



**Mid Upper Arm Circumference and
Weight-for-Height Z-score as indicators
of severe acute malnutrition:**

**a consultation of operational agencies
and academic specialists to understand the
evidence, identify knowledge gaps and to
inform operational guidance**

**Final review paper
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This report has been prepared by Tamsin Walters (ENN) and Victoria Sibson (SCUK), with support from Marie McGrath (ENN).

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Thanks to all the practitioners and experts who provided strong feedback and engagement throughout the consultation, reflecting great collaboration and commitment to this initiative and enabling progress.

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Mid Upper Arm Circumference and Weight -for-Height Z-score as indicators of severe acute malnutrition: a consultation of operational agencies and academic specialists to understand the evidence, identify knowledge gaps and to inform operational guidance. ENN, SCUK, ACF, UNHCR, 2012.



Cover photos, clockwise from left: UNICEF, 2008; Nicky Dent, 2004; UNICEFNYHQ2007-2670Pirozzi

Outline of paper

Executive summary	3
1. Introduction, background and rationale for the consultation	7
2. Objectives and scope of the consultation	9
3. Process	12
4. Current guidance and challenges in application	13
5. Factors influencing technical opinion	15
6. Overview of the evidence base informing the consultation	17
7. Agreed recommendations for practice and research priorities	21
8. The way forward	28
9. Bibliography informing the consultation and the discussion paper	30
10. Annexes	33
Annex 1: Key questions informing the review	33
Annex 2a: Meeting attendees	35
Annex 2b: Participants in the full consultation	36
Annex 3: Operational scenarios shared by agencies at the December 2012 meeting	37
Tables	
Table 1: Summary of recommendations	22
Table 2: Recommendations and related priority areas for research	23

Executive Summary

The treatment of severe acute malnutrition (SAM) is a cost-effective, evidence-based 'direct' nutrition intervention, according to the 2008 Lancet Nutrition Series. Recent years have seen a significant scale-up of community-based management of acute malnutrition (CMAM) to treat children with SAM. Mid upper arm circumference (MUAC) is increasingly recommended to field operations as the indicator of choice for screening and admission to CMAM programming.

However, uncertainty has remained amongst practitioners, and difference of opinion amongst practitioners and academic specialists, concerning the strength of the evidence to support this recommendation and the consequences for children identified with SAM using weight-for-height z-score (WHZ) only.

This consultation was instigated by Save the Children UK (SC UK) and facilitated by the Emergency Nutrition Network (ENN). It aimed to identify common challenges, wider experiences and additional evidence regarding MUAC and WHZ use in the context of CMAM interventions, and to reach a shared understanding of the operational issues, existing and upcoming evidence and implications for programming.

This paper represents the final stage outcomes of the four-month consultation process, which involved 19 academic specialists and 10 operational organisations. The consultation sought to complement and inform the WHO Nutrition Guideline Advisory Group (NUGAG) process that was instigated in February 2012.

Objectives of the consultation

- To present and develop SCUUK's and other operational agencies' understanding of the evidence on the utility of MUAC and WHZ in the context of treatment of SAM children 6-59 months of age in terms of:
 - screening/referral, diagnosis/admission and coverage estimation
 - monitoring SAM treatment progress in the individual child
 - determining discharge, and
 - surveillance and prevalence estimationⁱ
- To improve understanding of the challenges of implementation faced by practitioners in order to inform guidance
- To highlight knowledge/guidance gaps
- To propose pragmatic 'stop-gap' recommendations for practice where there is a gap in current guidance but a demand for direction from programming staff
- To consider practical application of recommendations

ⁱ This objective was subsequently considered to be beyond the scope of the current consultation and meriting a separate meeting. It was therefore dropped from discussions at the December meeting and no conclusions or recommendations are presented in this regard.

Process

A discussion paper was produced by SCUK with support from the ENN and informed by discussions with Action Contre la Faim (ACF) and the United Nations High Commissioner for Refugees (UNHCR). The paper was shared with practitioners (operational agencies and individuals) in the first instance, then revised to incorporate their feedback prior to being shared with academic specialists. A third version of the paper was then produced and a small meeting held on the 5-6th of December 2012 to finalise the process.

A premise of the consultation was that there is no gold standard anthropometric indicator of acute malnutrition: MUAC and WHZ are two imperfect indicators used as a proxy to assess nutritional status. However, the two indicators do not always identify the same children and, when they do the proportions identified using both methods vary between regions and countries.

Key findings on factors influencing technical opinions

Challenges to a consensus of opinion around the use of indicators appeared to stem from the overall weakness of the evidence base, as well as issues relating to the diversity of contexts and situations within which programming takes place and the variety of actors involved:

- There is a dearth of published evidence from a range of settings on this topic and what is widely available does not answer all the necessary questions, but currently provides partial answers to some of them.
- Different interpretations of CMAM and how it can feasibly be carried out in any given context has a strong effect on how some of the issues are viewed, the choice of anthropometric indicator and programme strategy.
- There are also perceived differences in who CMAM is for and what the outcome of CMAM treatment is: for some it is considered a treatment for the acutely malnourished most at risk of mortality; for others it is for the acutely malnourished that have any excess risk of mortality.
- Contextual features and differences add to the challenge of setting global recommendations, and in applying evidence generated in one situation to another. There is great variation in caseload profile (e.g. in terms of age and sex of those children enrolled in or eligible for CMAM programmes), as well as in the available resources and capacity to deliver programmes.

The question that was most consistently raised during the consultation was whether the evidence exists to support the exclusion of children with $WHZ < -3$ and $MUAC \geq 115$ from treatment.

Conclusions from the consultation

Neither MUAC nor WHZ reveal themselves to be ideal predictors of mortality; however, of the two indicators, MUAC appears to show consistently better predictive power. Therefore, MUAC is the best anthropometric predictor of mortality currently available. The use of both WFH and MUAC together does not appear to increase the predictive power over MUAC alone. The superior utility of MUAC over WHZ for community-based screening in most contexts was agreed. But there remain a great number of limitations in the use of the existing evidence to answer the question “What is the most relevant strategy to identify the children most at risk and who will benefit from the treatment of acute malnutrition?”

There was consensus at the December meeting on three major points:

- The primary objective of SAM management programmes is to identify and treat severely acutely malnourished children aged 6-59 months most at risk of short-term mortality
- MUAC and WHZ identify different children at risk of death from SAM
- On balance, MUAC appears to be the better predictor of mortality and has practical advantages. However the limitations and interpretation of the evidence base regarding this remain an area of considerable discussion.

Therefore, based on the best evidence currently available alongside practical considerations, it was agreed that the programmatic approach should prioritise MUAC in screening and admission. WHZ should be used as an additional admission criterion where feasible and where doing so does not compromise the coverage of children meeting the MUAC criterion.

An outstanding question remained as to whether treatment of SAM addresses the mortality risk observed and related to this, what are the responses and outcomes of children identified by different anthropometric criteria (MUAC or WHZ or both) treated for SAM.

Recommendations for practice

Recommendation 1:

At community level, there should be active case finding by MUAC to identify children requiring management of SAM

At health facility level (fixed or mobile), there should be systematic case finding by MUAC to identify children requiring management of SAM. If a child is not identified by MUAC, WHZ should be measured where it is feasible (capacity in terms of materials, time and trained human resources) without jeopardizing other essential health services; WHZ should be measured in particular where there are relevant clinical conditions, visible severe wasting, maternal concern and/or contextual factors (e.g. acute or prolonged emergency where more older children are affected).

Recommendation 2:

A threshold of MUAC < 115mm for admission to SAM treatment applies to all children 6 months and above in all contexts.

Where WHZ is used, a threshold of WHZ < -3 for admission to SAM treatment applies to all children 6 months and above in all contexts.

Recommendation 3:

Weight gain should be used to monitor response to treatment for all children.

MUAC should be recorded in millimetres at each visit in operational research settings to establish whether MUAC monitoring can be conducted accurately and whether it is feasible for use in monitoring progress of children.

Recommendation 4:

There is no firm recommendation that can be made currently for discharge criteria, until there is more evidence from various contexts.ⁱⁱ

Recommendation 5:

Children admitted under WHZ criterion should continue to be discharged when $WHZ \geq -2$ and free from oedema for 2 weeks, pending further research.

Recommendation 6:

The percentage weight gain should no longer be used as a discharge criterion.

Sixteen associated research priorities were identified that would support improvement of future recommendations.

The way forward

Actions identified at the meeting with some subsequent steps taken are:

Inform the WHO NUGAG recommendations. WHO have engaged in the consultation process and have been updated on the meeting and recommendations to inform the NUGAG recommendations (in particular with regard to recommendation 4), research needs, and the upcoming WHO manual to inform implementation of NUGAG recommendations.

Encourage the continued conversation between operational agencies and academic specialists, including the development of potential research opportunities and collaborations. A closed en-net forum was set up in Jan 2013 for those meeting attendees and others who wish to explore opportunities for research collaboration (technical discussion is directed to the open en-net forum). The meeting report will be widely shared.

Agencies attending the meeting to develop their own internal guidance. SC UK and ACF have begun drafting internal guidance and this will be shared in due course on en-net.

Interest was expressed in a follow up face-to-face meeting in the future, ideally 'piggy backed' onto another meeting or integrated as a topic in a technical meeting. The ENN is pursuing an inter-agency technical meeting and will advocate accommodating a follow up discussion on indicators of SAM.

ⁱⁱ Current practices include discharge at MUAC >115mm when clinically well and no oedema and where there is follow up (such as to a SFP) or discharge at MUAC >125mm (NUGAG recommendation). Evidence is currently being collected to inform a recommendation on appropriate MUAC discharge criteria.

1 Introduction, background and rationale for the consultation

1.1 Introduction to the review

This paper represents the final stage outcomes of a four-month consultation process involving 19 academic specialists and 10 operational organisations. It is the final paper in a series of four. The first three discussion papers include the detail and evidence that was submitted to the consultation. This paper now presents the key outcomes and agreements on the way forward. The consultation was instigated by Save the Children UK (SCUK), facilitated by the Emergency Nutrition Network (ENN) and supported by Action Contre la Faim (ACF) and the United Nations High Commissioner for Refugees (UNHCR).

1.2 Background and rationale for the consultation

Globally, there are an estimated 20 million children under 5 years living with severe acute malnutrition (SAM)ⁱⁱⁱ (WHO/WFP/UNSCN/UNICEF 2006). These children have an elevated risk of dying and require appropriate medical and nutritional therapy, as defined by the WHO (WHO 1999 and WHO/WFP/UNSCN/UNICEF 2006). The treatment of SAM is one of a package of cost-effective 'direct' nutrition interventions "with sufficient evidence to implement in all countries", according to the Lancet, whose authors recognise the feasibility of outpatient treatment using Ready to Use Therapeutic Food (RUTF) in community settings (Bhutta et al 2008). The 'Lancet interventions' form the basis of the global Scaling Up Nutrition (SUN) movement, which aims to increase funding for and implementation of 'direct' and 'indirect' nutrition interventions globally (Scaling Up Nutrition. A Framework for Action Policy Brief 2010). Recent years have seen a significant scale-up of community-based management of acute malnutrition (CMAM) to treat children with SAM in particular. For example, a UNICEF commissioned mapping exercise in 2011 found 61 countries implementing outpatient CMAM programmes to treat SAM; fifty-six percent of these were aiming for national level scale-up.

Mid-upper arm circumference (MUAC) is increasingly being recommended to field operations as the indicator of choice for screening and admission to CMAM programming^{iv}. This review was prompted by uncertainty amongst practitioners, and difference of opinion amongst practitioners and academic specialists, concerning the strength of the evidence to support this recommendation and what the consequences are for children identified with SAM using weight-for-height z-score (WHZ) only.

Current UN endorsed international guidance recommends both WHZ and MUAC for diagnosis of acute malnutrition in children 6-59 months of age and percentage weight gain for determining discharge. This guidance appeared to be applied differently by different actors in different contexts for a number of reasons including:

ⁱⁱⁱ SAM is defined for this estimate by weight for height below -3 z scores of the median WHO growth standards or by the presence of nutritional oedema.

^{iv} Guevarra E, Norris A, Guerrero S, Myatt M. Assessment of coverage of community-based management of acute malnutrition. CMAM Forum Technical Brief One; Oct.2012. <http://www.cmamforum.org/>

1

1. Differing interpretations of the guidance by practitioners, or different advice from academic specialists to practitioners
2. Inaccessibility and a lack of understanding by practitioners of the evidence-base informing current guidance and the use of undocumented or not widely shared experiences and research by practitioners and academic specialists to inform practice/guidance
3. Subjective judgement by practitioners, academic specialists or advisers, of the practical feasibility of each indicator in different field settings.
4. Experiences in different clinical or population contexts leading to adaptations

As a consequence, SCUK struggled to confidently issue urgently needed internal guidance on MUAC and WHZ use to programme staff at country level. Awareness that other agencies shared this challenge and were at different stages of researching the options and creating guidance led to the initiation of this consultation.

The consultation was aware of the WHO Nutrition Guidelines Advisory Group (NUGAG) process (NUGAG February 2012 meeting) with imminent recommendations pending around MUAC and WHZ use. When available, NUGAG recommendations have been considered through the course of the consultation and WHO engagement sought throughout. This consultation sought to complement and inform the NUGAG process, particularly with regard to the challenges and insights in applying and adapting global standards in operations and to highlight emerging research priorities. The final draft NUGAG recommendations (undergoing peer review) were made available to the consultation facilitators in early January 2013.

2 Objectives and scope of the consultation

The aim of the consultation was to identify common challenges, wider experiences and additional evidence regarding MUAC and WHZ use in the context of CMAM interventions, and to reach a shared understanding of the operational issues, existing and upcoming evidence and implications for programming.

2.1 Objectives

- To present and develop SCUK's and other operational agencies' understanding of the evidence on the utility of MUAC and WHZ in the context of treatment of SAM children 6-59 months of age in terms of:
 - screening/referral, diagnosis/admission and coverage estimation
 - monitoring SAM treatment progress in the individual child
 - determining discharge, and
 - surveillance and prevalence estimation^v
- To improve understanding of the challenges of implementation faced by practitioners in order to inform guidance
- To highlight knowledge/guidance gaps
- To propose pragmatic 'stop-gap' recommendations for practice where there is a gap in current guidance but a demand for direction from programming staff
- To consider practical application of recommendations

Annex 2 details SCUK's key questions that prompted the review and related questions and considerations that emerged through the consultation.

2.2 Scope of review

The consultation focused on the application in programming of two key anthropometric indicators of SAM – MUAC and WHZ.

The perspective is of an international NGO that focuses on treatment of acute malnutrition in situations prone to emergencies and whose programmes are funded bilaterally and by public and private donations. However, the majority of NGOs engaged in this consultation work with MOH staff at health facility level. Therefore consideration of how proposed recommendations could be applied by MOHs and might be accommodated in the context of national policies has been taken into consideration throughout.

^v N.B. We acknowledge that the use of MUAC and WHZ in surveillance and prevalence estimation is of relevance more broadly than solely within the context of CMAM programming.

2

The discussion of treatment refers exclusively to SAM treatment in CMAM programmes. It is acknowledged that more information is urgently needed on moderate acute malnutrition (MAM) to be able to make robust programming recommendations for this larger group of children.

It is acknowledged that a continuum exists between SAM and MAM. The distinction employed to focus on SAM in the consultation reflects the divide represented in programming. No attempt has been made here to define any recommendations to revisit SAM or MAM definitions or required programmes. Issues raised in the consultation feedback included challenges of identifying and managing MAM, the burden (caseload) and questions around the management of complicated MAM cases.

The consultation did not include analysis of CMAM programme efficacy and effectiveness.

While the discussion paper included considerations of indicator use for prevalence estimation and surveillance (as reflected in the objectives above), this was considered in the December meeting to be beyond the scope of the current consultation and meriting a separate meeting. It was therefore dropped from discussion and no conclusions or recommendations are presented in regard to these issues.

The focus of the consultation was children 6-59 months of age, who comprise the bulk of the programme caseload globally. The need to tackle the paper's objectives for infants 0-<6 months of age, older children and other vulnerable adults is acknowledged and was reiterated by contributors to the consultation. It is hoped that this initiative will incite similar complementary reviews for these groups.

2.3 A word on terminology

Weight-for-height z-score (WHZ) is considered throughout. The term 'low' WHZ is used to describe $WHZ < -2$ and 'severely low WHZ' to describe $WHZ < -3$. Similarly, 'low MUAC' is used to describe $MUAC < 125\text{mm}$ and 'severely low MUAC' to describe $MUAC < 115\text{mm}$.

The term weight-for-height (WFH) is used to include both weight-for-length (used in children $< 24\text{m}$) and weight-for-height.

WHZ is a statistical construct: it expresses the anthropometric value (weight) as a number of standard deviations or Z-scores below or above the reference median value for a given height. MUAC is an absolute measure. Further details on the indicators, including how they are calculated, can be found in WHO 1995 (see Section 9).

A comprehensive definition of CMAM includes^{vi}:

- Community outreach for community involvement and early detection, referral of cases of acute malnutrition and follow up of problem cases,

^{vi} Definition from the CMAM Forum, December 2012, <http://www.cmamforum.org/>

2

- Management of SAM in outpatient care for children 6-59 months without medical complications,
- Management of SAM in inpatient care for children 6-59 months with medical complications and children under 6 months with acute malnutrition,
- Management of MAM for children 6-59 months,
- The comprehensive CMAM model links with maternal, newborn, and child health and nutrition, water, sanitation and hygiene, food security and livelihood, and other community outreach initiatives.

This consultation focuses solely on the components related to the management of SAM and does not directly consider the management of MAM.

3 Process

3.1 Consultation of practitioners and academic specialists

A discussion paper^{vii} was produced by SCUK with support from the ENN and informed by discussions with ACF and UNHCR. This consolidated SCUK's thinking and position around use of MUAC and WHZ in the CMAM programmes it supports globally.

The paper was shared in the first stage of the consultation with operational agencies and individual practitioners ('practitioners')^{viii}. Six agencies provided consolidated feedback from different parts of their organisations and seven individuals also submitted responses.

Version 2 was then produced by the ENN with the addition of practitioner inputs in the form of:

- Edits to the main discussion paper, with clarifications/additional evidence as suggested in feedback
- An annex summarising elements of the practitioner feedback not easily incorporated in the main paper

Version 2 was shared with academic specialists engaged in relevant programming and research.

Version 3 was then produced, which included the academic specialist feedback incorporated by the ENN as far as possible, with additional discussion points and issues annexed.

3.2 Informal consultation meeting in London

Following consultation on the paper, a small meeting was held on the 5-6th of December 2012, hosted by SCUK and facilitated by the ENN. The meeting presented the main conclusions, enabled further discussion and review of grey areas in the evidence-base, allowed for presentation of emerging evidence and agency dataset analyses^{ix}, and sought to provide clear, informed guidance on programming options for interim use by field practitioners, whilst identifying and acknowledging further areas of research necessary evidence accumulation required to inform longer term guidance.

The objectives of the meeting were to:

1. Have an informed discussion between a selection of practitioners and academic specialists regarding MUAC and WHZ use to identify SAM cases for treatment in the context of CMAM
2. Improve mutual understanding regarding the use of MUAC and WHZ
3. Agree practical recommendations to meet identified operational needs.

A list of those who have engaged in the consultation process and who attended the meeting is given in Annex 2.

Annex 3 describes scenarios that present some of the challenges faced by operational agencies that were shared during the morning session of the meeting, to ground the discussion in reality.

^{vii} Available from the ENN.

^{viii} Participants who could actively contribute to the consultation were identified through targeting of known practitioners and academic specialists, recommendations and there was also an open invitation to take part at the GNC annual meeting, July 2012.

^{ix} Both scheduled and impromptu presentations were made at the meeting to help develop understanding and inform discussions of those present to aid the consultation process.

4 Current guidance and challenges in application

4.1 Current global UN guidance for use of anthropometric indicators

The WHO and UNICEF currently recommend that two anthropometric indicators can be used to diagnose SAM in young children (WHO/UNICEF 2009):

- Weight-for-height <-3 z score (WHZ <-3)
- MUAC <115 mm

In addition, bilateral pitting oedema on the lower limbs (the principal sign of kwashiorkor) is an independent criterion for diagnosis^x.

The same guidance (2009) recommends that children who have gained 15% of their initial body weight during treatment can be discharged. (Note that the latest NUGAG guidance overturns this recommendation (see below)).

Prevalence of severe wasting based on WHZ should be used to estimate the prevalence of SAM (WHO/UNICEF 2009).

Formally revised recommendations are pending following a meeting in February 2012 of the WHO's NUGAG, with the following significant changes^{xi}:

- MUAC <115 mm and/or presence of bilateral pitting oedema should be used for community screening and referral.
- "In primary health care facilities and hospitals, health workers should assess the MUAC or the WHZ status of infants and children 6-59 months of age, and examine them for bilateral oedema. Infants and children 6-59 months of age who have a MUAC less than 115 mm, or a WHZ less than -3 Z-scores, or who have bilateral oedema should be immediately admitted for the management of SAM."
- Percentage weight gain should not be used as a discharge criterion. Children should be discharged when their WHZ is at least ≥ -2 and they have had no oedema for 2 weeks, or their MUAC is ≥ 125 mm and they have had no oedema for 2 weeks.
- "The same anthropometric indicator that is used to confirm severe acute malnutrition should also be used to assess if a child has reached nutritional recovery."

^x Visible severe wasting has been excluded as a criterion since the 2009 WHO/UNICEF statement on the diagnostic criteria for malnutrition.

^{xi} WHO Guideline update: Technical aspects of the management of severe acute malnutrition in infants and children. Geneva. World Health Organisation, 2013. Draft shared for peer review December 2012.

4

4.2 Challenges in applying the global guidance for SAM

There are challenges when decisions are made to use one or the other or both indicators to diagnose SAM, in particular:

The two indicators do not always identify the same children and, when they do, the proportions identified using both methods vary between regions and countries (Berkley et al 2005; Cichon et al 2011, Field Exchange; Myatt et al 2007, unpublished; Pereyra et al 2011, unpublished).

The differences between the two indicators have significant consequences in practice:

- Different children are diagnosed and treated for SAM according to which indicators are used
- Assessment of recovery from SAM and readiness for discharge from treatment is judged differently according to the choice of indicator
- Prevalence rates of SAM and the ensuing intervention, will vary by indicator
- There are significant and varying consequences for caseload depending on which indicators (or both) are used for admission

Therefore, clarity was sought by practitioners on which of the following indicator(s) should be used to diagnose SAM, in a child without oedema:

- 'Severely low WHZ' only ($WHZ < -3$)
- 'Severely low MUAC' only ($MUAC < 115mm$)
- 'Severely low WHZ' AND/OR 'severely low MUAC' ($WHZ < -3$ and/or $MUAC < 115mm$) (i.e. the child meets either the WHZ criterion, or the MUAC criterion, or both)

Even where both indicators are accepted to diagnose SAM, opinion varies as to whether both 'types' of SAM should be admitted for treatment in the context of a CMAM programme.

Once a decision is made on which indicator/s to use for diagnosis of SAM and admission to CMAM, a decision must be made on the most appropriate indicator/s for monitoring treatment progress of the individual child and then for their discharge upon recovery.

5 Factors influencing technical opinion

Some key issues were raised or observed by the ENN during the consultation, which are considered important to situate the discussion and interpretation of the evidence base. These were presented in the opening session of the December meeting.

At the outset it is important to state that there is no gold standard anthropometric indicator of acute malnutrition: MUAC and WHZ are two imperfect indicators used as a proxy to assess nutritional status.

5.1 The evidence base available

There is a dearth of published evidence from a range of settings on this topic and what is widely available does not answer all the necessary questions, but currently provides partial answers to some of them^{xii}.

Much of the evidence gathered during the consultation was unpublished. This proved very difficult to ‘weight’ without a more stringent grading, that was beyond the scope of this project. There is a need for individuals and agencies to go through the publication process to facilitate sharing of experience and to build up a peer-reviewed evidence-base in this area.

Related to this, much of the ‘evidence-base’ relies on documentation to which many practitioners and decision-makers have little access. Unequal access to information leads to a lack of consensus on conclusions and recommendations for practice. This has led to significant variations in interpretation of published data and views on its potential use for informing programming decisions.

Much of the data routinely collected by agencies or through regular surveys often does not get analysed or reported, but could usefully contribute to informing the discussion.

5.2 Programming perspectives and contextual issues

During the process of the consultation, it came to light that there are a number of areas where there appears to be a difference in understanding and/or perspectives around programming that is influencing and in some instances, complicating discussions.

CMAM has become something of a catch-all term for a variety of programme approaches to respond mostly to children with SAM (not all include MAM), with a community outreach component. It

^{xii} The recent NUGAG consultation conducted a systematic review of the evidence and reports that “The overall quality of evidence was rated as very low due to methodological and reporting issues”. WHO Guideline update: Technical aspects of the management of severe acute malnutrition in infants and children. Geneva, World Health Organization, 2013. Draft December 2012.

5

means different things to different people: some distinguish between treatment of SAM in a clinical setting and settings in which children are identified purely through community screening and may be treated at outreach sites.

The nature of the 'community' where programming is being implemented varies greatly too: CMAM in a vast, dispersed region of Sudan or in a contained refugee camp in Bangladesh presents a different set of issues that affect the scope of the potential intervention and prioritisation of resources.

Different interpretations of CMAM and how it can feasibly be carried out in any given context has a strong effect on how some of the issues are viewed, the choice of anthropometric indicator and programme strategy.

There are also perceived differences in who CMAM is for and what the outcome of CMAM treatment is: for some it is considered a treatment for the acutely malnourished **most at risk of mortality**; for others it is for the acutely malnourished that have **any excess risk of mortality**.

Related to that, some consider that treatment outcomes should focus purely on averting mortality. Others consider the need to consider the child's growth and development in addition. For example, refugee contexts bring particular challenges and sometimes opportunities to deliver services in both acute and chronic situations. UNHCR has a responsibility and concern for those children under its protection, not only in terms of short term child survival but also in terms of longer term growth and development. There are situations, e.g. the Dadaab refugee camps in Kenya, where a generation has grown up in a camp setting. There, growth monitoring is part of the public health programme and there is capacity to identify and treat SAM using both MUAC and WHZ.

Contextual features and differences are pervading issues that add to the challenge of setting global recommendations, and in applying evidence generated in one situation to another. There is great variation in caseload profile (e.g. in terms of age and sex of those children enrolled in or eligible for CMAM programmes), as well as in the available resources and capacity to deliver programmes. Including multiple admission criteria has resource implications.

The issue or resources came up in different ways in the consultation: CMAM 'burdens' overstretched healthcare systems; there is limited capacity. This fuels the need to identify the most extreme cases to treat (rather than all acutely malnourished children) and the need to prioritise resources to the children most at risk.

Another viewpoint is that treatment should not be so tightly 'rationed', but the case for adequate resourcing of treatment for all children with SAM should be made.

It is also important to consider the treatment of SAM within the broader context of alternative potential interventions that could prevent children from becoming acutely malnourished or promote sustained recovery from SAM.

The question that was most consistently raised during the consultation was not whether MUAC should or should not be used, but **whether the evidence exists to support the exclusion of children with WHZ < -3 and MUAC \geq 115mm from treatment.**

6 Overview of the evidence base informing the consultation

The discussion paper presented an analysis of the existing evidence base, alongside practitioner and academic specialist commentary on this analysis and additional issues considered relevant and outstanding. The December meeting sought to agree on interpretation and implications of the evidence, its limitations and to highlight gaps that should or could be filled through further analyses, studies or research.

6.1 Nature of the evidence reviewed

It is an important caveat that the scope of this consultation did not permit a systematic review of evidence, nor did it permit any grading or weighting of unpublished evidence shared from analyses of programming data or field reports. The December meeting sought to bring together a range of expertise and experience to debate critical issues and agree on the best available evidence, its interpretation and the way forward. Some significant gaps in the evidence base were discovered which did not permit conclusive recommendations in all areas of interest. However, the process enabled a greater understanding of the strengths and limitations of the evidence (especially amongst practitioners) and sharing of new data and emerging analyses to facilitate agreement on priority research areas for moving forward.

6.2 Key points of agreement from the evidence base

MUAC and WHZ are two key indicators of acute malnutrition. However, there are some differences between them in terms of diagnosis:

- MUAC identifies stunted children (Berkley et al 2005). Programming experiences have also reported this (e.g. MSF Spain in Bihar, India, unpublished 2012; ACF in Myanmar, unpublished 2012).
- An analysis of WHO reference data on MUAC indicates that girls are more likely than boys to be classified as severely acutely malnourished by the MUAC criterion because they have a smaller arm circumference for any given age up to 5 years of age^{xiii}. (http://www.who.int/childgrowth/standards/ac_for_age/en/).
- Use of a fixed threshold MUAC classifies more young children as severely acutely malnourished than when applying an indicator based on WHZ, as MUAC increases with age. This has both positive and negative implications: capturing younger children at higher risk of mortality is a positive attribute. However, there remains concern over the older children (24-59 months) who might be excluded by application of MUAC only admission criteria in CMAM programmes. This issue was raised repeatedly in the consultation.
- Body proportion and hydration status may also influence diagnosis of SAM by different indicators, particularly WFH, although the evidence base is sparse.

Response to treatment and recovery has been insufficiently studied. Response to treatment was not discussed in detail at the December meeting. There is an absence of evidence and guidance for programmes on how to use rate of MUAC gain to monitor progress, although emerging data analyses

^{xiii} An analysis of ACF survey datasets to add to this evidence is pending.

6

suggest that MUAC gain mirrors weight gain (e.g. Roberfroid unpublished, 2012 and Seal, unpublished contribution to the consultation).

Recovery can be distinguished as ‘immediate’ (successful discharge) or sustained (at a defined period post-discharge). However with regard to discharge criteria, currently the published evidence is inadequate to inform programming and determine appropriate discharge indicators or cut-offs. Several studies are currently in progress/planned.

6.3 The relationship between anthropometric indicators and mortality

Identification of children at high risk of mortality is a key consideration for an indicator of SAM. The ability of the indicator to accurately identify children at high risk of malnutrition-associated mortality is the ideal. Therefore an indicator that responds to treatment with a fall in mortality risk that is sustained beyond the immediate recovery period would be most relevant.

Both a low MUAC and a low WHZ are associated with a risk of dying in the short term that increases non-linearly with the degree of malnutrition, below a certain low threshold (Pelletier 1994). The evidence-base behind the assertion that MUAC is a better predictor of mortality than WHZ was consistently questioned throughout the consultation. In particular:

The existing evidence is largely based on Receiver Operating Characteristic (ROC) curves^{xiv} (based on the cumulative frequency distribution of children who die versus those who survive in a population) from studies conducted in the 80s and 90s in contexts where treatment for SAM was largely inaccessible. These show that MUAC has a greater predictive power than WFH in terms of mortality risk of children aged 6-59 months (Pelletier et al 1994, Chen et al 1980, Alam et al 1989, Vella et al 1994, Van de Broeck et al, 1996). In addition, the use of both WFH and MUAC together does not increase the predictive power over MUAC alone (Vella et al 1994, Briend et al 2012).

However, there remain many questions around the utility of these ROC curves for the purpose of identifying children at high risk of malnutrition-related mortality. These include:

- The deaths reported in the studies (and used for the ROC curves) are not malnutrition-specific, but relate to all-cause mortality. However, since the focus is on SAM, deaths from unrelated causes are unlikely.
- Neither MUAC nor WHZ reveal themselves to be ideal predictors of mortality, as the area under the ROC curve (AUC) is not large in either case^{xv}. However, of the two indicators, MUAC appears to show consistently better results.

^{xiv} ROC curves illustrate the proportion of true cases that can be detected (sensitivity) while minimising false positives (specificity) along the entire range of a continuous variable (e.g. WHZ or MUAC). They are useful for assessment of mortality risk when resources are constrained because they inform how best to direct treatment to those patients most likely to die in the short-term. They do not quantify relative risk of death or even probability of death. A variable such as WHZ may be strongly associated with mortality yet not be very sensitive or specific (Simon Wheeler, academic specialist feedback).

^{xv} In Briend 2012, MUAC <115mm detected only 8% of deaths, compared with 4% using WHZ <-3.

6

- The WFH population reference used in the majority of studies was the NCHS growth reference; use of WHZ by WHO growth standards has been shown to predict mortality better, though it is considered that this is unlikely to make a significant enough difference to rival the better predictive power of MUAC.
- The analyses did not separate out oedema, and there is some evidence that MUAC identifies children with oedema. However, it was noted that oedema was not highly prevalent in many of the populations studied.
- Absolute values (e.g. weight, age, MUAC) have better predictive power of mortality than relative values (e.g. WFH, height-for-age, weight-for-age). This needs to be considered when trying to understand the effect of age on the predictive power of both MUAC and WFH.
- Age alone is a stronger predictor of mortality that is more sensitive and specific than WHZ or MUAC (Vella et al 1994). However age is not specific to SAM.
- All children from 6-59 months are included in the analyses, while the risk of death changes quite rapidly as children age. It would be useful to see the ROC curves for children 6-23 months compared with those for 24-59 months.
- The follow up time in these studies may be too long for appropriate analyses: acute malnutrition is by definition a short-term phenomenon occurring over a period of days to weeks; the studies examined outcomes after 6-12 months.

The studies cannot be repeated because there is now treatment for SAM in most contexts.

6.4 Conclusions and practical implications from the consultation

Conclusions

Conclusions from the consultation were:

Neither MUAC nor WHZ reveal themselves to be ideal predictors of mortality; however, of the two indicators, MUAC appears to show consistently better predictive power.

Therefore, MUAC is the best anthropometric predictor of mortality currently available.

The use of both WFH and MUAC together does not increase the predictive power over MUAC alone.

However, concern was raised that ROC curves may be an inappropriate tool to inform decisions concerning which indicator(s) to use and whether they should continue to receive the prominence in the debate that they have done to date. In particular, an indicator should predict recovery and not just identify children at high risk of mortality: it should identify children at high risk who should respond to treatment. **One question outstanding is whether treatment of SAM addresses the mortality risk indicated by the anthropometric indicator/s leading to admission** and related to this, what are the responses and outcomes of children identified by different anthropometric criteria (MUAC or WHZ or both) treated for SAM.

Answering the question of whether children who meet the WHZ criterion but not MUAC (i.e. $WHZ < -3$ and $MUAC \geq 115\text{mm}$) should continue to be admitted for treatment, requires follow up in the community of outcomes of treatment and consequences of non-admission. There is evidence of elevated mortality risk associated with low WHZ. There is absence of published data on the risks of not treating those children with a $WHZ < -3$ z-scores who have a $MUAC \geq 115\text{mm}$. There is poor understanding of the determinants of low WHZ and MUAC in any given context and their relationship to each other. Thus it was concluded that there is insufficient evidence to eliminate WHZ as an admission criterion for children 6-59 months. Where MUAC only programmes are in place/planned, there is a valuable opportunity to follow up children with very low WHZ who are not treated.

As a $MUAC < 115\text{mm}$ preferentially selects young children, there is a need to examine whether a different cut-off is needed for the children aged 24-59 months.

Practical considerations

High coverage of CMAM programmes for children in need of treatment is required for population level, public health impact.

Efficient screening and referral in the community is important to ensure a high coverage of any programme offering treatment for SAM children at health facilities.

Programme capacity to manage effectively the identified caseload is another consideration in determining the indicator choice for admission for children with SAM in to CMAM.

To monitor a child's response to treatment, the indicator must be precise and even if responsive, it must be feasible to implement with accuracy at a programming level.

Under optimal conditions, the limited evidence base suggests that the reliability of MUAC, weight and length are very good. Converting weight and length measurements into the WHZ may be more challenging and the combination of two measures means any measurement errors add up. However there is a paucity of published data on reliability of measures when they are undertaken by the people who use them in the field, as opposed to a research setting.

The superior utility of MUAC over WHZ for community-based screening in most contexts was agreed and recommended for practice.

However, there is notable concern over the need to improve the accuracy and precision of MUAC measurements. Suggestions were made for improving MUAC tapes (see research recommendations).

From a perspective of programme decisions, existing national protocols for the treatment of SAM and the provision of other direct nutrition interventions have to be taken into consideration. It should be noted which measurements may already be taking place (and what equipment and skills staff and volunteers possess) and where diagnosis and admissions based on these measurements may also economise on health worker time.

It is clear from operational experiences and reflected in the draft NUGAG guidance, that there should be consistency between screening and admission – children screened using MUAC should be admitted under MUAC. Applying the same principle, children screened using WHZ should be admitted under WHZ.

7 Agreed recommendations for practice and research priorities

7.1 Agreed recommendations

In this section, agreed recommendations from the consultation are set out. These recommendations were arrived at through consideration of the existing evidence base, alongside a concern for simplicity and practicality for implementation by practitioners. These represent interim, operational guidance for programmes, pending further evidence and revision of official, UN endorsed international recommendations.

There was consensus at the meeting on three major points:

- **The primary objective of SAM management programmes is to identify and treat severely acutely malnourished children 6-59m most at risk of short-term mortality**
- **MUAC and WHZ identify different children at risk of death from SAM**
- **On balance, it was concluded that MUAC appears to be the better predictor of mortality and has practical advantages. However the limitations and interpretation of the evidence base regarding this remained an area of considerable discussion.**

Therefore it was agreed that the programmatic approach should prioritise MUAC in screening and admission. WHZ should be used as an additional admission criterion where feasible and where doing so does not compromise the coverage of children meeting the MUAC criterion^{xvi}.

It is important to note that response to treatment of children admitted under different criteria was not explored in detail at the meeting and is highlighted in Section 8 for priority research.

Table 1 summarises the recommendations and Table 2 elaborates on the research priorities that were agreed during the meeting and that relate to each recommendation.

^{xvi} This decision was based on the best available evidence, alongside practical considerations of ease of MUAC use in the community and impracticality of WHZ in most community settings.

Table 1: Summary of recommendations

Recommendation 1:

At community level, there should be active case finding by MUAC to identify children requiring management of SAM

At health facility level (fixed or mobile), there should be systematic case finding by MUAC to identify children requiring management of SAM. If a child is not identified by MUAC WHZ should be measured where it is feasible (capacity in terms of materials, time and trained human resources) and without jeopardizing other essential health services; particularly where there are relevant clinical conditions, visible severe wasting, maternal concern and/or contextual factors (e.g. acute or prolonged emergency where more older children are affected).

Recommendation 2:

A threshold of MUAC < 115mm for admission to SAM treatment applies to all children 6 months and above in all contexts.

Where WHZ is used, a threshold of WHZ < -3 for admission to SAM treatment applies to all children 6 months and above in all contexts.

Recommendation 3:

Weight gain should be used to monitor response to treatment for all children.

MUAC should be recorded in millimetres at each visit in operational research settings to establish whether MUAC monitoring can be conducted accurately and whether it is feasible for use in monitoring progress of children.

Recommendation 4:

There is no firm recommendation that can be made currently for discharge criteria, until there is more evidence from various contexts*.

Recommendation 5:

Children admitted under WHZ criterion should continue to be discharged when WHZ \geq -2 and free from oedema for 2 weeks, pending further research.

Recommendation 6:

The percentage weight gain should no longer be used as a discharge criterion.

**Current practices include discharge at MUAC > 115mm when clinically well and no oedema and where there is follow up (such as to a SFP) or discharge at MUAC > 125mm (NUGAG recommendation). Evidence is currently being collected to inform a recommendation on appropriate MUAC discharge criteria*

Table 2: Recommendations and related priority areas for research

Recommendation	Research Priorities
<p>Recommendation 1:</p> <p>At community level, there should be active case finding by MUAC to identify children requiring management of SAM.</p> <p>At health facility level (fixed or mobile), there should be systematic case finding by MUAC to identify children requiring management of SAM. If a child is not identified by MUAC it is desirable to measure WHZ, where it is feasible (capacity material, time, trained human resources) without jeopardizing other essential health services particularly where there are relevant clinical condition, visible severe wasting, maternal concern and/or contextual factors.</p>	<p>Generate evidence to better understand the mortality and developmental risks of excluding children 6 to 59 months identified by WHZ only. Where MUAC only programmes are in place/planned (e.g. India), there is an opportunity to follow up children with very low WHZ who are not treated.</p> <p>Investigate additional simple measures of nutritional status for use alongside anthropometric indicators, e.g. visible severe wasting</p>
<p>Recommendation 2:</p> <p>A threshold of MUAC<115mm for admission to SAM treatment applies to all children 6 months and above in all contexts.</p> <p>Where WHZ is used, A threshold of WHZ <- 3 for admission to SAM treatment applies to all children 6 months and above in all contexts.</p> <p>The use of MUAC in millimetres for admission is preferred to promote accuracy and enable monitoring (screening can be conducted with colour-banded tapes).</p>	<p>Investigate whether an alternative cut-off of MUAC for children aged 24 to 59 months is necessary</p> <p>Investigate MUAC cut-offs for older children (>59 months), adolescents and adults</p> <p><i>MUAC cut-offs for infants < 6 months were scheduled for discussion in a separate meeting (7th December 2012).</i></p>
<p>Recommendation 3:</p> <p>Weight gain should be used to monitor response to treatment for all children.</p> <p>MUAC should be recorded at each visit in operational research settings to establish whether MUAC monitoring can be conducted accurately and whether it is feasible for use in monitoring progress of children.</p>	<p>Measure MUAC for research purposes (recorded in mm), to examine the evolution of MUAC gain during treatment</p> <p>Make systematic efforts to verify and improve the quality of MUAC measurements in programmes</p> <p>Develop an improved MUAC tape; suggestions included wider cuff, combined mm and colour coding and to use a more robust, flexible material.</p>

Table 2: Recommendations and related priority areas for research (cont'd)

Recommendation	Research Priorities
<p>Recommendation 4:</p> <p>There is no firm recommendation that can be made currently for discharge criteria, until there is more evidence from various contexts^{xvii}.</p>	<p>Investigate the use and implication of MUAC as a discharge criteria paying particular attention to the extent to which the plateau effect occurs:</p> <p>With the NUGAG proposed discharge criteria of $\geq 125\text{mm}$, very young children (less than 1 year) may not reach 125mm but be 'cured' and "plateau" at a lower MUAC.</p> <p>Investigate failure to respond to treatment in terms of reaching target MUAC, investigate the relationship between being stunted and reaching the target criteria, investigate the role of height gain in response to treatment.</p> <p>Potential discharge option to be researched:</p> <ul style="list-style-type: none"> Children ≥ 6 months, admitted on MUAC with weight < 4 kg on admission could be discharged with a lower MUAC (e.g. $> 120\text{mm}$). This would avoid necessity of height or age measurements to make a recommendation for the younger age group.
<p>Recommendation 5:</p> <p>Children admitted under WHZ criterion should continue to be discharged when $\text{WHZ} \geq -2$ and free from oedema for 2 weeks, pending further research.</p>	<p>Collect data to explore mid- and long-term outcomes (re-admission, morbidity, developmental outcomes, death) of discharging using this criterion in different contexts</p> <p>There is currently variation in practice, and a suggestion that discharge should be at $\text{WHZ} \geq -1.5$ unless an SFP programme or good follow-up service is available. This has resource implications and implies an extended length of stay required, which should be fully understood prior to adapting the recommendation.</p> <p>Decisions on appropriate discharge criteria require more evidence on MUAC and WHZ changes during treatment and the potential to use them.</p>
<p>Recommendation 6:</p> <p>The percentage weight gain should no longer be used as a discharge criterion.</p>	<p>This is in accordance with the latest NUGAG guidance and was well accepted amongst practitioners and academic specialists in this review.</p>

^{xvii} Current practices include discharge at MUAC $> 115\text{mm}$ when clinically well and no oedema and where there is follow up (such as to a SFP) or discharge at MUAC $> 125\text{mm}$ (NUGAG recommendation). Evidence is currently being collected to inform a recommendation on appropriate MUAC discharge criteria.

7.2 Research priorities

Identification and admission of children to programmes

1. More research is urgently needed to better understand the risks of **not** treating children with WHZ <-3 (and MUAC \geq 115mm) as SAM cases in terms of short, mid and long-term risks of death, morbidity and indicators of poor development. Coverage of severely low WHZ children will remain low with current recommendations and the risks need to be fully understood.
2. Investigation of the utility of other simple measures of nutritional status e.g. visible severe wasting, is proposed to decide whether they could be conducted alongside anthropometric measurements to enhance case-finding.

Examine self-referral versus active referral (anthropometry alone and anthropometry and the concern of the caregiver) to profile children coming to programmes spontaneously.

3. Investigation of whether there is need to use an alternative cut-off of MUAC for admission and discharge of children aged 24 to 59 months.
4. Investigation and establishment of MUAC cut-offs for older children (>59 months), adolescents and others.

A thorough discussion of additional groups (e.g. infants less than 6 months old, older people, pregnant and lactating mothers groups) was beyond the scope of this consultation^{xviii}. However the issue was consistently raised, in particular regarding the 'rationing' of treatment and the attention on under-fives only.

5. Conduct ROC analyses on the existing datasets separating age/height groups: examine the predictive value for mortality of different MUAC and WHZ cut-offs for the younger children (6-23 or 29 months) and the older (24 or 30-60 months) children.

Monitoring of children in programmes and discharge criteria

6. The effectiveness of the treatment on offer for children admitted with severely low WHZ, severely low MUAC, or both in different regions, nations and at sub-national level requires investigation, taking into account different programme delivery models.

More evidence on sustainable recovery, relapse and survival rates is required for setting standards for discharge. This research should compare outcomes of children admitted either by WHZ or MUAC, or fulfilling both criteria, and take account of the context into which children are

^{xviii} Infants less than 6 months old were the focus of discussions at a one-day follow-on meeting on 7th December 2012. Minutes for this meeting available from ENN, email: marie@ennonline.net

discharged. *Emerging evidence shared in this consultation suggests that children who suffer from acute malnutrition may be nutritionally rehabilitated successfully but remain at higher risk of morbidity and mortality than their better-nourished counterparts. In the pursuit of successful treatment, it is important to remain mindful that investment in prevention of acute malnutrition should remain a top priority in all operational contexts.*

7. There remains an urgent need for more published evidence from a variety of contexts, on change in MUAC and/or WHZ over the course of treatment: use of MUAC for monitoring should be investigated to understand evolution of MUAC gain during treatment. Research will also need to consider possible practical considerations such as ability of staff to accurately measure small changes in MUAC over the treatment course and use this to inform the caregiver of the child's treatment progress.
8. Issues relating to the stipulation of a minimum or maximum length of stay (LOS) require investigation. A maximum LOS of 3 months was suggested (and often used in programming) due to concern over metabolic syndrome and avoidance of overfeeding, however this was opposed due to the concern that uncured children may languish in a programme and simply be discharged after three months when they should be referred for investigation. It was also noted that young children (less than 1 year old) may not be able to attain a specified MUAC discharge (of 125mm for example, proposed by NUGAG), yet be 'cured' or no longer in need of treatment. Further evidence is needed to inform practice.
9. Research MUAC discharge criteria with particular attention to whether one cut-off can be used for all children 6-59 months: one discharge criterion might not be adapted to older children resulting in premature discharge, while children aged less than 1 year might not manage to reach a MUAC of 125mm but 'plateau' before. Investigation should include failure to respond to treatment in terms of reaching target MUAC as well as the relationship between being stunted and reaching the target criterion. Investigate the role that height gain plays, e.g. how height gain responds to treatment of SAM and whether it mirrors MUAC gain.

Include investigation of the utility of the suggestion that children ≥ 6 months, admitted on MUAC with weight < 4 kg on admission could be discharged with a lower MUAC than the NUGAG proposed ≥ 125 mm.

Collect data to explore mid and long term outcomes (re-admission, morbidity, developmental outcomes, death) of discharging using this criteria in different contexts.

10. Explore whether target discharge weight is calculated based on admission height in operations or adapted in response to height gain over the treatment course. (Height gain has been observed during treatment that will increase the target weight if a subsequent height is used).

Treatment issues and appropriate triage of children

11. Refresh attention on complicated versus uncomplicated caseload. Current guidance and opinion differs on whether children with MAM and complications should be admitted and managed as SAM cases. This needs to be resolved.

12. Assess physiological deterioration of those selected through facility-based screening on the basis of WHZ (with a higher MUAC). Investigate whether low MUAC and low WHZ indicate different physiologies.
13. Investigate the question of body shape (sitting to standing height ratio) in the Horn of Africa and its relationship with WHZ and MUAC. Chest and abdominal circumference were also raised as potential influences on WFH in other contexts.

Improving anthropometric tools

14. Conduct research to improve the instruments to improve reliability of MUAC measurement. Systematic efforts should be made to verify and improve the quality of MUAC measurements in programmes. Consider development of an improved MUAC tape with broader cuff, colour coding and millimetre measurements, and better quality material.

Operational research

These gaps in the evidence base need to be redressed through prioritisation of research with an emphasis on peer review and publication of findings. This would assist practitioners and ministries, as well as advisors, to make reasoned and appropriate decisions on protocols and policy.

15. Investigate means to collaborate on future research to strengthen data collection, methodology and analysis and to enable linkages between operational agencies and academic specialists to avail of research opportunities and maximise research quality.

8 Way forward

Actions identified at the meeting are listed below with subsequent steps taken/planned stated:

a. Inform the NUGAG process.

WHO have been engaged in the whole consultation process and have been updated on the meeting and recommendations in January 2013. We note here:

The final draft NUGAG guidance was made available in early January 2013 to the consultation facilitators. The review acknowledges the weak evidence base on which to base recommendations regarding MUAC and WHZ use. We have highlighted to WHO the research recommendations that were emphasized in the December meeting, and draw attention to those that are not reflected in NUGAG.

It is often necessary and possible to make strong recommendations based on weak evidence; the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach^{xix} enables this and underpins the WHO guidance development. There is largely consistency between the NUGAG proposed recommendations and those that have emerged in this consultation. A subtle difference is that this consultation prioritises MUAC over WHZ at facility level (both are presented as equal indicators in NUGAG at this level).

The difference of note between NUGAG and this consultation concerns the MUAC discharge recommendation. There was a strong feeling at the December meeting that there were significant practical limitations of the proposed NUGAG discharge criterion of 125mm (challenges of meeting a 125mm cut-off in infants and the potential inadequacy of a 125mm cut-off for older children). Since programmes are already reporting difficulties in applying this cut-off in different contexts, it was considered preferable not to make a specific recommendation pending further research and investigation. It was noted that frequent changes in official recommendations are troublesome (as will be the case with the percentage weight gain discharge criteria that was recommended in 2009 but is overturned in NUGAG 2012). These observations have been shared with WHO.

WHO are in the process of drafting a manual to inform implementation of NUGAG recommendations that will include case studies to guide programmers (definitive recommendations for practice are not possible due to the lack of evidence). The detailed scenarios that informed the meeting have been shared with WHO to help inform this process.

b. Encourage the conversation between operational agencies and academic specialists, including the development of potential research opportunities and collaborations.

A closed en-net forum was set up in Jan 2013 for those meeting attendees who wish to continue to engage on a largely practical level to pursue opportunities for research collaboration. Technical discussions will be directed to and continue to be moderated by the ENN on the open en-net forum^{xx}. This meeting report will be posted in the en-net forum and widely shared.

^{xix} <http://www.gradeworkinggroup.org>

^{xx} www.en-net.org.uk

- c. Agencies attending the meeting (SCUK, ACF and UNHCR, MSF) will move ahead to set their own internal guidance.

SC UK and ACF have begun drafting internal guidance and this will be shared in due course on en-net.

- d. Interest was expressed in a follow up face-to-face meeting in the future, ideally 'piggy backed' onto another meeting/integrated as a topic in a technical meeting.

The ENN is pursuing an inter-agency technical meeting and will advocate accommodating a follow up discussion on indicators of SAM when it is realised.

A word from SC UK

As an operational agency it is important that we have a good understanding of the evidence base on which the programmes we implement are based. We need knowledge to design, and implement effective and efficient, context-specific programmes that will result in impacts for those children we strive to assist; whether we do so directly or work in partnership to do so with others. We also need this knowledge to inform appropriate advocacy in support of improved practical actions by us, peer organisations and most importantly, by governments who need to take informed decisions on national policies that determine the well-being and survival of millions of children. This consultation has enabled a much improved understanding of the evidence that exists on the utility of two indicators of SAM: MUAC and WHZ. Vitaly, it has also provided clarity where the evidence does not exist or is weak and where we have a role to play in filling the gaps through rigorous operational research in our programmes. Lastly, it has also permitted a greater appreciation of the shared operational challenges we face in supporting the application of global policy on the treatment of SAM and has given us confidence to better and responsibly inform this process, wherever we work globally. We would like to thank those individuals and agencies who participated in and contributed to the process and supported the fulfilment of these successes and we look forward to future fruitful collaboration.

9

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Note: A more extensive literature was reviewed. Only those cited in this paper and/or the discussion paper are included here.

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Annex 1: Key questions informing the review

Key questions posed by SC UK at the outset of the review

1. Should MUAC and/or WHZ be used to diagnose children with SAM and admit them for treatment?
2. Does community screening need to include all indicators that are used for admission^{xxi}?
3. Should coverage assessment consider all indicators used for admission^{xxii}?
(This question was omitted from discussion at the December meeting due to time constraints. This issue should therefore be included in a future discussion).
4. Should MUAC and/or WHZ be used to monitor treatment progress?
5. Should MUAC and/or WHZ be used to determine discharge?
6. Is it necessary that the SAM indicator(s) used for admission is/are the same used for discharge for SAM for any given child^{xxiii}?
7. Should MUAC and/or WHZ be used to estimate the prevalence of SAM in the population during surveys or surveillance and in order to take decisions on the need for a CMAM programme?

Additional key questions and considerations that emerged during the consultation period, which would assist in answering the seven above included:

1. *What is the strength of evidence regarding MUAC and mortality compared to WHZ and mortality?*

The predictive power of MUAC for all cause mortality was substantiated in the feedback received from both practitioners and academic specialists. However, a degree of uncertainty remained regarding how much the confounding factors (such as age, sex, stunting, infection) affect the relationship and whether MUAC can therefore identify all acutely malnourished children throughout the 6-59 month age range who require and respond to CMAM treatment.

2. *What are the implications of not admitting children with WHZ <-3 to CMAM programmes?*

The implications of not admitting children with WHZ<-3 to programmes and how these might vary by context are unknown. Even if MUAC identifies high risk children, this does not mean that WHZ is low risk. Low WHZ is associated with excess mortality.

^{xxi} The question was phrased differently to practitioners 'Should a different or the same indicator be used to screen and refer children with SAM as that used for diagnosis and admission?'. However there were different interpretations so we have reworded to make the question clearer.

^{xxii} This question was added to capture practitioner feedback

^{xxiii} This question was amended to specify 'for any given child' for clarity.

10 Annex 1

While mortality risk is a paramount consideration, additional issues, such as longer-term health, nutrition, growth and developmental considerations for children experiencing low WHZ or low MUAC, must also be considered.

3. Are different MUAC/WHZ cut-off thresholds needed in different population/clinical/programming contexts or for different age groups?

The MUAC threshold for admission to CMAM programmes treating SAM is recommended to be fixed at 115mm. Is it appropriate to use one threshold for all children 6-59 months in all contexts?

Is MUAC-associated mortality risk the same for all ages between 6-59 months?

Should there be a higher MUAC cut-off for children in the age-group 24-59 months (or 30-59 months)? Would this improve sensitivity and specificity in selecting older children at-risk of mortality and/or adverse health outcomes?

*4. How should response to treatment and recovery be measured?
How does MUAC respond to nutritional treatment?*

How is nutritional treatment response and recovery affected by the clinical condition of the child? What is the role of infection and disease in the progression and longer-term recovery from SAM?

Are there differences in short-term and longer-term recovery from SAM and differences in recovery between children admitted with severely low WHZ and severely low MUAC?

How far does the treatment on offer reduce the mortality risk associated with severely low WHZ, severely low MUAC or both? Is this different in stunted children?

5. What (if any) relationship exists between MUAC and WHZ?

Does a relationship exist between them that can be defined? Does this change in different contexts? What causes the differences?

Is it necessary to explore and define a relationship or is it accepted that they capture different processes/states?

*6. What is the effect of body proportion on WHZ and MUAC?
Are context-specific recommendations needed?*

This remains a significant issue in the Horn of Africa, where prevalence and caseload varies greatly by indicator. The consequences of not treating those children identified as wasted by WHZ has been raised, however the consequence of treating them unnecessarily, in terms of misdirection of resources and programme focus away from the most at-risk children, is important.

10 Annex 2a

Annex 2a: Meeting attendees

Name	Organisation (where applicable)
Carmel Dolan	ENN (Facilitator)
Rachel Evans	SCUK (Rapporteur)
Tamsin Walters	ENN
Marie McGrath	ENN
Jeremy Shoham	ENN
Vicky Sibson	SCUK
Alex Rees	SCUK
Andrew Hall	SCUK
Geraldine le Cuziat	SCUK
Nathalie Avril	MSF
Pascale Delchevalerie	MSF
Benjamin Guesdon	ACF
Anne-Dominique Israel	ACF
Allison Oman	UNHCR
Ismail Kassim	UNHCR
Caroline Wilkinson	UNHCR
Mara Nyawo	UNICEF Sudan
Jay Berkley	KEMRI/Wellcome Trust, Kilifi, Kenya
André Briend	Independent
Mark Myatt	Brixton Health
Rogers Wanyama	Independent
Dominique Roberfroid	ITM Antwerp
Marko Kerac	UCL, UK
Andrew Seal	UCL, UK
Oleg Bilukha	CDC Atlanta
Hedwig Deconinck	Independent
Simon Wheeler	Brookes University, UK
Martha Mwangome	KEMRI/Wellcome Trust, Kilifi, Kenya
Mike Golden	Independent
Severine Frison	LSHTM
Kate Sadler	Valid International

Annex 2b: Participants in the full consultation

Name	Organisation (where applicable)	Name	Organisation (where applicable)
Francesco Checchi	LSHTM	Andrew Hall	SCUK
Bradley Woodruff	Emory University/Independent	Geraldine le Cuziat	SCUK
Mark Manary	Washington University	Nathalie Avril	MSF
Judith Appelton MBE	Independent Consultant	Pascale Delchevalerie	MSF
Christine Slater	International Atomic Energy Agency	Benjamin Guesdon	ACF
Claudine Prudhon	WHO	Anne-Dominique Israel	ACF
Zita Weise-Prinzo	WHO	Allison Oman	UNHCR
Carlos Navarro-Colorado	CDC	Ismail Kassim	UNHCR
Kate Golden	Concern	Caroline Wilkinson	UNHCR
Valerie Captier	MSF	Mara Nyawo	UNICEF Sudan
Nicky Dent	Valid International/Independent	Jay Berkley	KEMRI/Wellcome Trust, Kilifi, Kenya
Tanya Khara Latimore	Valid International/Independent	André Briend	Independent
Kate Godden	Westminster University, Centre for Public Health Nutrition	Mark Myatt	Brixton Health
Hanifa Namusoke	Mulago National Referral Hospital	Rogers Wanyama	Independent
Erin Boyd	UNICEF HQ	Dominique Roberfroid	ITM Antwerp
Justine Kavle	PATH	Marko Kerac	UCL, UK
Hana Yemane Wodajo	IMC	Andrew Seal	UCL, UK
Diane Holland	WFP	Oleg Bilukha	CDC Atlanta
Jeanine Condo	School of Public Health/ National University of Rwanda	Hedwig Deconinck	Independent
Tamsin Walters	ENN	Simon Wheeler	Brookes University, UK
Marie McGrath	ENN	Martha Mwangome	KEMRI/Wellcome Trust, Kilifi, Kenya
Vicky Sibson	SCUK	Mike Golden	Independent
Alex Rees	SCUK	Severine Frison	LSHTM
		Issakha Diop	HKI
		Kate Sadler	Valid International
		Anne Walsh	Valid International

Annex 3: Operational scenarios shared by agencies at the December 2012 meeting

All operational agencies were invited to outline particular operational challenges faced around MUAC and WHZ use, with reference to real country examples, to help 'ground' the meeting from the outset. The outlines submitted in advance of the meeting to the organisers are given below and formed the basis for informal verbal presentations made on the morning of Day 1. Experiences submitted by Concern are also shared^{xxiv}. Contributions made in the session by UNICEF Sudan and MSF regarding programming experiences are also noted.

Agency: SCUK

Location: Kenya, North Eastern Province (NEP)

Focal point: *Victoria Sibson/Assumpta Ndumi*

Save the Children has been working in NEP since initiating a CMAM programme in 2007, in response to 'emergency' levels of acute malnutrition (assessed using WHZ). A calculated strategic approach was taken to secure funding from ECHO to implement the programme whilst also permitting the undertaking of detailed and costly assessments (Household Economy Approach and Cost of Diet) which would be hard to justify alone, to guide longer term programming to address the underlying causes of malnutrition.

The population of NEP is marginalised and government services are understaffed with very poor coverage. Acute malnutrition prevalence rates assessed against WHZ (WHO growth standards) are perennially elevated in relation to WHO thresholds. Typically (among children 6-59 months) these are >25% during the annual hunger gap around February - April and >15% at times of peak food availability (typically during rains, when milk is abundant).

'IMAM' is a core component of our work. SCUK work with and through the MoH to screen, refer and treat children 6-59 months for severe acute and moderate acute malnutrition. SCUK apply national IMAM protocols which require admission of children on the basis of weight for height and MUAC. It should be noted that WFH based growth monitoring is a part of the health service package, requiring heights to be taken.

- Admission is based on WHZ <-3SD and MUAC <11cm for OTP and WFH <-2 and ≥-3 SD and MUAC <12.5cm for TSFP <5yrs
- Discharge is based on WFH ≥-3 SD and MUAC >11cm for OTP and WFH ≥-2SD and MUAC ≥12.5cm for TSFP <5 years

^{xxiv} Unfortunately Concern could not attend as planned but these programme experiences were submitted and referred to during the meeting on Day 2.

Challenges

- Interpretation of levels of acute malnutrition where low WFH is more prevalent than low MUAC and there are more significant changes in GAM based on WFH vs minimal changes based on MUAC (example in Table 3)

Table 3: Mandera West district

Date of survey	WHZ (WHO GS)		MUAC	
	GAM<-2	SAM<-3	<12.5cm	<11.5cm
April 2011	32.6% (27.8-37.8)	8.5% (5.7-12.4)	9.8% (7.3-13.2)	1.4% (0.7-2.6)
October 2011	15.6% (12.2-19.7)	1.8% (1.1-3.0)	5.1% (3.7-6.9)	1.3% (0.6-2.7)
March 2012	16.2% (13.0-19.9)	3.5% (1.9-6.4)	7.4% (5.4-10.0)	0.7% (0.3-1.8)

- There are more children admitted in feeding programmes based on WFH than MUAC. Most of the children admitted based on MUAC tend to be younger children and hence also take longer to recover – this is especially the case in TSFP, where the discharge criteria for a child admitted on MUAC is MUAC greater than 12.5cm.
- With CMAM being integrated within the health system and with the high caseloads for both OTP and TSFP, quality of CMAM is compromised due to health worker workload (measurement errors for both WFH and MUAC). Often times CMAM is implemented by CHWs who do not have the appropriate training hence quality is a big challenge. In this case, CMAM should be simplified and integrated with IMCI but this has a long way to go.
- Communities in NEP do not like height measurements while child is lying down, likening this to the “death” position and this often leads to measurement refusals during surveys or wrong measurements during programme based growth monitoring as they often measure children hurriedly.

Key questions

- Would it be appropriate to move to MUAC-only (with oedema) programming to reduce numbers to those most at risk? The staff perceives that many children with a low WHZ may not be as at risk, and are classified as acutely malnourished due to their long limbs. Also, limiting admissions to low MUAC children would enable an improvement in programme performance as caseloads would be smaller. However there is a desire to assess the risk of those children who are excluded. Would their exclusion from the programme and their follow up be ethical? Would this be acceptable to the MoH (in the past they have rejected this proposal, and the importance of weight for height GMP was highlighted as a reason). How and who should broker this request? Also would this be acceptable to the local population?
- How can the status quo of focusing on interpreting acute malnutrition rates assessed on WHZ only be addressed? Can guidance on interpretation be made available? Who could lead on this? What information would be needed?
- Should we switch to use of colour banded MUAC tapes to reduce measurement (classification) errors (which are a big issue)?

10 Annex 3

Agency: SCUK
Location: India
Focal point: *Victoria Sibson*

Save the Children India works in Khammam district, Andhra Pradesh state (south east of India, state capital is Hyderabad) on an ECHO funded programme which receives technical support from Save the Children UK's advisers. The beneficiary population is one of internally displaced populations (IDPs), massively dispersed between 260 remote and hard to reach settlements. The intervention targets 55 settlements with a total population of 4353. Each settlement contains only 20-274 individuals. IDP families are denied their fundamental rights and live with inadequate food, clean water, health care or livelihood opportunities. Living in a protracted emergency in a conflict-affected area, IDP communities live in tension with the local police and face uncertainty about their status, afraid to return to their native villages because of ongoing violence.

In February 2012, a representative and exhaustive MUAC screening among 617 children 6-59 months of age returned a prevalence of MUAC <125mm of 15.4% and of MUAC <115mm of 3.7% (prevalence of MUAC <125mm in children 6-24 months was 35.8%). There was one case of oedema. The MUAC prevalence rate was judged by the SC-India team as "above WHO critical cut-offs exceeding the 15% emergency threshold, and thus confirming the presence of an emergency nutrition situation".

Accordingly, SC-India elicited the support of SCUK to secure ECHO funds to respond to these 'emergency' needs. They defined a response strategy aiming to decrease acute malnutrition rates to acceptable levels as well as to create a framework for other developmental and more sustainable approaches, including promoting linkages to other programme interventions (i.e. health, livelihood and WASH interventions).

The operational model involves working through a local non governmental partner organisation (SIRI) who deliver the services directly and relatively independently of MoH given the poor access to government run health services among the dispersed and remote IDP population.

The programme is called 'CMAM' and follows the typical CMAM model: referral of children with SAM and medical complications to government run Nutrition Rehabilitation Centres for inpatient treatment, enrolment and treatment of SAM children without medical complications in 'OTP' provided to each of the 55 settlements on a weekly basis, and enrolment and treatment of MAM children and PLW in SFP in each of the 55 settlements, also on a weekly basis. However, the OTP ration does not meet WHO requirements due to the lack of government approval to use the available RUTF (Ezeepaste). Instead, a flour-based 'Hyderabad Mix' is provided (ingredients are whole wheat, roasted bengal gram dal, groundnuts, sugar, ground nut oil). The same ration is given to MAM children and PLW.

Community based screening and referral is carried out by community health workers of SIRI, using MUAC

For OTP: admission criteria are MUAC <115mm and/or WHZ<-3 and oedema. The last report indicated admission of 129 SAM children between April and September 2012. Most children fulfilled WHZ<-3 criteria, some have a MUAC<115mm and only 9 had MUAC<115mm with WHZ≥-3.

10 Annex 3

- The maximum length of stay in the programme is 3 months and a recovered discharge in this context (where there is SFP) is WHZ \geq -3 AND MUAC \geq 115mm for 2 consecutive measurements
- Programme performance is reasonable: 88% cure rate, 9% default rate, 2% non response rate and no deaths. However average length of stay of 66 days and there is a low average rate of weight gain at 2.3g/kg/day

Challenges

In accordance with an interpretation of the global WHO guidance that MUAC and WHZ should be used to admit children for SAM treatment, and in the absence of national protocols, SCUK advised SC-India to admit children to the programme using both criteria. However, in October 2012 the first national guidelines were released in draft form and these advise using MUAC only.

Local rates of acute malnutrition measured using weight for height and MUAC are not known and there are no national prevalence estimates available for the MUAC case definition. However district level surveys suggest lower prevalence rates; in the 100 'focus districts' included in the HUNGaMA survey which sampled a fifth of the under 5 year old population of India, prevalence of MUAC $<$ 115mm was 1.7% and prevalence of WHZ $<$ -3 was 3.3% (HUNGaMA 2011). The choice of admission criteria has important implications for the scale of needs and the cost to address them.

Key questions

- Should SC-India switch to a MUAC only programme in line with new (draft) national protocol? Are we assured that there is no excess mortality risk for children with WHZ $<$ -3 and MUAC \geq 115mm? And how could it be feasible to treat only children with MUAC $<$ 115mm in this location – the caseloads would be very low and dispersed caseloads and the government service does not extend to cover or is not accessible to the IDP population. It is for this reason that treatment is currently availed through use of ECHO/emergency funds to an NGO and partner.
- Should MAM be treated at such low prevalence? And if so, should it be identified using MUAC alone? What is the evidence base that this is appropriate? The national Integrated Childhood Development Service involves weight for age based growth monitoring of all children under 6 years of age, monthly. Children with a WAZ $<$ -3 are given double ICDS (supplementary) rations. In this context, and given an ICDS ration that at least meets the nutritional requirements of MAM children, is there a need to targeted MAM children, whether using MUAC or WHZ?

Agency: UNHCR

Location: East and the Horn of Africa

Focal points: *Allison Oman & Ismail Kassim*

Context – geographical, nutritional, community profile

UNHCR nutrition programmes in East and the Horn of Africa use WHZ and MUAC as independent admission criteria in MAM and SAM programmes, and both are collected during the yearly Standardised Expanded Nutrition Surveys (SENS). MUAC, however, is the primary tool used in refugee settings for screening at the community level and mass screening during emergencies.

10 Annex 3

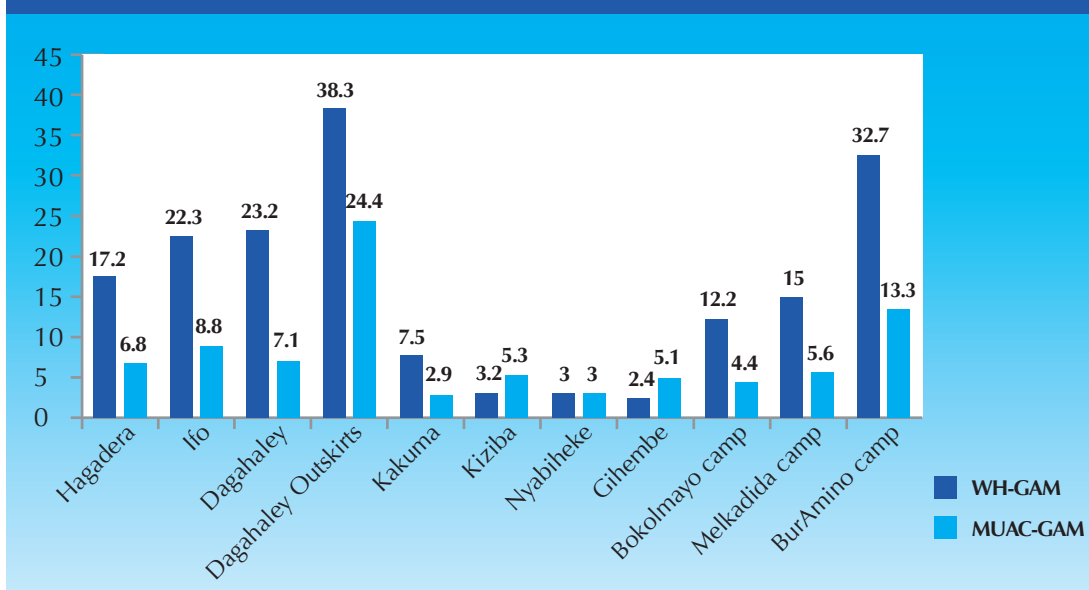
Poor correlation between MUAC and WHZ has been evident in the East and Horn of African refugee context, especially in refugees of Somali and Sudanese origin, over the years. However, the recent crisis in the Horn of Africa has further revealed the pronounced poor correlation. In reality, the rates of GAM using MUAC and WHZ were so different and different agencies working with UNHCR voiced concerns that WHZ was “over-estimating” the caseload in need while others felt MUAC was vastly “under-estimating” which children should be enrolled. Many debates were held about whether to expand the initial community screening MUAC cut-offs to ensure that these children had all opportunities to be admitted (at least under WHZ context). The various scenarios of referring children to centres to then be turned away versus not catching children (especially the above 36 months of age MAM cases) before they became severely malnourished caused intense stress on the nutrition team. A crisis of faith emerged about which was giving us a “real” understanding of the current situation and the expected debates about whether our purpose was to avert mortality or to avert malnutrition quickly derailed programmatic response. In the end, UNHCR has sought global support to instruct how to manage these differing tools in the emergency setting and how to harmonize screening at the community level and admission/discharge from selective feeding programmes.

Currently, MUAC is used mainly in referral of children to selective feeding programmes from the community, during mass screening campaigns in refugee camps and rapid screening during an influx of refugees. MUAC is preferred due to its ease of use, limited manpower requirement, efficiency when large numbers of children are screened, minimum training of community health workers and ease for transport (tape versus height board and scale). It is used as an independent criterion for admission into selective feeding programmes, and whichever of the two (MUAC or WHZ) will signal admission is used.

WHZ, in the East and Horn of Africa refugee camp context, is the indicator cited as the GAM, SAM and MAM in all nutrition survey reports, even though both MUAC and WHZ are recorded. In this region the WHZ shows a consistently higher GAM level than MUAC. In some cases, shown in Figure 1 below, the difference is extreme and raises issues about the validity of one or the other, or questions the reliability of using MUAC for screening if a large number of WHZ identified GAM cases would be missed. This therefore raises pertinent and ethical question on whether to continue MUAC in community screening when it has been shown to exclude a higher malnourished population and again, whether these are genuine cases of malnourished children and with risk of deterioration or even death is still unknown.

From Figure 1, the disparity between MUAC and WHZ is evident in Kenya Dadaab refugee camps (Hagardera, Ifo, Dagahaley, and Dagahaley outskirts) and Ethiopia Dolo camps (Bokolmayo, Melkadida and Bur Amino) which are 100% refugees of Somalia origin. On the other hand, a near perfect correlation is shown in Nyabiheke and close correlation in Kiziba and Gihembe although the malnutrition rates were low in these Rwanda camps, which are populated predominantly by refugees from DRC.

Figure 1: Prevalence of GAM based on WFH z-score and MUAC from cross-sectional nutrition surveys in different refugee camps in 2011-2012



In summary:

- MUAC and WHZ are used as independent criteria for admission into selective feeding programmes, but MUAC is used almost exclusively for community-based referrals, mass screenings and nutrition screening during influx.
- Nutrition survey data where both MUAC and WHZ are taken show a very poor correlation between GAM based on MUAC measurements and GAM based on WHZ, with the latter being considerably higher.
- UNHCR screenings are intended both to admit children severely malnourished and at risk of death, but also to identify those moderately malnourished to prevent further deterioration. Resource mobilisation for both SAM and MAM is fluid and so there is not a question of prioritisation but rather identification of all malnourished children for enrolment and rehabilitation.

Key questions

1. Is WHZ overestimating children with MAM and SAM? Is MUAC underestimating? Which is worse? Is this problem only specific to certain physiologies such as the Sudanese, South Sudanese and Somalis?
2. Is it better to have a more inclusive measurement tool in the screening at community level and then a narrower tool at the facility level so that children potentially at risk are being clinically examined? How to deal with the caregivers of children who come to the facilities but then are not admitted?
3. Which is the “gold standard” method to use for identification of acute malnutrition at the community level, bearing in mind user-friendliness, portability and minimum training? It seems unlikely we could use WHZ in the community, so do we use MUAC but relax the cut-off?

10 Annex 3

4. How do the MUAC and WHZ results compare? - is there any correlation between GAM/SAM based on WHZ and MUAC? Is there any pattern common in all the data sets from the different countries to aid interpretation?
5. How do the two measurements compare (MUAC versus WHZ)? Are there specific age groups/ categories that are more similar (such as younger SAM cases) and age groups/categories that are less compatible (older MAM cases)?
6. Is the MUAC/ WHZ difference based on poor measurements? Any technical inputs in the reliability of both measurements? Is MUAC really as “simple” to use as has been implied?
7. At what point does increasing the MUAC cut off point reduce the number of discordant measurement in MUAC and WHZ? Does increasing the MUAC cut off improve the sensitivity of the MUAC?

Agency: Concern General observations across programmes Focal point: *Kate Golden*

All programmes are using MUAC <115 mm as admission to SFP except Ethiopia, which is still using <110mm.

MUAC has a bias to identifying younger children (all six programmes that contributed to this review). Some consider this good, as young children have higher mortality rates (but some of this excess mortality is not directly linked to low MUAC/malnutrition itself). Others question whether this is using resources (particularly RUTF) wisely as these younger children often appear in good shape. We may also be doing the very young children harm, particularly those under six months where age is difficult to determine – we may be displacing breastmilk with RUTF. In Somalia, 90% of the children in OTO are under 24 months old and nearly three-quarters (73%) are under 12 months old.

MUAC in pastoralist regions may dangerously underestimate acute malnutrition (Uganda). In Karamoja Region of Uganda, among a largely pastoralist population, ACF and Concern found that MUAC was underestimating acute malnutrition and WHZ was a better determinant. This seems in accordance with the ‘Body Shape’ article findings, but upon observing children that would have been admitted by WHZ but not by MUAC, field practitioners felt that they were indeed acutely malnourished and required CMAM treatment (see more details below). This suggests using MUAC is not more appropriate in this context.

Correlation between low MUAC and general wellness of the child is different in Asia vs. Africa. Children with MUAC <110 in Nepal generally seem fine and might be running around, whereas in Africa a child of the same age with MUAC <110 seems truly malnourished with no energy (this contrast between the two contexts is more true of children over one year or age).

MUAC discharge thresholds often don't agree well with other discharge criteria – % wt gain, minimum length of stay, WHZ. For example, it takes much longer for children admitted to OTP/ SFP to achieve MUAC discharge than to achieve 15% weight gain (Ethiopia). This leads to children who seem well be kept in for longer while the 2nd or 3rd criteria is met. This is also confusing for staff. If one discharge criteria is always going to take the longest to reach (e.g. MUAC threshold), then should just use that criteria and drop the rest – but is there sufficient evidence to support one criteria?

10 Annex 3

Need sufficient and meaningful/evidence based difference between MUAC admission criteria and MUAC discharge criteria. Otherwise children may be readmitted days within being discharged.

MUAC cut-offs may be unfair to boys? (Somalia) Our Somalia team has found that the MUAC threshold of <115 identifies boys in a much worse state than girls.

Prevalence of GAM by MUAC tends to be considerably lower than according to WHZ (Somalia).

Table 4: Results of FSNAU nutrition surveys in Mogadishu

	GAM by WHZ	GAM by MUAC	SAM by WHZ	SAM by MUAC
April 2012, IDPs	16.1% (13.3-19.5)	10.6% (7.9-14.0)	3.7% (2.3-5.7)	1.9% (1.0-3.4)
April 2012, residents	10.3% (7.9-13.4)	6.6% (5.1-8.6)	1.7% (0.9-3.1)	1.2% (0.7-2.3)
July 2012, IDPs	9.6% (7.1-13.0)	8.4% (6.5-10.9)	1.8% (1.0-3.2)	2.6% (1.5-4.5)
July 2012, residents	10.8% (8.3-13.9)	5.4% (3.8-7.6)	1.5% (0.7-3.0)	1.2% (0.5-2.6)

Agency: Concern

Location: Uganda

Focal point: *Sinead O'Mahony and Hilda Kawuki*

Context

Concern has been supporting CMAM in the Karamoja district of Uganda since 2008. It is largely a pastoralist population.

National Protocol admission criteria for 6-59 months:

- Bilateral pitting oedema (+/Grade 1 or ++/Grade 2) or
- WFH/BMI for age < -3 z-scores or
- MUAC < 11.5 cm

National Protocol Discharge criteria

- WFH > -2 z-scores for 2 consecutive visits or
- Weight gain of > 20% for children and
- no oedema

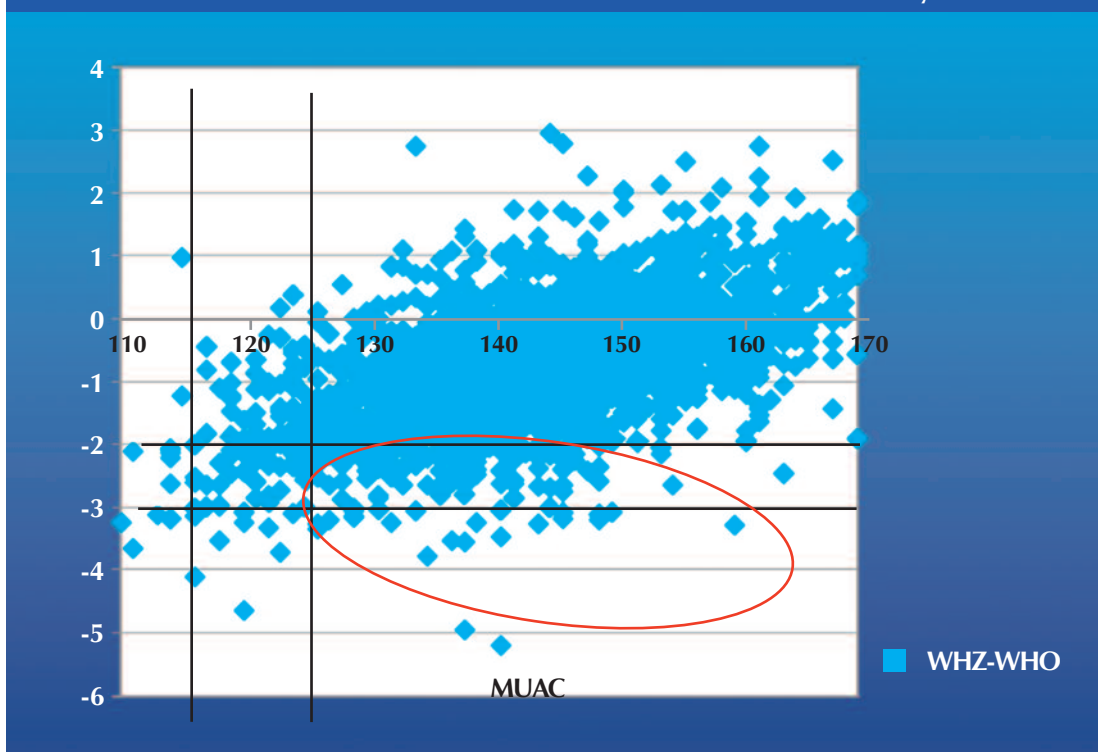
Main country programme concerns

In Uganda (in Amudat District) the main issue with MUAC for the country programme is the discrepancy between MUAC and WHZ. The population in Amudat district are primarily pastoralist. As is common in pastoralists, MUAC is less sensitive than WHZ in recognising SAM and MAM. Although this is typical in pastoralist populations, MUAC seems to be very insensitive to recognising malnutrition in this population.

10 Annex 3

Based on five rounds of nutrition survey data from 2010 – 2012 carried out by ACF in partnership with the Ministry of Health, only 7 children have been identified as severely malnourished in this chronically food insecure district over the space of 2 years. Our question in Uganda is whether it is possible that MUAC is actually underestimating the situation and not sensitive to malnutrition in this specific population - as from our experience on the ground children look malnourished and their WHZ is <-2 but their MUAC is >125 mm. Figure 2 shows the extent of the insensitivity of MUAC in recognising malnutrition in Amudat District. It shows data for 2552 children aged 6 – 59 months from five rounds of nutrition surveillance data from 2010 – 2012. This data shows out of 2552 cases, only four children have both a WHZ <-3 and a MUAC <11.5 cm. A MUAC of <12.5 and >11.5 represents less than half of children with a WHZ <-2 .

Figure 2: MUAC in relation to WHZ in Children 6 – 59 months based on Karamoja Nutrition Surveillance Round 4 December 2010 – Round 8 May 2012



Additional questions are:

- Children who are stunted and wasted can sometimes not reach -3 z scores because they are so short. What is their prognosis? Is MUAC better for use on stunted children?
- How does weight gain relate to changes in MUAC and changes in W/H and is weight gain a good measure of improvement that will reduce risk of mortality?
- How does intestinal parasite load affect the sensitivity/ specificity of MUAC vs. WHZ (seems MUAC would pick up wasted children with high parasite load, while WHZ wouldn't as the wt is still there – inside the worm, inside the child's belly)

Agency: ACF

Location: Myanmar

Focal point: *Geraldine Le Cuziat (relating experience when working with ACF, currently SC UK staff member)*

Context – geographical, nutritional, community profile

In Myanmar, in the Northern Rakhine State (NRS), the prevalence of malnutrition remains at a critical level, and has been consistently well above the thresholds of emergency according to WHO (i.e. GAM \geq 15%)^{xxv} with the last SMART survey conducted by ACF in December 2010. NRS is one of the poorest, most densely populated and vulnerable areas of the country characterised by protracted high rates of acute and chronic malnutrition. Chronic food and nutrition insecurity is the direct consequence of marginalisation of the Muslim population who have been victims of discriminative policies for more than 50 years. This situation is affecting the ability of the majority of households to access sufficient levels of nutritious food and income as well as basic services such as clean water, health and education.

Operations – History, programming, rationale/strategy

ACF is the main actor in nutrition in Northern Rakhine State (NRS) and has been running nutrition programmes in Maungdaw (MGD) and Buthidaung (BTD) townships respectively since 2003 and 2004. The nutrition activities in NRS have been through a number of changes since it started in 2003 (e.g. the involvement of ACF has evolved from direct implementation of inpatient facilities to the introduction of outpatient care, admission criteria from NCHS to WHO etc.). The integration of Community-based Management of Acute Malnutrition (CMAM) into routine national health services has not been considered as a feasible and sustainable solution so far due to a number of limiting factors (e.g. unaffordable health costs, poor access to health service, lack of skilled staff and/or no medical staff from the Bengali Population etc.), although discussions were on-going before the eruption of violence again in 2012.

Challenges

Key challenges are:

- Lack of guidance/international cut-offs on how to interpret the results of MUAC screening and translating them into appropriate WHZ rates
- Mismatch between the prevalence of GAM from nutrition anthropometric surveys and caseload estimation for programme purposes if admission criteria are also based on MUAC, as MUAC and WHZ may identify different children as acutely malnourished.
- Community screening and referral only on MUAC while WFH and MUAC are both used as admission criteria and may identify different children as acutely malnourished.
- Use/guidance for discharge criteria (MUAC, WFZ, % gain of weight etc.) for children admitted on MUAC
- Mismatch between international guidance and some national protocols

^{xxv} In Maungdaw, 19.7% [14.8 – 25.8 95% C.I.] of children under five were acutely malnourished. 2.9% [1.5 – 5.5 95% C.I.] were suffering from SAM. In Buthidaung, the prevalence of GAM was 20.3% [16.2 - 25.1 95% C.I.]. The prevalence of SAM was 2.6% [1.5 - 4.3 95% C.I.].

10 Annex 3

- SQUEAC surveys estimating the coverage on MUAC only and not WFH – missing a big chunk of children that are acutely malnourished and likely to overestimate coverage
- Lack of authorisation from national authorities to perform rapid MUAC screening

Key questions and considerations

Should we be considering to:

- Conduct regular active case finding using WHZ (though time/resources consuming) in country where overlap between MUAC and WFZ is low (e.g. < 20%)
- Conduct nutrition anthropometric surveys and report systematically prevalence rates using both MUAC and WHZ.
- Potentially use different MUAC thresholds in population with high prevalence of high GAM but with low mortality – value of research in country where this is an identified issue in collaboration with national authorities.
- Guidance on discharge criteria and consistency across admission and discharge criteria is needed
- Increasing the use of tools such as Moyo charts and ensuring health staff receives appropriate training

Agency: ACF

Location: Burkina Faso

Focal points: *Benjamin Guesdon & Anne-Dominique Israel*

In Burkina, ACF activities are typical of what we call “integrated CMAM”, meaning that we are supporting the MoH in delivering CMAM within its own structures and own staff. ACF is mainly working in the Diapaga health district, providing a multifaceted support: active case finding and referral within the communities (direct implementation or through partnership with local NGOs depending on the area), training and supervision of SAM management in OTP as well as in stabilisation centres, funding (free care for SAM children), logistics, providing information (surveys and monitoring of the programme). The national protocol does exist, yet has still not adopted the WHO criteria and cut-offs for SAM and MAM identification and admission (this is pending).

There are challenges in promoting a wider use of MUAC at community and health centres level, mainly because of lack of awareness and community mobilisation about SAM and confidence in the utility of the MUAC tape. Nevertheless, ACF is consistently working on it, and trying to do better through partnerships with local NGOs or authorities.

On the other hand, there are consistent links with other health programmes and the growth monitoring (with weight and WFA (weight for age) follow-up) which is delivered to children between 0 and 2 years in the health centres.

Finally, with the 120mm cut-off for MAM used in active case finding (110mm for SAM) in the community, and with other types of referral like passive screening or self-referral, we think that we do include a significant proportion of cases with low WFH and a MUAC over 115mm in this context (it seems that they represent between 33 and 50% of the SAM cases in the population according to recent surveys). In Burkina, we have no database to prove this, but we see this in other similar contexts.

10 Annex 3

In this case, typically, the need for increased coverage through increased low MUAC case detection is very strong, and should necessarily be accompanied by an increased awareness raising campaign. For this very same reason, we can expect that many more children with low WFH and MUAC \geq 115 will arrive in nutritional centres, so that for this same reason, we feel that WFH should not stop being used for case detection and admission/referral whenever it is possible to promote and support it. Furthermore, in Burkina Faso, it could also be an option to increase the capacity of the growth monitoring programme (GMP) so that it would also be measuring height and WHZ in a more systematic way.

Agency: ACF

Location: Bangladesh

Focal points: *Benjamin Guesdon & Anne-Dominique Israel*

In Bangladesh ACF are working on two very different type of CMAM:

The first one, as UNHCR implementing partner for nutrition in the Rohingya refugee camps of Kutapalong and Nayapara, Cox's Bazaar district. Here ACF is providing a "full" CMAM programme package (outpatient and inpatient for SAM under 5 years, SFP for MAM under 5 years, SFP for PLWs and other at-risk categories, outreach activities including active case finding and referral) AND a full monthly growth monitoring programme with height, weight and MUAC measurements for all children under 5 years. This is direct programming, as an implementing partner of UNHCR, and in partnership with MoH regarding the other health activities inside the camps.

There is a low SAM prevalence yet still a high prevalence of MAM due to camp conditions and insufficient/unbalanced food rations/ lack of income generating activities.

The second CMAM 'type' is as a partner of the MoH and UNICEF to support the delivery of CMAM to the host communities of the two locations where the camps are located, meaning Ukhia and Teknaf upazillas. It is important to mention that a national protocol for CMAM has only recently been endorsed by the Government, which represents as such a huge progress. However, this protocol only considers the use of MUAC for the detection and admission of children as SAM or MAM into CMAM programme. Also so far, no OTP has yet been opened to manage SAM children who should not go to inpatient. So in practice there are very few changes on the ground, except that children are starting to be referred from active case finding and cannot receive an adequate treatment. The restriction of admission criteria to low MUAC was probably chosen because of the enormous caseload which was expected in case both anthropometric indicators would have been used.

This raises concerns for our team, mainly are we providing the right treatment to the right children? First, there is a concern about the fact that around 80% of SAM children (proportion of low WFH and MUAC $>$ 115) will be denied access to treatment. Can we at least plan to admit all children arriving on self-referral yet with MUAC $>$ 115? Also, there are doubts regarding the acute malnutrition status of young girls stunted presenting a low MUAC, with the general feeling that these children probably rather suffer from chronic undernutrition and should be referred to an adequate long-term programme after being discharged from OTP. There are also signs that these children could not easily reach the 125mm discharge criteria, while they are continuously gaining weight. The same feeling has been recently reported to ACF by the Haiti mission and formerly by the Myanmar mission.

10 Annex 3

Agency: UNICEF Sudan
Location: Sudan
Focal point: *Mara Nyawo*

- Prevalence of acute malnutrition by WFH is much higher than MUAC
- Programmes admit on MUAC and WFH (UNICEF has to supply height boards and training is necessary)
- High prevalence with WFH, stunting reduces with age but acute malnutrition prevalence increases. This reinforces the body shape issue – that WFH is more affected by limb length than MUAC so is an imperfect indicator of acute malnutrition
- UNICEF Sudan is supportive of MUAC-only programming in this context. Their programme goal is to target children most at risk of dying. There is a high SAM prevalence by WFH but mortality rates do not seem high in this group. There are limited resources and a high burden of children with acute malnutrition, so a need to prioritise.
- BUT MoH is largest partner and won't move away from using WFH until a global recommendation is made.

Operational challenges

Regarding the question about not treating children with WFH < -3:

- Conversely, in treating them - are we using resources unnecessarily?
- Is it harmful to include children in programmes who shouldn't be treated? Are we altering children's metabolism/ taste perception?
- Should the choice of indicator be resource driven?

Agency: MSF
Location: Bangladesh
Focal point: *Pascale Delchevalerie*

- Programme based in Dhaka, mortality low, acute malnutrition prevalence high (differs from Africa)
- MSF support primary health care and CMAM
- Admission criteria include MUAC, WFH & oedema (88% children admitted under WFH)
- National protocol recommending to abandon WFH

MSF followed a cohort of 158 children (137 final number) without treatment (WFH < -3 but MUAC > 115). Follow up for 3 months, reviewed morbidity, mortality & nutritional status. They found little ill effect from not treating these children. Only 7% had to be referred to nutrition programme (weight loss or reduced MUAC), 3 medical referrals, 66 of children increased, 27 remained below -3Z scores.

The validity of this trial was questioned as follow up affects survival, these are relatively low risk children already and mortality in the community can happen very quickly in vulnerable children (follow up only 3 months).

10 Annex 3

It was appreciated that there is no comparison so it's a judgement call whether the observed mortality really is low or not.

Operational challenges

- MUAC favours younger children (addressing 2 different populations). Is a single cut-off of MUAC sufficient?
- Should a distinction be made between 6-23 and 24-59m? MSF are doing this now in South Sudan – MUAC alone for under 2 year olds and MUAC and WHZ for >24 month olds
- Do we need an indicator for ill children? e.g. for convalescent feeding
- How to measure mortality outcomes without affecting mortality through cohort follow-up? Gold standard for survival studies cohort studies. Observer effect reduces over time.



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