Nutrition Information in Crisis Situations

United Nations System
Standing Committee on Nutrition

Assessing micronutrient deficiencies in emergencies

Current practice and future directions

October 2007

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Foreword

Micronutrient deficiencies are widespread in developing countries with more than 2 billion people being affected. They have many detrimental effects such as an increase in morbidity and mortality risk as well as impaired growth and mental development. Eradicating micronutrient deficiencies is a fundamental component of public health.

Micronutrient deficiencies occur more frequently in individuals on a monotonous or restricted diet, which is characteristic of most emergency situations. Micronutrient deficiencies have been reported for years in emergency settings and especially in refugee camps, where they were most frequently assessed (table 1).

Although increased attention has been paid to micronutrient deficiencies in recent years, assessments have remained scarce. Less than 10% of the anthropometric nutrition surveys reported in the NICS bulletins in 2005-2006 included assessment of micronutrient deficiencies [UN/SCN, 2005-2006]. Anaemia, measured by blood haemoglobin concentration, and vitamin A deficiency, assessed by clinical signs or symptoms, were the main deficiencies investigated. This phenomenon might be explained by the difficulty in measuring micronutrient deficiencies and challenges to prevent and cure them. Correct diagnosis of clinical signs or symptoms of micronutrient deficiencies requires qualified staff and training may be difficult. Moreover, clinical signs and symptoms are often not specific of a given deficiency. Biochemical measure of micronutrient deficiencies requires collection and conservation of blood or urine samples, as well as biochemical tests that sometimes involve the use of high technology and are expensive. These constraints might be difficult to overcome in emergency settings.

Estimation of the micronutrient content of diets may also give some indication of potential micronutrient deficiencies but is not yet routinely conducted. Although this type of assessment also poses a number of challenges, it may be useful to trigger further investigation.

This document explores options available for investigating micronutrient deficiencies, draws attention to best practices and includes references to practical tools and guidelines.

Table 1 Micronutrient deficiencies reported in emergency situations

Location	Years
Vitamin C deficiency	
Somalia*	1982, 1985
Sudan*	1984, 1991
Ethiopia*	1989
Kenya*	1994, 1996
Afghanistan	2001, 2002
Vitamin A deficiency	
Sudan*	1985, 1987
Kenya*	1998, 2001
Nepal*	1999
Ethiopia*	2001
Uganda*	2001
Niacin deficiency	
Malawi*	1989, 1990, 1991, 1996
Angola (internally displaced persons)	1999, 2000
Angola	2002
Anaemia	
Kenya*	1998, 2001
Nepal*	1999
Uganda*	2001
Ethiopia*	2001
Algeria*	2002
Thailand*	2001-2002
Jordan*	1990
Lebanon*	1990
Syria*	1990
Gaza*	1990
West Bank*	1990
Thiamine deficiency	
Thailand*	1992
Nepal*	1994-1995
Kenya (internally displaced persons)	2000

*In refugee camps

References: [Tool, 1992; Cheung, 2003; Kemmer, 2003; Weise-Prinzo, 2002; Seal, 2005; Seal, 2007; Hassan, 1997; Baquet, 2000]

1. Introduction

As described above, micronutrient deficiencies may affect populations with a high prevalence. For example, iron deficiency has been found at a prevalence of 23-75% in child refugee populations in Africa, and this deficiency contributes substantially to the high prevalence of anaemia found in many scenarios (13-72%) [Kemmer, 2003; Seal, 2005; Hassan, 1997]. Other micronutrient deficiency diseases (MNDD) may be much rarer and, when they do occur, they may be found at a much lower prevalence although the consequences for the individuals affected may be at least as serious.

In describing the seriousness of a MNDD within a population the prevalence is most often used, although for outbreaks, such as seen with niacin deficiency (pellagra), the incidence or attack rate may be quoted. It is difficult to compare the seriousness of different situations when different epidemiological descriptors are used, and this should be borne in mind in any assessment.

The effects of deficiencies may be categorized as clinical or sub-clinical. In clinical deficiency there are signs or symptoms that can be specifically ascribed to the deficiency disease. In sub-clinical deficiency, no specific clinical signs or symptoms can be detected but the nutrient levels are low enough in the individual to result in a biochemical or functional parameter being below the normal reference range. When investigating MNDD, it should be remembered that clinical signs will usually only represent the tip of the iceberg, beneath which a much greater burden of sub-clinical deficiency will almost always be found. Two main approaches may be used to investigate micronutrient deficiencies, that is direct and indirect assessment:

- *Indirect assessment* involves the estimation of nutrient intakes at a population level and extrapolating from this the risk of deficiency and the likely prevalence and public health seriousness of MNDD.

- *Direct assessment* involves the measurement of actual clinical or sub-clinical deficiency in individuals and then using that information to give a population estimate of the prevalence of the MNDD.

The guidance currently provided in standard field nutrition manuals is often sketchy despite a fair amount of experience gained by different research, public health groups, and operational agencies over the last 15 years. The WHO reviews published in 1999 and 2000 on scurvy, beriberi and pellagra provide useful reviews of background information and, very importantly, suggested prevalence criteria for defining public health problems [WHO, 1999; WHO, 1999a; WHO, 2000]. Further information is presented in 'The management of nutrition in major emergencies' [WHO, 2000a]. However, there still remains a lack of practical guidance on how to do assessments of micronutrient deficiencies. This is partly perhaps, because it is anticipated that outside technical inputs would be available, and partly because there is, as yet, a lack of agreed protocols for such assessments. This situation is now starting to change with the production of a field manual from CDC and MI [MI, 2007].

The Sphere Project manual provides guidance on micronutrient deficiency assessment and intervention as outlined in the box below [Sphere, 2004]. More recently, a more proactive intervention approach has been advocated by WHO, WFP and UNICEF as outlined in their 2006 joint statement [WHO/WFP/UNICEF, 2006]. This statement calls for micronutrient supplementation of pregnant and lactating women and children (6-59 months)

during all emergencies without the need for an assessment of deficiency.[1] This emergency supplementation would be in addition to any ongoing iron, folate or vitamin A supplementation or food fortification programmes. The operational effectiveness and safety of this approach has been the subject of some research [De Pee, et al., 2007] but experience to date is limited. Moreover, these recommendations must be considered together with the recent WHO statement on iron supplementation of young children in regions where malaria transmission is intense and infectious disease highly prevalent [WHO].

Despite these recent initiatives, many gaps exist in our knowledge of how to assess micronutrient deficiencies and how to react to the information that is collected.

Box 1 Sphere Project Guidance [Sphere 2004]

4. ***Micronutrient deficiencies:*** if the population is known to have been vitamin A-, iodine- or iron-deficient prior to the disaster, it can be assumed that this will remain a problem during the disaster. When analysis of the health and food security situations suggests a risk of micronutrient deficiency, steps to improve the quantification of specific deficiencies should be taken

5. ***Epidemic micronutrient deficiencies:*** four micronutrient deficiencies – scurvy (vitamin C), pellagra (niacin), beriberi (thiamine) and riboflavin – have been highlighted, as these are the most commonly observed deficiencies to result from inadequate access to micronutrients in food aid-dependent populations and are usually avoidable in a disaster situation. If individuals with any of these deficiencies present at health centres, for example, it is likely to be as a result of restricted access to certain types of food and probably indicative of a population-wide problem. As such, deficiencies should be tackled by population-wide interventions as well as individual treatment (see Correction of malnutrition standard 3 on page 152). In any context where there is clear evidence that these micronutrient deficiencies are an endemic problem, their levels should be reduced at least to pre-disaster levels.

6. ***Endemic micronutrient deficiencies:*** tackling micronutrient deficiencies within the initial phase of a disaster is complicated by difficulties in identifying them. The exceptions are xerophthalmia (vitamin A) and goitre (iodine) for which clear 'field-friendly' identification criteria are available.

[1] The recommended level of supplementation for pregnant and lactating women is one RNI (Recommended Nutrient Intake) per day for each of 15 micronutrients. For children (6-59 months) it is recommended that the same micronutrients are supplied at 1 RNI per day where foods are not fortified, and 2 RNIs per week where food is fortified.

2. Indirect Assessment of micronutrient deficiencies in food aid dependent populations - Monitoring the micronutrient content of the diet

Defining Adequate Micronutrient Intake – Issues and current recommendations

When using the indirect assessment approach a prerequisite to identifying nutrient deficiency problems is to know what the nutrient requirements of individuals and populations actually are. Nutrient intake values (NIVs) aim to provide guidance, based on the available evidence and statistical probability, about the nutrient intakes that healthy individuals require. However, they come in many varieties and there may be large differences in NIVs presented in different publications. In addition, the basis for the derivation of different NIVs may be different and a number of conceptual distinct measures are used.

Moreover, to obtain population nutrient requirements, assumptions have to be made as to the demographic profile of the population, the bioavailability of nutrients within the diet, the energy requirement of the population, and allowances made for population health status. None of these assumptions are straightforward.

Currently, WHO recommends Safe Levels of Intake (SLI) for vitamins A, D, B1, B2, B3, B12, C, folic acid, iron, iodine and calcium, for emergency affected populations [WHO, 2000a]. These recommendations are available by age group and for a "typical population", based on calculations including demographic breakdowns. However, these SLI were calculated prior to the adoption of the latest NIVs by WHO and FAO in 2002 [FAO, 2002; WHO, 2004]. They also do not cover the full range of micronutrients considered essential for human health.

In compiling the 2004 version of the Sphere Project, provisional population requirements were added for the additional micronutrients, vitamin E, K, zinc, selenium, biotin, pantothenate and magnesium (table 2) [Sphere, 2004]. These were calculated using the NIVs available from the FAO/WHO 2002 report and population data revised by the UN in 2002 [FAO, 2000; UN, 2003].

However, these recommendations at population level have some limitations:

- They incorporate the requirements of all age groups and both sexes. They should not be used for as requirements for an individual.
- They are based on a particular population profile [UN, 2003]. As the demographic structure of different populations varies, this will affect the nutritional requirements of the population concerned.

Table 2 Current standards for population nutritional requirements-to be used in planning purposes in the initial stage of a crisis

Nutrient	Mean population requirements
Energy	2,100 Kcals
Protein	10-12% total energy (52g-63g), but < 15%
Fat	17% of total energy (40g)
Vitamin A	1.666 IU (or 0.5 mg retinol equivalents)
Thiamine (B1)	0.9mg (or 0.4 mg per 1,000 kcal intake)
Riboflavin (B2)	1.4mg (or 0.6mg per 1,000 kcal intake)
Folic Acid	160µg
Niacin (B3)	12.0mg (or 6.6mg per 1,000 kcal intake)
Vitamin B12	0.9µg
Vitamin C	28.0mg
Vitamin D	3.2-3.8µg calciferol
Iron	22mg (low bio-availability ie 5-9%)
Iodine	150 µg
Magnesium*	201mg
Zinc*	12.3mg
Selenium*	27.6µg
Vitamin E*	8.0mg alpha-TE
Vitamin K*	48.2µg
Biotin*	25.3µg
Pantothenate*	4.6µg

Values given are Safe Levels of Intake taken from The Management of Nutrition in Major Emergencies [WHO, 2000a] except those marked * which are Provisional Population Requirements from The Sphere Project [Sphere, 2004]

Moreover, debate still continues on whether all of the micronutrients listed in the Sphere Project compilation should in fact be included or, indeed, whether others should be added.

Food rations

The micronutrient content of general rations distributed in many food aid operations has been the subject of criticism for a number of years [Seal, 2005; Tomkins, 1992]. Recommended rations generally include cereal, pulses, oil, salt and multi-micronutrient fortified blended food, which was added as a component of the ration since the mid-nineties to improve its micronutrient content [WHO, 2000a, UNHCR, 2002]. It is also recommended that salt is fortified with iodine, oil with vitamin A and D and wheat and maize flour with multi-micronutrients [UNHCR, 2002]. However, analysis of the micronutrient content of standard theoretical rations still reveals the presence of numerous deficiencies. For example, two recommended rations are analysed in table 3 and both show severe deficiencies of riboflavin, calcium and the maize based ration is also badly deficient in vitamin C. Moreover, the high anti-nutrient content (especially phytate) of such diets further decreases the absorption of micronutrients.

Table 3 - Micronutrients are deficient in standard general rations

Daily Ration			
Rice based ration g/person/day		Maize based ration g/person/day	
Rice, Polished	350	Maize Grain, White	400
Lentils	100	Beans, Dried	60
Vegetable Oil	25	Vegetable Oil	25
Blended Food	50	Blended Food	50
Sugar	20	Sugar	15
Salt, Iodized	5	Salt, Iodized	5

Nutrient Adequacy (%)*												
Ration Type	Planned kcal	Energy	Protein	Fat	Calcium	Iron	Iodine	Vit. A	Vit. B1	Vit. B2	Niacin	Vit. C
Rice	2,100	100	102	**76**	**29**	**86**	102	95	99	**41**	207	107
Maize	2,100	99	116	112	**36**	**90**	102	95	212	**83**	108	**86**

The calculations were performed using NutVal 2004, a WFP/UNHCR spreadsheet for the planning and monitoring of food aid rations. The adequacy is derived from the WHO SLI for an emergency affected population [WHO, 2000a]. It was assumed that commodities were fortified according to WFP specifications [UNHCR, 2002].

There has been more and more recognition of the importance of improving the micronutrient content of the ration. The WFP has recently taken steps to advance the role of micronutrient nutrition in their policy and practice. At a meeting of the Executive Board in 2004, new policy papers on emergency food aid, mainstreaming nutrition and fortification were passed [WFP, 2004]. These emphasized the importance of the micronutrient content of rations and nutrition as an outcome. "The importance of micronutrients in achieving the goals of emergency operations is increasingly well-understood and there is evidence of the need for greater use of fortified foods than in the past."

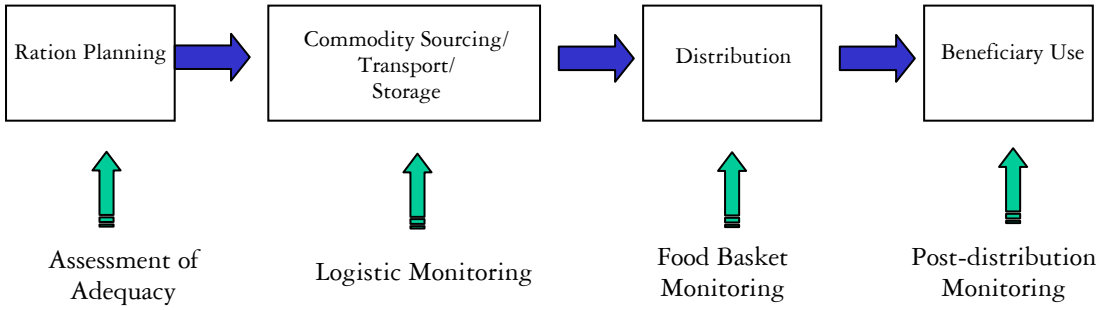
Monitoring ration contents and dietary intakes

The theoretical ration (what should be distributed according to population needs) for a general food distribution might not correspond to what is consumed by the population for several reasons:

- The planned ration actually distributed on a particular distribution cycle might differ from the theoretical one for logistic reasons; for example some items might be missing and be replaced (or not) by others
- At the distribution point, problems in distribution procedures might mean that people do not receive the quantities of intended planned ration
- Food rations are often not entirely used for consumption but may be sold or exchanged for different purposes such as milling cereals, buying fresh foods and condiments to diversify the diet, buying essential non food items.
- The population might consume other foods in addition to the general ration
- The size and structure of the beneficiary population may change due to in or out migration, births and mortality, making the population planning figure obsolete.

Good data on the functioning of a food aid system is essential for monitoring the risk of MNDD (figure 1). Assuming that the ration has been planned and assessed to be adequate,

FIGURE 1 – MONITORING POINTS ON A FOOD AID SYSTEM



the three components of a good food aid monitoring system will usually include (1) monitoring of the food aid logistics chain and distribution process, (2) food basket monitoring (FBM), also sometimes called onsite distribution monitoring, and (3) post-distribution monitoring (PDM) at the household and market level.

The aim of FBM is to compare the food actually received by families to the planned ration and to follow-up on any shortfall reported. Protocols for FBM are laid out in MSF and UNHCR Guidelines [MSF, 1995; UNHCR, 1997]. It is good practice for the agency doing the FBM to be organisationally separate from that involved in food distribution to avoid any conflict of interest that might arise. Criteria for the interpretation of FBM data have been laid down by UNHCR [UNHCR, 1997]. According to the UNHCR guidelines the cut-offs for acceptable distributions are < 90% or >110% of the planned kcal/person/day. While this is a useful criterion it takes no account of differences that may be found in the distribution of different commodities and the impact on micronutrient sufficiency of the ration.

Post Distribution Monitoring (PDM) is usually conducted some time after the distribution (roughly 10-20 days after the distribution if the distributions are done on a monthly basis). The PDM looks at the use of the ration and the adequacy of the distribution system. In general, the scope of PDM is quite broad and includes other relevant food security information. In many food aid operations the recipient populations may have access to a wide range of other commodities. While determining what these foods are may be relatively straightforward, gaining an accurate assessment of the quantities available and consumed often proves extremely difficult. The various food security methods that exist are very valuable for gaining in depth insight into household economies but are somewhat cumbersome to use to try and quantify the risk of micronutrient deficiencies. The accurate measurement of dietary nutrient intake using weighed intakes, portion sizes or other methods is a challenging undertaking in any setting. Such approaches are usually inappropriate in refugee or emergency assessments although they have been used in research studies [Banjong, 2003]. The measurement of a Diet Diversity or Food Variety Score using food frequency questionnaires is, in contrast, a much simpler and robust technique and the resulting scores have been shown to correlate with anthropometric status and haemoglobin concentration [Savy, 2005; Torheim, 2003; Swindale, 2005]. In these methods the survey subjects are asked whether they have consumed a specific food item or food group, typically within the last 24 hours or 7 days. While it is not possible to calculate the actual quantities consumed, the Diet Diversity Score or Food Variety Score approach may be useful for understanding the sources of micronutrient rich foods in the diet and for monitoring access to different foods over time.

In situations where food from non-food aid sources may reasonably be assumed not to represent a significant part of the diet a more reliable approach may be to assess the nutrient content of the food aid component independ-

ently, with the aim of ensuring a balanced ration.

When food aid is not intended to cover the full needs of the population, a significant amount of micronutrients might come from other sources of food. In this case, it might be difficult to assess the nutrient content of the diet with reasonable precision.

When using indirect assessment for population subgroups, practical problems might occur. Although the WHO SLI are given for different age and gender groups these may not always correspond to the groups that are being considered. For example, when considering school aged children it is very difficult to derive a meaningful estimate of requirements using the SLI age groups.

A variety of software tools have been designed for calculating the nutrient content of food aid rations. The most well known include NutCalc, which was developed by EpiCentre for ACF, and NutVal, which was developed for UNHCR and WFP by ICH. Many other software products for calculation of nutrient content exist but these tend not to be specialised for food aid operations. NutVal 2006 is currently recommended by WFP and UNHCR for use in planning and monitoring food aid rations. However, the food database is limited and for a full analysis of dietary intakes where people are consuming a wide variety of local foods or for a detailed research project other software would be more appropriate. Some of these other options to consider include:

NutriSurvey http://www.nutrisurvey.de/

USDA National Nutrient Database for Standard Reference http://www.ars.usda.gov/main/site_main.htm?modecode=12354500

World Food Dietary Assessment System http://www.fao.org/infoods/software_worldfood_en.stm

A list of other available software is also available from FAO http://www.fao.org/infoods/software_en.stm

Anecdotal reports indicate that ration monitoring by itself is a rather a blunt tool for predicting the risk of micronutrient deficiency disease outbreaks, partially because a populations' access to alternatives means of dietary diversification may be underestimated.

In contrast, examples of the chronic persistence of seriously deficient diets together with direct evidence of clinical deficiency are also found. For example, in refugee camps in Bangladesh, food aid rations have been seriously deficient in riboflavin for years and there is an associated high prevalence of angular stomatitis [UNHCR, 2003] - a strong clinical indicator of deficiency. Clearly, the evidence gained from indirect assessment of deficiency risk is not always effective at producing the necessary change in policy and practice in food aid programmes.

3. Direct Assessment – Measurement of micronutrient deficiencies in individuals

There are two main approaches that can be used in direct assessment of micronutrient deficiencies:

- Clinical signs and symptoms
- Biochemical testing

Each approach has potential advantages and disadvantages when considered for use in an emergency context. Each will be considered below.

Clinical signs and symptoms

Observation of clinical signs or the use of questionnaires to elucidate symptoms has the advantage of being non-invasive, usually low cost, and is often the most logistically feasible option in remote areas. Clinical signs continue to be used in nutrition surveys to try and obtain a prevalence measure of clinical deficiency. By definition, the use of clinical signs cannot tell us about the prevalence of sub-clinical deficiency and the detection of a clinical case usually represents the tip of the iceberg of a deficiency problem.

An important distinction exists between clinical signs and symptoms. Clinical signs are pathological changes that can be observed by the surveyor or medical practitioner. The subject may or may not be aware of the presence of clinical signs. Symptoms are changes that are apparent to the patient or subject but may not always be observable by others. Therefore, in survey work clinical signs rather than symptoms are almost always used. The use of carer or self reported night blindness as an indicator of vitamin A deficiency is one notable exception.

While clinical signs are very useful they are, with a few exceptions, often quite non-specific. Goitre is a good example of a specific clinical sign of iodine deficiency but even here, a goitre may actually result from iodine excess or some other disease process, rather than iodine deficiency. Angular stomatitis is often considered as a specific sign for riboflavin deficiency but, in fact, is associated with at least three nutrient deficiencies (riboflavin, vitamin B6 and zinc). Nonetheless, the sensitivity and specificity is adequate to make such signs extremely useful for inclusion in surveys.

Clinical signs are often used in outbreak investigations such as in a scurvy outbreak in Afghanistan and a pellagra outbreak in Angola [Cheung, 2003; Baquet, 2000]. There are many examples of surveys reporting the use of clinical signs in assessment of deficiencies. Recent examples reported in NICS include surveys of goitre in Ivory Coast, and bitots spots for vitamin A deficiency in Darfur [UN/SCN, 2004-2005].

Training staff in correct diagnosis of clinical signs is sometimes challenging and the use of medically qualified staff is recommended whenever possible. Photo-aids have been produced by different agencies and are of great use during the pre-survey training sessions but nothing is as good as observing actual cases prior to survey commencement. A clear and simple case definition is essential and inter observer reliability should be assessed. Where rare conditions are being surveyed it is advisable for the survey supervisor to revisit all suspected cases to confirm the diagnosis.

Biochemical tests

Biochemical tests have the advantage of providing objective measures of status. However, for some micronutrients the concept of nutritional status may be difficult to define. This is because its two components, recent intake of the nutrient and body stores of the nutrient, are difficult to disaggregate and many biochemical measures tend to capture elements of both. A classification of the different types of biochemical tests is given in Box 2.

The collection of biological samples for testing often presents logistic, staff training, cold chain and sometimes acceptability challenges. Biochemical measurements are also not always as clear-cut, i.e. as sensitive and specific, as might be imagined. Individuals have a wide range of normal values and there are large differences between the average values of different healthy individuals. There also may be diurnal and seasonal variation.

Furthermore, different laboratories may produce results that do not agree well. Indeed, this has been demonstrated in European laboratories using a 'ring test' for vitamin C analysis and in developing country laboratories analysing vitamin A. Good quality assurance and quality control testing is essential and should always be considered when selecting a laboratory for sample analysis.

A number of different biochemical tests may be available for the same micronutrient which do not necessarily give comparable answers. For example, iron status may be quantified by measuring a number of different components including serum ferritin, serum transferrin receptor, zinc protophorphyrin, and transferrin saturation. At the population level it may also be estimated from haemoglobin concentration. However, each of these measures is focused on a different part of the iron metabolic pathway so it should be no surprise that different estimates of deficiency may be obtained when using these different tests with the same samples. Which ever test is chosen, standardisation of methodologies and cut-off values is essential to allow valid comparisons between surveys or studies.

Biochemical measurements might sometimes only give part of an answer. For example, low haemoglobin blood concentration measures anaemia. However, anaemia might be related to iron deficiency or to infections, especially malaria or hookworm, which causes a reduction in haemoglobin blood concentration, or to inherited conditions such as sickle cell anaemia or thalassaemia.

When people have an infection the body launches an acute phase response in which the levels of protein production change and the concentration of circulating nutrients in the blood is altered. This response may help the body in combating the infection and is a normal physiological response to inflammation.

Box 2 – Types of biochemical tests for detecting nutritional deficiencies

1. Static measurements of nutrient under study in blood, urine, or other biological sample (e.g. serum retinol)
2. Measurement of a nutrient metabolite, (e.g. N-methylnicotinamide in urine as an indicator of Niacin status)
3. Biochemical functional test (e.g. enzyme activity in red blood cells for vitamins B1 and B2)
4. Presence of abnormal metabolites (e.g. homocysteine for folate deficiency)
5. Product of nutrient under study (e.g. haemoglobin concentration for iron status)
6. Load or saturation test (e.g. vitamin C in urine after a high dose tablet)
7. Other procedures (e.g. use of stable isotopes)

Adapted from 'Laboratory Tests for the Assessment of Nutritional Status' (1999) Sauberlich HE, CRC Press

Table 4 – Recent examples of field studies using biochemical testing

Survey or Study	Location	Nutrient	Test
Blanck et al. (2002)[2]	Nepal - refugees from Bhutan	Riboflavin	EGRAC
McGready (2003)[3]	Thailand - Karen refugees	Thiamine and vitamin A	ETKAC, breast milk retinol
Kemmer et al. (2003)[4]	Thailand - refugees from Myanmar	Iron	Haemoglobin and zinc protoporphyrin
Seal et al. (2005)[5]	Africa - refugees from various countries	Vitamin A and iron	Serum retinol and sTfR
Bennett and Coninx (2005)[6]	East Africa - prisoners	Vitamin C	Serum ascorbic acid
Seal et al. (2006)[7]	Angola - post conflict resident population	Niacin	Urine excretion of N-methyl nicotinamide and 2-pyridone

However, it does mean that if certain indicators of nutritional status are measured in a person with infection they will appear to have a worse nutritional status than they actually do. This applies in particular to serum retinol and ferritin, two popular indicators of iron and vitamin A status. Measurement of acute phase proteins, which are markers of inflammation, can allow for adjustment of the measured nutrient indicators, but there is not yet a widespread consensus on how adjustments should be applied.

Finally, for some of the micronutrients, published methods may prove very difficult to apply in field based surveys, e.g. because of contamination in trace element analysis or the requirement for extended sample collection time.

In conclusion, before embarking on an assessment involving biochemical testing it should be understood that the results obtained should not always be regarded as definitive, but they can provide an invaluable additional tool in reaching conclusions. Tables 4 and 5 provide examples of recent studies where measurements have been taken and a summary of biochemical tests that may be considered for inclusion in surveys.

Operational organizations are, in general, becoming more aware of the importance of measuring micronutrient malnutrition. For example, UNHCR has integrated haemoglobin measurement into routine nutrition surveys in a number of camps, particularly in Tanzania, Algeria and Kenya. Data from these periodic surveys is used for nutritional surveillance. In addition, the prevalence of anaemia was recently adopted by UNHCR as a recommended indicator for inclusion in nutrition surveys when resources and logistics permit. The WFP has contracted external research organizations to conduct studies on micronutrient malnutrition and to assess the effectiveness of their response.

Before deciding to use biochemical sampling as a tool in nutritional surveys there are a number of important considerations to take into account. The points below do not comprise a manual for how-to-do-it but may help to indicate a few of the challenges and potential pitfalls.[8]

[2] Blanck, H. M., Bowman, B. A., Serdula, M. K., Khan, L. K., Kohn, W., & Woodruff, B. A. (2002) Angular stomatitis and riboflavin status among adolescent Bhutanese refugees living in southeastern Nepal. Am.J.Clin.Nutr. 76: 430-435.

[3] McGready, R., Simpson, J. A., Arunjerdja, R., Golfetto, I., Ghebremeskel, K., Taylor, A., Siemieniuk, A., Mercuri, E., Harper, G., Dubowitz, L., Crawford, M., & Nosten, F. (2003) Delayed visual maturation in Karen refugee infants. Ann.Trop.Paediatr. 23: 193-204.

[4] Kemmer TM, Bovill ME, Kongsomboon W. Iron deficiency is unacceptably high in refugee children from Burma. J Nutr. 2003, 133:4143-9

[5] Seal AJ, Creeke PI, Mirghani Z & al. Iron and vitamin A deficiency in long-term African refugees. J Nutr. 2005, 135:808-13

[6] Bennett, M. & Coninx, R. (2005) The mystery of the wooden leg: vitamin C deficiency in East African prisons. Trop.Doct. 35: 81-84.

[7] Seal AJ, Creeke PI, Dibari F & al. Low and deficient niacin status and pellagra are endemic in postwar Angola. Am J Clin Nutr. 2007, 85(1):218-24

[8] A draft manual describing the use of Hemocue photometers in anaemia surveys is available from WHO http://www.who.int/malaria/docs/mis/bc1.pdf

Table 5 – Biochemical tests for anaemia and selected nutrient deficiencies

Available Options	Recommended	Rational
Anaemia		
(1) Haemoglobin (Hb) (2) Haematocrit	Haemoglobin	Haemoglobin concentration is a direct measure of anaemia. Using a field photometer such as the Hemocue, measures are quick, easy, and can be carried out at household level during surveys.
Iron		
(1) Serum tranferrin receptors (sTfR) (2) Ferritin (3) Serum iron (4) Transferrin saturation (5) Erythrocyte protoporphyrin	sTfR	sTfR is affected little by concurrent infections and is a widely used measure of iron deficiency. Measurements can be made on serum samples prepared from a finger stick capillary blood sample. If ferritin is used the values obtained have to be controlled for inflammation status.
Iodine		
(1) Urinary iodine (2) Neonatal TSH (3) Thyroglobulin	Urinary Iodine	Single samples of urine can be easily collected from school aged children or adult women. Samples are stable and it is not essential to freeze them during transport. Calculation of the median urinary excretion is widely accepted as a valid method of measuring population status.
Vitamin A (Retinol)		
(1) Serum retinol (2) Retinol binding protein (3) Relative dose response tests	Serum retinol	Serum retinol concentration is a good population indicator of status. Measurements can be made on serum samples prepared from a finger stick capillary blood sample. Samples from the same finger stick can be used for both iron and vitamin A measurements.
Vitamin B1 (Thiamine)		
(1) Erythrocyte Transketolase Activity Coefficient (ETKAC) (2) Blood concentration of thiamine (3) Urine excretion	All methods have disadvantages but ETKAC is generally regarded as the most valid measure of status.	The ETKAC assay measures the activity of an enzyme that is dependent on thiamine. A well accepted functional measurement but requires the collection, centrifugation and freezing of venous blood samples.
Vitamin B2 (Riboflavin)		
(1) Erythrocyte Glutathione Reductase Activity Coefficient (EGRAC) (2) Blood concentration of riboflavin	Both methods have disadvantages but have been used successfully in field studies.	The EGRAC assay measures the activity of an enzyme that is dependent on riboflavin. A well accepted functional measurement but requires the collection, centrifugation and freezing of venous blood samples.
Vitamin B3 (Niacin)		
(1) Urinary excretion of metabolites (1-methyl nicotinamide and 1-methyl-2-Pyridone-5-carboxamide) compared to creatinine concentration in urine	Urinary excretion	The excreted metabolites are stable during storage, samples are easily collected and the method has been successfully used in field surveys.
Vitamin C		
(1) Serum/plasma concentration (2) Leukocyte concentration (3) Urine excretion	Serum concentration	Although storage and transport of serum samples requires freezing and may be problematic, serum vitamin C is an easier measure and requires lower sample volume than the isolation of white blood cells. Urine excretion only reflects recent intake and more research is required to assess how useful it is in population surveys.

For a consideration of the sample sizes required for different assessment methods see table 6

- Employing the use of good training and technique, and following universal safety precautions helps to minimise the risk of cross-infection with pathogens such as HIV and Hepatitis B. Any potential benefits of conducting the survey need to be balanced against the risks to participants and staff. Survey participants need to be given full and honest information about the objectives and methods of the survey and informed consent must be obtained and documented.

- Selection of sampling method and equipment can greatly reduce the risk and discomfort for both parties. If at all possible, capillary blood collection should be used instead of venous sampling and the sample collected straight into a specialised tube with the appropriate anticoagulant or serum separator gel.

- Safety lancets with automatic self-retracting blades minimise the risk of needle stick injuries and makes reuse and cross-contamination impossible. If venous sampling is strictly necessary then vacuum loaded blood tubes smooth the collection process and a good quality, disposable sharps collection box permits storage and transport of waste between survey sites.

- If surveys are being conducted at household level then care must be taken not to contaminate any items with blood, to remove any waste, and to leave the house as it was found. While sticking plasters should be applied after any incisions it is good practice not to use 'child-friendly' plasters with pictures of animals or the like, as these may end up being popular and swappable items.

- Disposable or washable plastic cups should be used for urine collection and disposable plastic tubes for faecal samples. Medical plastic gloves for sample collectors often end up comprising the heaviest items in the survey supplies list and these and other items may need to be sourced from national or international suppliers a long way distant from the survey site. Good planning and use of a detailed inventory is essential.

- Sample preservation before and during transport/or analysis is often challenging. Supplies of ice or dry ice are usually required but may be difficult to source. Fridges and freezers may work intermittently and extra fuel may need to be purchased, or solar power laid on to keep them going 24/7 hours during the duration of the survey. The use of dried blood spots (DBS), where a spot of blood is dried onto filter paper and then transported in a normal envelope provides a, potentially, much simpler solution for sample storage. But caution is advised unless studies have already been performed to show that the results obtained from samples stored in this way are comparable with results from liquid samples.

- Finally, formal ethical clearance may be required from national and/or international bodies and obtaining the necessary paperwork may be a time consuming process.

Selection of appropriate population groups and methodology

In deciding on a method for assessment of a suspected micronutrient problem it is critical to select the appropriate population group for study. Table 6 gives guidance which groups to select to gain the most useful indicator. This depends on the relative susceptibility of different age and gender groups to the deficiency disease and the availability of assessment methods.

The sample size required for micronutrient surveys is typically very large where clinical signs are used but a lot smaller where biochemical measurements are taken. This reflects the relative rarity of overt clinical cases compared to the more prevalent sub-clinical biochemical deficiency that is usually encountered. Sampling methods may utilise a number of different techniques depending on the target population but cluster sampling using Proportional Population Size will frequently be appropriate and may sometime allow integration with a standard nutrition survey.

In some situations the careful documentation of individual case studies may be powerful and sufficient evidence to advocate for intervention, especially where the condition is rare, such as for scurvy or pellagra. However, quantification at the population level is often required.

Surveillance systems are a partial alternative to conducting surveys and if micronutrient deficiencies, assessed using either biochemical tests or clinical signs, are effectively integrated into a functioning Health Information System (HIS) the monitoring may be relatively low cost and reliable.

Table 6 Public Health Cut-offs for Indicators of Micronutrient Deficiencies and Example Sample Sizes[9]

Micronutrient Deficiency Indicator	Recommended Age Group for Prevalence Surveys	*Definition of a Public Health Problem*		Prevalence to detect	Precision	Sample size
		Severity	Prevalence (%)			
Vitamin A Deficiency[10]						
Night Blindness (XN)[11]	6-71 months	Mild	> 0 – < 1	-	-	-
		Moderate	≥ 1 – < 5	1.0	0.50	2,275
		Severe	≥ 5	5.0	2.50	438
Bitots spots (X1B)	6-71 months	Not specified	> 0.5	0.5	0.25	4,559
Corneal Xerosis/ ulceration/ keratomalacia (X2, X3A, X3B)	6-71 months	Not specified	> 0.01	0.01	0.005	153,650
Corneal scars (XS)	6-71 months	Not specified	> 0.05	0.05	0.025	30,718
Breast milk retinol (≤ 1.05 µmol/L)	Mothers	Mild	< 10	-	-	-
		Moderate	≥ 10 – < 25	10	5.0	208
		Severe	≥ 25	25	7.5	221
Serum retinol (≤ 0.7 µmol/L)	6-71 months	Mild	≥ 2 – < 10	2.0	1.0	1,128
		Moderate	≥10 – < 20	10	5.0	208
		Severe	≥ 20	20	7.5	164
Iodine Deficiency[12]						
Goitre (visible + palpable)	School-age children	Mild	5.0 – 19.9	5.0	2.5	438
		Moderate	20.0 – 29.9	20	7.5	164
		Severe	≥ 30.0	30	10	121
Median urinary Iodine (µg/l)	School-age children	Normal	100 – 300[13]	N/A[14]	N/A	≥ 40
		Mild	50 – 99	N/A	N/A	≥ 40
		Moderate	20 – 49	N/A	N/A	≥ 40
		Severe	< 20	N/A	N/A	≥ 40

[9]Calculations were performed with EpiInfo 6.04 and are based on a population size of 500,000 and a design effect of 1.5 for cluster surveys

[10]Indicators for Assessing Vitamin A Deficiency and their Application in Monitoring and Evaluating Intervention Programmes' p.7 (1996) World Health Organisation, Geneva WHO/NUT/96.10

[11]The letter codes beginning in X, XN, X1B etc. are shorthand for the different types of xeropthalmia

[12]Trace Elements in Human Nutrition and Health' p.58-60 (1996) World Health Organisation, Geneva

[13]Figures given here are for the concentration of iodine in urine, not the prevalence.

[14]Not applicable

Table 6 (continued) Public Health Cut-offs for Indicators of Micronutrient Deficiencies and Example Sample Sizes[15]

Micronutrient Deficiency Indicator	Recommended Age Group for Prevalence Surveys	*Definition of a Public Health Problem*		Prevalence to detect	Precision	Sample size
		Severity	Prevalence (%)			
Iron Deficiency[16]						
Anaemia (Non-pregnant women haemoglobin <12.0 g/dl; children 6-59 months <11.0 g/dl) [17]	Women, Children	Low	5 – 20	5.0	2.5	438
		Medium	20 – 40	20	7.5	164
		High	≥ 40	40	10.0	139
Beriberi[18]						
Clinical Signs	Whole population	Mild	≥ 1 case & < 1%	-	-	-
		Moderate	1 – 4	1.0	0.50	2,275
		Severe	≥ 5	5.0	2.5	438
Thiamine pyrophosphate effect (TPPE) ≥ 25%	Whole population	Mild	5 – 19	5.0	2.5	438
		Moderate	20 – 49	20.0	7.5	164
		Severe	≥ 50	50.0	12.0	101
Urinary thiamine per g creatinine (Age group specific cut-offs)	Whole population	Mild	5 – 19	5.0	2.50	438
		Moderate	20 – 49	20.0	7.5	164
		Severe	≥ 50	50.0	12.0	101
Breast milk thiamine (< 50 µg/L)	Lactating women	Mild	5 – 19	5.0	2.50	438
		Moderate	20 – 49	20.0	7.5	164
		Severe	≥ 50	50.0	12.0	101
Dietary intake (< 0.33 mg/1000 kcal)	Whole population	Mild	5 – 19	5.0	2.50	438
		Moderate	20 – 49	20.0	7.5	164
		Severe	≥ 50	50.0	12.0	101
Infant mortality	Infants 2-5 months	Mild	No decline in rates	-	-	-
		Moderate	Slight peak in rates	-	-	-
		Severe	Marked peak in rates	-	-	-

[15]Calculations were performed with EpiInfo 6.04 and are based on a population size of 500,000 and a design effect of 1.5 for cluster surveys
[16]Classification proposed in: 'The Management of Nutrition in Major Emergencies' (2000) World Health Organisation
[17]Cut-offs are given for < 1000m and may need to be adjusted according to age, sex and altitude
[18]Criteria proposed in: 'Thiamine Deficiency and its Prevention and Control in Major Emergencies' p.14 (1999) WHO/ UNHCR, Geneva WHO/NHD/99.13

Table 6 (continued) Public Health Cut-offs for Indicators of Micronutrient Deficiencies and Example Sample Sizes [19]

Micronutrient Deficiency Indicator	Recommended Age Group for Prevalence Surveys	*Definition of a Public Health Problem*		Prevalence to detect	Precision	Sample size
		Severity	Prevalence (%)			
Pellagra[20]						
Clinical Signs (Dermatitis) in surveyed age group	Whole population or women >15 years	Mild	≥ 1 case & < 1%	-	-	-
		Moderate	1 – 4	1.0	0.50	2,275
		Severe	≥ 5	5.0	2.5	438
Urinary N-methyl nicotinamide (< 0.5 mg/g creatinine [21, 22])	Whole population or women >15 years	Mild	5 – 19	5.0	2.50	438
		Moderate	20-49	20.0	7.5	164
		Severe	≥ 50	50.0	12.0	101
Dietary intake of niacin equivalents (<5 mg/day)	Whole population or women >15 years	Mild	5 – 19	5.0	2.50	438
		Moderate	20 – 49	20.0	7.5	164
		Severe	≥ 50	50.0	12.0	101
Scurvy[23]						
Clinical signs	Whole population	Mild	≥ 1 case & < 1%	-	-	-
		Moderate	1 – 4	1.0	0.50	2,275
		Severe	≥ 5	5.0	2.5	438
Deficient serum ascorbic acid (< 0.2 mg/100 ml)	Whole population	Mild	10 – 29	10.0	5.0	208
		Moderate	30 – 49	30.0	10.0	121
		Severe	≥ 50	50.0	12.0	101
Low serum ascorbic acid (< 0.3 mg/100 ml)	Whole population	Mild	30 – 49	30.0	10.0	121
		Moderate	50 – 69	50.0	12.0	101
		Severe	≥ 70	70.0	15.0	54

[19] Calculations were performed with EpiInfo 6.04 and are based on a population size of 500,000 and a design effect of 1.5 for cluster surveys

[20] Provisional criteria suggested in 'Pellagra and its Prevention and Control in Major Emergencies WHO/UNHCR, 2000, WHO/NHD/00.10 and 'Management of Nutrition in Major Emergencies', World Health Organisation, Geneva, 2000

[21] Although the use of the urinary ratio of 2-pyridone:N-methyl nicotinamide is provisionally recommended in WHO publications, subsequent research has demonstrated that when urine is collected at a single time point, such as during a survey, the metabolite ratio is not a stable indicator of nutritional status.

[22] Recent survey work from an area of Angola where pellagra is endemic has suggested that this cut-off needs to be revised upwards to 1.6 mg/g creatinine, and that the measurement of the 2-pyridone metabolite is a more reliable analytical measure. [Seal, 2007]

[23] Provisional criteria suggested in 'Scurvy and its Prevention and Control in Major Emergencies' p.9 (1999) World Health Organisation/UNHCR WHO/NHD/99.11

4. Conclusion and ways forward

This document shows that although tools for assessing micronutrient status are available, there are a number of challenges that limit their implementation in the field.

Further improvements in field friendly techniques for the assessment of deficiencies are needed. Whilst some techniques have been developed using dried blood spots, direct collection and storage of liquid serum and urine remain a more reliable method of sample collection. More work on sample collection and storage methods is required to make field surveys easier to conduct in remote locations.

Another difficulty is access by populations to a diet adequate in micronutrients. This has been taken into account more and more seriously and ways to improve the provision of micronutrients in emergencies have been explored. The increasing introduction of micronutrient-fortified foods in food rations, and especially of blended food since the mid-nineties, has probably helped to prevent a number of major micronutrient outbreaks. However, micronutrient deficiencies have remained a significant public health problem.

Several options for furthering the improvement of micronutrient intake are available that might be complementary and used according to the context. Increasing access to fresh food, improving livelihoods and access to markets, enhanced fortification of food items of the general food distribution, distribution of pills, and home-based fortification with micronutrient powders or fortified condiments are some of the alternatives.

For the rapid design of nutritionally adequate rations at minimum cost, linear programming and other mathematical optimisation techniques can be important tools. They can take into account constraints such as dietary practices and food costs in developing diets that meet nutrient recommendations, and can be used to model the worst and best case scenarios to more reliably determine the risk of deficiency. They might also be used to assess the economic value of fortified food supplements [Briend, 2001]. These approaches have recently been used to design food-based dietary guidelines in Malawi [Ferguson, 2004]; examine the cost of nutrient-dense diets in France [Andrieu, 2006]; and assess the minimum cost of a healthy diet in Bangladesh, Myanmar, Ethiopia and Tanzania [Chastre, 2007].

Implementation of these approaches in easy-to-use software tools could lead to dramatic improvements in the nutritional quality of rations and a reduction in costs. However, they have seldom been used in emergency contexts to date.

To provide sufficient micronutrients in the absence of fortification or supplementation, diets need to be diversified and balanced. They may need to include foods that might not be available on a large scale in local markets or that populations may not be able to afford. Moreover, it has proved difficult to distribute fresh, perishable foods on a large scale due to logistic constraints. To locally produce fresh foods may also be challenging, especially in camps, due to overcrowding, and often limited access to water and land outside the camps. However, some small-scale successful home gardening programmes have been reported, but their impact on nutrient intake was not investigated [Radice, 2005; Cavagieri, 2005].

Fortification of food aid commodities may be achieved at different stages of the logistic pathway. To assess if milling and fortification could be implemented at the WFP Extended Delivery Point (EDP) a pilot project was set up in a refugee camp in Zambia using custom de-

signed milling and fortification technology. Centralised milling and fortification of cereals were successfully implemented and was associated with a decrease in anaemia and stunting in 6-59 months old children and in vitamin A deficiency in adolescents [Van den Briel, 2006; Seal, 2007]. Guidelines on food fortification have been recently released by WHO and initiatives to increase the fortifications of foods within developing countries continue to expand [WHO, 2007].

While distribution of pills has proven to be useful in preventing/treating micronutrient deficiencies in the short-term, such as during an outbreak of scurvy in Afghanistan [Cheung, 2003], long term supplementation with pills might be less sustainable. Maintaining a distribution network to serve the whole population and ensuring adherence and safe use by different population sub-groups would also be a major challenge for health and nutrition agencies.

Home-based fortification using a micronutrient powder, highly fortified paste or source (pouring into food after cooking) has been increasingly used in programmes to improve the micronutrient content of the diet of young children and to successfully treat anaemia [Menon, 2006]. However, published evidence on its use in emergencies is still scarce. Home-based fortification using a fortified condiment that was added to the cooking pot has proved acceptable in a small-scale pilot project in Angola [Depoortere, 2004], and distribution was reported to be feasible and effective as a complement to a selective feeding programme in Haiti [Loesch, 2006]. A large-scale distribution of a micronutrient powder to children aged 6 months to 12 years in families displaced by the Tsunami was also successfully implemented in Aceh and Nias provinces of Indonesia in 2005-2006 [de Pee, 2007], but no data on nutritional impact has been reported.

A number of issues related to supplementation persist. For example, the potential toxicity of supplementing children with iron in malarious areas has been brought to the fore again with the recent publication of a randomised controlled trial from Zanzibar [Sazawal, 2006]. This study raised concerns about possible adverse health effects (increased risk of hospitalization and mortality) if supplementation is targeted at the whole population rather than only those known to be iron deficient. WHO has since released a statement emphasising the importance of an integrated approach, including malaria treatment in the control of anaemia and will shortly be defining a research agenda on this topic [WHO]. The concerns raised about iron toxicity do not extend to food fortification where the dose and delivery vehicle is considerably different from a supplement tablet. However, uncertainty, and therefore caution should prevail over the use of micronutrient powders in home fortification programmes until a clearer picture emerges.

Although the problem is very unusual, micronutrients may at times be consumed in excess amounts and this may lead to associated clinical or sub-clinical conditions. With the increasing use of fortified commodities and products, and persistent issues of quality control in fortification and manufacture [SUSTAIN, 2001], potential problems may arise [Seal, 2006]. These deserve careful consideration in programme planning and evaluation.

The micronutrient requirements for people living with HIV/AIDS are a controversial and evolving topic. As yet, it is recommended that micronutrient intakes at daily recommended levels be assured in HIV-infected adults and children through consumption of diversified diets, fortified foods, and micronutrient supplements as needed [WHO, 2005]. The food aid world needs to keep abreast of developments and be prepared to adapt rapidly as new findings become available.

Despite the many challenges that remain, efforts to improve the micronutrient status of populations in emergency situations should continue and be given priority as a major public health issue.

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Abbreviations

ACF	Action contre la Faim
CDC	Center for Disease Control and Prevention, Atlanta
DBS	Dried Blood Spot
DDS	Diet Diversity Score
EGRAC	Erythrocyte Glutathione Reductase Activity Coefficient
ETKAC	Erythrocyte Transketolase Activity Coefficient
FAO	Food and Agriculture Organisation
FBM	Food Basket Monitoring
FVS	Food Variety Score
ICH	Institute of Child Health, London
MI	Micronutrient Initiative
MNDD	Micronutrient Deficiency Diseases
MSF	Médecins Sans Frontières
NIV	Nutrient Intake Value
PDM	Post Distribution Monitoring
SLI	Safe Levels of Intake
sTfR	Serum Tranferrin Receptors
UN	United Nations
UNHCR	United Nations High Commissioner for Refugees
WFP	World Food Programme
WHO	World Health Organisation

UN Standing Committee on Nutrition

The Administrative Committee on Coordination (ACC), which was comprised of the heads of the UN Agencies, recommended the establishment of the Sub-Committee on Nutrition in 1976, following the World Food Conference and with particular reference to Resolution V on food and nutrition. This was approved by the Economic and Social Council of the UN (ECOSOC) by resolution in July 1977. Following the reform of the ACC in 2001, the ACC/SCN was renamed the United Nations System Standing Committee on Nutrition or simply "the SCN". The SCN reports to the Chief Executives Board of the UN, the successor of the ACC. The UN members of the SCN are ECA, FAO, IAEA, IFAD, ILO, UN, UNAIDS, UNDP, UNEP, UNESCO, UNFPA, UNHCHR, UNHCR, UNICEF, UNRISD, UNU, WFP, WHO and the World Bank. IFPRI and the ADB are also members. From the outset, representatives of bilateral donor agencies have participated actively in SCN activities as do nongovernmental organizations (NGOs). The SCN Secretariat is hosted by WHO in Geneva.

The ***mandate of the SCN*** is to serve as the UN focal point for promoting harmonized nutrition policies and strategies throughout the UN system, and to strengthen collaboration with other partners for accelerated and more effective action against malnutrition. The ***aim of the SCN*** is to raise awareness of and concern for nutrition problems at global, regional and national levels; to refine the direction, increase the scale and strengthen the coherence and impact of actions against malnutrition worldwide; and to promote cooperation among UN agencies and partner organizations. The SCN's annual meetings have representation from UN agencies, donor agencies and NGOs; these meetings begin with symposia on subjects of current importance for policy. The SCN brings such matters to the attention of the UN Secretary General and convenes working groups on specialized areas of nutrition. Initiatives are taken to promote coordinated activities—interagency programmes, meetings, publications—aimed at reducing malnutrition, reflecting the shared views of the agencies concerned. Regular reports on the world nutrition situation are issued. *Nutrition Policy Papers* are produced to summarize current knowledge on selected topics. *SCN News* is published twice a year, and the *NICS* (formerly *RNIS*) is published quarterly. As decided by the SCN, initiatives are taken to promote coordinated activities—interagency programmes, meetings, publications aimed at reducing malnutrition, primarily in developing countries.

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Funding support is gratefully acknowledged from the Canadian International Development Agency and the French Ministry of Foreign Affairs.
