REPORT
International Symposium on Understanding Moderate Malnutrition in Children for Effective Interventions 27 – 29 May 2014

The International Atomic Energy Agency (IAEA) hosted the Symposium on Understanding Moderate Malnutrition in Children for Effective Interventions in order to help bridge, on the one side, recent research findings and technological advances with, on the other, operational approaches and policy-development processes.

The symposium convened over 350 individuals, the majority of whom represented governments responding to moderate malnutrition in their populations; nearly 70 national and international organisations from the United Nations and non-governmental sectors, universities from around the world, as well as donor governments and private sector entities.

The symposium was structured around nine sessions over a 3-day period, progressing from a global analysis of the scale of the problem to recent research findings relevant to designing effective interventions. A number of papers have been compiled, based on the presentations made at the symposium. These will be published separately in a special issue of the Food and Nutrition Bulletin, with Dr Eileen Kennedy as the special Guest Editor.

What follows are the main highlights from each session.

**Session 1: Setting the Scene**

**Session 2: Prevention of MAM in the First 1000 Days and in Emergencies**

**Session 3: Management of Acute Malnutrition in Infants Aged Under 6 Months (MAMI)**

**Session 4: Community-based Management of Acute Malnutrition (CMAM)**

**Session 5: Impact Assessment of MAM: Methodological Challenges**

**Session 6: Capacity Building**

**Session 7: Ready-to-Use Foods in the Management of MAM**

**Session 8: Hot Topics in Research**

**Session 9: The Way Forward**
Session 1: Setting the Scene

Chair: Eileen Kennedy (Tufts University)
Rapporteurs: Rebecca Brown (CMAM Forum)
Jeremy Shoham (Emergency Nutrition Network, ENN)

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An estimated 51 million children worldwide suffer from acute malnutrition, 17 million of which are severely affected. Sixty nine percent of this global burden is located in Asia. Acute malnutrition occurs during emergencies, seasonally and endemically in different contexts. Acute malnutrition affects linear growth as well as soft-tissues, and is usually also associated with micronutrient deficiencies. Acute malnutrition accounts for 12.6% of deaths in under-five year olds, with severe acute malnutrition (SAM) accounting for 7.6% of deaths.

With such public health significance, the World Health Assembly included acute malnutrition within its global targets addressing undernutrition, to reduce and maintain childhood wasting to less than 5% by 2025. Many countries are not on track to achieve this as well as other targets.

Whilst global and national estimates of wasting are based on prevalence rates, it may be more appropriate to consider incidence rates for such a transient condition, though it is acknowledged that the data-collection burden for this would be significant.

In considering what current evidence can tell us about what works in managing moderate acute malnutrition (MAM), serious limitations emerge because of the poor quality of the evidence available. Consequently, systematic reviews have only been able to include a small number of studies relating to the effectiveness of interventions aimed at managing MAM.

Conclusions that can be drawn from studies about MAM effectiveness include:

1. Food supplements work in the treatment of MAM;
2. Lipid-based nutrient supplements (LNS) have been found to be more effective in terms of weight gain and recovery rates;
3. Little evidence on the comparative efficacy of different products in terms of mortality, defaulting and progression to SAM is available;
4. There are too few studies, based mainly in Africa, to make general conclusions. Furthermore, it is difficult to generalise from available evidence due to the heterogeneity of studies (research methods, programmatic approaches, contextual differences etc.).

Future research relating to MAM management should examine many issues including:

- Rapid weight gain versus sustained recovery and improved functional outcomes;
- Cognitive outcomes;
- Cost-effectiveness of different approaches.

In conclusion it was emphasised that acute malnutrition is both a development and humanitarian challenge. In order to strengthen the quality of responses, it is vital to improve the quality of research.

Maternal malnutrition is clearly linked to malnutrition in children, though evidence gaps remain a critical constraint. Of particular importance is the lack of evidence and data on the nutritional status of adolescent girls, although it is estimated that in some countries up to 50% are stunted.

Although there has been some reduction in maternal wasting since the 1980s, maternal malnutrition still accounts for 7% of the global disease burden and contributes to 20% of poor pregnancy outcomes. Women of reproductive age often also suffer from multiple micronutrient deficiencies, and there has been no change in the prevalence of anaemia over the last 20-30 years.

The aggregation of data on women’s nutritional status gives a false impression, as obesity is clustered in older women and wasting is clustered in younger women.

In terms of birth outcomes, the following were highlighted:

- Data on low birth weight (LBW) is very weak, often based on the family’s perception of the baby’s size (small, normal or big);
- In 2011, there were 32 million small for gestational age (SGA) births, accounting for 27% of total births in low and middle-income countries;
- 20% of stunting at 2 years of age could be attributed to SGA;
- Data from Pakistan show that half of childhood stunting was established by 6 months, which points to a link with maternal undernutrition;
- Foetal growth restriction may account for 12% of deaths by the age of 5 years;
- 50% of girls in the poorest socioeconomic quintile gave birth before 18 years of age: ‘children having children’.

The evidence that we do have points to the need to go beyond nutrition-specific interventions in tackling maternal undernutrition. We need to address ‘nutrition blind spots’ such as nutrition in adolescent girls, and to reduce the number of pregnancies among girls below 18 years of age.

Regarding the role of the UN, WFP, FAO, WHO and UNICEF all have roles in relation to MAM and endeavour to work together to ensure complementarity and coherent programming. The need to improve the coherence of SAM and MAM programming was highlighted.

At country level, the need for strong government leadership and coordination, and for including MAM programming in national budgets to ensure sustainability was underlined.
There are both similarities and differences in the physiology of stunting and wasting, that should be taken into consideration when designing programmes. Undernutrition with a stress such as infection depletes muscle tissues; in the absence of infection, undernutrition uses up fat stores. Survival is linked to muscle mass when malnutrition and infection are both present. Muscle mass is reduced in both wasting and stunting; fat stores may also play a role in survival and regulate bone linear growth. There is no rationale for having different programmes for these two forms of undernutrition, except in cases of stunted children with adequate fat stores (in which case feeding regimes could increase the risk of obesity). Operationally, two priority groups emerge: young children (who have lower muscle mass); and young children who are also stunted and wasted, and thus have a higher mortality risk. Mid-upper arm circumference (MUAC) is the best predictor of mortality as it picks up younger children who have a low muscle and fat mass.

The question was raised as to whether we should use mid-parental height or maternal height to adjust the risk for death associated with stunting, since mortality risk seems to be different in South-East Asia, where parents tend to be shorter compared to those in Africa. However, since we now have strong evidence that low MUAC is associated with a higher risk of death, and have interventions that can prevent such deaths, it would be unethical to undertake new cohort studies to examine the relationship with stunting adjusted for parental height.

Typically, the programmes aimed at the prevention of wasting during ‘lean’ seasons and emergencies are child survival, growth and development (which are similar outcomes to the prevention of undernutrition through the focus on the first 1000 days). Emergencies and lean seasons exacerbate underlying nutrition problems. In order to determine the most appropriate response in a given emergency, the MAM Task Force (created in March 2011) produced a MAM Decision Tool, a Product Sheet and a Guidance Note. A subsequent global MAM mapping, carried out in 2013, showed that most prevention programmes were either forms of blanket feeding or cash/voucher distributions. Indeed, blanket supplementary feeding programmes (BSFP) were operational in 44 countries, reaching 7 million children. Coverage of BSFP varies, and WFP’s target is 70% (achieved, for example in Niger in 2012). Attention is increasing on other legitimate
interventions that could help to prevent MAM, and the emphasis needs to be on building on existing programmes so as to maximise the continuity between pre- and post-emergency efforts.

A recent review of nutrition-specific and nutrition-sensitive approaches shows that prevention of MAM has involved numerous interventions — from food- or health-based interventions, to programmes aimed at strengthening the position of women and the caregiving environment. Supplementary feeding is commonly recommended practice for both preventing and treating MAM, even though the evidence to justify this is limited and/or conflicting. Nutrition-specific interventions include support to pregnant women, infants and young children — the nine ‘proven’ interventions promoted by the 2008 Lancet Series. Nutrition-sensitive interventions include food security and livelihoods, water, sanitation and hygiene (WASH), early childhood development and positive caregiving (including increasing attention on women’s mental health that can impede caregiving practices). Overall, the review found that by embedding short-term interventions into long-term systems, better outcomes can be achieved. Technical briefs will be published on the above and will incorporate information from this symposium.

Three separate studies conducted in Niger in subsequent years assessed the impact of different blanket interventions for prevention of acute malnutrition. All three were nested in very large programmes, which provided health and nutrition interventions, but one was a randomized trial; another was observational in design and the third analysed programme experience. Because a negative comparison group that does not receive an intervention cannot be included in studies done in emergencies, a combination of different designs, or a triangulation of findings from studies using different designs is warranted to build up the evidence base regarding MAM prevention to inform programmes. Concerns were raised regarding the time frame required by different research methods; which group should be targeted; and the difficulty in assessing impact.

The results of a longitudinal cohort study of non-malnourished children who received a monthly unconditional cash transfer were presented. Children belonging to households classified as poor and very poor were found to have a higher risk of malnutrition, even though 80-90% of the transfer was spent on food. According to the authors, malnutrition was therefore probably caused by other (non-food) factors. Remaining questions include:

1. Can delivering cash transfers earlier prevent more children from becoming wasted?

2. Can cash transfers have longer-term impacts on household food security and livelihoods and nutrition outcomes compared to food-based interventions?

For any programme aimed at preventing MAM, a key consideration is coverage, and the ability of governments to provide services that can reach the millions of undernourished children that need support, and to be able to do so in an affordable and sustainable manner.

Panellists discussing whether cash is an appropriate intervention to prevent acute malnutrition put forward different positions:

- In emergencies, cash alone is not as effective as interventions that include nutritious supplementary foods targeted to young children. Distribution of supplementary foods in conjunction with household support (such as cash for the most vulnerable) should remain a key pillar of emergency interventions. In terms of preventing acute malnutrition, free quality health care should come first.
- Cash works only when adequate nutritious foods can be purchased locally, but may cost more than blanket provision of nutritious food. The poorest households may require cash or other food assistance in addition to special nutritious food for their youngest child(ren).
- In many contexts it is likely that cash transfers need to be integrated with other interventions from other sectors such as health and WASH in order to effectively reduce risk of acute malnutrition in infants and young children. Criteria and benchmarks need to be established to identify these contexts. Income from cash transfers may be used to create more sustainable household assets, which may have longer lasting impact in preventing acute malnutrition. Earlier intervention with cash may improve results.
- Prevention requires a combination of interventions as identified by the conceptual framework. Cash can be part of the solution. Currently there is no single agency/line ministry responsible for preventing acute malnutrition. This creates an operational challenge for all proposed interventions.

Concerns around corruption and diversion were raised. In fact, delivery mechanisms for cash transfers have been improved over the last 10 years, and tend to have more robust monitoring systems than for in-kind distributions. What is needed is a clearer rationale for the type and amount of cash given, based on the context and on household level needs.

There is not one single approach that can be recommended for sustainable management of acute malnutrition. It’s the key question, but it is unlikely that there is a single answer. Even with SAM, treatment and prevention is not sustainable, since community-based management of acute malnutrition (CMAM) (or other) programmes are mainly funded externally rather than by governments. Context, incidence, risk of deterioration, and food security situation, are important factors to consider when deciding what approach to implement, such as prevention for all during first 1000 days with or without food supplements; SAM treatment; MAM treatment; or a combination.

Session 3: Management of Acute Malnutrition in Infants Aged Under 6 Months (MAMI)

Chair: Marko Kerac (University College of London)
Rapporteurs: Nina Schlossman (Global Food and Nutrition Inc.) Ricardo Uauy (University of Chile; London School of Hygiene and Tropical Medicine)

| MAMI background and future needs – making policy when evidence is sparse | Marie McGrath (ENN)  
Marko Kerac (University College London) |
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Acute malnutrition - both moderate and severe - in infants under six months of age (<6m) is not well documented or understood. Distinguishing MAM and SAM in this age group is not a priority; identifying sick infants (complicated cases) wherever they are on the spectrum is much more important for outcome. In-utero factors can lead to babies who are born SGA or with LBW who are at higher risk for acute malnutrition unless they received special nutritional and health care. Postnatal clinical practices and nutritional factors can also lead to later malnutrition. Evidence on how to manage infants who are malnourished has, to date, been sparse and localized. Few practices are based on evidence derived from controlled studies of alternative modes of care.
More operational and basic research is required to determine successful approaches to both preventing and correcting acute malnutrition during early infancy, and how to integrate this into national level policies and programmes.

An estimated 4.7 million infants <6m globally have MAM. The problem is often missed because it is not actively looked for or considered. Infants <6m are typically not included in nutrition surveys, the assumption being that exclusive breastfeeding (EBF) prevents all forms of malnutrition. This is a false assumption, however, given that, firstly, infant wasting can occur for reasons other than inadequate breastfeeding practices; and, secondly, that rates of EBF are commonly low.

Infant malnutrition should arguably be seen more as a symptom than a diagnosis. In particular, it is best understood as a symptom of ‘failed relationships’ (within the family/home; within the array of nutrition/health actors). Addressing MAMI requires a focus not just on the mother infant dyad but also on the wider family and social dynamics. The updated WHO guidelines on SAM management (2014) for the first time explicitly address infants <6m, recommending both inpatient (complicated cases) and outpatient treatment. Future progress requires attention to:

- **Measurement and indicators.** Infant anthropometrics alone do not provide the full picture of acute malnutrition risk. Medical and social complications are often ignored.
  - We need better assessment tools to identify high-risk infants in first 6 months.
  - Studies from Kenya and the Gambia show MUAC as more strongly associated with mortality than weight for length.
  - Low MUAC in infants led to an 8 to 12 fold increased risk of death by age 5 years.
- **Scaling up successful local projects to national/international coverage is an added challenge.** In Bangladesh, peer counsellors to support mothers to breastfeed improved nutrition outcomes through increased exclusive breastfeeding.
- **Wasting associated with LBW/SGA/preterm is very distinct from wasting that develops later in the six months after birth; there is a need to be specific about the root causes of infant acute malnutrition that potentially require different treatment approaches.**

Finally, to move forward in the face of the current weak evidence base for MAMI, there was a strong call for a global network to collaborate in operational and other forms of applied research to address key policy and programme implementation related questions. Such a network could help address critical blockages regarding MAMI, including:

1. **The need for better assessment tools for identifying high-risk infants in the first six months of life.** These need to:
   - Capture feeding; clinical and other social issues;
   - Consider the special needs of LBW infants (either preterm or SGA) for optimal growth and later development.

2. **An operational research agenda – how can we scale up community support for vulnerable infants?**

3. **Influence policy and ask policy-relevant questions in the first place, and communicate closely in operations:**
   - Work with policy makers at the design stage (operational research and primary research);
   - Identify vulnerable infants (preterm or SGA) and promote healthy physical growth and mental development.
Session 4: Community-based Management of Acute Malnutrition (CMAM)

Chair: Paluku Bahwere (Valid International)
Rapporteurs: Marie McGrath (ENN)
Klaus Kraemer (Sight&Life)

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The CMAM model includes treatment of SAM, treatment of MAM and community engagement. However, though the latter element is critical, it is often missed. CMAM services tend to focus on SAM treatment. CMAM has evolved from a non-government organisation (NGO)-led model, implemented in emergencies, to a government-centric approach, emphasising integration into health services plus surge support to bolster existing capacity. More than 60 countries are at different stages of implementing CMAM, though coverage remains a constraint in many. Urban contexts have particular challenges. Most experience on CMAM has come from Africa, yet the major burden of acute malnutrition is in Asia. CMAM has relied on repeated emergency funding; longer term costed country plans are an important component of nutritional governance.

Globally, only about 10% of SAM cases have access to treatment. MAM cases should access basic medical treatment and growth monitoring. Many of the barriers to treatment access are common to other global health initiatives. For this reason, the global nutrition and global health communities need to work more closely together to galvanise around strengthening health systems.

A pilot programme in Bangladesh that integrated SAM treatment into a package of basic services showed that Community Health Workers (CHWs) could provide high quality cost effective care for SAM. The synergies achieved through an integrated package of community health services improved nutrition outcomes. The additional burden on CHWs was relatively low and did not impact on other responsibilities. The programme relied on international NGO logistics for product supplies. There is potential to use other delivery models to provide SAM treatment, such as ICCM (Integrated Community Case Management). Whether this is feasible at scale and should/could be expanded to include MAM requires further study.

Post-discharge outcomes of MAM children are a concern. A follow up study of successful discharges from MAM treatment in Malawi found that 80% were well nourished at 3 months follow-up, 69% at 6 months and 62% at 12 months. Overall, 4% had died by 12 months (compared with 1% in the general child population). Amongst a sub-group of 400 children fed for 12 weeks irrespective of anthropometry, outcomes were better. A portfolio of support for MAM-treated children is needed to improve post-discharge outcomes.
Key points emerging from the discussion:

- Experiences from SAM treatment are not necessarily transferable to MAM. There are risks of using the same treatment model for MAM as used for SAM, e.g. overburdening the healthcare system; clinical differences that justify different medical and nutritional treatments; and huge resource implications for specialised product supply (governments are already struggling to deal with the resource implications of ready-to-use therapeutic food (RUTF) for SAM).
- Integrating MAM treatment into CHW workload may require different and broader expertise, e.g. on infant and young child feeding (IYCF), that has implications for their work burden.
- MAM treatment needs to align more closely to preventative (and many established) initiatives than to SAM treatment. Treatment does not necessarily include food.
- Bangladesh is developing local evidence (e.g. efficacy trials for local RUTF) for a context specific, sustainable approach.
- Multi-sector approaches for the prevention/treatment of MAM, including livelihoods, and stronger linkages of such approaches to MAM treatment programmes are needed. We should consider if and how such support is extended to recovered SAM cases.
- There is a lack of resources available in French and other languages.

Session 5: Impact Assessment in MAM: Methodological Challenges

Chair: Henrik Friis (University of Copenhagen)
Rapporteurs: Kathryn Dewey (University of California, Davis)
Kim Fleischer Michaelsen (University of Copenhagen)

| The importance of body composition as a primary outcome in trials on MAM | Jonathan Wells (Institute of Child Health) |
| Study design issues in trials among children with MAM | Henrik Friis (University of Copenhagen) |
| WinFood data from Kenya and Cambodia: constraints on field procedures | Victor Owino (Technical University of Kenya) |
| Small-quantity lipid-based nutrient supplements, together with malaria and diarrhoea treatment, improve growth and prevent MAM in young Burkinabe children | Sonja Hess (University of California, Davis) |
| The effect of dietary supplementation on the change in body composition of young Malian children with MAM | Christine McDonald (Famine Early Warning System) |

Traditional anthropometric outcomes (weight, length/height and MUAC) are the usual focus of trials involving children with MAM, but body composition can provide a deeper understanding of the physiology of growth and its short- and long-term consequences. The amounts of body fat and lean mass have very different implications on outcomes. While lean mass is important, fat tissue also has functional effects, e.g. for immune function, and should not be regarded only as an energy depot. There are several methods for assessing body composition, e.g. deuterium dilution, air displacement plethysmography and Bio-Electrical Impedance (BIA). Bio-electrical Impedance Vector Analysis (BIVA) can differentiate variability in hydration from variability in lean mass and can potentially predict problems with hydration.
The discussion highlighted the need for more funding and cheaper methods to measure body composition. In addition, the value of simple skinfold measurements which reflect subcutaneous fat should be recognized.

Many of the published intervention studies among children with MAM have serious limitations in design and/or reporting. There is a need for cost-effective interventions and well-planned randomised trials, using designs such as stepped wedge, cluster randomized or factorial designs. There are both scientific and ethical issues in choosing a control group. If the “standard of care” is no supplementation it might be ethically justifiable to have an un-supplemented group, which is followed closely and could receive a delayed intervention. In choosing the food intervention, the types of foods, energy content, nutrient content and level and type of added micronutrients should be considered carefully, as only a few aspects can be feasibly tested. The effect of a nutrition intervention may depend on the nutritional status at baseline, and the possibility of adverse effects (e.g. in iron-replete children) should be considered. In the discussion, the advantage of performing parallel studies in different populations, with different baseline nutritional status, was cited. The importance of the quality of dietary fat was underlined, as it affects both functional outcomes and body composition. The use of local foods when deciding which interventions to test is also a key consideration.

Randomized trials in Kenya and Cambodia, Burkina Faso, and Mali illustrated the challenges and successes of projects in evaluating the impact of nutritionally enhanced foods for preventing and treating MAM in young children. In the WinFood project in Kenya and Cambodia, indigenous nutrient-rich foods such as small dried fish, termites and spiders were incorporated into complementary food formulations and provided to children aged 6 to 15 months. Challenges included depletion of the food ration due to food insecurity (in Kenya), high mobility of families causing attrition, difficulties with collection of saliva and blood samples, and limited local research capacity. In a Burkina Faso trial of small-quantity LNS provided from 9 to 18 months of age, together with treatment for malaria and diarrhoea, stunting prevalence was reduced from 39% to 29% and prevalence of MAM was reduced from 11% to 7%, despite challenges with adherence. In Mali, four dietary supplements for the treatment of MAM were compared: 1) Supplementary Plumpy, 2) Corn Soy Blend ++, 3) Misola, and 4) locally milled flours with added sugar, oil and micronutrients. In a sub-sample in whom body composition was measured before and after the 12-week intervention, increases in body weight and MUAC were greatest in the Supplementary Plumpy group but the percentage of fat mass did not differ between groups. Field-friendly methods for measuring body composition are needed. Key issues during the discussion included the relationship between processed fortified foods and home-prepared foods, and the relative costs of such interventions if taken to scale.
Session 6: Capacity Building

Chair: Emorn Udomkesmalee (Wasantisut), (Mahidol University)
Rapporteurs: Ann Hill (London School of Hygiene and Tropical Medicine)
Nina Schlossman (Global Food and Nutrition Inc.)

| Capacity development for prevention and management of malnutrition | Alan Jackson (University of Southampton) |
| Pre-service and in-service capacity building: lessons learned from the Integrated Management of Childhood Illness (IMCI) | Wilson Were (WHO) |
| Panel Discussion: Capacity development in MAM – Demand from countries and supply from agencies | Tahmeed Ahmed (International Centre for Diarrhoeal Disease Research, icddr,b) Helen Semu (Ministry of Health, Tanzania) Anne-Dominique Israel (ACF) Paul Rees-Thomas (Maximising the Quality of Scaling Up Nutrition Programmes Framework Contract, MQ SUN) |

Within the Scaling up Nutrition (SUN) Movement, there is a willingness to act to enhance capacity for the prevention and management of MAM — but countries need support to build capacity in order to implement and monitor action plans and improve service delivery. This requires professional groups, notably paediatricians and nutritionists, to come together to form ‘communities of practice’ and provide technical expertise to help national civil society networks and government agencies fulfil their capacity-building role. Professional groups will need to be structured and organised so that they are accessible to national groups. Suggested structures and lead professionals are:

- Facility-based clinical care for complicated SAM – paediatric lead within IMCI;
- Uncomplicated SAM and MAM – public health nutrition lead;
- Locally-produced therapeutic and supplementary foods – food technology lead;
- Food security – agriculture, marketing, livelihoods leads;
- Body composition, growth and development – nutrition scientist lead.

The session continued by exploring lessons about pre-service and in-service capacity building, drawing on the experience of the IMCI. Several key points emerged:

Several obstacles made sustaining in-service IMCI training a challenge, including: the cost of off-site training, shortage of experienced trainers, inadequate supply of training materials, poor follow-up and supportive supervision, attrition of trained staff, release of essential staff for off-site training, reluctance to apply locally learned skills from centralised courses and not reaching private practitioners. Many countries shortened the IMCI course although the content was largely retained. A meta-analysis showed that the standard course was superior in terms of health worker performance.

Many countries provide pre-service IMCI training to nurses, midwives, health officers and medical doctors. The main challenges are negotiating adequate time and placement into the curriculum, ensuring adequate clinical sessions, sustaining the supply of teaching materials, and coordinating between different academic programmes.
Non-residential training options include interactive e-learning programmes such as the IMCI computerised adaptation and training tool (ICATT) and the IMCI distance learning courses (dIMCI). Pre-service training reaches the majority and should be the main focus of training while in-service training should be used for continuing medical education (CME) and refresher training. Suitable options and training approaches that focus on core competences are needed for different settings.

In a panel discussion exploring the demand and supply side of capacity development, the point was made that resources are needed to improve health systems at the community level, including a functional referral system for SAM and MAM, training for CHWs, and improved access to locally-produced ready-to-use supplementary food (RUSF) and RUTF. In a country like Bangladesh, advocacy to government is essential, but this requires that development and donor partners speak the same language and align their messages. The issues in Tanzania concerned the need for training and strengthened leadership and coordination to support decentralization and integration of MAM prevention, treatment and referral into community services without overburdening CHWs; operational research to develop the evidence for advocacy to increase engagement of policy makers; improved structures to ensure sustainability; and pooled resources to foster collaboration and integration across sectors. Dedicated resources are needed to strengthen infrastructure to ensure a productive working environment, a reliable pipeline for essential supplies and foods and better tools for assessment, monitoring and evaluation.

With regard to the supply side of capacity development, NGOs invest in creating awareness, demand and building capacity for health professionals in nutrition. ACF has experience in successful in-service curriculum design (Liberia), joint development of a curriculum for nutrition professionals (Afghanistan), and teaching innovations. Challenges have been weaknesses in country systems for capacity development; lack of human resources in the health system (undermined by ‘brain drain’ as well as high staff turnover); in-service and pre-service training that cannot keep pace with high staff turnover; misaligned approaches creating duplication and confusion in training; and the need for strong professional identity development to attract people to become nutrition leaders and advocates.

The need to embed capacity building for MAM into national settings and integrate it in national frameworks (e.g. as promoted through SUN) was emphasised, based on the experience of MQSUN. Multi-level and multi-sector capacity building is needed for effective advocacy, leadership, governance, costing, mediation, and for developing integrated plans and relevant outcome indicators. Country frameworks need to include appropriate system-wide incentives to retain trained personnel. ‘Hotspots’ with successful leadership, champions, media and political platforms should be identified to take forward the nutrition message and make effective use of communities of practice networks. New technologies for training will be needed such as LATTICE (Learning and Teaching Through Innovation, Collaboration and Engagement).

Other points made in the discussion included the need for clarity as to what constitutes ‘core competencies’; the need to improve the effectiveness of training and supervision of new staff when integrating MAM management in IMCI; and the need for an international regulatory system for locally produced RUTFs.

Now is the time to focus on capacity development in nutrition. Countries need to commit to scale up and include it in government SUN frameworks to achieve nutrition goals. There is a need to move beyond conventional capacity development, seek innovation and incorporate technology (IT tools) at macro and micro scale. Many SUN countries budget for capacity development; international
agencies need to align behind capacity development for MAM. The Chair appealed to the audience to provide the leadership required to help move globally into sustainable, retained capacity at country level.

**Session 7: Ready-to-Use Foods in the Management of MAM**

**Chair:** Saskia Osendarp (Micronutrient Initiative)

**Rapporteurs:** Christopher Wegner (IAEA)

**Tarik Becic** (IAEA)

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<td>Peter Akomo (Valid International)&lt;br&gt;Filippo Dibari (WFP)</td>
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<td>Mark Manary &amp; Kelsey Ryan (Washington University School of Medicine)</td>
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<td>Michael Golden (Aberdeen University)</td>
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<td>Panel discussion: Ready-to-use foods in the management of MAM</td>
<td>André Briend (University of Tampere)&lt;br&gt;Saskia de Pee (WFP)&lt;br&gt;Paluku Bahwere (Valid International)&lt;br&gt;Mark Manary &amp; Kelsey Ryan (Washington University School of Medicine)</td>
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<td>Development and acceptability of ready-to-use supplementary food made of local food ingredients for preventing and treating moderate acute malnutrition</td>
<td>Munirul Islam (icdds,b)</td>
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<td>PlumpyField – Network of local producers of ready-to-use foods</td>
<td>Hilina Belete (Hilina Enriched Food – Processing Center PLC)</td>
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It is the responsibility of parents, communities, governments, and all of us to prevent the death of children. Ready-to-use foods (RUFs) have a place in this for children with SAM and MAM, even though there are a number of questions and issues surrounding RUFs.

Although RUTFs have been shown to be effective, there remains a serious challenge in increasing programme coverage. There are advantages to treating MAM with RUTFs as demonstrated by a study in Niger (2007), but further evidence is required to address issues such as the use of local foods for sustainability; cost; dose to use for MAM rather than SAM; and RUTFs as a model to test rehabilitation diets. It is paramount that RUTFs need to be optimised in parallel in order to use them as a model for MAM — including their mineral and vitamin content, protein source, protein quality, flatulence factors, and anti-nutrient levels.
The linear programming method for designing new formulations of acceptable and efficacious RUTFs was discussed. Two examples were described using chickpea and sesame, and soybean, maize and sorghum. Both were found to be acceptable amongst children; they contained little or no milk, used locally available ingredients, and were peanut-free. Though it is possible to integrate the development and production of RUFs to the local agriculture value-chain, such formulations need to be optimized for children under two years of age, and specific attention is needed to reduce antinutrients. Issues relating to local production of RUSFs and making operational choices regarding which type of RUSF to use when there is a choice were discussed. For example, corn soy blend (CBS+), soy RUSF and soy-whey RUSF, were shown to be effective treatments of MAM. A software prepared by WHO for developing food-based dietary guidelines, could also be used to support such operational decisions — announcement on its release is expected soon. It was pointed out that product quality and safety criteria are essential pre-requisites regardless of the scale of production. These therefore need to be built into the business case developed early on when exploring the feasibility of local production. Understandably, not every country needs to produce their own foods and could join forces with other countries.

A study from Malawi which examined the sharing and diversion of supplementary foods was presented. Porridge targeted to young children tends to get shared with siblings. CSB was given away more than oil. Oil was used for other family cooking more than CSB. Nevertheless, especially sharing and lending may have important advantages for a household in terms of building social capital and being seen to be responding to cultural expectations.

A reflection on the presentations for this session shows how nutrition security is finally coming to the forefront and food quality is now seen as more important than food quantity. The challenge is not addressing SAM, but keeping normal children normal. Weight gain is not a very appropriate measure of success. We need to go even beyond body composition to physiology that includes the measurement of, for example, glucose tolerance, renal function, immune function, delayed hypersensitivity reactions, and thymus growth. Obesity should not be considered as ‘over’ nutrition, because it reflects a positive energy balance and imbalanced nutrient intake; it is associated with the consumption of ‘empty calories’ and therefore would more appropriately be categorised as ‘under’ nutrition.

The news that UNICEF and WFP are currently exploring the use of a single product for the treatment of SAM and MAM elicited some discussion. Whilst it was considered technically possible, it was not seen as necessarily desirable. The composition of RUSFs and RUTFs and the amounts given to certain age groups need to be considered carefully. The priorities for a research agenda on the composition of products were discussed, and particularly in the context of MAM treatment which is provided in addition to the local diet attention was given to: optimising the formulation of RUFs, food safety, technological innovations to secure the quality of foods, and tailoring programmes to the local context.

More fundamental operational research priorities that would inform the scale-up of programmes need to be included; understanding why people spend what little money they have on items that are not used to prevent malnutrition; how to prevent undernutrition across the lifecycle; involving both the private and marketing sectors to understand why people are motivated to do something to prevent malnutrition; and better understanding impact pathways and how to measure this.

A case-study on the development and acceptability of RUSFs made from local food ingredients was presented. Rice-lentil and chickpea-based RUSFs were consumed more and were the most acceptable based on colour, aroma, flavour and texture. The operational functioning of a local producer of RUSFs that is a member of the PlumpyField network in Ethiopia was also presented.
**Session 8: Hot Topics in Research**

Chair: Michael Freemark (Duke University)
Rapporteurs: Christopher Wegner (IAEA)
Tarik Becic (IAEA)

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<td>Possible role of the microbiome in the development of acute malnutrition and implications for food-based strategies to prevent and treat acute malnutrition</td>
<td>Mark Manary (Washington University School of Medicine)</td>
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<td>Long term cotrimoxazole prophylaxis targeting mortality, morbidity &amp; growth amongst HIV-uninfected children with severe acute malnutrition – a randomised, double-blind controlled trial</td>
<td>Jay Berkley (KEMRI-Wellcome Trust)</td>
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<td>Metabolomics in nutrition research: assessment of metabolic status, response to treatment, and predictors of mortality in malnourished children</td>
<td>Michael Freemark (Duke University)</td>
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Pathogenesis is an important consideration with respect to the treatment of malnutrition. Insights from metabolism, metabolomics, immunology, microbiology and pharmacotherapy will hopefully give new insights on the management of SAM and MAM.

The relevance of the microbiome in the development of acute malnutrition was explored. The microbiome consists of a complex and dynamic ecological community of microorganisms and is specific to each person. These microorganisms influence the growth and differentiation of gut epithelial cells and play pivotal nutritive, metabolic, immunological and protective functions. However, their functionality varies across age, diet, genetic background, geography, and health status and is dramatically altered in SAM. A study on Malawian twin pairs, discordant for Kwashiorkor, suggests the microbiome may play a role in the pathogenesis of Kwashiorkor; transfer of microbiome contents from severely malnourished children caused growth failure in mice in the setting of a nutrient-poor diet. Another study where children in Malawi received either a standard RUTF or one with four probiotics and four prebiotics to treat SAM showed no clinical benefit or healing of the gut. Future research directions include understanding the microbiome as a key step in furthering the treatment of malnutrition.

A recent randomized trial on the use of antimicrobial prophylaxis as part of the management of complicated SAM was discussed. Previous studies on the use of antibiotics had varying results as to the impact on height and growth. The hypothesis that prophylactic use of antibiotics would reduce infection and thereby reduce the mortality in children with SAM was tested. Additionally, it was predicted that long-term administration of antimicrobial prophylaxis would alter the microbiome and reduce immune activation — thereby, promoting growth and repair and thus reducing mortality. 2,439 children were recruited, aged 2 to 59 months, with low MUAC and negative for HIV antibodies. The children were given the antibiotic cotrimoxazole (CTX) or a placebo. These children were both stunted and severely wasted. CTX did not reduce subsequent mortality or improve long-term growth. There was a high incidence of severe infection and death despite CTX, therapeutic and supplementary feeding, regular clinic follow up and free walk-in clinics. Questions about the aetiology of infections, as well as compliance and absorption remain.

New insights on the possible pathogenesis of SAM through a comprehensive profiling of metabolic status and changes in hormones, cytokines, and growth factors were provided. The hypothesis was
that hormonal and metabolic factors at baseline would predict subsequent mortality during treatment. Patients were treated with F75 formula and then moved on to F100 during 2 weeks of inpatient admission, followed by RUTF. The major biochemical factor predicting mortality was a low level of the adipocyte hormone leptin; the combination of hypoleptinemia, HIV seropositivity and low weight/height z score predicted mortality in oedematous as well as non-oedematous children. Consideration was given to metabolic and hormonal profiling as a means to providing a comprehensive analysis of adaptations to childhood malnutrition and treatment. The findings suggest that leptin could possibly serve as a marker of pre-clinical malnutrition and a clinical biomarker for mortality in oedematous and non-oedematous individuals. The role of leptin in fighting infection, and an adjunct to nutritional therapy, should be considered in future research. Additional investigation is needed to compare the biochemical phenotype of SGA children with that of malnourished children, since both are critical factors in long-term morbidity and mortality.

Session 9: The Way Forward

Chair: Ziauddin Hyder (World Bank)
Rapporteurs: Christopher Wegner (IAEA) Tarik Becic (IAEA)

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<th>Implications of the symposium – What have we learned and what can we do to improve the management of MAM?</th>
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<td>Albert Lule (Ministry of Health, Uganda)</td>
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<td>Kwaku Aning (Technical Cooperation, IAEA)</td>
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<td>Rethy Chhem (Human Health, IAEA)</td>
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<td>Najat Mokhtar (NAHRES, IAEA)</td>
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An overview of the most important issues raised during the symposium regarding the management of MAM was provided. The first issue centred on the importance of strong government leadership and accountability in order to tackle the multiple fronts involved in addressing MAM. Vital to this effort is supporting the SUN Movement and the 52 participating countries. Attention was drawn on the need to address the evidence gap regarding effectiveness of nutrition-sensitive interventions, and on the need to reach out to sectors outside of the health paradigm. Special attention needs to be given to stimulating local agriculture and food production and to subsidising healthy food choices.

The essential pre-requisite of national capacity continues to be a common bottleneck, and efforts to strengthen technical, managerial and strategic skills are needed at all levels and across many sectors. The importance of strengthening communities’ capacity to demand and support nutrition services was emphasised. Impact assessment and program evaluation, in conjunction with quality assurance, should be integral to all efforts aimed at addressing MAM. Positive examples of countries that have successfully tackled malnutrition were given, including Brazil and Bolivia.
Representatives from four governments then shared their perspectives on the relevance of this symposium. It was highlighted that this was the first high-level meeting on MAM, and partnerships built during this conference should be kept alive in order to tackle malnutrition through international collaboration. Several key points were raised including the importance of system strengthening, at all levels; the necessity of cost-effective large-scale preventive programmes; nutrition included in the developmental agenda of countries; the importance of the SUN movement; food safety measures; and expansion of the role of the private sector. The need for stronger and wider political commitment to nutrition at country level, and for capacity building that focuses on pre-service training was expressed. The country perspective was summarised by stating the three most important aspects to tackling MAM: system-strengthening, capacity building, and active leadership.

The chair provided a final wrap-up. He began by highlighting that investments in nutrition need to be understood as investments in national economic growth and development. This needs to be communicated more effectively to key government bodies, such as Ministries of Finance, Planning and Development.

Secondly, evidence-based policy and action requires that research, information and data be given higher priority. We learned that weight gain alone does not reveal important physiological and biochemical changes during the recovery period, that might have bearing on longer-term health outcomes. Body composition would provide insights into changes in fat and muscle whilst weight is increasing (and nuclear techniques should be considered when evaluating national programmes); leptin could become an important marker for severe malnutrition and mortality; micronutrient status continues to be under-reported, even though this is undoubtedly a burden in all forms of malnutrition — stunting, wasting and obesity. We also learned that incidence rates may provide more sensitive analyses of changes in acute malnutrition, in contrast to point prevalence estimates.

Another dimension to the MAM challenge is the nutritional status of women — pre-conception as well as during pregnancy. This is an under-researched area that should be given higher priority. More research is also needed to better understand the transition from MAM to SAM.

Community and women’s empowerment are critical factors in addressing MAM. This cuts across all areas of support relevant to MAM — exclusive breastfeeding; health-seeking behaviours; hygiene practice and sanitation; early pregnancy; diversifying livelihoods; foods suitable for complementary feeding; local production of RUFs; and so on.

Finally, one of the constant threads in the 3 days of discussion was the importance, and limitation, of national capacity. It featured as a universal concern, at all levels from community to ministerial levels; and across all aspects of ‘good nutrition governance’ — from data collection and analysis to strategic priority setting.

One of the key felt benefits of the symposium was the gathering of operational, policy and research practitioners, which allowed two-way learning and exchange. Kwaku Aning (Technical Cooperation, IAEA) called for strong partnerships and fruitful collaborations across the various actors, and IAEA remains committed to provide expertise in, for example, the use of stable isotope techniques in learning lessons about programme effectiveness. Rethy Chhem (Human Health, IAEA) emphasised the importance of nutrition in human health and expressed the need for further progress in managing child malnutrition through international partnerships. Najat Mokhtar (NAHRES, IAEA) thanked everyone for a successful event and called for future collaboration and partnership in nutrition and expressed the IAEA’s commitment to improve health in all its Member States.
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Valid International

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