infant and young child nutrition as a critical component of a global multisectoral nutrition framework. This plan aims to provide further support to countries to bring forward the Infant and Young Child strategy and highlight the areas that require greater commitment and investment, as well as to take into account the developments of the evidence base. It also addresses more broadly the window of opportunity from conception to early childhood which is the critical period for improving infant and young child nutrition.

The following five actions are envisaged:

- to create a supportive environment for the implementation of comprehensive food and nutrition policies;
- to include all required effective health interventions with an impact on nutrition in national health and nutrition plans;
- to stimulate the implementation of non-health interventions with an impact on nutrition;
- to provide sufficient human and financial resources for the implementation of health interventions with an impact on nutrition;
- to monitor and evaluate the implementation of policies and programmes

A set of indicators for monitoring the realization of the comprehensive implementation plan is given in Table 6.

Table 6. Indicators for monitoring the realization of the comprehensive implementation plan

Inputs	Outputs/outcomes	Impact
Policy/strategy environment for nutrition: nutrition governance score	Prevalence of children aged under six months who are exclusively breastfed	Incidence of low birth weight
Human resources: ratio of community health workers to total population	Proportion of children aged under five years who have received two doses of vitamin A supplements[1]	Proportion of stunted children below five years of age
Legal frameworks: adoption and effective implementation of International Code of Marketing of Breast-milk Substitutes	Proportion of households with consumption of iodized salt	Proportion of wasted children below five years of age
	Proportion of population with sustainable access to an improved water source	Proportion of thin women[2] of reproductive age
	Individual food consumption score	Proportion of children below five years of age with haemoglobin concentration of <11 g/dl
	Proportion of children receiving a minimum acceptable diet at 6-23 months of age	Proportion of women of reproductive age (15-49 years) with haemoglobin concentration of <12 g/dl
	Prevalence of children (aged 0–59 months) with diarrhoea who received oral rehydration therapy and therapeutic zinc	Median urinary iodine concentration (μg/l) in children aged 6-12 years
	Proportion of pregnant women receiving iron and folic acid supplements	Maternal mortality ratio (per 100 000 live births)
		Infant mortality rate (per 1000 live births)
		Under-five year mortality rate (per 10 000/day)

[1] Children aged 6-59 months in settings where vitamin A deficiency is a public health problem.

[2] Women with Body Mass Index <18.5 kg/m².

Appendix 1. Suggested indicators for food and nutrition surveillance systems *(32)*

The classification of indicators is shown in Box A1.1. The indicators listed in Tables A1.1–A1.9 should be included in the surveillance system according to the objectives and situation in each country, bearing in mind the criteria of selection and the available resources.

Box A1.1 Classification of indicators

Demographic indicators
Population
Growth rate
Natural increase
Life expectancy
Population density
Fertility rate

Mortality indicators
Neonatal mortality rate
Postneonatal mortality rate
Infant mortality rate
Child mortality rate
Maternal mortality ratio

Socioeconomic indicators
Gross national product and gross domestic product
Per capita income
Inflation rate
Employment rate
Unemployment

Table A1.1 Education and health indicators for nutrition monitoring

Education indicator	Definition
Adults	
Adult literacy rate	% of men and women aged 15 years and over, able to read and write in any language
Literacy rate of 15–24 year olds	
% of adults aged >15 years who have completed primary education	
Average level of education of adults aged 15–49 years (by sex)	
% of households with no literate member	
Children	
Gross enrolment rate of children (by sex) in primary and secondary education	% of children registered regardless of age, in relation to total number of children in age group corresponding to each level
Net enrolment rate of children (by sex) in primary education	% of children registered belonging to the age group corresponding to primary level in relation to the total number of children in this age group
Net attendance rate of children (by sex) in primary education	% of children belonging to the age group corresponding to primary level actually attending primary school in relation to the total number of children in this age group
Health indicator	**Definition**
Proportion of population with access to health care services	
% of vaccinated children aged <5 years	
% women receiving tetanus toxoid injections (care during pregnancy)	
Health indicator	**Definition**
Incidence, prevalence, severity, duration (possibly disaggregated by sex and age) of infectious diseases, in particular acute respiratory infections; diarrhoea; HIV; malaria; tuberculosis; cholera	
Classification of major causes of infectious diseases (malaria, measles, acute respiratory infection, diarrhoea)	
Immunization rate of children (aged <1 year and by age group):	% of children immunized against each disease, among target age group % of 1-year-old children (or aged <7 years) fully immunized (adequate number of doses during the first year of life) against infectious diseases (tuberculosis, diphtheria, tetanus, pertussis, poliomyelitis, measles)
Incidence of measles in children	
% of children <36 months who had diarrhoea during the past 2 weeks (diarrhoea defined as more than three liquid stools per day)	

Table A1.2 Indicators for breastfeeding for nutrition monitoring

Breastfeeding and complementary feeding	Target population
% of children who have never received breast milk	Children <3 years (or <5 years)
Rate of exclusive breastfeeding (breast milk alone without other liquids or foods)	Infants 0–6 months
Rate of predominant breastfeeding (breast milk and other water-based liquids)	Infants 0–6 months
Rate of timely complementary feeding (solid/semisolid complementary foods given in addition to breast milk)	Infants 6–9 months
Rate of continued breastfeeding at 1 year	Children 12–15 months
Rate of continued breastfeeding at 2 years	Children 20–23 months
Average duration of breastfeeding or mean age at weaning	
Bottle-feeding rate	Children 0–11 months
Rate of timely initiation of breastfeeding (% of infants who are breastfed within 1 h or within 8 h of birth)	Children <24 months
Number of maternity hospitals designated as “Baby Friendly” according to the criteria of the Baby Friendly Hospital Initiative	
Number of meals per day eaten by children 6-59 months	
Frequency of changes in infant’s diet in case of illness	
% of children for whom breastfeeding was discontinued because of diarrhoea	Children breastfed for <24 months
% of children continuing to be fed during diarrhoea	Children 0–59 months
% of children who have had diarrhoea during the past 2 weeks, who have received more liquids and whose feeding was maintained during the episode	Children 0–59 months

Table A1.3 Indicators for household and environmental sanitation for nutrition monitoring

Water
% of population (or of households) with sustainable access to an improved water source (piped water, public tap, borehole with a pump, protected well, protected spring or rainwater) (by urban/rural residence where appropriate)
Volume of water (litres) per person per day consumed at household level (drinking, cooking, washing, home cleaning)
% of population (or of households) with sustainable access to an improved water source (piped water, public tap, borehole with a pump, protected well, protected spring or rainwater) (by urban/rural residence where appropriate)
Volume of water (litres) per person per day consumed at household level (drinking, cooking, washing, home cleaning)
% of population (or of households) per type of water supply (in a rural environment and in a dry/wet season: pond, dam, river, spring, rainwater, well; in an urban environment: private, communal or both)
% of households with available washing facilities (private, communal, none)
% of recurring costs of water supply services paid by the community using these services
% of water supply installations whose maintenance is carried out by the beneficiary community
Sanitation
% of population (or of households) with access to adequate sanitation (toilets, latrines) (disaggregated by urban/rural residence)
% of population using adequate sanitation facilities (toilets, latrines)
% of households per type of sanitation facility (rural environment: main sewer, septic tank, pit, bucket, none; urban environment: private, communal access, pit, other)
Household characteristics
Number of persons per room
% of dwellings without an adequate ventilation system

Table A1.4. Anthropometric indicators for nutrition monitoring

Anthropometric indicator	Reference cut-off point
Preschool children (0–59 months)	
% of newborns with a low birth weight	<2500 g or <–2 Z-scores of the local reference if it exists
% of children 0–59 months with a low weight-for-age index (underweight), overall and by age group	<–2 Z-scores of the reference (possibly also consider the severe form <–3 Z-scores)
% of children 0–59 months with a low weight for height index (wasting), overall and by age group	<–2 Z-scores of the reference (possibly also consider the severe form <–3 Z-scores)
% of children 0–59 months with a low height-for-age index (stunting), overall and by age group	<–2 Z-scores of the reference (possibly also consider the severe form <–3 Z-scores)
Preschool children (0–59 months)	
% of children 0–59 months with a high weight for height index (overweight), overall and by age group	>+2 Z-scores of the reference
% of children 0–59 months with a high weight for height index (obesity), overall and by age group	>+3 Z-scores of the reference
School-age children (6–14 years)	
% of children with a low height-for-age index (stunting) on entering primary school	<–2 Z-scores of the reference
% of children with a high weight-for-height index (overweight)	>+2 Z-scores of the reference
% of children with a high weight-for-height index (obese)	>+3 Z-scores of the reference
Adults (18 years)	
% of adults with a low BMI (wasting or chronic energy deficiency)	<18.5 kg/m^2 (possibly consider also the secondary cut-off of <17.0 kg/m^2 and <16.0 kg/m^2)
% of adults with a high BMI	>25.0 (overweight) and >30.0 (obesity)
Average BMI	A national average between 21 and 23 is regarded as desirable
% of pregnant women with a low weight gain during pregnancy	<1 kg/month (from the third month of pregnancy)
% of women with a low weight	<45 kg
% of women of small stature	<145 cm

BMI: body mass index

Table A1.5 Noncommunicable disease indicators

Indicator	Comments
Rate of chronic noncommunicable diseases (for specific age groups and by sex, as applicable), specifically:	
Diabetes mellitus	Number and % of persons with hyperglycaemia (fasting blood glucose ≥110 mg/dL of whole blood)
Cardiovascular diseases	Number and % of persons with hypertension (systolic blood pressure >140 mmHg and/or diastolic pressure >90 mmHg) or average systolic pressure Number and % of persons with hypercholesterolaemia (total cholesterol >6.5 mmol/L) or average cholesterolaemia (mmol/L)
Nutritional and endocrine disorders	
Malignant tumours	
Monitoring of noncommunicable disease risk factors	
Physical inactivity	The percentage of the population aged 15 or older engaging in less than 30 minutes of moderate activity per week or less than 20 minutes of vigorous activity three times per week, or equivalent
Raised blood pressure	The percentage of the population aged 25 or older having systolic blood pressure greater or equal to 140mmHg and/or diastolic blood pressure greater or equal to 90mmHg or on medication to lower blood pressure
Raised blood glucose	The percentage of the population aged 25 or older having a fasting plasma glucose value greater or equal to 7.0 mmol/L (126 mg/dl) or on medication for raised blood glucose
Overweight	The percentage of the population aged 20 or older having a body mass index (BMI) greater or equal to 25 kg/m^2
Obesity	The percentage of the population aged 20 or older having a BMI greater or equal to 30 kg/m^2
Raised cholesterol	The percentage of the population aged 25 or older having a total cholesterol value greater or equal to 5.0 mmol/L (190 mg/dl)
Salt intake	The percentage of the population having a salt consumption of more than the WHO-recommended amount (< 5 gram per day)
Fat intake	The percentage of the population with fat intake of more than the WHO-recommended amount of (15–30% of total energy)

Table A1.5 Noncommunicable disease indicators (*concluded*)

Trans-fatty acid intake	The percentage of the population who consumed trans-fatty acids more than the WHO-recommended amount (<1% of the total energy per day)
Free sugar intake	The percentage of the population consuming free sugars more than the WHO-recommended amount (<10% of the daily energy sources)

BMI: body mass index

Table A1.6 Indicators concerning pregnancy

Indicator	Reference cut-off point
Interpregnancy interval	
<6 months	<6 months between pregnancies
6–18 months	6–18 months between pregnancies
>18 months	≥18 months between pregnancies
Parity	A pregnancy is defined as 20 or more weeks' gestation regardless of whether the infant(s) was alive or dead at birth. Multiple births count as one. The current pregnancy does not count
0	0 previous pregnancies
1	1 previous pregnancy
2	2 previous pregnancies
≥3	3 or more previous pregnancies
Prepregnancy multivitamin consumption	Women who reported taking a multivitamin four times a week or more in the month before pregnancy
Multivitamin consumption during pregnancy	Pregnant women who reported taking vitamins or minerals in the past month
Prepregnancy BMI	
Underweight	<19.8
Normal weight	19.8–26.0
Overweight	>26.0–29.0
Obese	>29.0
Maternal weight gain (Institute of Medicine recommendation for weight gain based on prepregnancy BMI) *(39)*	
Less than ideal	Underweight (BMI <19.8) prepregnancy: 12.7–18.1 kg
Ideal	Normal weight (BMI 19.8–26.0) prepregnancy: 11.3–15.9 kg
Greater than ideal	Overweight (BMI >26.0–29.0) prepregnancy: 6.8–11.3 kg
	Obese (BMI >29.0) prepregnancy: 5.0–9.1 kg

BMI: body mass index

Table A1.7 Indicators of nutrient deficiencies

Indicator	Target population	Reference cut-off point
Iodine deficiency		
Total goitre rate (or of different stages of goitre) in the population or in groups at risk (%)	Total population School–age children (6–12 years) Pregnant (and/or breastfeeding) women in prenatal care centres	Grade 1 and 2
Cretinism (prevalence %)	Total population	
Prevalence of low urinary iodine level (% of individuals)	Target population School age children (6–12 years)	<100 µg/L (deficiency low to severe) <50 µg/L (severe and moderate deficiency)
Median urinary iodine (µg/L)	School age children	
Median serum thyroglobulin concentration (ng/mL)	Children and adults	
Prevalence of high levels of thyroid stimulating hormone in whole blood (% of individuals)	Newborns	>5 mIU/L
Vitamin A deficiency		
Indicators of prevalence		
Individuals affected by clinical signs of vitamin A deficiency (%)	Pregnant women and women with a previous pregnancy that ended in a live birth in the past 3 years Children 2–5 years	Night blindness Night blindness or Bitot's spots
Individuals with a low serum retinol measured by high performance liquid chromatography (%)	Children aged 2–5 years	<20 µg/dL (0.7 µmol/L)
Individuals with abnormal relative dose response test or modified test (%)	Children aged 3–6 years	>20% (relative dose response test) >0.06% (modified relative dose response test)
Individuals with abnormal 30-day serum response test (%)	Children aged 3–6 years	20%
Lactating women with a low breast-milk retinol level (%)	Lactating women	<1.05 µmol/L
Individuals with abnormal conjunctival impression cytology (%)	Children aged 3–6 years	
Indicators of risk		
Breastfed children with a low dietary intake of vitamin A (excluding breast milk)	Infants 6–12 months Infants 12–24 months	<950 µg retinol equivalents/week <1450 µg retinol equivalents/week
Weaned children with a low dietary intake of vitamin A (%)	Weaned children	< 2450 µg retinol equivalents/week
Individuals and/or families with a low intake of vitamin A-rich foods	Children 1–6 years and women of 15–45 years Families	<50% of recommended daily intake or <3 times per week
Individuals with a low daily fat intake	Children Pregnant or lactating women	<5 g fat/day <20 g fat/day

Table A1.7 Indicators of nutrient deficiencies (*concluded*)

Indicator	Target population	Reference cut-off point
Iron deficiency anaemia		
Prevalence of low haemoglobin concentration (specific for sex, age and physiological status) (% of individuals)	Children 6–59 months, and pregnant women	<110 g/L
	Children 5–11 years	<115 g/L
	Adolescents 12–14 years and non-pregnant women >15 years	<120 g/L
	Men >15 years	<130 g/L
	Severe anaemia (all groups)	<70 g/L
Prevalence of low haematocrit level (specific for sex, age and physiological status) (% of individuals)	Children 6–59 months, and pregnant women	<33%
	Children 5–11 years	<34%
	Adolescents 12–14 years and non-pregnant women >15 years	<36%
	Men >15 years	<39%
Prevalence of low transferrin saturation coefficient (% of individuals)	Children <5 years	<12%
	Children 5–10 years	<14%
	Adults	<16%
Prevalence of low serum ferritin concentrations (% of individuals)	Children <5 years	<12 mg/L
	Children >5 years	<15 mg/L
Prevalence of high zinc protoporphyrin levels (% of individuals)	Children <5 years	>70 µg/L
	>5 years	>80 µg/L
Prevalence of low haematocrit level (specific for sex, age and physiological status) (% of individuals)	Children 6–59 months, and pregnant women	<33%
	Children 5–11 years	<34%
	Adolescents 12–14 years and non-pregnant women >15 years	<36%
	Men >15 years	<39%
Prevalence of low transferrin saturation coefficient (% of individuals)	Children <5 years	<12%
	Children 5–10 years	<14%
	Adults	<16%

Table A1.8 Indicators of food security

Food availability
Intra-annual price variation of staple food commodities
Per capita calorie availability
Production per vulnerable household
Yield
Area under improved natural resource management practices
Rates of trade production
Trade diversity (partners and commodities)
Value of total trade
Food marketing costs and margins
Costs of key agricultural inputs
Availability of key agricultural inputs
Postharvest management losses
Food access
% of vulnerable population consuming minimum standards of daily nutrient requirements
% of population in poverty (based on 2–3 measures)
Real per capita income
Real per capita expenditures
Value of household assets
% of children in school (proxy indicator)
Increase in household income earned by women
Women's effective rights to use, own and inherit land and other production assets
% of all small loans given to and repaid by women (proxy)
% of all girls completing primary education (proxy)
Safety net effectiveness
% of safety net funded from domestic sources
% of beneficiaries reaching pre-determined cut offs for nutritional status
% of population receiving safety net assistance
Intra household food sharing

Table A1.9 Indicators of food utilization

Indicator	Reference cut-off point
Nutritional status	Height for age (<5 years old) Weight for age (<3 years old)
Diarrhoeal disease	Diarrhoeal episodes per child per year
Birth spacing	% of infants/children <24 months after previous birth
Dietary intake in vulnerable individuals/populations	% of vulnerable population consuming minimum standards of required intake/diet
Utilization of nutrients in vulnerable populations	Meal/food frequency Frequency of consumption of local index foods reflective of adequate amounts of micronutrients Appropriate mother and infant/child feeding practices
Facilities	% of measles immunization at 12 months % of mothers continuing infant/child feeding during diarrhoea Average personal water consumption % of target population with access to potable water for drinking and sanitation % of households with functioning sanitation

1. Learning objectives

- To identify different methodologies for measuring individual malnutrition.
- To identify the relevant indicators to be addressed in each method.
- To identify different methodologies for assessing the nutritional status of a population.

2. Introduction (*40*)

Nutritional status describes the relationship between the intake of nutrients by an organism and the expenditure of these nutrients in the processes of growth, reproduction and health maintenance. Because this process is highly complex and quite individualized, nutritional status assessment can include many aspects of nutrients ranging from nutrient levels in the body, to the products of their metabolism and the functional processes they regulate. Nutritional status can be measured for individuals as well as for populations. Accurate measurement of an individual's nutritional status is required in clinical practice. Population measures are more important in epidemiological studies and monitoring. They can be used to describe nutritional status of the group, to identify populations or population segments at risk for nutrition-related health consequences, and to evaluate interventions.

The choice of nutritional status assessment method must take into account the level at which one wants information, as well as of the validity and reliability of the method. All methods are prone to errors. There are several different indicators to assess nutritional status. To be able to judge the status, reference data must be available. The quality of the available reference data is, therefore, another factor that affects the assessment data.

Ideal methods are sensitive and specific. Unfortunately, it is difficult to achieve both in the assessment of nutritional status. Sensitivity is the ability of a system to detect the cases or other health events it is intended to detect. Specificity is the proportion of people without disease who are correctly identified as not having disease.

BMI (kg/m^2) is a global measure of nutritional status that illustrates the difference between sensitivity and specificity when using the according cut-offs. Most persons who consume insufficient energy or have high energy expenditure show low BMI ($<18.5\ kg/m^2$), thus the measure is sensitive. However, there are other causes of low BMI, including genetics and diseases leading to catabolic metabolism, thus BMI is not specific to this side of nutritional status.

A nutrition assessment is an in-depth evaluation of both objective and subjective data related to an individual's food and nutrient intake, lifestyle and medical history. Once the data on an individual are collected and organized, the practitioner can assess and evaluate the nutritional status of that person. The assessment leads to a plan of care, or intervention, designed to help the individual either maintain the assessed status or attain a healthier status.

3. Elements of the nutritional assessment

The data for a nutritional assessment fall into four categories: anthropometric, biochemical, clinical and dietary.

3.1 Anthropometric data

Anthropometrics are the objective measurements of body muscle and fat. They are used to compare individuals, to compare growth in the young and to assess weight loss or gain in adults. Weight and height are the most frequently used anthropometric measurements, and skin fold measurements of several areas of the body are also taken.

Anthropometric approaches to nutritional assessment are, for the most part, methods that assess the size or body composition of an individual.(*40*) For adults, body weight and height are used to evaluate overall nutritional status and to classify individuals as at a healthy or non-healthy weight.

In children, growth charts have been developed to allow researchers and clinicians to assess weight and height for age, as well as weight for height. For children, low height for age is considered stunting, while low weight for height indicates wasting. In addition to weight and height, measures of mid-arm circumference and skin fold measured over the triceps muscle at the mid-arm are used to estimate fat and muscle mass. Anthropometric measures of nutritional status can be compromised by other health conditions. For example, oedema characteristic of some forms of malnutrition and other disease states, can conceal wasting by increasing body weight. Head circumference can be used in children 36 months and younger to monitor brain growth in the presence of malnutrition. Brain growth is better spared than either height or weight during malnutrition.

To interpret anthropometric data, they must be compared with reference data. Because well-nourished children in all populations follow similar patterns of growth, reference data need not come from the same population as the children of interest. It is of greater importance that reference data be based on well-defined, large samples, collected in populations that are healthy and adequately nourished.

3.2 Biochemical data

Laboratory tests based on blood and urine can be important indicators of nutritional status, but they are also influenced by non-nutritional factors. Laboratory results can be altered by medication, hydration status, disease states or metabolic processes such as stress. As with the other areas of nutrition assessment, biochemical data need to be viewed as a part of the whole.

3.3 Clinical data

Clinical data provide information about an individual's medical history, including acute and chronic illness and diagnostic procedures, therapies or treatments that may increase nutrient needs or induce malabsorption. Vitamins, minerals and herbal preparations also need to be reviewed. Physical signs of malnutrition can be documented during the nutrition interview and are an important part of the assessment process.

3.4 Dietary data

There are many ways to document dietary intake. The accuracy of the data is frequently challenged. During a nutrition interview the interviewer may ask what the individual ate during the previous 24 h, beginning with the last item eaten prior to the interview. Documentation should include portion sizes and how the food was prepared. Brand names or the restaurant where the food was eaten can assist in assessing the details of the intake. Estimating portion sizes is difficult and requesting that every food be measured or weighed is time consuming and can be impractical. Food models and photographs of foods are therefore used to assist in recalling the portion size of the food.

Food frequency questionnaires are used to gather information on how often a specific food, or category of food, is eaten.

Choosing a dietary approach to nutritional status assessment (*40*)

Several techniques exist for collecting dietary data with which to estimate nutritional status. Because these techniques vary in cost for data collection, burden on the respondent and which aspects of diet they are designed to measure, it is important to clearly articulate the goals of dietary assessment of nutritional status before choosing an assessment strategy.

The primary consideration in choosing a dietary assessment method is the specific type of data needed. Is the objective to document intake of "foods" or of "nutrients"? If the answer is foods, the method must take account of the population's food habits. These include variability in food intake patterns (e.g. day-to-day, seasonal, ritual cycles); differences in food consumption by sex and age; and what items the population considers to be legal "food". If the objective is to measure nutrient intake, the method must take into account several additional factors: food preparation techniques, including the addition of condiments and the effects of the technique on nutrient composition of the food; sources of error in the determination of amounts of foods consumed; differentiation distribution of nutrients among foods; and the contribution of "non-food" consumption (such as starch, and vitamin and mineral supplements) to total nutrient consumption.

Another important consideration is the time period the data are intended to represent. If the period is a relatively discrete one, it may be possible to document diet quite precisely.

Population measures of dietary status can be derived either from data describing the entire population or population subgroup, or from data describing samples of individuals.

4. Measuring malnutrition: individual assessment (*41*)

Information on malnutrition rates is frequently included in assessments of individual nutritional status. The information is commonly used to identify target groups and geographical areas in need of health and nutrition interventions.

Measuring malnutrition through anthropometry is a well-established and widely understood subject area. However, there are unresolved technical challenges associated with measuring malnutrition that practitioners and policy-makers need to be aware of, including the introduction of the new WHO growth standards in 2006 and the measurement of adolescents and the elderly.

Measuring malnutrition usually involves assessment of the anthropometric status and biomarkers. Often only anthropometric measures are used to describe the nutritional status of individuals. In practice, the focus is usually on young children. This is because children from 6 to 59 months of age are particularly nutritionally vulnerable and show signs of malnutrition earlier than other age groups.

4.1 Anthropometry

Anthropometry is the use of body measurements such as weight, height and mid-upper arm circumference in combination with the age and sex of the child to assess nutritional status. In children, anthropometry is used to track growth or failure to grow. Growth failure in children under the age of 5 years is usually attributed to inadequate dietary intake or a compromised health status (Table 1). Three forms of malnutrition in children can be assessed through anthropometry: wasting (acute malnutrition); stunting (chronic malnutrition); and underweight (acute and/or chronic).

Table 1. Types of growth failure in children

Wasting	Wasted children are extremely thin Wasting is the result of recent rapid weight loss or a failure to gain weight due to acute infection and/or inadequate dietary intake Wasting is readily reversible once conditions improve Wasting is evidence of acute malnutrition Wasting is measured by the weight for height index or mid-upper arm circumference
Stunting	Stunted children are short for their age Stunted children may have normal body proportions but look younger than their actual age Stunting develops over a long period as a result of inadequate nutrition or repeated infections, or both The development of stunting is a slow, cumulative process The presence of stunting does not necessarily mean that current dietary intake or health is inadequate – the growth failure may have occurred at some time in the past By two years of age, stunting may be irreversible Stunting is measured by the height for age index
Underweight	Underweight children are too light for their age Underweight is due to either wasting or stunting or a combination of both Underweight is measured by the weight for age index

Source: adapted from (*41*)

Adults can also be wasted, stunted or underweight. In emergencies, wasting is the form of malnutrition of most concern because it reflects recent conditions and can deteriorate quickly and lead to increased risk of morbidity and mortality.

Anthropometry cannot be used to detect some forms of malnutrition, such as micronutrient malnutrition. Anthropometry can be used for individual assessments, for example:

- Growth monitoring and promotion can be part of a mother and child health programme where the growth (weight gain) of infants and young children is monitored over time. The indicator of choice is weight for age.
- Nutritional screening in the form of measuring children can be used to determine the need for further check-ups or for services such as supplementary or therapeutic feeding. The indicators of choice are mid-upper arm circumference and weight for height.

4.2 Measuring malnutrition in younger children

The basic information and body measurements needed to assess anthropometric status in children are age, sex, weight, height, oedema (fluid retention) and mid-upper arm circumference. If a child is too young or too sick to stand, length rather than height is measured. Height is measured for children 24 months or older and length for children aged less than 24 months. If the age of the child is not known then height should be measured for children more than or equal to 85 cm and length should be measured for children less than 85 cm. Guidelines for measuring height, length, weight and mid-upper arm circumference can be found in Appendix 1.

Nutritional indices in children

Different nutritional indices measure different aspects of growth failure (wasting, stunting and underweight) and thus have different uses. In emergencies, weight for height (wasting) is the primary nutritional index of concern as it reflects recent changes in dietary intake and infection. Wasted children can rapidly deteriorate but will also improve rapidly if treated appropriately. The main nutritional indices for children and their uses are summarized in Table 2.

Table 2. Nutritional indices for children (6–59 months) and their uses

Nutritional index	Use
Weight for height or length	Weight for height is the preferred indicator for nutrition surveys Weight for height growth charts are used to monitor the weight gain of children in maternal and child health programmes (growth monitoring on “Road to Health” cards, WHO new growth standards chart)
Mid-upper arm circumference	Often used to initially screen for growth monitoring
Mid-upper arm circumference for age, sex and height	Used for screening purposes
Height for age	A useful indicator for nutrition surveys during chronic emergencies or when wasting levels are low
Weight for age	Weight for age growth charts are used to monitor the weight gain of children in maternal and child health programmes (growth monitoring on “Road to Health” cards) Weight for age is a useful indicator for nutrition surveys during chronic emergencies or when wasting levels are low

Source: adapted from (*42*)

Bilateral oedema (fluid retention on both sides) is a clinical sign of severe acute malnutrition. When an individual has oedema, body weight increases thus anthropometric indices involving weight cannot be interpreted in the same way in oedematous individuals as in those suffering from only wasting. Appendix 1 illustrates how to identify bilateral oedema.

Growth standards

The WHO Child Growth Standards (*42*) provide a technically robust tool for assessing the well-being of infants and young children. Compared with the National Center for Health Statistics/WHO growth reference, (*43*) which is based on children from a single country, the WHO Child Growth Standards are based on an international group of children.

The origin of the WHO Multicentre Growth Reference Study dates back to the early 1990s when WHO initiated a comprehensive review of the uses and interpretation of anthropometric references and conducted an in-depth analysis of growth data from breastfed infants. This analysis showed that the growth pattern of healthy breastfed infants deviated to a significant extent from the National Center for Health Statistics/WHO international reference.

Age-specific and sex-specific reference values (*41*)

Reference values for boys and girls differ substantially and sex-specific reference tables are therefore used whenever possible. However, sex-combined tables are often used in the field in situations where it is important to simplify systems as much as possible.

Table 3. Cut-off points for different nutritional indices for children

Z-score	Growth indicators			
	Length/height for age	**Weight for age**	**Weight for length/ height**	**BMI for age**
Above 3	[a]	[b]	Obese	Obese
Above 2			Overweight	Overweight
Above 1			Possible risk of overweight[c]	Possible risk of overweight[c]
0 (median)				
Below -1				
Below -2	Stunted[d]	Underweight	Wasted	Wasted
Below -3	Severely stunted[d]	Severely underweight[e]	Severely wasted	Severely wasted

BMI: body mass index.
[a] A child in this range is very tall.
[b] A child whose weight for age falls in this range may have a growth problem, but this is better assessed by weight for length/height or BMI for age.
[c] A plotted point above 1 shows possible risk. A trend towards the -2 Z-score line shows definite risk.
[d] It is possible for a stunted or severely stunted child to become overweight.
[e] This is referred to as very low. (*44*)

Source: adapted from (*42*)

Cut-off points to classify nutritional status in children (*41*)

Cut-off points are used to classify the severity of malnutrition measured through anthropometric indices. The cut-offs for different nutritional indices for children are shown in Table 3.

Birth weight (41)

The birth weight of a baby is an important anthropometric indicator, reflecting both the duration of gestation and the rate of foetal growth. It is an indicator of the child's future health and nutritional status as well as an indicator of the mother's health and nutritional status. As such, birth weight is a pivotal indicator in programmes aimed at pregnant and lactating women and young children. A birth weight under 2.5 kg is defined as a low birth weight. Reliable birth weight data are often scarce, particularly during an emergency, thus it is important to interpret any existing data with caution. In addition, data collected at hospitals may be skewed towards better-nourished mothers, who are more likely to give birth in institutions. Fewer women may be able to access hospitals when there is an emergency. Variation in the amount of time between birth and the baby being weighed is also an important source of bias in birth weight data.

4.3 Measuring malnutrition in older children, adults and the elderly (*41*)

Increasing attention is being paid to assessing malnutrition in older children, adults and the elderly. Women, especially during pregnancy and lactation, have long been considered a nutritionally vulnerable group. In some emergencies, high rates of wasting, stunting and being underweight among adults and the elderly have been noted.

Adolescents

Adolescence, which occurs from around 10–18 years of age, is a period of rapid growth. Hence, the anthropometric indices to assess wasting, which are used for slower growing age groups, are not applicable. WHO recommends that adolescent wasting be assessed by calculating BMI for age. New growth curves have been developed that accord with the new WHO Child Growth Standards. BMI for age scores are compared to reference data for American children and a cut-off point below the fifth percentile indicates malnutrition. To assess stunting, height for age is used in the same way as for younger children; the same cut-off points apply.

Adults

The most useful measure of malnutrition in adults is the BMI, an indicator of weight deficit in relation to height, which is equivalent to wasting.

The elderly

The elderly are a difficult group to define and a particularly difficult group to assess anthropometrically. In developing countries, a person may be considered elderly from the age of 45 years onwards, whereas in developed countries, old age is considered to start at around 60 years of age.

As the elderly are more likely to be disabled, bedridden or unable to stand straight, accurately measuring height and hence BMI is difficult. Furthermore, height decline occurs with age at a rate of 1–2 cm per decade after the age of 40 years and even more rapidly in older age. Research suggests that measures such as the arm length and knee length can be used to estimate height in the elderly. However, no standard method of estimating height from these proxy measures has been established.

There are circumstances where the elderly are a particularly vulnerable group (e.g. in middle-income countries where there are low rates of infectious disease but high rates of chronic disease) and where it may be necessary to assess the nutritional status of the elderly at a population level. In these circumstances, BMI should be assessed and the same cut-off points as for adults applied.

5. Measuring malnutrition: population assessment

5.1 Nutrition surveys (*45*)

Measurement of nutritional status for a population is one of the key indicators for:

- monitoring the overall welfare of a population and
- measuring the impact of change in factors that affect the welfare of a population.

Nutrition surveys or assessment provide information for assessment, planning, interventions, monitoring and evaluation of food and nutrition status for the populations. Assessment of nutrition situation for a population is very sensitive, and can be considered reliable and comprehensive if the survey meets the following criteria:

a) accurate assessment of anthropometry during nutrition assessments
b) collection of information that allows an understanding of the situation to be developed, an
c) analysis and interpretation of the anthropometric and related information.

Collection of anthropometric data in isolation presents great challenges in interpreting the meaning of that information and limits the use of the information for good decision-making. The inclusion of a component on diet, along with existing health, water and sanitation, represents a shift of emphasis from anthropometry alone to the collection of information that leads to a greater understanding of the context. Negative change in the nutritional status of a population indicates a problem. The effects of increasing malnutrition are felt in a society both in the short term and long term. The availability of good data provides a strong foundation for the more important next step: the analysis of the information. Malnutrition rates are meaningless without explanations for the levels and trends. Frameworks help in the analysis of information and facilitate a better understanding of the factors that interact to influence nutrition at both the individual and population level.

A better understanding of causes of malnutrition provides a sound basis for the design and implementation of interventions across the sectors. Understanding the roles of different actors leads to more effective strategies and efficient use of limited resources.

Using information on nutrition and other background information supports analysis and decisions on interventions and programs for both short and long-term projects. More specifically, nutrition information:

- serves as a vital indicator of the overall health and welfare of populations especially where regular demographic and health surveys are lacking;
- is critical during crises and emergencies for the identification of most vulnerable or affected individuals or groups;
- serves as a screening tool to identify malnourished individuals needing special assistance;
- helps to evaluate the progress of growth among nutritionally vulnerable groups and to monitor effects of nutrition interventions among vulnerable groups;
- invaluable for programme management (planning, implementation, monitoring and evaluation) in many sectors including food security (agriculture and livestock), health, water and sanitation, education and environment;
- can contribute to designing of food, health and other development policies;
- facilitates analysis of socioeconomic factors, demographics, food security and cultural aspects of a population;
- can be used in crisis mitigation, especially as an early-warning indicator. this speeds up response to threats like droughts or disease outbreaks.

The principal users of nutrition information are: government authorities and nongovernmental organizations that support food security, health and nutrition-related programs and Donors.

Planned nutrition assessments should be part of an overall food security and nutrition information system, that covers both macronutrient and micronutrient assessment.

5.2 Methodology

There are four main data collection methodologies: (*46*)

- repeated surveys
- growth monitoring
- sentinel site surveillance
- school census data.

Repeated surveys

Repeated surveys are population-based surveys that use standard methodologies to collect quantitative and qualitative data. They assess type, severity and extent of malnutrition, and often also its causes, among a representative sample of the population (children and/or adults). The purpose is to support policy-makers and managers to design and prioritize geographical areas and types of interventions. Repeated surveys include national surveys, which are periodically conducted at national level, and small-scale surveys, which are carried out at local level to gather nutrition information within the shortest time possible.

Growth monitoring

Growth monitoring is the continuous monitoring of growth in children. At the individual level, the objective is to identify the slowing of growth or of growth faltering in order to correct it quickly through, for example, a health intervention. At the group level, the objective is to monitor the general nutritional status in order to mobilize local resources to support nutrition-related activities.

Growth is usually measured as weight for age, once per month. Growth monitoring can be conducted by health professionals at maternal and child health clinics (clinic-based growth monitoring) or by trained members of the community in villages (community-based growth monitoring).

Sentinel site surveillance

Sentinel site surveillance involves surveillance in a limited number of sites to detect trends in the overall well-being of the population. The sites may be specific population groups or villages that cover populations at risk. Trends are monitored for various indicators, including nutritional status, morbidity, dietary issues, coping strategies and food security.

Data can be collated and analysed centrally (centrally based sentinel site surveillance) or by trained members of the community (community-based sentinel site surveillance).

School census data

Nutritional assessment is occasionally undertaken in schools, where first-grade children are measured through censuses that are carried out every two to three years. The objective is to identify high-risk children with poor health, malnutrition and low socioeconomic status.

Results can be used to target school feeding programmes and to support policy-making in food-based strategies.

5.3 Elements of the assessment (*45*)

Data for a nutritional assessment fall into four categories: anthropometric, biochemical, clinical and dietary.

Anthropometrics

Anthropometrics are the objective measurements of body muscle and fat. They are used to compare individuals, to compare growth in the young and to assess weight loss or gain in the mature individual. Weight and height are the most frequently used anthropometric measurements and skin fold measurements of several areas of the body are also taken.

Clinical examination and biochemical testing (*46*)

Biochemical testing and clinical examination can contribute to diagnosing micronutrient deficiencies. Iodine, vitamin A deficiency and iron deficiency anaemia are the most common deficiencies. Other micronutrient deficiencies recur during emergencies, for example scurvy, beriberi (vitamin B1 deficiency) and pellagra (vitamin B3 deficiency).

These conditions are usually initially identified clinically, while biochemical means tend to be used mainly to confirm a suspected outbreak. As part of measuring malnutrition risk factors, it is suggested that the following biochemical investigations are included in the surveillance system.

Blood sugar

Raised fasting blood sugar gives sufficient validity to estimate population changes in diabetes and related impairment of glucose tolerance. Diabetes mellitus is an important marker of risk for arterial disease of the coronary, cerebral and peripheral arterial trees, and for microvascular disease leading to blindness and renal failure. For surveillance purposes, mean fasting blood sugar is sufficient as the population-wide indicator of the likely burden of diabetes mellitus. Fasting blood sugar can be measured in the field from a finger prick using a blotting paper technique (or glucometer), which has been standardized. (*47*)

Blood cholesterol (47)

The concentration of cholesterol in the blood shows a continuous and graded relationship with risk of coronary heart disease. The relationship between total cholesterol and risk of cerebrovascular disease (stroke) remains less clear, though lowering cholesterol has shown reduced incidence of stroke in patients on medication. Indians have been shown to be at high risk, even at significantly lower values of cholesterol, and hence a lower range of values for normal cholesterol will have to be decided on. Total blood cholesterol can be measured in the field from a finger prick using a dry chemical technique, which has been standardized.

Dietary assessment (*46*)

Food intake or consumption surveys assess, as accurately as possible, the types and amounts of food eaten. This can be represented in terms of daily energy and nutrient intake per person. The approach may involve weighing amounts of food eaten or using dietary recall.

- *Disadvantages.* Weighed intake assessments are very labour intensive, time consuming and costly. Dietary recall assessments are less invasive but more dependent on memory. The analysis of food intake surveys requires a high level of skills and the use of specific software, as well as the availability of a food composition table.

- *Advantages.* The value of food intake surveys is that they can provide invaluable information on quantities, diet quality and on whether energy and nutrient intakes are being met. Generally, this type of assessment is undertaken in stable contexts where more information is needed about dietary causes of malnutrition.

Dietary diversity scores

Individual dietary diversity scores are a proxy of nutritional quality of the diet. Dietary diversity scores consist of a simple count of the number of food groups consumed by an individual or a household over a given period of time.

The assumption is that the higher the score, the better the quality of the diet. Assessing dietary diversity is useful in evaluating the impact of a wide range of programmes on dietary quality, for example livelihoods and crop diversification, nutrition education, and school and homestead gardens.

These assessments may be carried out in stable situations where there is a known problem of lack of dietary diversity and where efforts to improve agricultural diversification in order to improve diet have been ongoing for many years.

The dietary diversity assessment can also be used in emergency contexts, where shock can adversely impact the quality of the diet.

5.4 Nutrition country profiles

Nutrition country profiles are an example of an integrated multisectoral analysis. They usually include:

- population (population indicators, population pyramid);
- agriculture (land use and irrigation statistics, main crops, agricultural calendar, seasonal food shortage, livestock production and fisheries);
- economy;
- social indicators (health indicators, water and sanitation, access to health services, education, level of development, poverty and other social indicators);
- food and nutrition situation;
- qualitative aspects of the diet and food (food consumption patterns, food security situation);
- national food supply data (supply of major food groups, dietary energy supply, distribution by macronutrient and diversity of the food supply, vegetable/animal origin of macronutrients, dietary energy supply by food group, food imports and exports expressed as percentage of dietary energy supply, food aid);
- food consumption (national-level surveys);
- infant and young child feeding practices;
- nutritional anthropometry (low birth weight, anthropometry of preschool children, anthropometry of school-age children and adolescents, anthropometry of adult women, anthropometry of adult men);
- micronutrient deficiencies:
    - iodine deficiency disorders (prevalence of goitre and urinary iodine level, iodization of salt at household level);
    - vitamin A deficiency (prevalence of subclinical and clinical vitamin A deficiency, vitamin A supplementation);
    - iron deficiency anaemia (prevalence of iron deficiency anaemia, interventions to combat it and other micronutrient deficiencies);
- policies and programmes aiming to improve nutrition and food security.

Appendix 1. Anthropometric measurement of children aged 6-59 months *(41)*

A brief description of the specifications of weighing and measurement equipment suitable for anthropometric surveys is given below.

Weighing equipment

A suitable instrument for weighing children under 5 years of age is a 25-kg hanging spring scale marked out in increments of 0.1 kg. Weighing pants should be provided with the scale. Normally, Salter scales are used (see Figure A1.1). Salter scales can sometimes be bought in a country, although they may be of poor quality. Scales can be ordered from overseas or from UNICEF.

Equipment for measuring height and length

A measuring board is normally at least 130 cm long, is made of hardwood and has a hard water-resistant finish. The board should have a metal or fibreglass tape measure attached to it, which should be marked out in increments of 0.1 cm. Note that metal can get very hot in the sun, so keep equipment in the shade. The head board must be movable and the foot board must be large enough for a child to stand on it (see Figure A1.2).

Height boards are usually ordered from carpenters, although you may be able to obtain them from international agencies or UNICEF. A height arch can be used for measuring children under 110 cm. This can be constructed simply and should consist of a horizontal bar fixed at 110 cm above the ground at right angles to a vertical pole (or between two vertical poles). Any child who can walk under this horizontal bar without hitting it and without stooping should be included in the sample for further measuring.

Equipment for measuring mid-upper arm circumference

Mid-upper arm circumference measurements should be made using a flexible, non-stretch tape made of fibreglass. Alternatively a fibreglass insertion tape can be used. Some agencies such as Oxfam and Action Contre la Faim have produced specially made mid-upper arm circumference tapes for use in nutrition screening. These are colour banded so that the measurer knows whether or not to refer a child for further weight and height measurements.

Measuring children aged six months to five years

Estimating age

Nutrition surveys frequently measure the weight and height of children aged 6 to 59 months. However, in many rural areas of the developing world, the age of children is not known. In general, the younger the child is, the more accurately you can estimate her or his month of birth.

The following methods are helpful for determining or estimating the age of a child, if the mother does not know.

- Look up age in official registers. In rural communities, you normally cannot find local official registers of births or a baptismal certificate book. Instead, some households may have the child's immunization card. If health workers properly recorded the date of birth on the immunization card, then you can copy the date from the card. Therefore, when trying to determine a child's age, you should always ask to see the child's immunization card.

- Use the birth date of a neighbour's child as a reference. If the age of a neighbour's child is known, then you can ask other women whether or not their child was born before or after the reference child.
- Use a local events calendar. A local events calendar shows all the dates on which important events took place during the past five years, for example local holidays, hailstorms, the opening of a nearby school or clinic, elections, etc. You should ask the mother whether or not the child was born before or after a certain event and work out a fairly accurate age in this way.

Estimating age from height

WHO recommends that if for some reason no age data are available and a local events calendar cannot be used to estimate the age of the children, then it may be useful to use a height cut-off instead. WHO has recommended that only children 65–100 cm tall should be included in countries where the prevalence of stunting is known to be high. (*48*)

Weight

Weight should be measured to the nearest 100 g. Although various types of scales are used for weighing young children in the field, the most commonly used is the hanging spring balance, which can weigh up to 25 kg. Hanging scales are robust, inexpensive and easy to carry.

Calibration of the scales should be checked immediately before, and during, each weighing session, using the same known weights. The scales should first be set at zero, with the weighing pants or basket attached.

Suitable items for the calibration include a stone or a standard 5–10 kg weight.

Spring balance scales should be replaced whenever the springs are so stretched that readings are incorrect.

Figure A1.1 shows the correct procedure for weighing a child with a hanging spring balance. It is also important to:

- explain the procedure to the child's mother or carer before starting;
- install a 25-kg hanging spring scale (graduated by 100 g) – if mobile weighing is needed, the scale can be hooked on a tree or a stick held by two people;
- suspend weighing pants from the lower hook of the scale and recalibrate to zero;
- remove the child's clothes and any jewellery and place him or her in the weighing pants (older children may hold on to the bar and lift themselves off the ground); be aware of local culture and temperature when you chose where to measure the child;
- ensure nothing is touching the child;
- read the scale at eye level (if the child is moving about and the needle does not stabilize, estimate weight by using the value situated at the midpoint of the range of oscillations);
- announce the value to the assistant, who repeats, verifies and records.

In cold climates it may not be appropriate or acceptable to weigh children without their clothes on. In this situation, careful preparation before the survey should be conducted so that children can be weighed already clothed. This involves preparing:

- a reference sheet of the weights and descriptions of popular children's clothing items based on the child's age and the season in which the survey is being conducted;
- an album with photographs of different items of clothing with a description of the item, its principal fabric, the age of the children wearing it and its weight.

The team needs to be carefully trained to recognize the items accurately. In the analysis, the weight of each child's clothing should be subtracted from the weight measured. This can result in an accurate estimate of the child's weight.

Source: (*49*)

Figure A1.1. How to weigh a child using Salter scales

Height and length

Every effort should be made to measure children's height accurately, to the nearest 0.1 cm if possible. Measurement errors of 2–3 cm can easily occur and cause significant errors in classifying nutritional status.

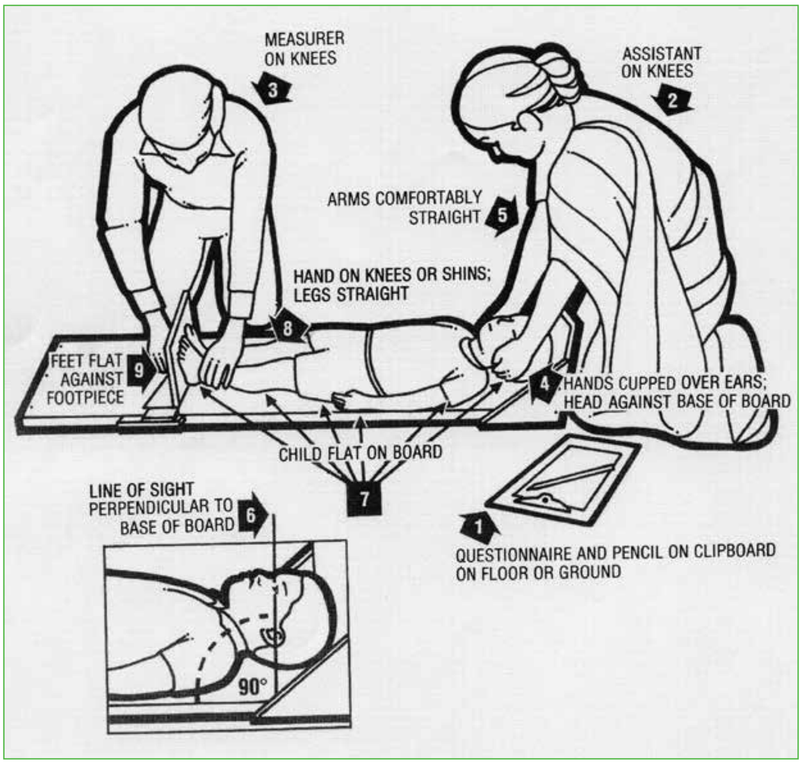
Children aged less than 24 months (or up to 85 cm in height) are measured supine (lying down) on a horizontal measuring board. When children are able to stand, those aged 24–59 months (or over 85 cm) should be measured standing up as children measured lying down will be taller than when they are standing up, so the measurement has to be standardized.(*47*)

Once a child can stand it is easier and more convenient to measure him or her standing up; children are also normally happier to stand than to lie down as it is less frightening for them. In terms of accuracy, it is important to follow the rule that children must be measured in a lying position when they are younger than 24 months and in a standing position when they are older than 23 months. This approach is used because this was how the reference children were measured, and individuals measured in the lying position are taller (on average between 0.5 and 1.5 cm) than individuals measured in the standing position. Thus, if you measure children in a different way from that used to measure the children in the reference tables, you have to adjust for this when you are comparing their heights.

Figure A1.2 shows the correct procedure for measuring the length of a child aged less than 24 months. The only way to learn to do this well is to practise; it cannot be taught just by looking. In addition:

- explain the procedure to the child's mother or carer;
- remove the child's shoes and any hair ornament or top knot on the child's head;
- place the child gently on to the board, with the head against the fixed vertical part, and the soles of the feet near the cursor or moving part (the child should lie straight in the middle of the board, looking directly up);
- the assistant should hold the child's head firmly against the base of the board, while the measurer places one hand on the knees (to keep the legs straight) and places the child's feet flat against the cursor with the other hand;
- the measurer reads and announces the length to the nearest 0.1 cm;
- the assistant repeats and verifies the measurement and then records it.

Note also that in some cultures, measuring a child lying down is related to death (measurement of the coffin). Where this occurs, information and education sessions may be held to prepare mothers for this kind of procedure.

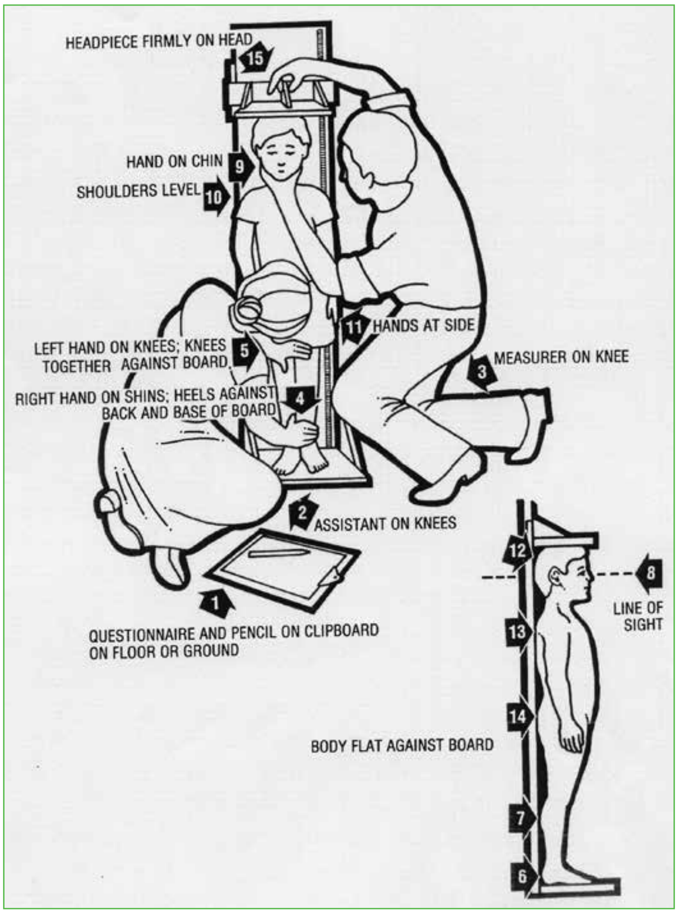


Source: (*49*)

Figure A1.2. How to measure length of a child aged less than 24 months

Figure A1.3 shows the correct procedure for measuring the height of a child aged more than 24 months. In addition:

- explain the procedure to the child's mother or caretaker;
- place the measuring board upright in a location where there is room for movement around the board;
- remove the child's shoes and any hair ornament or top knot on the child's head and stand the child on the middle of the measuring board;
- an assistant should firmly press the child's ankles and knees against the board;
- ensure that the child's head, shoulders, buttocks, knees and heels touch the board;
- the measurer should position the head and the cursor at right angles – the mid-ear and eye socket should be in line and the hair should be compressed by the cursor;
- the measurer reads and announces the height to the nearest 0.1 cm;
- the assistant repeats and verifies the measurement and then records it.



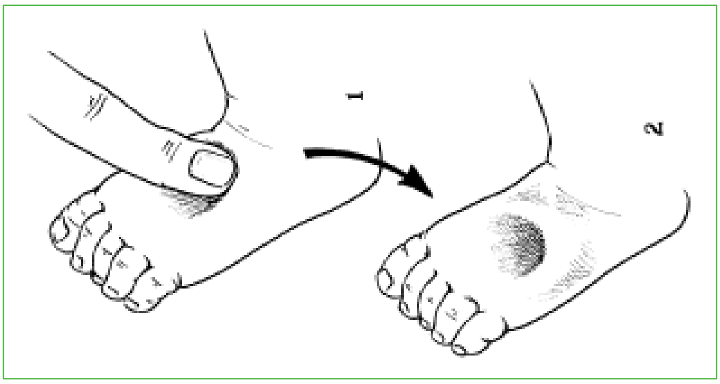
Source: (*49*)

Figure A1.3. How to measure the height of a child aged 24 months or more

Bilateral oedema

Oedema is the retention of water and sodium in extracellular spaces. Generally, it accounts for 10%–30% of body weight, but in the most severe cases of kwashiorkor the proportion can reach 50%. To diagnose oedema, moderate thumb pressure is applied to just above the ankle or the tops of the feet for about three seconds (if you count "one thousand and one, one thousand and two, one thousand and three" in English, pronouncing the words carefully, this takes about three seconds). If there is oedema, an impression remains for some time (at least a few seconds) where the oedema fluid has been pressed out of the tissue.

A child should only be recorded as oedematous if both feet have oedema, as shown in Figure A1.4.



Source: (*49*)

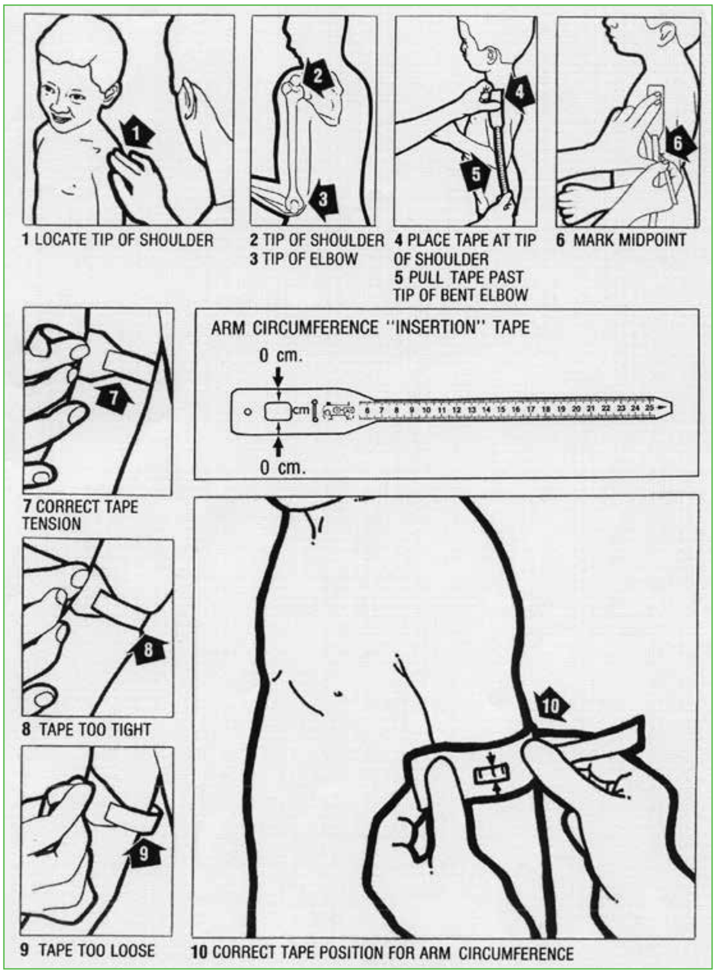
Figure A1.4. How to check for oedema

Mid-upper arm circumference

Arm circumference is measured on the upper left arm. Measurements should be made to the nearest millimetre. Figure A1.5 shows the correct procedure for measuring the mid-upper arm circumference of a child. In addition:

- explain the procedure to the child's mother or carer;
- if possible, the child should stand erect and sideways to the measurer;
- bend the left arm at 90 degrees to the body;
- place a measuring tape along the upper arm and find the midpoint of the upper arm – the midpoint is between the tip of the shoulder (olecranon) and the elbow (acromion process);
- mark the mid-upper arm point with a pen;
- let the left arm hang relaxed at the side of the body;
- place the mid-upper arm measuring tape on the midway point;
- pull the tape until it fits securely around the arm (the tape should not be left too slack nor pulled too tightly – it should touch the skin all the way around the arm, but not make a dent in the skin);
- read the measurement at the window of the tape measure;
- record mid-arm circumference to the nearest 0.1 cm.

Note: mid-upper arm circumference measurement is fast and simple, but not easy, and variations in measurements often occur between different measurers. This is mainly related to how the tape is pulled or squeezed around the arm and to whether the arm muscles are flexed or relaxed.



Source: (*49*)

Figure A1.5. How to measure the mid-upper arm circumference of a child

Appendix 2. Sampling of population *(50)*

What is sampling and why do we do it?

- Sampling is the process of selecting a number of subjects from all the subjects in a particular group.
- A sample is the selected subset of a particular group or universe.
- We sample because we cannot measure every person in the population.
- The goal of sampling is to estimate some measure in the larger population.

To achieve its goal of estimating some measure in the larger population, the sample must be representative of that larger population. Regardless of the sampling method, if the sample is not representative, it tells you nothing about the population.

Preparing the sample *(51)*

Overview

Introduction	This section covers the principles, methods and tasks needed to prepare, design and select the sample for your food and nutrition surveillance system survey.
Intended audience	This section is primarily designed to be used by those fulfilling the following roles: • statistical adviser • surveillance system site coordinator • surveillance system coordinating committee.
Tasks	The sample is prepared as part of the process of planning and preparing the surveillance system survey. This process should take between two days to one week, depending on the methods chosen and availability of information needed to draw the sample. The main tasks are: • define target population • determine sample size • identify sample frame and design • select sample participants • document sample selection.
In this section	The following topics will be covered in this section: • sampling guidelines • determining the sample size • identifying the sampling frame • choosing the sample design • selecting the sample.

Sampling guidelines

Introduction	High-quality survey techniques can provide a good picture of risk factors for nutrition and nutrition-related health problems in a population by using a sample of that population. This is achieved by scientifically selecting the sample from the population. If the sample is drawn correctly it will represent the entire target population. High standards of sample design and selection are essential to achieve valuable and useful results.
Reflecting the scope of the survey in the sample	To achieve a sample that reflects the scope of the survey you need to: • define a target population • scientifically select a sample of the population that is representative of the target population • plan ahead for reporting of survey results by sex and desired age groups.
Define the target population	Each site needs to define the target population for the survey. To define the population you need to take into account the purpose and use of the survey data. For example, do you need the survey to be representative of the entire population or of a specific region?
Sample population	The sample population is a scientifically selected subset of the target population. Once you have defined the target population you select the sample of participants within the target population.
Estimates for age–sex groups	The prevalence of most nutrition and nutrition-related diseases tends to increase with age and vary by sex. Therefore, it is recommended that survey results include estimates for specific age groups for each sex, in addition to the total survey population estimates, in order to provide a more nuanced picture of the prevalence of malnutrition risk factors in the target population To ensure that precise estimates for each age–sex group can be calculated from the survey data, the total number of age–sex groups must be taken into consideration when calculating the sample size. Reporting estimates for a greater number of age groups will require a larger sample size. The next section includes instructions for how to incorporate the total number of desired estimates into the calculation for sample size.

Determining the sample size

<table>
<tr>
<td>Introduction</td>
<td colspan="2">In order to ensure a sufficient level of precision of the survey results, an adequate sample must be drawn from the target population. To calculate the sample size needed, the following factors must be taken into consideration:
• desired level of confidence of the survey results
• acceptable margin of error of the survey results
• design effect of the sampling methodology
• estimated baseline levels of the indicators that we want to measure.
Additionally, the sample size must be adjusted for:
• number of age-sex estimates
• anticipated non-response.</td>
</tr>
<tr>
<td rowspan="5">Helpful terminology</td>
<td colspan="2">The following table provides a brief description of several key statistical terms. It is important to develop a good understanding of this terminology before proceeding to calculate the sample size.</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
</tr>
<tr>
<td>Sample mean/ prevalence</td>
<td>The estimated mean or prevalence of a given population parameter (e.g. mean number of days fruit was consumed in a given week) that is calculated from the survey data</td>
</tr>
<tr>
<td>Population mean/ prevalence</td>
<td>The true mean or prevalence of a given parameter for the entire target population. The sample mean is an estimate of the population mean</td>
</tr>
<tr>
<td>Confidence intervals</td>
<td>A range of values around the sample mean or prevalence in which the population mean or prevalence is likely to fall. For example, a 95% confidence interval indicates that for 95 out of 100 surveys, the population mean would fall into this range of values around the sample mean</td>
</tr>
</table>

Variables used for calculating sample size	The table below provides a description of the variables used in calculating the sample size as well as the recommended values for each variable.		
	Variable	**Description**	**Recommended value**
	Level of confidence	• Probability value that is associated with a given confidence interval • Describes the level of uncertainty in the sample mean or prevalence as an estimate of the population mean or prevalence • The higher the level of confidence, the larger the sample size needed	• 1.96 • Note: 1.96 is the probability value associated with a 95% confidence interval
	Margin of error	• The expected half-width of the confidence interval • The smaller the margin of error, the larger the sample size needed	• 0.05 • Note: If the estimated baseline levels of the indicators you wish to measure are very low (e.g. < 0.10), then the margin of error should be decreased to 0.02 or less
	Design effect	• Describes the loss of sampling efficiency due to using a complex sample design • The design effect for a simple random sample is 1.00. Sample designs more complex than a simple random sample require a larger sample to achieve the same level of precision in survey results as a simple random sample. Thus, the design effect increases as the sample design becomes more complex	• 1.50 • Note: The value 1.50 is recommended for most surveys with complex sample designs. If design effect information is available from previous national surveys of a similar design to the proposed survey, it is recommended to use the previous estimates for design effect
	Estimated baseline levels of the indicators we want to measure	• The estimated prevalence of the risk factors within the target population • Values closest to 50% are the most conservative, requiring the largest sample size	• 0.50, if no previous data are available on the target population • The value closest to 0.50, if previous data is available on the target population

Equation for calculating sample size	The equation for calculating sample size is as follows: $n = Z^2 \frac{P(1-P)}{e^2}$ where: Z = level of confidence P = baseline level of the indicators e = margin of error
Example calculation	Using the above recommendations for each variable, the initial calculation for sample size would be: $n = 1.96^2 = \frac{0.5(1-0.5)}{0.5^2} = 384$ However, this number must be adjusted to account for the design effect of the sample design, the number of age-sex estimates to be reported, and the anticipated non-response.
Adjusting for design effect	To adjust for the design effect of the sample design, simply multiply the sample size by the design effect.
Adjusting for number of age-sex estimates	As discussed previously, it is recommended that survey results be reported separately for specific age groups for each sex. In order to have an adequate level of precision for each age-sex estimate, the sample size must be multiplied by the number of age-sex groups for which estimates will be reported. The number of age-sex estimates will vary according to the target age range of the survey and the resources available for the survey. If the age range of your survey extends beyond the recommended age group, the total number of age-sex estimates may need to be adjusted accordingly. For example, if the age range of 15-24 were also to be included in the survey and 10-year age-sex estimates are desired, the total number of age-sex estimates would be 10.
Adjusting for anticipated non-response	To adjust for anticipated non-response divide by the anticipated response rate. A non-response rate of 20% is the recommended rate to anticipate. This is a conservative estimate based on response rates of previous surveys. If response rates have been consistently higher at your site for similar household surveys, a less conservative (i.e. smaller) non-response rate may be used, such as 10%. Example: For an anticipated non-response rate of 20%, divide the sample size by 0.80.
Summary of sample size calculation	The table below provides a summary of the above steps to calculate sample size.

Step	Description
1	Determine the value of all variables needed to calculate sample size
2	Use the level of confidence, margin of error and baseline level of the indicators in the above equation to get an initial estimate for *n* (sample size)
3	Multiply *n* by the design effect and by the number of age-sex estimates
4	Divide the result from step 3 by the anticipated response rate to attain the final sample size

Sample Size Calculation Example 1	In this example, the recommended values for all parameters of the sample size equation will be used. Thus, the initial calculation proceeds as follows: $$n = 1.96^2 = \frac{0.5(1-0.5)}{0.5^2} = 384$$ This initial n is then multiplied by the design effect of 1.5 and the 8 age-sex estimates desired for the survey results: n = 384 * 1.5 * 8 = 4608 Finally, n is divided by 0.80 to adjust for the anticipated 20% non-response rate: n = 4608 ÷ 0.80 = 5760 5760 is the final sample size.
Sample Size Calculation Example 2	In this example, the recommended values for all parameters of the sample size equation will be used and the initial calculation proceeds just as in the previous example: $$n = 1.96^2 = \frac{0.5(1-0.5)}{0.5^2} = 384$$ However, in this example the estimates will only be reported for 20-year age groups for each sex as the sample size required for 10-year age groups is too large for the resources available. Thus, the initial n is then multiplied by the design effect of 1.5 and 4 age-sex estimates desired for the survey results: n = 384 * 1.5 * 4 = 2304 Finally, n is divided by 0.80 to adjust for the anticipated 20% non-response rate: n = 2304 ÷ 0.80 = 2880 2,880 is the final sample size.

<table>
<tr><td rowspan="9">Sampling very small populations</td><td colspan="2">When the target population is very small (appx. <50 000 people) the sample size can be reduced using a Finite Population Correction (FPC). The steps below describe how to check if the FPC is appropriate for your site and how to apply it to reduce your sample size.</td></tr>
<tr><td>Step</td><td>Description</td></tr>
<tr><td>1</td><td>Complete only steps 1 and 2 in the preceding table to obtain the n for each estimate.</td></tr>
<tr><td>2</td><td>Calculate the target population size for each estimate using available census data or a similar reliable data source.
Example: If 8 10-year age-sex groups will be the estimates, the number of individuals in each age-sex group (e.g. number of males aged 25-34) must be calculated.</td></tr>
<tr><td>3</td><td>The FPC should only be applied when the sample to be drawn represents more than 10% of the target population. Thus for each estimate the n calculated in Step 1 must be divided by the target population size for that estimate to check to see if the FPC can be applied.
Example: n has been calculated as 384. Eight 10-year age-sex estimates are desired. The table below shows the data collected for the first four estimates.

<table>
<tr><td>Desired Estimates</td><td>Target Population Size</td></tr>
<tr><td>Males, 25-34</td><td>2548</td></tr>
<tr><td>Females, 25-34</td><td>2641</td></tr>
<tr><td>Males, 35-44</td><td>3465</td></tr>
<tr><td>Females, 35-44</td><td>3356</td></tr>
</table>

Divide n by the target population for each estimate:
384/2548 = 0.15
384/2641 = 0.15
384/3465 = 0.11
384/3356 = 0.11</td></tr>
<tr><td>4</td><td>If most or all of the quotients from step 3 are 0.10 or higher, then the FPC can be applied (continue to next step). Otherwise, return to step 3 in the preceding table and continue to calculate the total sample size using the n already calculated.</td></tr>
<tr><td>5</td><td>Apply the FPC to the n for each estimate using the following equation:
$$\text{new } n = \cfrac{n}{1 + \cfrac{n}{\text{population}}}$$
where "population" refers to the target population for a given estimate, not the entire target population.</td></tr>
<tr><td>6</td><td>Sum all new n together and multiply the sum by the design effect.</td></tr>
<tr><td>7</td><td>Divide the result from step 6 by the anticipated response rate to attain the final sample size.</td></tr>
</table>

<table>
<tr><td rowspan="10">Further modifications to sample size</td><td colspan="3">There are a variety of situations that may require an adjustment to the sample size resulting from the calculations above. The table below describes some of these situations with directions on how to adjust the sample size.</td></tr>
<tr><td>If</td><td colspan="2">Then</td></tr>
<tr><td rowspan="4">Data for specific subgroups are required (e.g. ethnic groups, urban vs rural dwellers)</td><td colspan="2">There are two ways to proceed depending on the information desired:</td></tr>
<tr><td>If</td><td>Then</td></tr>
<tr><td>Data will only be reported for all individuals in each subgroup</td><td>Set the number of estimates to the larger of:
• the number of age–sex estimates desired
• the number of new subgroups</td></tr>
<tr><td>Data will be reported for each age–sex group within each subgroup</td><td>Multiply the number of age–sex groups by the total number of new subgroups (e.g. total number of ethnic groups) to determine the total number of estimates</td></tr>
<tr><td></td><td colspan="2">Note: It is important to take these subgroups into consideration when allocating the sample to ensure a sufficient number of participants can be drawn from each subgroup (see next topic)</td></tr>
<tr><td>Oversampling is desired for very small subpopulations</td><td colspan="2">Increase the overall n by increasing the n for the specific estimate(s) by 10%</td></tr>
<tr><td>Oversampling is desired for specific subpopulations with higher than average non-response</td><td colspan="2">Increase the overall n by increasing the n for the specific estimate(s) by 10%–20%</td></tr>
<tr><td colspan="3">Note: If oversampling is desired, adjustments usually must also be made when allocating the sample (see next topic). Often, in addition to increasing the sample size, the sample allocation must take into consideration the location of hard-to-reach groups and allocate a greater proportion of the sample to these areas</td></tr>
</table>

Identifying the sampling frame

Introduction	A sampling frame is a list of units or elements that defines the target population. It is from this list that the sample is drawn. A sampling frame is essential for any survey.
Finding available sampling frames	To identify available sampling frames and determine which is best for your site, search for updated lists, databases, registers or other sources that give good coverage of the population you wish to survey. For example, look for population registers or census lists. Various government departments and national bodies should be consulted to establish what frames exist in your country and, if suitable, whether they may be accessed for the surveillance.
Enumeration areas	Most often the sampling frame will use enumeration areas, which are small- to medium-sized geographic areas that have been defined in a previous census. Most countries have this information and it is usually preferable to incorporate this into the sampling frame.
Factors to consider	A sampling frame, or a collection of them, should cover all of the population in the surveyed site. Good coverage means that every eligible person in the population has a chance of being included in the survey sample. Representativeness for all subpopulations should be considered when deciding which frame(s) to use. Watch out for the possibility that particular age, gender or ethnic groups or geographical areas are more or less likely to be included in the sampling frame. Bias will occur if there is poorer coverage for some groups.
Multiple sampling frames	Owing to logistical and financial limitations, most national surveys employ multistage sampling, which is discussed in detail in the following topic. A multistage sample design will require a sampling frame for each stage of sampling.
Features of a good sampling frame	Some features of a good sampling frame are: • it does not contain duplicates, or if present they can easily be identified and removed • it does not contain blanks (e.g. empty houses or a deceased individual) • it contains information enabling all units to be distinguished from all others and to be easily located (e.g. a complete street address) • at the minimum, it contains information about the number of households or total number of individuals • it could be made accessible to the surveillance team within a reasonable timeframe and at no large expense. Note: Sampling frames must be assessed for all the above features, but particularly for completeness and potential bias.

Choosing the sample design

Introduction	The selection of the sample design is highly dependent on a variety of factors, most importantly the size of the population, the geography of the area to be covered and the resources available for the survey. All factors must be kept in mind in selecting the sample design for the survey.
Stratification	Stratification is the process of dividing the sampling frame into mutually exclusive subgroups or strata. The sample is then drawn either proportionately or disproportionately from all strata. How the target population is stratified depends on the information that is available for the sampling frame and the information that is desired from the survey results. Strata are often based on the physical location of the sampling units. Some examples of these types of strata are: • enumeration areas or other well-defined geographic regions • urban vs rural areas. Less often, strata are based on the characteristics of the individuals in the sampling frame. This is less common in large national surveys due to a lack of precise data on all individuals in the target population and the difficulties in developing sampling frames for each strata. Some examples of these types of strata are ethnicity, socioeconomic status and gender. Stratification is not required but is recommended for the following reasons: • increased precision of survey estimates • guaranteed coverage of all strata • administrative convenience. Stratification can be applied in conjunction with other sampling strategies This section discusses simple random sampling and multistage cluster sampling, both of which can be used along with stratification, as described later in this topic.
Stratification and sample allocation	If the decision has been made to stratify the population, it must then be decided whether to sample proportionately from all strata or to sample a larger proportion of individuals from some strata and a smaller proportion of individuals from other strata (disproportional allocation). *Proportional allocation* means sampling the same proportion of individuals from each stratum so that the resulting sample is distributed across the strata similarly to the underlying target population. This type of sample allocation is the appropriate method for surveys that will only be reporting data for all strata combined. *Disproportional allocation* means sampling some strata at a higher rate than other strata. Often this is implemented by drawing an equal-sized sample from each stratum. This type of sample allocation is appropriate when survey results are desired for each individual stratum. In this situation, a larger sample size is usually required to ensure adequate precision in the strata-specific estimates. The primary drawback to this method is a loss of sampling efficiency for the estimates for all strata combined. Note: In some cases where very small strata exist, proportional allocation may be done but oversampling may be required for the very small strata.

<table>
<tr>
<td>Proportional allocation example</td>
<td>
Because proportional allocation is more likely to be used for a survey, an example is provided here.
In this example, the sample size has been calculated to be 3000. The target population has been divided into the four government districts of the country These districts will serve as strata. The target population within each strata has been listed in the table below along with the proportion each comprises of the total target population.
<table>
<tr><th>Strata</th><th>Target population</th><th>Proportion of population</th></tr>
<tr><td>District 1</td><td>25 955</td><td>0.24
(25 955/108 155)</td></tr>
<tr><td>District 2</td><td>30 568</td><td>0.28</td></tr>
<tr><td>District 3</td><td>32 578</td><td>0.30</td></tr>
<tr><td>District 4</td><td>19 054</td><td>0.18</td></tr>
<tr><td>Total</td><td>108 155</td><td>1.0</td></tr>
</table>
To compute the number of individuals from the total sample to be drawn from each strata, multiply the total sample size by the proportion for each strata
<table>
<tr><th>Strata</th><th>Target population</th><th>Proportion of population</th><th>Sample</th></tr>
<tr><td>District 1</td><td>25 955</td><td>0.24</td><td>720
(0.24 × 3 000)</td></tr>
<tr><td>District 2</td><td>30 568</td><td>0.28</td><td>840</td></tr>
<tr><td>District 3</td><td>32 578</td><td>0.30</td><td>900</td></tr>
<tr><td>District 4</td><td>19 054</td><td>0.18</td><td>540</td></tr>
<tr><td>Total</td><td>108 155</td><td>1.0</td><td>3 000</td></tr>
</table>
</td>
</tr>
<tr>
<td>Simple random sampling</td>
<td>
In a small number of settings simple random sampling may be feasible. For household surveys, the following characteristics generally should be met:

small target population
small survey area, the entirety of which can be covered by the resources available
detailed sampling frame is available, listing, at minimum, all households in the survey area, or, at best, all eligible individuals in the survey area.

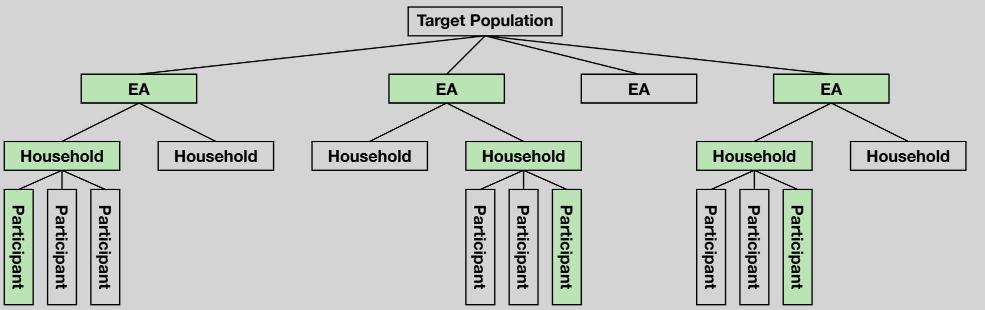
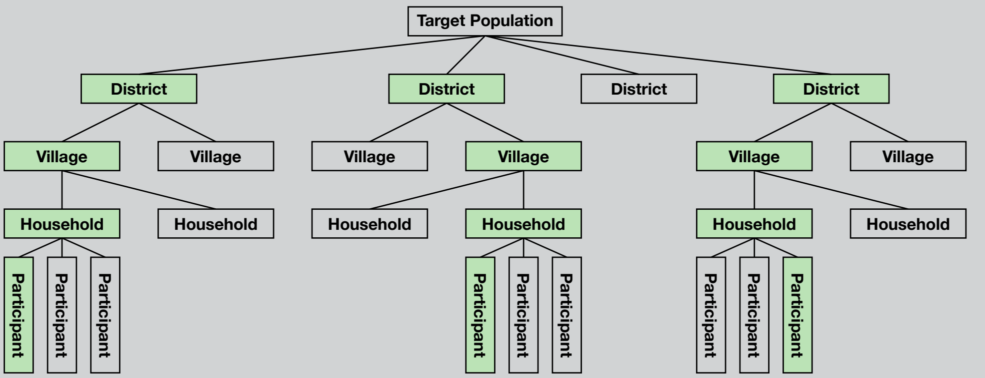
Simple random sampling can be combined with stratification. In stratified random sampling, the population is first stratified and then a random sample is drawn from each strata.
Note: If simple or stratified random sampling is deemed to be feasible at your site, a smaller sample size can be used. In the calculation for sample size a design effect of 1 should be used
</td>
</tr>
<tr>
<td>Multistage cluster sampling</td>
<td>
Multistage cluster sampling is one of the most common sample designs for national surveys and it is the recommended method for most surveys.
"Multistage" indicates that sampling is done in several steps. First, larger sampling units are selected then smaller sampling units are selected within the selected larger units. "Cluster" refers to the fact that the sampling units are subdivided into mutually exclusive clusters and, unlike stratification, only a sample of these clusters is selected for the survey.
</td>
</tr>
</table>

<table>
<tr><td rowspan="4">Why use multistage cluster sampling?</td><td colspan="2">The table below highlights two primary reasons for using multistage cluster sampling. These are very common problems in national surveys that can be overcome with the use of multistage cluster sampling</td></tr>
<tr><td>Problem</td><td>Solution</td></tr>
<tr><td>Detailed information does not exist for all households or individuals in the sample population and it is not feasible to create a detailed sampling frame for the entire survey area</td><td>Multistage cluster sampling allows for the selection of larger sampling units (e.g. villages) that require less detailed information about the target population. It is only at the final stage of sampling (most often the selection of households) that detailed information needs to be available. However, because only a selection of clusters will be chosen at each stage of sampling, the detailed sampling frames are only needed for a subset of the entire target population</td></tr>
<tr><td>The survey area is too large and/or travel costs are too high to draw a sample from the entire country or all regions of interest</td><td>Because the sample is only drawn from selected clusters, multistage cluster sampling allows for a reduced area to be surveyed while maintaining a sample that is nationally (or subnationally) representative
Note: Using multistage cluster sampling does not guarantee a representative sample. If done incorrectly, it will not result in a representative sample. The design of the clusters and the selection of clusters at every stage must be done carefully and consistently and must be documented in detail</td></tr>
<tr><td>Preparing a multistage cluster sampling</td><td colspan="2">In order to implement multistage cluster sampling, the population must be divided into clusters, each of which contains either a number of smaller clusters or, at the final stage, households or individuals. The flowchart below is one example of the multiple sampling stages that could be defined for a site:
Population → District → Village → Household → Individual

Most often the first stage uses enumeration areas from census information. The intermediary stages, if any, may be comprised of existing geopolitical units (e.g. villages) or artificially created units (e.g. a specified collection of city blocks).

Important: The number of sampling units at the initial stage must be fairly numerous (i.e. >100) so at least 50–100 of them can be selected. Selecting a smaller number of sampling units at the initial stage of sampling results in more clustered data and a loss of precision in survey estimates.

A sampling frame will need to be constructed for all clusters in the first stage of sampling. At minimum, these sampling frames must contain the total number of households or total number of target individuals in the cluster. Sampling frames will only be needed for selected clusters at all subsequent stages of sampling, with detailed information (i.e. lists of households or eligible individuals) only needed for the sampling frames for the last stage of sampling.</td></tr>
</table>

<table>
<tr><td rowspan="5">Multistage cluster sampling terminology</td><td colspan="2">The table below describes some key terminology for multistage cluster sampling</td></tr>
<tr><td>Primary sampling unit</td><td>These are the clusters that are selected first. Most often the primary sampling units are enumeration areas from a recent census</td></tr>
<tr><td>Secondary sampling unit</td><td>The clusters that are selected second, separately within each selected primary sampling unit</td></tr>
<tr><td>Tertiary sampling unit</td><td>The clusters that are selected third, separately within each selected secondary sampling unit</td></tr>
<tr><td colspan="2">The list of terms could be extended to describe more levels of sampling as needed.</td></tr>
<tr><td>Example 1</td><td colspan="2">In the following example, there are three stages of sampling. Enumeration areas (EAs) are serving as the primary sampling units. For each selected primary sampling unit, a sampling frame was created comprised of a list of households in the enumeration area. Households were then selected within each primary sampling unit and then one participant was selected within each household. Shaded boxes indicate that the cluster or participant was selected.

</td></tr>
<tr><td>Example 2</td><td colspan="2">In this example, there are four stages of sampling. Districts are serving as the primary sampling units. For each selected primary sampling unit, a sampling frame was created comprised of a list of all villages (the secondary sampling units) with the target population of each village. For each selected village, a sampling frame was also created, comprised of a list of all households in the village. If a detailed list of all eligible individuals were available for any selected village, this list could be used in place of the household list and selection could proceed directly from the village level to the participant level. Shaded boxes indicate that the cluster or participant was selected.

</td></tr>
</table>

<table>
<tr>
<td>Qualities of a good multistage cluster design</td>
<td>One very important check to perform on the multistage cluster design is that every individual in the target population is included in only one sampling unit per stage. This means that the clusters at each level of sampling must cover the entire target population and be mutually exclusive (non-overlapping).

Additionally, it is important to check the characteristics of the primary sampling units. The first two items in the table below can also be used to check the secondary sampling units, tertiary sampling units, etc., but given the nature of multistage cluster designs, these checks are most critical for the primary sampling units.
<table>
<tr><th>If</th><th>Then</th></tr>
<tr><td>Primary sampling units exist that are very small</td><td>Combine these primary sampling units with a neighbouring primary sampling unit before selecting the sample</td></tr>
<tr><td>Primary sampling units exist that are very large</td><td>Split these primary sampling units into two or more smaller primary sampling units that are more similar in size to other primary sampling units</td></tr>
<tr><td>Total number of primary sampling units is small (i.e. < 100)</td><td>Begin sampling at the secondary sampling unit level (the secondary sampling units would then become primary sampling units) or subdivide the existing primary sampling units to ensure that at least 50–100 primary sampling units can be selected</td></tr>
</table>
</td>
</tr>
<tr>
<td>Sample allocation and multistage cluster design</td>
<td>Once the sampling units to be used for primary sampling units, secondary sampling units, etc. have been determined, the allocation of the sample must be decided, i.e. the total number of primary sampling units to be selected, the total number of secondary sampling units to be selected per primary sampling unit, etc. must be determined. The table below describes the steps to take to determine how to allocate the sample.
<table>
<tr><th>Step</th><th>Description</th></tr>
<tr><td>1</td><td>Calculate the total sample size</td></tr>
<tr><td>2</td><td>Assess the resources available and determine the total number of primary sampling units to be sampled, keeping in mind that at least 50–100 primary sampling units should be selected</td></tr>
<tr><td>3</td><td>Divide the total sample size by the number of primary sampling units to be sampled to determine the number of individuals to be sampled per primary sampling unit</td></tr>
<tr><td>4</td><td>Continue subdividing the sample size at each stage of sampling according to the number of sampling units to be selected at each stage</td></tr>
</table>
Note: As stated previously, stratification can be combined with a multistage cluster design. The total number of primary sampling units would be allocated proportionately or disproportionately (depending on the requirements of the survey results) across all strata and sample allocation would continue within each strata following the steps above.
</td>
</tr>
</table>

<table>
<tr>
<td>Example</td>
<td>
For this example, assume that the total sample size has been calculated to be 3200 individuals. It has also been decided that regions will serve as primary sampling units, villages will serve as secondary sampling units, and then households will be selected in each village. Resources will allow for 80 primary sampling units to be selected, meaning that 40 (= 3200/80) individuals will be selected per primary sampling unit.
There is some flexibility in how the 40 individuals per primary sampling unit are allocated. At this point it would be worthwhile to consider a few scenarios and select the one that is feasible yet provides a good distribution of individuals across the primary sampling unit (i.e. not too many or two few of the 40 individuals drawn from a given village). Two scenarios are presented below.
Scenario 1
10 individuals will be selected per village, meaning that 4 villages (= 40/10) must be selected per primary sampling unit
Sample allocation:
80 regions × 4 villages/region × 10 individuals/village = 3200
Scenario 2
5 individuals will be selected per village, meaning that 8 villages (= 40/5) must be selected per primary sampling unit
Sample allocation:
80 regions × 8 villages/region × 5 individuals/village = 3200
In terms of resources, the key difference between the above scenarios is the number of villages that would need to be visited within each primary sampling unit. This number will likely be a deciding factor in the allocation of the sample, keeping in mind that having a high number of individuals selected from only a few villages would result in greater clustering of survey data and a potential loss of precision in survey estimates.
</td>
</tr>
<tr>
<td>Example with stratification</td>
<td>
For this example, assume again that the total sample size has been calculated to be 3200 individuals and that regions will serve as primary sampling units, villages will serve as secondary sampling units, and then households will be selected in each village. Just as in the previous example, resources will allow for 80 primary sampling units to be selected. However, in this example, the survey designers wish to ensure that the sample is drawn proportionately across the four islands that comprise the country.
The table below shows the proportion of the total underlying population that each island represents. The right-most column shows how the number of primary sampling units would be proportionately allocated across these four islands or strata.
<table>
<tr><th>Island</th><th>Proportion of total population</th><th>Primary sampling units</th></tr>
<tr><td>A</td><td>0.50</td><td>40</td></tr>
<tr><td>B</td><td>0.175</td><td>14</td></tr>
<tr><td>C</td><td>0.125</td><td>10</td></tr>
<tr><td>D</td><td>0.20</td><td>16</td></tr>
<tr><td>Total</td><td>1.00</td><td>80</td></tr>
</table>
Thus, 40 regions (primary sampling units) will be picked out of all regions on island A, 14 regions will be picked out of all regions on island B, and so on. Once the primary sampling units are selected per island, sample allocation continues just as in the preceding example, with the same number of villages being selected in each primary sampling unit, regardless of the island on which the primary sampling unit is located.
</td>
</tr>
</table>

Selecting the sample

<table>
<tr><td>Introduction</td><td colspan="2">Once the sample design is selected and the sampling frame has been prepared, you are ready to proceed with sample selection. This section provides instructions for the various stages of sampling.</td></tr>
<tr><td>Available tools</td><td colspan="2">There is an Excel workbook entitled “STEPSsampling.xls” that includes spreadsheets for every stage of the sample selection. This will:
• provide probability proportional to size sampling (see description below) for primary and secondary sampling units as needed
• randomly select households or individuals
• provide information for weighting the data
The workbook is available on the STEPS website. (*52*)</td></tr>
<tr><td>Probability proportional to size sampling</td><td colspan="2">Probability proportional to size sampling is a method for selecting a sampling unit in which the probability of selection for a given sampling unit is proportional to its size (most often the number of individuals or households within the sampling unit). It is appropriate for use when sampling units are of markedly different size. In these situations, were random sampling to be used to select sampling units, those individuals in the larger sampling units would have a much smaller chance of selection than those individuals in the smaller sampling units. Probability proportional to size sampling corrects this problem, therefore reducing bias in survey estimates.</td></tr>
<tr><td rowspan="6">Instructions for probability proportional to size sampling</td><td colspan="2">The table below outlines the steps required to perform probability proportional to size sampling on a list of sampling units. Before beginning, a list of sampling units and their corresponding sizes (in number of households or in population) must be compiled. It is recommended that this list be organized geographically, meaning that sampling units located near each other are also near each other on the list. Additionally, the number of sampling units (clusters) to be selected must be decided. The STEPSsampling.xls tool will automatically perform steps 3–8 in the table below. The instructions worksheet inside the file explains how to perform probability proportional to size sampling using either the primary or secondary sampling unit worksheet in the file</td></tr>
<tr><td>Step</td><td>Action</td></tr>
<tr><td>1</td><td>Create a list of all sampling units with their size (either number of households or population). If possible, order this list geographically, placing sampling units that are physically adjacent near each other on the list</td></tr>
<tr><td>2</td><td>Determine the number of sampling units to be selected from the list</td></tr>
<tr><td>3</td><td>Create a new column containing the cumulative size of the sampling units. The final total should match the total population across all sampling units</td></tr>
<tr><td>4</td><td>Divide the total cumulative population size (N) by the number of sampling units to be selected (n) to obtain the sampling interval (k): $k = N/n$</td></tr>
</table>

	Step	Action
	5	Choose a random number (r) that is between 1 and the sampling interval (k): $1 < r < k$
	6	Start at the top of the list and select the first sampling unit whose cumulative population size includes the random number (r)
	7	To select the second cluster, first add the sampling interval to the random number (r). Then begin counting from the previous cluster selected until the cumulative population size includes this sum ($r + k$)
	8	Select the remaining clusters by adding the sampling interval, multiplied by 2, then 3 and so on, to the random number. Always start counting from the previous cluster selected not the start of the list: $r + (k \times 2)$ $r + (k \times 3)$, etc.
	9	Continue until the end of the list is reached. Do not stop as soon as n units have been selected. To avoid bias, all units selected must be used in the survey, even if the number is slightly greater than n
Using probability proportional to size sampling with a multistage cluster design	Probability proportional to size sampling can be applied at all stages of a multistage cluster design except for the final stage in which households or individuals are selected. The STEPSsampling.xls tool provides worksheets for selecting your primary and secondary sampling units using probability proportional to size sampling. The worksheet entitled primary sampling unit allows for the selection of up to 100 primary sampling units from an entered list of all primary sampling units. The worksheet entitled secondary sampling unit allows for the selection of the secondary sampling units within each selected primary sampling unit. Therefore, the secondary sampling unit worksheet must be duplicated, one for each primary sampling unit that was selected, so that an independent selection of secondary sampling units can be performed for each primary sampling unit.	

<table>
<tr><td rowspan="5">Selection of households and/or individuals</td><td colspan="2">The final stage of sampling, the selection of households and/or individuals, will depend on the type of information available. The table below describes the possible scenarios for the final stage of sampling and the sample selection process for each.</td></tr>
<tr><td>If</td><td>Then</td></tr>
<tr><td>A list of eligible individuals is available for the selected sampling unit (e.g. village)</td><td>First check that the list of eligible individuals meets the following requirements:
• the list is up to date (e.g. people who have moved away or who have died are not included in the list)
• the list contains specific information allowing for each selected individual to be located by the interviewers
If both conditions are met, the selection of individuals can be done randomly from the list</td></tr>
<tr><td>No or limited information is available about the individuals in the selected sampling unit but a list of households exists for the sampling unit</td><td>First check that the list of households meets the following requirements:
• the list is up to date and each household listed represents a single dwelling
• the list contains specific information allowing for each selected household to be located by the interviewers
If both conditions are met, the selection of households can be done randomly from the list
If there is a concern that the list may be out of date, it is recommended that the survey team first perform a quick survey of the sampling unit to update the list, noting abandoned/destroyed dwellings, new dwellings, or expanded dwellings (single family into multifamily)</td></tr>
<tr><td>The number of households is known for the sampling unit but there is no information about their location</td><td>In this situation the sampling unit should be mapped to determine the location of the households. Please contact the STEPS team for more guidance on this method or other alternatives</td></tr>
</table>

30 × 30 Cluster sampling (52)

Current guidance recommends the use of the two-stage cluster sampling technique for nutritional surveys. This is an adaptation of a design originally applied to immunization coverage surveys. A cluster is a group of neighbouring households. This methodology involves selecting 30 clusters randomly in the first stage and then selecting 30 children randomly within each cluster in the second stage (giving a total sample of 30 × 30 = 900 children). Some organizations recommend that households are sampled in the second stage rather than children, and that all the children within the sampled household are measured. This means that the final sample size may be higher or lower than 900. The cluster approach is more convenient than simple random sampling, as the number of sites that must be visited is considerably reduced. Also cluster sampling does not require a complete list of all sampling units (households or individuals) in the population (known as the sampling frame). Appendix 4 describes cluster sampling in more detail.

However, cluster surveys have a number of drawbacks:

- accurate population data are needed to list the population in villages or population units and these may not be available in an emergency;
- the data cannot be disaggregated to produce statistically reliable results for subsamples (e.g. different age groups);
- sparsely populated areas are underrepresented, even though the methodology attempts to address the fact that the probability of a cluster being selected is proportional to the size of the population in that particular village or population unit;
- mobile and pastoral populations are difficult to assess because they do not easily form an identifiable cluster with 30 individuals to be measured;
- cluster surveys are time consuming and expensive.

Appendix 3. Nutrition assessment checklist *(53)*

Below are sample questions for assessments examining the underlying causes of malnutrition, the level of nutritional risk and possibilities for response. The questions are based on the conceptual framework of the causes of malnutrition. The information is likely to be available from a variety of sources and gathering it will require a variety of assessment tools, including key informant interviews, observation and review of secondary data.

1. What information exists on the nutritional situation?
   - Have any nutrition surveys been conducted?
   - Are there any data from mother and child health clinics?
   - Are there any data from existing supplementary or therapeutic feeding centres?
   - What information exists on the nutritional situation of the affected population prior to the current crisis (even if people are no longer in the same place)?
2. What is the risk of malnutrition related to poor public health?
   - Are there any reports of disease outbreaks that may affect nutritional status, such as measles or acute diarrhoeal disease? Is there a risk that these outbreaks will occur?
   - What is the estimated measles vaccination coverage of the affected population?
   - Is vitamin A routinely given in measles vaccination? What is the estimated vitamin A supplement coverage?
   - Has anyone estimated mortality rates (either crude or under five years)? What are they and what method has been used? (see Module 3, Appendix 1).
   - Is there, or will there be, a significant decline in ambient temperature likely to affect the prevalence of acute respiratory infection or the energy requirements of the affected population?
   - Are people already vulnerable to malnutrition due to poverty or ill health?
   - Have people been in water or wet clothes for long periods of time?
3. What is the risk of malnutrition related to inadequate care?
   - Is there a change in work patterns (e.g. due to migration, displacement or armed conflict) which means that roles and responsibilities in the household have changed?
   - Is there a change in the normal composition of households?
   - Are there large numbers of separated children?
   - Has the normal care environment been disrupted (e.g. through displacement), affecting access to secondary carers, access to foods for children, access to water, etc.?
   - What are the normal infant feeding practices? Are mothers bottle-feeding their babies or using manufactured complementary foods? If so, is there an infrastructure that can support safe feeding?
   - Is there evidence of donations of baby foods and milks, bottles and teats or requests for donations?
   - In pastoral communities, have the herds been away from young children for long? Has access to milk changed from normal?
4. What is the risk of malnutrition related to reduced food access?

5. What formal and informal local structures are currently in place through which potential interventions could be channelled?
   - What is the capacity of the Ministry of Health, faith-based organizations, infant feeding support groups or nongovernmental organizations with a long- or short-term presence in the area?
   - What is available in the food pipeline?
   - Is the population likely to move (e.g. for pasture, assistance or work) in the near future?
6. What nutrition intervention or community-based support was already in place, organized by local communities, individuals, nongovernmental organizations, government organizations, United Nations agencies, faith-based organizations, etc.? What are the nutrition policies (past, ongoing and lapsed), the planned long-term nutrition responses, and programmes that are being implemented or planned in response to the current situation?

Appendix 4. 30 × 30 two-stage cluster sampling methodology *(53)*

Step 1: Selection of the 30 clusters

1. Identify the population to be surveyed (e.g. population of a refugee camp or drought stricken area).
2. Divide the population into existing or natural groupings (e.g. villages, districts or camp sections).
3. Estimate the population in each village, district or camp section (use census data if available).
4. Make a table with six columns (see Table A4.1):
   - column 1 should include the name of each locality (village, district or camp section) in any order;
   - column 2 should contain the estimated total population of each locality;
   - column 3 should contain the estimated population of the children in each locality;
   - column 4 should contain the cumulative population of the children (obtained by adding the population of each locality to the combined population figure of the preceding localities);
   - column 5 should contain the attributed numbers for each unit – the range of the cumulative population for each unit.
5. Calculate the "sampling interval". This is obtained by dividing the total 6–59 months population by the desired number of clusters, which is usually 30. In this example, the sampling interval is 10 000/30 = 333.
6. Determine the location of the first cluster. Its location is randomly chosen by selecting a number within the first sampling interval (1–333 in this example). The number can be randomly selected using a random number table. Let us assume that 256 is the starting point. This number places the first cluster in "Locality 1" in the example because it has the attributed numbers 1–500.
7. Select the other clusters. Add the sampling interval sequentially to the starting number until 30 numbers are chosen. Each number chosen represents the population of a geographic unit. In this example, the first cluster is at 256 (Locality 1), the second cluster at 256 + 333 = 589 (Locality 2), the third cluster is at 589 + 333 = 922 (Locality 4), the fourth cluster is at 922 + 333 = 1255 (Locality 4), etc. A large geographical unit may appear twice – two clusters are drawn in Locality 4 in the example. In the same way, a small geographical unit (smaller than the sampling interval) may not be selected – Locality 3 in the example.

Table A4.1. Selection of the 30 clusters

Geographical unit	Estimated total population	Estimated children aged 6–59 months	Cumulative population aged 6–59 months	Attributed numbers	Location
Locality 1	2 500	500	500	1– 500	1
Locality 2	1 000	200	700	501– 700	1
Locality 3	800	160	860	701– 860	0
Locality 4	3 250	650	1 610	861–1610	2
Etc.					
Total	50 000	10 000			30

Step 2: Selection of the 30 children in each of the 30 clusters

Having identified the 30 clusters, a team of data collectors should go to the site of each cluster. At any given cluster, or locality the following procedure is followed:

1. Go to the centre of the selected locality (ask local people for information).
2. Randomly choose a direction by spinning a pencil or pen on the ground and noting the direction in which it points when it stops.
3. Walk in the direction indicated by the pen, from the centre to the outer perimeter of the locality, counting the number of households along this line.
4. Select the first household to be visited by drawing a random number between 1 and the number of households counted when walking. For example, if the number of households counted was 27, then select a random number between 1 and 27. If the number 5 was chosen, then the fifth household on the walking line is the first you should visit.
5. Go to the first household and examine all children aged 6–59 months in the household. The subsequent households are chosen by proximity. In a locality where there is a high population concentration, proceed by always choosing the next house to the right or to the left (decide which at the beginning of the survey and always use this choice). Continue to go to the left or right until the required number of children has been measured. The same method should be used for all clusters. However, if the locality has a very spread-out population, then proceed by simply choosing the nearest house. The nearest house is the one with the door nearest to the last house surveyed, whether it is on the right or left (this should save you a lot of time in an area where the dwellings are very spread out). Continue the process until the required number of children has been measured.
6. If there are no children aged under 5 years in a household, proceed to the next house. All eligible children are included and thus should be measured and weighed.
7. This means that all children in the last house should be measured even if this means exceeding the number required. If a child is not present at the time of the survey go back to the house later to find the child (continue to look for the missing children until leaving the survey area). If a child cannot be found, replace the child with another by continuing the sampling methodology. If a child has been admitted to a feeding centre, the team must go to the centre and measure the child there. It is extremely important to follow this house-to-house method. If children are just called to the centre of the locality, it is likely that some of the children could be missed which could result in bias.
8. If there are insufficient children found in a locality (i.e. 30 children) then proceed to the nearest locality. Repeat the process of spinning a pen and randomly selecting a house to start. Proceed from house to house until you have measured a sufficient number of children.

Appendix 5. New methods for estimating coverage *(53)*

Programme coverage is an important indicator for monitoring and evaluating humanitarian interventions. A 30 × 30 cluster survey is the recommended method to assess coverage. However, cluster surveys have a number of drawbacks. For example, areas that are sparsely populated and that may be farthest from health services and aid distribution points risk being left out, as clusters are more likely to fall in highly populated areas. Furthermore, the sample size will usually be too small to estimate coverage with reasonable precision. New methods for estimating coverage of selective feeding programmes are therefore being tested. Two methods are the lot quality assurance sampling approach and the centric systematic area sampling approach.

Lot quality assurance sampling approach

The lot quality assurance sampling approach is often used in industries to identify defective products. The approach is relatively easy to do and can be done using small sample sizes. The method sets acceptable and unacceptable performance thresholds in which selected units fall into the categories of either “Pass” or “Fail”. To assess malnutrition, a threshold for acute malnutrition is set (e.g. 10%) in a defined population (e.g. children aged 6–59 months) and a “lot” defined (e.g. group of households).

The use of lot quality assurance sampling to assess acute malnutrition and other child-level indicators has been examined in food-insecure settings. Three lot quality assurance sampling designs were developed to assess acute malnutrition thresholds of 10%, 15% and 20%. The designs were field tested at the same time as a 30 × 30 cluster survey in Siraro, Ethiopia in June 2003. Using a nested study design, anthropometric, morbidity and vaccination data were collected on all children aged 6–59 months in sampled households.

The estimated prevalence of acute malnutrition was similar using the lot quality assurance sampling designs or the 30 × 30 cluster survey and the confidence intervals for the lot quality assurance sampling designs were only slightly wider than the confidence intervals for the 30 × 30 cluster survey, yet the lot quality assurance sampling designs could be carried out quicker. The study concluded that the lot quality assurance sampling designs provide statistically appropriate alternatives to the more time-consuming 30 × 30 cluster survey. However, additional field testing is needed.

Module 5: Supervision, monitoring and evaluation

This module describes steps to supervise, monitor and evaluate a food and nutrition surveillance system.

1. Learning objectives

- To describe the role of a central nutrition surveillance unit for monitoring and evaluating the quality of food and nutrition surveillance activities in relation to the surveillance plan.
- To describe the objectives and steps in supervising, monitoring and evaluation of activities of the surveillance system.

2. Introduction

"Good supervision helps health staff to perform their best. During supervision one must just observe and reinforce stipulated practices in surveillance. The crux of supervisory visits should be on education, coordination, motivation, facilitation and guidance with the overall objective of implementing corrective action.

Monitoring is the routine tracking of priority information about a programme and its intended outcomes. This is likely to include monitoring of inputs and outputs through record-keeping and regular reporting systems as well as health facility observation and client surveys." (*54*)

"Monitoring is also a vital component of any surveillance programme and would determine the efficacy and effectiveness of the surveillance mechanisms in place. The various indicators should be continuously and vigorously monitored at different levels. Quality of data generated by the surveillance system is crucial if the decisions are to be made on the basis of analysis of results. All the activities related to Integrated Disease Surveillance Projects require to be monitored for quality control. These actives include collection of data; compilation of data; analysis and interpretation; follow-up action and feedback." (*55*)

Evaluation is an occasional activity of greater complexity than monitoring. Evaluation is used to determine the impact of a programme and the effectiveness of the various components in supporting the outcomes and impact.

"The main objective of supervision and monitoring and evaluation is to encourage and improve the quality of work associated with surveillance and not to find fault with the individual and system." (*55*)

Monitoring and evaluation can accomplish the following:

- document success of a programme towards achieving its goals and objectives;
- identify and help address areas that need to be strengthened;
- provide information to help others initiate surveillance systems;
- strengthen established nutrition surveillance systems;
- provide reliability to the government, nationally and internationally;
- provide evidence of success that can be used in fundraising. (*56*)

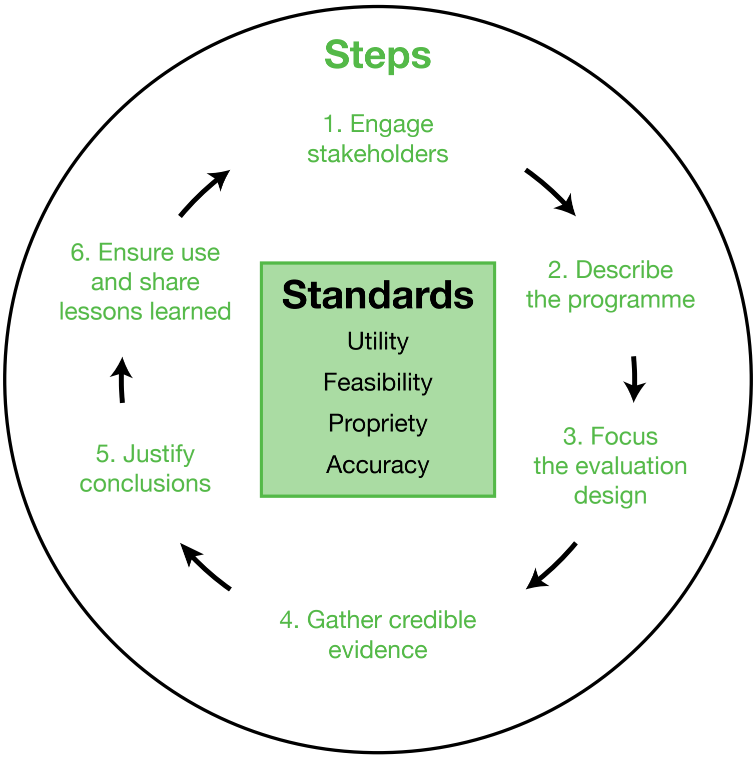
All concerned personnel of the nutrition and nutrition-related information at all levels are directly responsible for the quality of data generated.

Regular quality control is the responsibility of the district and national surveillance officers. (*55*) In addition, during the implementation phase of the surveillance, external evaluation of the surveillance will be carried out by appropriate agencies identified by the central nutrition surveillance unit.

3. Monitoring and evaluation cycle (*56, 3*)

Programmes usually begin with an assessment or situation analysis of country needs. Based on this information, a programme is designed with appropriate goals and objectives. A logic model including inputs, processes, expected outputs, outcomes and impact is usually part of programme planning. Monitoring of inputs, processes, outputs and outcomes, as described in the logic model, occurs throughout programme implementation and provides feedback for the improvement of programme design and activities. Additionally, a more formal and thorough evaluation of the various programme components and effects will be carried out at intervals, which will also provide feedback for the improvement of programme implementation.

Monitoring is carried out consistently throughout programme implementation and evaluations occur at several designated points throughout and following programme implementation. The frequency and number of planned evaluations will change based on the length and needs of the programme. It is useful to schedule evaluation points during the planning phase of the surveillance, but additional evaluations may be added as needed.



Source: (*56*)

Figure 1. Framework for programme evaluation in public health

The framework is composed of six steps that must be taken in any evaluation (Figure 1). They are starting points for tailoring an evaluation to a particular public health effort at a particular time. Because the steps are all interdependent, they might be encountered in a non-linear sequence; however, an order exists for fulfilling each as earlier steps provide the foundation for subsequent progress. Thus, decisions regarding how to execute a step are iterative and should not be finalized until previous steps have been thoroughly addressed. The steps are as follows:

- Step 1: Engage stakeholders
- Step 2: Describe the programme
- Step 3: Focus the evaluation design
- Step 4: Gather credible evidence
- Step 5: Justify conclusions
- Step 6: Ensure use and share lessons learned.

Adhering to these six steps will facilitate an understanding of a programme's context (e.g. its history, setting and organization) and will improve how most evaluations are conceived and conducted.

The second element of the framework is a set of 30 standards for assessing the quality of evaluation activities, organized into the following four groups: (*56*)

- Standard 1: *Utility:* serve the information needs of intended users.
- Standard 2: *Feasibility:* be realistic, prudent, diplomatic and frugal.
- Standard 3: *Propriety:* behave legally, ethically and with due regard for the welfare of those involved and those affected.
- Standard 4: *Accuracy:* reveal and convey technically accurate information.

Monitoring and evaluation play a role in providing information to identify connections between programme efforts and resources and programme goals.

A key to a useful evaluation is proper documentation of the programme's activities. Setting up a complete and consistent monitoring system will provide the data needed for evaluation. Tools and activities for ongoing monitoring and evaluation of system activities, products and impacts should be implemented with the initiation of the nutrition programme. These processes should then become routine in order to increase the effectiveness of both monitoring and evaluation.

The surveillance system must be continuously supervised and monitored if a high quality of surveillance is to be ensured. Constant and supportive supervision vastly improves the quality of the surveillance and motivates the staff to improve their performance. Ongoing monitoring and prompt corrective action are also essential for the success of any surveillance programme.

4. Supervision

Supervision should help the nutrition and health staff to improve their knowledge and performance and not be a faultfinding exercise. Supervisors and health professionals work together to review progress, to identify problems, to decide what has caused the problem and to develop feasible solutions.

4.1 Prerequisites for supervision

The following are all prerequisites for supervision:

- *Job descriptions.* For effective supervision, each category of health staff should have job descriptions (charter of duties) for surveillance. The job description should clearly describe the surveillance activity to be performed. It should also mention who the health staff reports to and also under which supervisor the staff functions.
- *Resources.* The supervisory team will require resources to perform this activity.
- *Attitude.* The supervisory team should not be a faultfinding mission; they should be a support to the field staff and enable them to implement their activities.

4.2 Steps in supervision

The following steps should be followed in supervision:

1. *Supervisory plan.* A supervisory plan should be prepared to cover all the surveillance units. Supervisory visits of the surveillance units are vital to correct any problems such as shortages of reporting formats, etc. and hence mobility of the supervisor is critical. This plan must be communicated to field staff so that they are prepared for the visit.
2. *Checklist.* A checklist is a tool to help the supervisory team. It helps the team to review most of the important activities.
3. *Review the previous supervisory visit report.* This should be done so that the supervisory team is acquainted with the situation in the field. It will also make them review the follow-up actions from the previous visit.
4. *Supervisory visit.* The supervisory team should then visit the field and, using tools such as the checklist, review records and assess staff performance. Any gaps identified should be tackled on the spot if possible, or solved at a later stage. On-the-job training should also be provided to improve the quality of activities.
5. *Feedback.* During the visit the supervisor should provide feedback to the staff so that corrective measures can be implemented to improve the surveillance. Both positive and negative feedback should be given so that the supervisee is immediately aware of his or her performance.
6. *Recommendation.* Specific recommendations and actions should be taken in a specific time frame. (*55*)

5. Monitoring (*56*)

The list of the required indicators builds the basis for the information that can be collected to monitor the system. Ongoing monitoring can help with advocating for resources and early identification of problems or potential problems.

The use of monitoring information assumes that the system is being implemented according to a plan developed to achieve specific desired outcomes. Ideally, monitoring and evaluation are included in the plan to help ensure a successful implementation of the surveillance system. The programme plan describes important outcomes and the activities necessary to achieve them, and includes a timeline.

A monitoring and evaluation plan specifies indicators of the actual performance of the necessary activities and methods and a timetable for collecting and reviewing the indicator data (monitoring indicators) and responding to the monitoring results, in much the same way that a surveillance team frequently reviews surveillance data using clear, objective standards and criteria.

Monitoring should be conducted at various levels of system implementation. Some examples of how monitoring can be used are described below.

Inputs

Programmes may choose to monitor inputs, such as the number and qualifications of surveillance supporters. This would allow the programme to identify and implement any needed improvements in recruiting and marketing.

Outputs

Programmes may want to monitor outputs, such as the number of detected emerged nutrition problems and related health consequences, or surveillance evaluations completed. These can be tracked by the type of problem investigated, type of surveillance system evaluated, area of the country, or individual student or student cohort. A programme may want to look at the quality of the outputs by measuring such things as proportion of investigations or evaluations that have been presented at international meetings or have resulted in a published paper.

Outcomes

Programmes may also look at whether the recommendations from the work were implemented. These can all be examined in the detail and timing decided by the programme. If many studies were done but no action taken as a result, a programme may want to consider the reasons for this and look at the appropriateness of the topic of study, the quality of the work or the appropriateness of the recommendations.

The five essential components of a monitoring system are: (*57*)

1. definition of essential data to collect, including case definitions (i.e. a set of standard criteria for deciding whether a person has a particular disease or health-related condition – criteria can be clinical, laboratory or epidemiological);
2. systematic collection of data;
3. organization and analysis of data;
4. implementation of nutrition and health interventions based on the data;
5. re-evaluation of interventions.

6. Evaluation (*58*)

The evaluation of the food and nutrition surveillance system should promote the best use of public health resources by ensuring that only important problems are under surveillance and that surveillance systems operate efficiently and include recommendations for improving quality and efficiency. Most importantly, an evaluation should assess whether a system is serving a useful public health function and is meeting the system's objectives.

Because surveillance systems vary widely in methodology, scope and objectives, characteristics that are important to one system may be less important to another. Efforts to improve certain attributes, such as the ability of a system to detect a health event (sensitivity), may detract from other attributes, such as simplicity or timeliness. Thus, the success of a system depends on the proper balance of characteristics, and the strength of an evaluation depends on the ability of the evaluator to assess these characteristics with respect to the system's requirements. In an effort to accommodate these objectives, any approach to evaluation must be flexible.

6.1 Steps for evaluating a surveillance system

The steps for evaluating a surveillance system are as follows:

1. Describe the public health importance of the health event.
2. Describe the system to be evaluated.
3. Indicate the level of usefulness of the system.
4. Evaluate the system.
5. Describe the resources used to operate the system (direct costs).
6. List conclusions and recommendations.

1. Describe the public health importance of the health event

The following are the three most important categories to consider:

- incidence and prevalence of nutrition and health problems
- indices of severity such as the mortality and morbidity rates
- preventability.

The public health importance of a nutrition and health problem and the need to have that problem under surveillance can be described in several ways. Nutrition and health problems that affect many people or require large expenditures of resources clearly have public health importance.

Measuring the public health importance

Parameters for measuring the importance of a nutrition and health problem, and therefore the surveillance system with which it is monitored, include:

- incidence and prevalence
- indices of severity
- mortality rate and morbidity
- an index of lost productivity (e.g. bed-disability days)
- an index of premature mortality (e.g. years of potential life lost)
- medical costs
- preventability.

Preventability can be defined at several levels from preventing the occurrence of disease (primary prevention); through early detection and intervention with the aim of reversing, halting, or at least retarding the progress of a condition (secondary prevention); to minimizing the effects of disease and disability among those already ill (tertiary prevention). From the perspective of surveillance, preventability reflects the potential for effective public health intervention at any of these levels.

2. Describe the system to be evaluated

The objectives of the system define a framework for evaluating the specific components.

- List the objectives of the system.
- Describe the nutrition and health problems under surveillance.
- Draw a flow chart of the system.
- Describe the components and operation of the system.

This can be done by answering the following questions:

- What is the population under surveillance?
- What is the period of time of the data collection?

- What information is collected?
- Who provides the surveillance information?
- How is the information transferred?
- How is the information stored?
- Who analyses the data?
- How are the data analysed and how often?
- How often are reports disseminated?
- To whom are reports distributed?
- How are the reports distributed?

3. Indicate the level of usefulness of the system

Indicate the level of usefulness by describing actions taken as a result of the data from the surveillance system. Characterize the entities that have used the data to make decisions and take actions. List other anticipated uses of the data.

A surveillance system is useful if it contributes to the prevention and control of adverse nutrition and health problems, including an improved understanding of the public health implications of such problems. A surveillance system can also be useful if it helps to determine that an adverse nutrition and health problem previously thought to be unimportant is actually important.

An assessment of the usefulness of a surveillance system should begin with a review of the objectives of the system and should consider the dependence of policy decisions and control measures on surveillance. Depending on the objectives of a particular surveillance system, the system may be considered useful if it satisfactorily addresses at least one of the following questions.

Does the system:
- Detect trends signalling changes in the occurrence of disease?
- Detect high prevalence and/or emerging nutrition problems?
- Provide estimates of the magnitude of morbidity and mortality related to the nutrition and health problem under surveillance?
- Stimulate epidemiological research likely to lead to control or prevention?
- Identify risk factors associated with disease occurrence?
- Permit assessment of the effects of control measures?
- Lead to improved clinical practice by the health-care providers who are the constituents of the surveillance system?

4. Evaluate the system for each of the following attributes

Simplicity

The simplicity of a surveillance system refers to both its structure and ease of operation. Surveillance systems should be as simple as possible, while still meeting their objectives.

A chart describing the flow of information and the lines of response in a surveillance system can help assess the simplicity or complexity of a surveillance system. The following measures might be considered in evaluating the simplicity of a system:
- amount and type of information necessary to establish the diagnosis
- number and type of reporting sources

- method(s) of transmitting case information/data
- number of organizations involved in receiving case reports
- staff training requirements
- type and extent of data analysis
- number and type of users of compiled case information
- method of distributing reports or case information to these users
- time spent with the following tasks:
  - maintaining the system
  - collecting case information
  - transmitting case information
  - analysing case information
  - preparing and disseminating surveillance reports.

Flexibility

A flexible surveillance system can adapt to changing information needs or operating conditions with little additional cost in time, personnel or allocated funds. Flexibility is probably best judged retrospectively, by observing how a system responded to a new demand.

Acceptability

Acceptability reflects the willingness of individuals and organizations to participate in the surveillance system. In terms of evaluating a surveillance system, acceptability refers to the willingness to use the system by:

- persons outside the sponsoring agency (e.g. those who are asked to do something for the system);
- persons in the sponsoring agency that operates the system.

To assess acceptability, one must consider the points of interaction between the system and its participants. Quantitative indicators of acceptability include:

- subject or agency participation rates;
- if participation is high, how quickly it was achieved;
- interview completion rates and question refusal rates (i.e. if the system involves interviews with subjects);
- completeness of report forms;
- physician, laboratory or hospital/facility reporting rates;
- timeliness of reporting.

Some of these measures may be obtained from a review of surveillance report forms, while others may require special studies or surveys.

Sensitivity

The sensitivity of a surveillance system can be considered at the level of nutrition problem reporting; the proportion of cases of a nutrition or health condition detected by the surveillance system can be evaluated.

The sensitivity of a surveillance system is affected by the likelihood that:

- persons with certain nutrition or health problem seek medical care;
- the nutrition or health problem will be diagnosed, reflecting the skill of care providers and the sensitivity of diagnostic tests;
- the case will be reported to the system, given the diagnosis.

The extent to which these questions are explored depends on the system and on the resources available for the evaluation. The measurement of sensitivity in a surveillance system requires:

- the validation of information collected by the system
- the collection of information external to the system to determine the frequency of the condition in a community.

Predictive value positive

Predictive value positive is the proportion of persons identified as having cases who actually do have the condition under surveillance. In assessing predictive value positive, primary emphasis is placed on the confirmation of cases reported through the surveillance system. Its effect on the use of public health resources can be considered on two levels. At the level of an individual case, predictive value positive affects the amount of resources used for case investigations. The other level is that of detection of epidemics. Calculating the predictive value positive may require that records be kept of all interventions initiated because of information obtained from the surveillance system. A record of the number of case investigations done and the proportion of persons who actually had the condition under surveillance would allow the calculation of the predictive value positive at the level of case detection.

Representativeness

A surveillance system that is representative accurately describes:

- the occurrence of a health event over time
- its distribution in the population by place and person.

Representativeness is assessed by comparing the characteristics of reported events to all such actual events. Although the latter information is generally not known, some judgement of the representativeness of surveillance data is possible, based on knowledge of:

- characteristics of the population (e.g. age, socioeconomic status, geographic location);
- natural history of the condition (e.g. latency period, mode of transmission, fatal outcome);
- prevailing medical practices (e.g. sites performing diagnostic tests, physician referral patterns);
- multiple sources of data (e.g. mortality rates for comparison with incidence data, laboratory reports for comparison with physician reports).

Quality of data is influenced by the clarity of surveillance forms, the quality of training and supervision of persons who complete surveillance forms, and the care exercised in data management.

Timeliness

Timeliness reflects the speed or delay between steps in a surveillance system. The interval usually considered first is the amount of time between the onset of a nutrition and health problem and the report of the problem to the public health agency responsible for instituting control and prevention measures. Another aspect of timeliness is the time required for the identification of trends, outbreaks or the effect of control measures.

5. Describe the resources used to operate the system (direct costs)

The resources directly required to operate a surveillance system are sometimes referred to as direct costs and include the personnel and financial resources expended in collecting, processing, analysing and disseminating the surveillance data.

In estimating these resources consider the following:

- *Personnel requirements.* A first step is to estimate the time it takes to operate the system (e.g. person-time expended per year of operation).
- *Other resources.* These may include the cost of travel, training, supplies, equipment and services (e.g. mail, telephone and computer time).

The application of these resources at all levels of the public health system, from the local health-care provider to municipal, county, state and federal health agencies, should be considered.

6. List conclusions and recommendations

List conclusions and recommendations and state whether the system is meeting its objectives. Also address the need to continue and/or modify the surveillance system.

1. Learning objectives

- Describe and identify the data management elements; basic data management consolidation and analysis of the data and dissemination of the results.
- Describe and identify the data management function and the role of the data management team in the food and nutrition surveillance system.
- Describe the methods to assess the quality of data.
- Describe the steps of data processing and analysis and the role of the statistician in the surveillance system.

2. Introduction

An important aspect of a successful food and nutrition surveillance system is that it provides timely and accurate information. Continued, high-quality information from national surveillance sites is crucial. The surveillance data manager must be able to generate data analyses that are meaningful, readily available and reliable. The analyses and reports generated can be used to monitor the workload and to monitor progress towards achieving the goals of the surveillance system.

3. What is data management?

Data management can be defined as "The planning, execution and oversight of policies, practices and projects that acquire, control, protect, deliver, and enhance the value of data and information assets." (*59*) This definition makes clear that data management does not start at the point of data collection, but must already be part of the planning phase of any programme such as a surveillance survey.

A data management system should be established as a tool for facilitating those tasks.

4. The data management system (*60*)

A functional data management system supporting surveillance activities consists of the following elements:

- basic data management
- consolidation and analysis of the data
- dissemination of results.

4.1 Basic data management

Data entry and update

The system must allow for basic data entry, retrieval, modification, validation and deletion capabilities.

Data cleaning

A well-designed validation process may facilitate the detection and reduction of various types of errors in the data. A computer system can use three methods:

- entry validation, i.e. ensuring that the data entered are adapted to preset specifications;
- error reports can be generated to identify a number of problems; these reports should identify the record for easy retrieval as well as indicate the variable and value in error;
- double data entry, i.e. entering each record twice, preferably by different people, and comparing them for discrepancies.

Maintaining data reliability

One should, at all times, be able to read the data entered into the data management system and these data should exactly reflect all entries and modifications. Although this seems an obvious statement, several factors may prevent the maintenance of such data reliability:

- hardware failure, such as a crashed disk, can occur at any time without warning;
- computer viruses can affect the content of data files;
- an unauthorized person may gain access to the data and, purposely or not, make modifications;
- the user may make unplanned changes, such as accidentally deleting files or records.

To counteract the effects of computer viruses, an antivirus package should be used. Inappropriate access to the system may be minimized by including security features in the software and/or in the physical environment.

Making a copy of the data on a different disk (i.e. backing up the data) represents the best way to avoid a major disaster should any of the above problems occur. Data should be backed up on a routine basis as well as before and after exceptional events, such as when transferring the complete system to another machine. Multiple copies of the data should be made, dated and stored in different locations. Off-site storage should be considered in case of fire or theft. While good data preservation procedures cannot guarantee data integrity, they decrease the possibility of serious loss of data.

4.2 Consolidation and analysis of the data

Data consolidation is very important in order to be able to provide information on the number of cases of nutritional problems by time, place and person. In general, the process of analysis consists of making comparisons and drawing conclusions. For example, a comparison of the number of vitamin A deficiency cases reported each month may lead to the observation that this number is increasing and thus one might conclude that action needs to be taken to control this emerging increase.

Surveillance data provide a basis for identifying new or unexpected events. However, the identification of such events can often be achieved by ad hoc analyses of the data. A good information system will therefore provide easy access to statistical software. *Epi Info* (61) *WHO Anthro* (62) and *SMART* (63) facilitate quick and easy analysis for nutritional status.

4.3 Dissemination of results

Dissemination of results may involve feedback, and reports and other forms of presentation to decision-makers and others.

Feedback

Feedback is critical for two reasons:

- it motivates people to continue sending data, as they can see how their data are being used;
- the quality of the data is likely to be better, as the reports may have errors that are obvious to those who supplied the data and can therefore be corrected.

Two types of feedback reports should be used:

- *Audit reports.* The purpose of the audit report is to ensure that the data have been correctly received and entered. It is of particular relevance in those situations where the data are received on paper and need to be entered on computer at the next level. Essentially, the report consists of a line listing of cases with all or selected (i.e. the most important) variables, which must then be checked for completeness and accuracy by those who supplied the data. The audit report should be structured to facilitate this process and should be scheduled to allow timely correction.
- *Analytic reports.* Analytic feedback reports should incorporate two important analyses not possible at the reporting level: comparison of the reporting site with other reporting sites and comparison with the total.

Ideally, each reporting site should be capable of analysing its own data. In some instances, this may not be possible and the more central level may produce site-specific analyses as a service to the reporting site.

Audit and analytic feedback reports may be produced at different times covering different time periods; for example, audit reports may be sent monthly while analytic reports could be sent quarterly.

Reports to decision-makers

It should be obvious that results must be made available to those who implement or influence public health action at all levels. The analyses should be clearly presented in a manner appropriate to the audience, should support the recommendations being made and should be as timely as possible. Limitations of the data should also be clearly described.

Other reports

Periodic reports may be required on a routine basis by other administrative bodies or partner agencies. Standard report formats can be designed and produced as part of the surveillance system. For example, in order to keep the public informed about the condition under surveillance, the media can be informed through periodic or routine reports. These could range from a single article to regular updates, using basic text as well as images such as graphs or maps to convey information.

Format of presentation

In general, graphic presentation of data communicates more effectively than tables. Maps should be used to describe results by place, line charts for describing results by time, bar charts when comparing groups and pie charts to represent percentage contribution of a total.

All graphic presentations should be clearly explained with titles indicating person, time and place, axes labels and footnotes showing the source of the data.

The importance of graphic presentation suggests that the surveillance computer system should incorporate graphics software and that the raw data can easily be converted to a format accessible to this software. *Epi Info* has built-in graphics capabilities, while *Epi Map* (a component of *Epi Info*) can read *Epi Info* data files. The WHO *HealthMapper* software (*64*) is designed to generate maps for distribution of any event by its location, levels, size and importance or by any other factor the user requires the event to be displayed with.

Tables also have their place as they can contain more information and give exact numbers. When compiling a report, the target audience and aim of the presentation should help determine the appropriate balance of tables and graphs.

Feed forward

The term "feed forward" refers to the process by which data are supplied by one level to the next more central level. It is the responsibility of each level to ensure that the more central level is kept informed about the condition under surveillance.

Each level in the health service, from facility level to district, province and national levels, and to WHO regional and central levels, needs to know what surveillance data are required by the more central level. Agreement must be reached between the two levels concerned on how often and when data should be sent, as well as the format in which data should be sent. Data might be forwarded on standard forms or may be submitted electronically on diskette or by e-mail.

5. Data quality

The quality of the data can be assessed by asking the following questions:

- Are the collected data appropriate to achieve the objectives of the surveillance system?
- Are the data representative?
- Are data sources taken into account when interpreting the results (e.g. school, clinic, etc.)?
- Are seasonal variation taken into account (e.g. food consumption patterns in an agriculture area; diseases that are affected by seasonal variability, etc.)?
- Are the data valid and reliable?
- Are surveyors qualified and did they receive proper training, supervised by qualified supervisors?
- Are standardization procedures used for the measurements?
- Has the measuring equipment been calibrated by a responsible person?
- Are the results consistent with other countries in the Region or with countries of similar economic, climatic or demographic characteristics?

Quality control measures include the following:

- thorough training of staff plus pretesting of tools;
- standardization tests – intrapersonal/interpersonal errors;
- close monitoring of fieldwork by qualified persons;
- cross-checking of field questionnaires for irregularity;
- review of data collectors' experiences and problems;
- progress review per plan and by checklist;
- data cleaning: collection, entry;
- integrity of equipment;

- data analysers are a key factor for obtaining suitable data outputs, adequately interpreted in relation to the decisions and within reasonable time periods;
- tabulations of nutritional and related outcome indicators by suitable groupings that can lead to action by decision-makers.

6. Data processing *(65)*

Data processing is the process of converting data into information. Processing is done through computers, which accept raw data as input and provide information as output. Data processing steps are as follows:

1. *Collecting.* The first step is collecting the raw data to be processed. The first question to answer is from which data do you want information?
2. *Sorting.* The relevance of data is very important in data processing. Irrelevant data decrease the quality of the information and sorting is required to obtain relevant output information. Data must be in proper categories.
3. *Structuring.* This is similar to "netting" or "coding". Random data may create processing problems. Structuring involves aligning random data in a particular structure, thus enabling data processing.
4. *Entering data.* There must be data for the software to process. Thus entering organized data in to the software required to obtain processed information at the end of the process.
5. *Cleaning.* This step increases the quality of the processed data. At this stage the quality controller double checks and validates the data. Cleaning helps to process data more efficiently.
6. *Proper formatting.* The final step is the most important, as proper formatting helps in the understanding of the data and without this data processing has no meaning.

Regardless of the kind of data processed or the kind of device or equipment used, all data processing systems involve at least three basic steps: input, processing and output. These three steps constitute the data processing cycle:

1. *Input.* In this step initial data, or input data, are prepared in some convenient form for processing.
2. *Processing.* In this step input data are changed and usually combined with other information to produce data in a more useful form. This step usually involves a sequence of basic processing operations.
3. *Output.* Here the results of the preceding steps are collected. The particular form of output data will depend on the use to which the data are to be put.

7. Data collection team *(66)*

Building the capacity of interviewers and other field personnel is crucial to successful data collection. The quality of data collection depends on the consistency and quality of these workers. Training staff is therefore a major task.

The data collection team undertakes a core function in the quality of the surveillance system. The following staff may be necessary, depending on the objectives of the system:

- data collection supervisor;
- interviewers;
- clinic and health professionals to take blood samples and other biochemical measurements;
- laboratory technicians;
- administrative staff.

The data collection supervisor may be the same person as the site coordinator. The core roles of the data collection supervisor are:

- training field staff;
- obtaining and managing household lists and maps for each area or other lists to be used as the sampling frame;
- ensuring data quality;
- managing human resource performance and issues;
- sending progress reports to the STEPS site coordinator or regional focal point;
- providing completed instruments to the data entry supervisor at the end of each day.

8. Data management team *(66)*

The data management team includes all those who have been recruited to enter, check, clean, correct and analyse the data gathered by the surveillance team.

8.1 Data management supervisor

The data management supervisor acts as the team leader, planning and organizing staff and workload to ensure work proceeds smoothly. The data management supervisor's role may sometimes be filled by the surveillance coordinator or the data analyst.

The core roles of the data collection supervisor are:

- training data entry staff
- obtaining the necessary hardware and software
- planning, preparing and setting up the computing environment
- supervising the data entry and validation processes
- managing human resource performance and data management team issues
- seeking and providing advice on software support
- creating a master dataset
- reporting problems or interview errors to the data collection team supervisor.

8.2 Data entry staff

The data entry staff are all those who have been recruited to enter, check and validate the data gathered by the surveillance team. The core roles of data entry staff are:

- logging receipt of completed instruments
- filing and organizing paper copies of instruments
- entering surveillance data
- identifying errors and resolving problems with supervisors.

Data entry staff should have the following skills and attributes:

- accurate keyboard skills
- computing experience or willingness to learn
- methodological and tidy work habits
- clear handwriting
- ability to follow instructions consistently but to raise concerns when appropriate
- interact efficiently with others to achieve accurate results.

9. Statistical adviser *(66)*

The statistical adviser plays a key role in the sampling and data management process. The statistical adviser may be part of the coordinating committee or the analysis team. If a statistical adviser within a site cannot be identified, the Regional Office will be able to advise and assist with this role.

The statistical adviser provides an integral role in the sampling and weighting of the surveillance data. The objective of the adviser is to ensure that a proper sample is selected and that the sample can be weighted to make the results nationally representative.

The statistical adviser should have:

- an advanced degree in statistics
- a special interest in surveillance statistics
- experience with sampling and weighting data
- an interest in population health statistics
- ability to discuss concerns and convey advice clearly to the data analysis team.

The statistical adviser, under the guidance of the coordinating committee, will be responsible for:

- collecting the sample frame
- drawing the surveillance sample
- reviewing available tracking material and adapting to site-specific samples
- applying weights to surveillance data
- providing statistical advice during the analysis and reporting process.

Note that the tracking material is the interview tracking form. The statistical adviser or the supervisor will advise the data collection team on the importance of properly tracking the sample and the impact it has on making the data representative of the target population.

10. Data analysis team *(66)*

The data analysis team should work closely with the site coordinator, data management team and statistical adviser to produce results for inclusion in various site reports.

Data analysts are staff who have been assigned to undertake the descriptive and statistical analysis of data gathered using a standard procedure. The core roles of the data analyst are:

- supervising and/or conducting variable checks on entered data
- importing the dataset, creating a database and data protectio
- generating derived variables
- undertaking exploratory data analysis
- undertaking descriptive analyses (e.g. means and proportions)
- undertaking nutritional status analysis
- calculating weights for estimation, under guidance of the statistical adviser
- producing tables and graphs for reports
- assisting in report preparation.

It is desirable that the data analyst has some qualifications and experience in data analysis and statistics. They should:

- have a science or computing background
- be computer literate
- understand outputs of means, proportions and confidence intervals.

11. Data entry office *(66)*

Good quality data need a good quality facility. The data entry office will need to accommodate the data management team. When setting up the data entry office, consider the following:

- the room or rooms need to be of adequate size to accommodate all data entry staff and computers;
- set up tables to optimize physical work flow;
- create a pleasant environment for the team, who will often sit for long periods;
- provide boxes or folders for questionnaires awaiting data entry;
- provide work space for stacking papers at different stages of processing;
- provide temporary storage for individual questionnaires requiring problem resolution;
- set up a filing system for questionnaires once data entry and checking are completed;
- set up computers with good ergonomic positioning, to minimize reflections on screen and to avoid build up of heat generated by machines.

General office equipment and supplies required for the coordination of the surveillance survey and the data entry office include:

- benches and table space
- photocopier
- shelving
- filing cabinets or boxes
- telephone
- at least one computer with internet connection
- office stationery supplies (e.g. paper, pens, envelopes, staplers).

Computers

Where there is a choice, the general advice for computer selection is as follows:

- choose industry-standard computers and operating systems
- machines must have capability to transfer information (i.e. CD writer, networked or USB (flash disk) drive;
- purchase from reputable dealers;
- if buying new, seek the highest specification machine(s) you can afford;
- speed of processing, memory capacity and hard disk space are important for data analysis but machine(s) with less memory may be adequate for data entry;
- desktop machines are usually cheaper and more easily maintained than portable machines;
- have at least two machines available to ensure backup in case of failure.

Printers

The quality of printer required is determined by the amount and type of printing the surveillance materials and data entry team requires:

- producing lists, error checking and reporting progress generally only requires a simple black-ink printer;
- producing high-quality letters, main results and reports with tables and graphs requires a more highly specified machine, possibly with colour capacity.

If purchasing a new printer, use reputable dealers and buy well-known, industry-standard machines and accessories.

Other equipment that may be needed, depending on the location and facilities, include:

- data back up (e.g. CD drivers, blank CDs, USB flash stick, fireproof safe);
- power supply – uninterruptible power supply machines.

Software

The following is a list of software that you will need to have set up on your office computer(s):

- *Microsoft Office 2003* or higher (recommended for reports, correspondence and general word processing);
- virus-scanning software, if connected to the internet and/or exchanging files outside the office;
- *WHO Anthro* and *WHO Anthro plus* (or later version) for data entry;
- Statistical analyses: e.g. *Epi Info* 3.3 (or later version) for data analysis or *SPSS*. (*67*)

WHO Anthro, *WHO Anthro plus*, and *Epi Info* are available free. *SPSS* has to be purchased.

12. Preparing the data management environment (*68*)

This section covers all the tasks that need to be conducted to set up, prepare and test data files for the surveillance data entry. It is designed for use by people who have been assigned the following roles:

- data management team supervisor
- data management team
- surveillance coordinator.

These tasks may be started but not completed until the data management team has been recruited and trained.

The section covers the following topics:

- software
- setting up the computer environment
- installing software
- data entry templates
- modifying the templates
- file security
- setting up the data entry process
- documentation
- testing
- completing *Epi-Info* or *SPSS*, *WHO Anthro* and *WHO Anthro plus* software installations, which allow users to:
    - capture the survey data
    - verify data entry accuracy
    - conduct the analysis
    - generate reports.

Where complex multistage sampling methods have been used, statistical packages other than Epi-Info may be required for analysis purposes. Some sites may also have other software installed for which local expertise is available. Using familiar methods may be a sensible option in these situations. However, if you do wish to consider using methods other than the recommended, carefully consider what features the programmes require.

The stages in the process of preparing the data management environment are:

1. Create a master computer.
2. Create the surveillance data file folders.
3. Access and install *WHO Anthro*, *WHO Anthro plus*, *SPSS* or *Epi-Info*.
4. Install the data entry templates.
5. Modify the data entry templates.
6. Test.
7. Complete the software installation.
8. Install the "master" data entry system on all other computers.

12.1 Setting up the computer environment

It is important to set up your computer environment properly prior to working with the data files.

Create the master computer and label others

Designate and label one of the computers in the surveillance office as the master computer. This computer is used to install, modify and test the data entry templates prior to installing them on the other computers.

Label all the other computers (e.g. A, B, C, D, etc.).

Identify computers

You need to identify which machine will be used for which function. Most likely you will not be using all the data entry machines for analysis. Prior to installing any software you should have identified:

- a master computer
- data entry computers
- data analysis computers.

12.2 Setting up the data entry process

Prior to receiving completed instruments in the surveillance office for data entry, you will need to set up a standard working method to ensure accurate and efficient handling of surveillance material and data entry.

Working method

Create a standard working method that includes the following elements:

- labels for computers being used for data entry
- boxes or folders for each computer to store instruments and tracking forms
- coversheets for computer-specific folders/boxes
- data entry guidelines and rules (protocols)
- data entry staff assigned to specific data entry computers.

Labelling computers

Where there is more than one computer being used for data entry, you will need to label each machine so you can enter and track specific information.

Filing process

Establish a system of boxes or folders to store the hard copies of the instruments that have been entered on each computer. Label these with the coversheet.

Stages of the filing process are as follows:

1. Create generic filing/ storage area for instruments with coversheets.
2. Create computer-specific folders with coversheets for instruments that are assigned to a machine but not yet entered (category: first keying).
3. Create computer-specific folders with coversheets for instruments that have been first keyed (category: second keying).
4. Create computer-specific folders with coversheets for instruments that have been second keyed (category: completed).

Note: Each folder needs to be used for only one section of the instrument. A section refers to the defined parts of the instrument (e.g. survey or location). If a machine is being used to enter more than one section, a set of folders will need to be created for each section.

Protocols

Create data entry protocols to cover each of the key stages in the data entry process. Key stages in the data entry process that should be covered with data entry protocols are:

- *Handling incoming instruments.* Specify how to sort, label and handle the completed incoming instruments for the data collection team.
- *Data entry.* Specify how data entry staff will perform the data entry process and what they should do when they find unexpected or ambiguous data.
- *Marking and filing.* Ensure any paper is easily located at any time and all instruments and forms show on them their stage of processing.
- *Handling uncertain data.* Obtain a supervisor's ruling on uncertain data and a method for documenting what decisions are made.
- *Documentation.* Ensure an audit track of all completed and altered records.

Data entry staff

You should permanently assign data entry staff to work at a specific computer through the whole data entry process.

12.3 Documentation

Documentation is essential for an efficient and effective surveillance.

Documenting data files

All data files must be documented to ensure:

- standardization of processes and procedures among all data management team members;
- non-reliance on certain individuals to provide key information;
- easy access to essential information, regardless of absence;

- data entry and data analysis can be done when the person who created the database is not available;
- survey data comparisons are possible in the future.

Other documentation requirements

All surveillance files and resources must be:

- stored systematically (both paper and electronic)
- fully documented
- documented continuously (i.e. do not plan to come back later to make notes, instead make it a habit to comment on your files and code as you work).

12.4 Testing *(66)*

Once the templates have been set up, the data entry screen and all data entry systems and processes must be thoroughly tested to identify and correct any faults prior to data entry. The two test phases are:

- primary testing;
- pilot testing of all data entry processes.

Who should be involved?

Table 1 identifies who should be involved in each testing stage.

Table 1. Functions involved in the testing stages

Type of test	Who should be involved
Primary test data entry	Supervisor or person responsible for modifying the templates.
Pilot test data entry processes	Data entry staff (and/or members of the data collection team if necessary) and the data entry supervisor

Testing timeframes

The length of time required to thoroughly test data systems is as follows:

- the primary test takes a few hours;
- pilot testing takes place over a few days.

Primary test

Table 2 shows the steps involved in the primary test. This should be done on the same machine and by the same person who modified the templates.

Table 2. Steps of primary testing

Step	Action
1	Using the finalized surveillance Instrument, create 8–12 completed surveillance questionnaires: • use different coloured paper or otherwise distinguish between these test forms and real ones by labelling them as test • make them straightforward, correct and clear, but with a variety of “participants” (e.g. smokers and non-smokers, active and sedentary)
2	Create a new folder entitled "Test"
3	Copy the entire folder and paste it into the new test folder
4	Use the "Test" file for the testing phase
5	Run an initial test to check the templates

Pilot test

Use your trained data entry team to fully pilot test all the modified templates and data entry processes. The data entry staff should use the data entry handbook, which outlines the protocols and procedures. Table 3 shows the details of the testing process.

Table 3. Steps of the testing process

Step	Action
1	Create a full set of data collection forms including: • interview tracking forms • 8–12 surveillance instruments • blood collection forms • biochemical measurement forms (if used) Include some errors in these forms too, e.g. • torn pages • non-existent clusters • invalid participant identification numbers
2	Test all logging and sorting processes: • use data entry log to sort and distribute all instruments • use data entry tracking form to document data entry
3	Test all error correction systems including: • documentation • data recovery (practice backing up data)
4	At each step, report errors to supervisor and refine the original data template and instructions for handling different scenarios
5	When testing is complete and error free, delete test folders from the computers

13. Training guides

The training guide provides guidance on how to plan, prepare for and deliver training to the data collection, data entry and data analysis teams. It is designed for use by people who have the following roles:

- surveillance site coordinator
- data collection team supervisors
- data management team supervisors.

Purpose of training

The purpose of the training is to:

- explain the rationale of the food and nutrition surveillance system
- ensure a uniform application of the surveillance materials
- motivate interviewers and surveillance staff
- ensure good overall quality of data
- ensure useful and meaningful results are reported

Training courses

A combination of formal classroom training and hands-on experience is required to adequately train staff recruited to work on the food and nutrition surveillance survey.

The following three separate training courses should be conducted to ensure each member of the three recruited teams receives appropriate training:

- interviewer training
- data entry training
- data analysis training.

Refresher training is optional but may be useful if:

- there is a significant gap between when the classroom training was completed and the start of the survey;
- the pilot test showed up knowledge gaps and some aspects of the training need to be repeated.

Training module content and duration

Training module content and duration may need adaptation for individual sites; for example, some modules in the data entry course may be shorter if participants already have relevant experience, or longer if the participants have not used computers before.

Participation

The training courses are intended primarily for members of the respective teams. However, to help with coordination, the team supervisors could be invited to attend one or more of the training courses.

It is recommended that in addition to the data analysis course, the statistical adviser should also attend the data entry course, and attend the data collection course too if possible.

Training preparation

Training preparation involves the following tasks:

- finding and setting up a suitable training room
- scheduling training sessions
- coordinating training tasks and events
- preparing, printing and distributing training materials
- informing participants about course content, date, time and location and prerequisite requirements.

Scheduling training sessions

Schedule training sessions for data collection and data management staff in advance, to ensure each course is well attended and training is provided to all team members before the survey begins.

Coordinating training tasks

It may be necessary to plan for and arrange some, or all, of the following coordination tasks:

- selection of a pilot community
- book accommodation and arrange transport if necessary
- develop and set up exercises to be used during classroom training

- determine, develop and compile training and reference materials for course participants
- obtain maps or list of households.

Preparing training materials

Prior to training sessions, print out one set per participant of the relevant materials from the surveillance manual. Print the whole manual for each participant, or only relevant selected sections, as follows.

- Data collection introduction
- Planning and preparing a surveillance
- Preparing a surveillance site
- Interviewer's guide
- Guide to demographic and behavioural measurements
- Guide to physical measurements
- Data collection
- Surveillance instrument
- Question by question guide
- Interview, blood collection and data entry forms
- Data entry introduction
- Preparing the data management environment
- Data entry guide
- Data entry and data management
- Interview and data entry forms
- Data analysis introduction
- Preparing the sample
- Preparing the data management environment
- Data analyst's guide

14. Data analysis *(69)*

Data analysis is one of the more important stages in research. Without performing exploratory analyses of our data, we set ourselves up for mistakes and loss of time.

The goal is to be able to "visualize" the data and get a sense of their value. Plot histograms and compute summary statistics to observe the trends and the distribution of the data.

14.1 Statistics/data analysis/data cleaning *(69)*

"Cleaning" refers to the process of removing invalid data points from a dataset. Many statistical analyses try to find a pattern in a data series, based on a hypothesis or assumption about the nature of the data. "Cleaning" is the process of removing those data points that are either:

- obviously disconnected with the effect or assumption that you are trying to isolate owing to some other factor that applies only to those particular data points;
- obviously erroneous, i.e. some external error is reflected in that particular data point, either due to a mistake during data collection, reporting, etc.

In the process, we ignore these particular data points and conduct our analysis on the remaining data.

Cleaning frequently involves human judgement to decide which points are valid and which are not, and there is a chance of cleaning valid data points caused by some effect not sufficiently accounted for in the hypothesis/assumption behind the analytical method applied.

The points to be cleaned are generally extreme outliers. Outliers are those points that stand out for not following a pattern that is generally visible in the data. One way of detecting outliers is to plot the data points (if possible) and visually inspect the resultant plot for points that lie far outside the general distribution. Another way is to run the analysis on the entire dataset and then eliminate those points that do not meet mathematical "control limits" for variability from a trend, and then repeat the analysis on the remaining data.

Cleaning may also be done judgementally, for example in a sales forecast by ignoring historical data from an area or unit that has a tendency to misreport sales figures. To take another example, in a double blind medical test a doctor may disregard the results of a volunteer whom the doctor happens to know in a non-professional context.

Cleaning may also sometimes be used to refer to various other judgemental/mathematical methods of validating data and removing suspect data.

The importance of having clean and reliable data in any statistical analysis cannot be stressed enough. Often, in real-world applications the analyst may become mesmerized by the complexity or beauty of the method being applied, while the data themselves may be unreliable and lead to results that suggest courses of action without a sound basis. In the author's personal opinion, a good statistician/researcher spends 90% of his or her time on collecting and cleaning data, and developing hypotheses that cover as many external explainable factors as possible, and only 10% on the actual mathematical manipulation of the data and deriving results.

14.2 Review of data quality *(70)*

Surveillance data are useful for programme management and policy development only if the data are of good quality. Inaccurate conclusions about a health problem in a population may be drawn from poor-quality data. The information presented in this section can be used to:

- identify potential data quality problems so that efforts can be made to improve data quality at the contributor and local level;
- help users understand the edit criteria that identified the data quality error.

Data quality problems can be caused by:

- data processing issues, such as contributor computer information system constraints;
- problems in extracting the data;
- reporting errors.

Two data quality reports should be generated to help improve the quality of data in the annual surveillance reports:

- the periodic summary of record volume and data quality report
- the annual summary of record and data quality report.

The summary section of the periodic summary of record volume and data quality report summarizes the errors identified in the data quality section of the report. This summary includes a list of the types of data quality problems identified in the report and the number of fields with each type of data quality problem.

The data quality section includes:

- missing
- mis-codes
- cross-check errors
- unusual data distribution
- low and high standard deviation
- surveillance survey completion code or record linkage errors.

Missing

Missing is used to measure the completeness of the data.

Mis-codes

Mis-codes are unacceptable data for a specific field. The edit criteria for miscode errors are:

- A clinic code number on more than 10 records does not match a clinic code number on the central surveillance unit. This code file prepared by the contributor contains geographic codes for the clinic/school, county (all required) and a choice of one or more set of codes for local agencies, areas and regions/school districts (all optional). An updated code file should be sent to the central surveillance unit any time there are changes in these geographic codes.
- A field that contains 0 when 0 is not an acceptable code or value on more than 2% of records. For example, if valid codes for the field, diarrhoea, are 1 =Yes, 2 = No, and blank or 9 = Unknown or Refused; then a code of 0 is a miscode because it is an invalid code.
- A field that has unacceptable codes on more than 5% of the records. For example, if valid codes for the field, currently breastfed, are 1 = Yes and 2 = No, then a code of 3 is an unacceptable value or a miss-code.

Cross-check errors

Cross-check errors are coding inconsistencies between specific fields. The edit criteria for cross-check errors are:

- Field coding is inconsistent on more than 5% of the records. For example, if currently breastfed = 1 (Yes, infant is currently breastfed) and length of time breastfed = 5 (Number of weeks breastfed for infant who has stopped breastfeeding), both fields are listed as a cross-check error.

Unusual data distribution

Unusual data distributions are fields that have data following a pattern that is not typical, based on observations of national data.

The edit criteria for unusual data distribution errors are:

- A field containing no data in the acceptable ranges of the field other than 0. For example, 0 is a valid code for field, drinks/week last month; however, when 0 is coded on 100% of the records, this may indicate that the field was initialized to 0 and no valid data were added to the field.
- Fields with values of unusual data distributions.

Fields with values of unusual data distributions may include maternal weight and height, prepregnancy weight, weight gain, birth weight, and haemoglobin and haematocrit. When these data fields have more than 20% of values below the 5th or above the 95th percentile of the national data distribution, they have an unusual data distribution compared with national data and are therefore suspected of errors. Haemoglobin and haematocrit values are also evaluated for digit preference defined as rounding to the nearest integer or half integer. Haemoglobin and haematocrit values should be recorded as actual values and not rounded values. A higher than expected percentage indicates excessive rounding of the haemoglobin or haematocrit values that results in an unusual distribution of the data. The edit criteria for digit preference is more than 30% of haemoglobin or haematocrit values that fall on the integer or half integer (e.g. 11.0, 11.5, 12.0, etc.).

Specific field edits for frequency of responses for data items have been developed to identify data that do not follow the distribution of coded responses at the national level. For example, the edits to identify unusual data distributions for maternal education are:

- more than 20% of women completed less than the 7th grade (national data distribution is about 55% for women that completed less than the 7th grade);
- more than 20% of women completed over 15 years of education (national data distribution is about 5% for women that completed over 15 years of education);
- fewer women completed the 12th grade than completed any other single grade (national data distribution is about 40% for women that completed 12th grade more than any other single grade);
- more than 10% of women received no education (national data distribution is about 20% for women that received no education).

Additional information about how the edits for unusual data distributions were developed for each field that is edited is provided below.

Low and high standard deviation

The standard deviation is a measure of the amount of variation among values such as haemoglobin or weight for height in a population. A low or smaller standard deviation defines data that are less spread out (with less variation) than would be expected for the population. A high or larger standard deviation defines data that are more spread out than would be expected for the population.

Surveillance survey completion code or record linkage errors

Records of prenatal and postpartum data are recorded at different times, i.e. during and after a pregnancy. Contributors are expected to combine information from these two different time periods into a single record. A completion code is assigned to a record to indicate whether the record contains data from both time periods (prenatal or postpartum) defined as a "complete record". Data from only the prenatal or postpartum periods are therefore defined as "prenatal only" or "postpartum only" records.

This data quality error identifies problems with:

- assigning completion codes to the records;
- linking prenatal and postpartum record information in surveillance survey records.

Completion code or record linkage errors are errors that result in incorrect data for the record type or insufficient data for the record type, or duplicate field values on a record.

- Errors of insufficient data for the record type. These are most likely the result of incorrect assignment of the completion codes. For example, a prenatal-only record with less than two prenatal fields containing data is probably a postpartum-only record that was incorrectly assigned the completion code of prenatal-only rather than postpartum-only.
- Duplicate field values. Duplicate field values are when more than 90% of complete records include two different fields that contain exactly the same data on the majority of complete records (e.g. a woman's weight value at her prenatal visit is the same as her weight at her postpartum visit). The edit criteria are: complete records with duplicate field values on more than 90% of records.

14.3 Analysis of surveillance data (*70*)

Ongoing analysis of surveillance data is important for detecting outbreaks and unexpected increases or decreases in nutritional problem or disease occurrence, monitoring nutritional problem and related disease trends, and evaluating the effectiveness of nutrition control programmes and policies. This information is also needed to determine the most appropriate and efficient allocation of public health resources and personnel.

Analyses should be performed at regular intervals to identify changes in nutritional problem and related disease reporting. These analyses can be performed using standard approaches (e.g. tabulating reports manually and filling in a summary data sheet, or running a standard computer program to generate a summary report). Findings of analyses should be reviewed regularly and provided as feedback to data providers and others in the community who are asked to report cases. Often additional, special analyses are needed to answer specific questions that arise; these analyses may require additional customized approaches beyond those that are routinely performed.

Skilful interpretation of the data is needed to determine why any aberrations may be occurring or to decide whether additional action is necessary. Therefore, both technological and human factors play important roles in analysis of surveillance data. Despite the increased speed and accuracy of a sophisticated trend analysis, it must be supplemented by familiarity with the people and the disease patterns in a community and with the reporting system being used.

The mistake most commonly made in analysis and use of nutrition or any health surveillance data is not related to statistical testing, improper presentation of data or failure to perform complex multivariate analyses; the most common mistake is not looking at the data. Computer hardware and software can facilitate the epidemiologist's task, but they are no substitute for looking, thinking, discussing and taking action.

The analytic process

Analysis of surveillance data begins with characterizing the pattern of nutrition problem reports by person, place and time. Patterns of disease reports should be compared:

- at different times (e.g. the number of underweight cases reported in 2009 compared with the number of cases in 2010);
- in different places (e.g. the number of measles cases reported in one district compared with the number in another district);
- among different populations (e.g. the number of measles cases reported among infants, preschool age children, school age children, adolescents and adults).

Vaccination status of case patients should also be examined; if there is disease transmission in the community, lack of vaccination is likely to be the factor most strongly associated with illness.

Analyses that examine delays in reporting, completeness of reporting of critical variables and applying case definition criteria are also useful in evaluating the quality of case investigation and reporting and should be undertaken regularly. Missing or inaccurate data may limit the usefulness of any analysis. Erroneous or incomplete data cannot be corrected through statistical procedures.

14.4 Report writing

A report is a tool to communicate findings to an audience by presenting processed data and information as knowledge. It is written for a clear purpose and to a particular audience.

A nutrition surveillance report should be written as soon as possible after the field data collection is completed, as timeliness matters to make important decisions based on the findings of the assessment. It should be evidence-based, clear, informative and easy to read and professional in its presentation. The information should be presented in a clearly structured format making use of sections and headings so that the information is easy to locate and follow. Brief guidance on each section of the report is given below.

How to write a nutrition assessment report

Cover page/title page

- Clearly state the purpose of the report, the geographical location and the duration covered, using the fewest possible words.
- Include the details of the organizations which implemented the assessment and the funding agency, details of the person/organization who prepared the report and the date of submission of the report

Acronyms/abbreviations

- List the abbreviations used in the report; usually in alphabetical order.

Table of contents

- List the headings, appendices, tables and figures. Make sure the correct page numbers are shown opposite the contents.

Report summary

- Write the summary last, after the rest of the report is complete.
- Make sure all important information is here and is very clear; often readers will only look at this section. Diagrams are very useful. This section of the report should be short (one or two pages).
- Include information on the area covered, the date and the objectives of the assessment, the methodology used, the main results and the recommendations.

Introduction

- Write the introduction in a clear and concise manner aiming to provide sufficient background information to the reader.
- Describe the context in which the assessment was carried out, including the following information.
  - What population was surveyed, over what period and in which geographical area.
  - How the surveyed community lives and what has happened to them. This information is mainly from secondary sources, or interviews with district officials, etc.

Objectives of the assessment

- Clearly state the objectives of the assessment.
- Describe what was measured, in which population and why.

Methodology

- Describe in a straightforward way the methods employed, including sampling techniques. This is necessary so that readers can be sure of the validity of the assessment and have a clear reference for future comparison.
- Describe any problems encountered or suspected bias.
- Describe selection criteria for inclusion in the survey.
- Describe what measurements were taken, by whom and using what instruments.
- Describe how the questionnaires were designed and piloted, and how qualitative data collection was organized.

Results

- Include a table of the distribution of the sample, according to age and sex.
- Report the anthropometric statistics and other variables based on standard indicators using tables or graphs.
- Write the text in relation to the tables and illustrations and draw out important findings. Make sure that the facts in the text match accurately with the data in the tables and figures.
- Use tables when you wish to present exact values and graphs to show trends and relationships. Do not use graphs to duplicate information already given in the table.
- Present qualitative data in tables or narrative forms as desired.

Discussion

- Aim to explain the results (for example, prevalence of malnutrition and mortality rates) in terms of the causes of malnutrition – health, care environment and food security.
- Organize the discussion by addressing the questions below:
  - Is the level of malnutrition typical (referring back to previous surveys or baseline levels)?
  - Is the level of mortality typical?
  - What are the major causes of malnutrition and mortality resulting from the emergency (taking into account causes already addressed by other interventions)?
  - What are the prospects for the coming months?

  - Who is worst affected?
  - What are the chronic causes of malnutrition?
  - What does the community recommend?
  - Do the results seem plausible? Are there any unanswered questions?
- Do not simply repeat what is already stated in the results section. Refer back to the results section and look at the findings in the light of the causal analysis based on key informant interviews, observations, etc.
- Consider including a diagram showing the location specific causal framework of malnutrition.
- Pull the threads of the argument together in logical order using observed facts so as to reach conclusions. Do not discuss results that have not been presented.

Conclusions

- Describe the seriousness of the situation and the relationship between the underlying cause(s) of malnutrition and the current situation.
- Cross-check the link of high mortality rates and low rates of malnutrition to understand the concept of “replacement malnutrition” and the related “survivor bias” that affects the conclusion of the assessment report.

Recommendations

- Include recommendations.
- Be specific in terms of time to address the situation, responsible organization and target groups. The long term recommendations can be addressed through an integrated development programme while the short term recommendations might be addressed through sector specific and emergency interventions as well.

Bibliography/references

- Include all references cited in the text in the list of references and ensure citations are complete and accurate.

Appendices

- Attach details of some data, maps and reports that are supportive to the report as annexes and appendices.

Tips

- Use precise, logical and simple language with appropriate vocabulary, correct grammar and clear writing style.
- Avoid inclusion of inaccurate, outdated or irrelevant data.
- Avoid conclusions and recommendations that are not supported by the other sections of the report.
- Use consistent and appropriate formatting with page numbers, headings and sub-headings.

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This manual is designed to be a user reference manual for policy-makers and programme managers for the development of a food and nutrition surveillance system, with the focus on application. It provides a model for developing a surveillance system and provides a general overview of the basic principles, as well as the essential steps and issues involved in the different activities to be undertaken.