Special Section on MAMI:

Management of at risk mothers and infants under six months

Field research officers measure the MUAC of an infant under six months in Barisal, Bangladesh, 2016

Save the Children

This issue of *Field Exchange* features six articles on managing nutritionally vulnerable infants under six months of age. This MAMI[1] section provides a snapshot of developments involving research, evaluation, programme experience and guidance development. Together they tell a story of progress, challenges and direction of travel that we reflect on here.

In 2015 Emergency Nutrition Network (ENN), London School of Hygiene and Tropical Medicine (LSHTM), Save the Children and a group of agencies and researchers developed the C-MAMI[2] Tool; a much-needed framework and approach to help guide programmers on how to manage malnourished infants under six months of age. Agencies have been utilising the Tool, notably Save the Children in Bangladesh and GOAL in Ethiopia. The C-MAMI Tool has now been updated to produce Version 2, shared in this issue, greatly informed by these and other programming experiences, most notably an evaluation of the Bangladesh and Ethiopia programmes also summarised in this issue. Key developments in the latest version include strengthened content on managing at-risk mothers as part of an infant-mother pair; assessment of nutritionally vulnerable infants under six months old beyond acute malnutrition parameters; and greater emphasis on health considerations. These reflect an understanding that assessment and management of vulnerability must include adequacy of infant growth, clinical care and the wellbeing of mothers.

Significant gaps of knowledge remain around the caseload of at-risk infants in different contexts and how to quantify caseload accurately. Research by Save the Children in Barisal district, Bangladesh, also summarised in this edition, examined this, investigating prevalence, risk factors and outcomes of infants with severe acute malnutrition (SAM) in a prospective cohort study. Unsurprisingly, the researchers found that existing treatment services that rely on inpatient care were poorly accessed – only 17% of severely malnourished infants reported for care. While at first glance it looks like a high proportion of infants had 'recovered' by six months of age, it emerged that nearly one quarter were still severely malnourished, 3.9% had died and, compared to the cohort of non-SAM infants, the SAM group was significantly more stunted and underweight at six months. These findings highlight the limitations of only considering SAM as a measure of risk (and recovery) and support the need for early identification and accessible interventions for nutritionally vulnerable infants. Informed by this study, Save the Children is now trialling the C-MAMI Tool in this setting, with results due late 2018.

Save the Children's research in a stable context in Bangladesh proved a valuable springboard for its response to the Rohingya crisis in 2017/18. Infants under six months old were identified as a concern on the ground and the C-MAMI Tool was adapted and piloted in the response with UNICEF support; lessons learned are shared in a field article and have informed both Version 2 of the C-MAMI Tool and programme adaptation. A critical impediment to programme planning, monitoring and scale-up, highlighted in this experience, is a lack of field-friendly indicators to identify at-risk infants at community level, both in surveillance and for assessment by community level workers – there are no MUAC thresholds for this age group and weight-for-length (the current measure recommended for risk assessment) is impractical. Scale-up is being planned as part of the response, but without clear quantification of caseload, making planning and impact assessment problematic.

As programmers get deeper into MAMI programming, they encounter challenging cases. When it comes to vulnerability, we know that low birth weight (LBW), premature and disabled infants are at greater risk of malnutrition and death, but this is poorly quantified and typically becomes a hidden burden. Neonatal interventions focus on survival of these infants, but what happens afterwards to their growth and development? When a child is admitted to a CMAM programme at seven months of age, we have no idea of their birth history and growth trajectory up to that point. An article by Partners in Health (PIH) in Rwanda gives some insight into the burden and challenges of managing this subset of infants and again highlights the need for earlier intervention than is currently typical. District hospitals in Rwanda are increasingly including neonatal care units (NCUs), which means there is increasing survival of LBW/premature infants and infants born with disability. Cross-sectional follow-up data by PIH on infants discharged from NCUs found prevalence of malnutrition way above that of the general child population; children had significant feeding difficulties and were anaemic, stunted and wasted. In response, several paediatric development clinics (PDCs) were developed – a medical-home model to provide more comprehensive and specific medical/nutritional follow-up. Subsequent analysis of follow-up data on referred cases again showed they still weren't doing well, which has led to significant programme developments to address gaps around skilled capacity and assessment.

This intervention is unusual in a low-resource setting in terms of the specialist input and capacity needed to deliver this level of service. If it might be difficult to implement or sustain in many settings, why have we included it in this issue? Its relevance is that it provides a valuable insight into the burden, complexities of management and possible approaches to address management of a complex sub-set of infants that currently are invisible but that programmes will increasingly encounter once they start to manage infants under six months of age. We know that the burden of LBW/prematurity/disability in developing countries is high and underestimated. These infants are contributing to the CMAM programme burden, the stunted population, sick children and those who die. Shouldn't we be intervening early and figuring out how we do that? There is no magic bullet and it does need skilled support that takes investment in staff and time. One key challenge is to determine a quick and simple means of identifying the most at-risk of these infants, so that interventions are targeted to those where it will make the greatest difference – a focus area of the MAMI Special Interest Group[3]. In Rwanda they are 'feeling' their way through an approach that can work in their context; we can learn from them. Different approaches will be needed in other settings.

A critical question is whether MAMI interventions are cost-efficient and cost-effective. Save the Children calculated the cost-efficiency of a protocol based on the C-MAMI Tool in Bangladesh compared to the standard, inpatient-based protocol. The cost of C-MAMI to the healthcare provider was higher than the standard, but more cost-efficient per infant treated. If fully integrated into the national health system, the cost of C-MAMI would be halved. Costs to caregivers were lower for the C-MAMI Tool. More data are needed on the costs of such interventions that include the societal costs of not intervening – sick, chronically undernourished and developmentally delayed infants cost systems and lives.

Marie McGrath
Field Exchange Co-Editor and MAMI Special Interest Group Co-ordinator

[1] Management of At risk Mothers and Infants under 6 months. Formerly 'Management of Acute Malnutrition in Infants under 6 months', this was revised in 2017 by the MAMI Special Interest Group to reflect the profile of infant-mother pairs being identified, their associated risks, and consequently the wider scope of interventions needed to cater for/support them; these include but are not limited to nutrition.

[2] Community Management of At Risk Mothers and Infants under six months.

[3] www.ennonline.net/ourwork/research/mami

The Paediatric Development Clinic: A model to improve outcomes for high-risk children aged under-five in Rural Rwanda

Mothers playing with their babies in the Rwinkwavu Hospital PDC

Cecille Join Auila, Partners in Health

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The authors would like to thank the contribution of the entire Paediatric Development Clinic team, including clinicians, advisors, researchers and data analysts, who contributed to this work and the day-to-day operation of the PDCs. We would also like to thank the patients and caregivers for entrusting us and the entire PDC team with their healthcare and the Ministry of Health Rwanda and UNICEF for their support to the PDCs and MAITS, D-Tree International, and Boston Children's Hospital for their collaboration to improve quality of care.

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Location: *Rwanda*

What we know: In Rwanda 9.5% of newborns are born prematurely and 6% are born low birth weight (LBW). Identifying and managing growth failure in LBW infants is challenging.

What this article adds: Preterm and LBW survival is increasing in Rwanda, partly due to opening of neonatal care units (NCUs) in district hospitals. Review of progress of a cross-section of infants aged 1-3 years post-discharge found prevalent feeding difficulties, anaemia and stunting and wasting rates well above that of the general infant/child population. In response Paediatric Development Clinics (PDCs) were developed by Ministry of Health/UNICEF/Partners in Health (PIH) to provide more comprehensive and specific medical/nutritional follow-up. Subsequent review of a cohort of 316 enrolled infants less than six months old indicated ongoing poor nutritional status (25% severely underweight, 5% severely malnourished). Implementation challenges included difficulties calculating corrected age and gaps in capacity to assess and support feeding difficulties. Actions taken include specialist training for staff on managing infant feeding difficulties in low-resource settings, identification and training of expert mothers, strengthened breastfeeding support in the NCUs, adaptation of the C-MAMI tool to manage malnourished cases, and development of a mobile app to help anthropometric/growth assessment. Further experiences will be documented. Research is examining contributing factors to malnutrition in this age group.

Background

Postnatal medical, nutritional and developmental needs of infants born preterm, low birth weight (LBW), with hypoxic ischemic encephalopathy (HIE) (a brain injury following asphyxia), central nervous system (CNS) infections and other disabilities, including trisomy 21, are different from those of normal weight, full-term infants without developmental disabilities and have a higher risk of respiratory, hematologic, infectious, sensory and neurologic complications and require regular monitoring and early intervention. Optimal nutrition and growth requires monitoring growth velocity over time, including weight, length and head circumference, and adequate interpretation of z-scores to assess for malnutrition. Identifying growth failure in LBW infants is particularly challenging as this group includes a mix of preterm infants, small for gestational age (SGA) infants, and infants who are both preterm and

SGA. Current World Health Organization (WHO) growth charts to assess nutritional status (weight-for-length) exclude infants <45 cm. Intergrowth 21 has recently published international growth standards based on appropriate gestational age (AGA) for preterm infants, yet detailed information on gestational age and birth weight is often lacking in low- and middle-income countries (LMICs).

Infants born preterm may also have difficulties breastfeeding due to potential for an immature suck pattern, difficulties coordinating breathing and vomiting during or after feeding, and have reduced milk intake. This requires strategies to regulate the infant, including providing Kangaroo Mother Care (KMC) for thermoregulation and bonding and strategies to improve suck and reduce vomiting. Infants born with syndromes such as trisomy 21 may have low muscle tone or exhibit "floppiness," causing the infant to be less alert and have decreased tone and sensation in the mouth and throat, resulting in difficulty swallowing. Infants born with HIE may demonstrate high muscle tone, causing stiffness and resulting in difficulty in positioning for breastfeeding, and "tight" jaws, causing difficulty in latching.

To address these challenges, specialised feeding support by trained personnel is needed to ensure adequate breastfeeding and therefore appropriate growth. In addition, higher risk of developmental delay in these newborns requires early stimulation and developmental monitoring over time.

Country context

In Rwanda 9.5% of newborns are born prematurely and 6% are born LBW (Every Preemie Scale, 2017). Preterm and LBW survival is increasing in Rwanda, in part due to the opening of neonatal care units (NCUs) in district hospitals. Postnatal follow-up of healthy newborns is performed at the community level by Agent de Santé Maternelle et Infantile de Santé (ASM), who are Community Health Workers (CHWs) in charge of maternal and newborn health. After facility discharge following delivery, ASMs conduct postnatal home visits that include identification of danger signs, with referral to health facilities if needed, breastfeeding education, encouragement of KMC for LBW infants, and weighing newborns. However, no national system is in place for targeted postnatal follow-up of high-risk newborns including preterm, LBW, or infants with other vulnerable medical conditions. In a study conducted in Kayonza district in eastern Rwanda, LBW and preterm infants discharged from the hospital NCU were followed up at one to three years post-discharge to determine their nutritional, medical and developmental status in the absence of routine follow-up (Kirk et al, 2017. Caregivers reported 47% of children had feeding difficulties and 40% reported signs of anaemia; 67% had an abnormal development screening on the Ages and Stages Questionnaire-3 (ASQ-3). Notably, malnutrition parameters were more than double or triple the 2014/2015 Demographic Health Survey (RDHS, 2014/15) national averages: 79% stunted, 9% wasted and 38% underweight, vs. 38%, 2%, and 9% nationally, respectively. Lack of comprehensive and consistent follow-up can have detrimental impacts on the health and well-being of high-risk newborns, which has lasting implications beyond the neonatal and infant periods.

Paediatric Development Clinics

In 2014 Partners In Health (PIH), in collaboration with the Rwanda Ministry of Health (MoH) and UNICEF, implemented Paediatric Developmental Clinics (PDCs) to provide integrated early-intervention clinical, nutritional, social and developmental services to infants born with perinatal complications in rural Rwanda. Currently there are eight PDCs across two districts in the eastern province of Rwanda. To our knowledge, this is the only clinic of its kind in sub-Saharan Africa. PDC provides integrated care to at-risk infants and children under-five years old in a medical-home model, using a comprehensive and continuous team-based approach. Nearly 90% of infants admitted to the PDCs are neonates discharged post-NCU admission for prematurity, birth weight <2000 grams, HIE, cleft lip/palate, or trisomy 21. Other reasons for admission include developmental delay, hydrocephalus and those <12 months old who had required hospitalisation for complicated severe acute malnutrition. PDCs are funded by the MoH with support from PIH. A costing study is underway to assess the cost of providing PDC care.

PDC interventions

At each PDC visit caregivers participate in a group education session followed by individual consultation, where the nurse screens the patient for danger signs following Integrated Management of Childhood Illness (IMCI) guidelines (and refers to IMCI if needed), weighs the patient, measures the length/height and head circumference, and calculates corrected age up to two years in infants born premature, interval growth in children <2 years (targets include ≥20 grams/day <3 months and ≥15 grams/day 3-6 months) and z-scores using WHO growth charts. A feeding assessment is conducted to assess appropriateness of the diet at home and the child's appetite. Certain conditions require medical management; for example, providing iron to premature infants up to 12 months old or provision of anticonvulsants to infants with seizures. Referrals are made to specialists where needed, including physiotherapy, cardiology and optometry to address medical complications. Children are screened for developmental problems at specific ages (including 6, 12 and 18 months), using the ASQ-3. Counselling is provided to the caregiver by the nurse and/or social worker regarding medical conditions, growth assessment, nutrition and feeding, and/or developmental status. Social workers may conduct home visits to those most vulnerable patients.

Food supplementation is provided to mothers of infants with growth faltering and counselling to breastfeeding mothers where needed. Those with medical complications are referred to district hospitals.

PDC staff training and mentorship

Nurses in PDCs are usually general nurses with a post-secondary diploma in nursing. Social workers typically also have a post-secondary diploma. Both nurses and social workers have been trained in the PDC protocol annually since 2014, with new PDC staff trained as new clinics open.

PDC has adopted the Mentoring and Enhanced Supervision for Healthcare (MESH) model (Anatole et al, 2013), developed by PIH and MoH, and utilises one-on-one provider mentorship as a method for continuous quality improvement. PDC mentors are district hospital-based nurses in charge of hospital PDCs who have demonstrated exceptional provision of quality care. They are trained in mentorship methods and are facilitators during annual PDC trainings. Mentors utilise checklists to assess quality of care during mentorship visits, which inform targeted feedback to the mentee.

Additionally, the PDC receives mentorship support from the PDC Manager (who is a clinician), a pediatrician/internist doctor trained in the United States and nutritionists from PIH and district hospitals.

Nutrition outcomes in the PDCs

Nutritional status of infants under six months old was assessed over the period January 2015 to December 2016. During this period, 316 infants under six months old completed follow-up (52% female) and had 2,117 individual PDC visits. They were enrolled with the following diagnoses: prematurity or LBW (70%), HIE (28%) and other conditions (9%). About half (43%) were born <37 weeks (32% with missing gestational age data), 53% had a low weight at birth (14% VLBW (very low birth weight)), and 32% were SGA (36% with missing data).

Prevalence of weight-for-age (WAZ) and weight-for-length (WHZ) were used to assess nutritional status at 3 and 6 months old. When a gestational age was available, corrected age was used. Prevalence data show that, at three months, 9% had moderate acute malnutrition (MAM: WHZ <-2) and 5% had severe acute malnutrition (SAM: WHZ <-3). Seventeen per cent were moderately underweight (WAZ <-2) and 25% were severely underweight (WAZ <-3). By six months, SAM increased slightly to 6% and MAM almost doubled (16%). By six months, WAZ <-2 increased to 22% and WAZ <-3 decreased to 23%. WAZ <-2 at six months is more than five times the national prevalence (4.3%), while WHZ <-2 at six months is three times the national prevalence (5.4%). The same infants were not used to assess growth trajectory over time in these data, which only show prevalence of malnutrition at three and six months of age.

Nutrition-related challenges and solutions developed in PDCs

Although the PDC has provided a much-needed service in the absence of high-level postnatal follow-up for high-risk infants, some challenges remain.

Nutrition assessment

Identification of accurate gestational age at birth remains a challenge in many low and middle-income countries (LMICs). This prevents differentiating prematurity, SGA and LBW, which has implications for growth trajectory and achieving optimal growth targets.

For infants with a known gestational age, nurses calculate corrected age up to two years old, which is used to determine z-scores and (ideally) in counselling on timing for introduction of complementary feeding. Calculation of corrected age and interval growth, or growth velocity, is a challenge in the PDCs. Corrected age requires calculation of chronological age and subtracting weeks premature from the chronological age. For interval growth, nurses determine the number of days since the last PDC visit and divide this by the difference between the child's current weight and previous weight. Errors in calculations lead to discrepancies in both corrected age and interval growth. Initial data showed that corrected age was not calculated for around three quarters of infant visits and interval growth was missing for one quarter (Ngabireyimana et al, 2018).

Plotting WHO z-scores has also remained a challenge for nurses, particularly with those infants who fall on the lower end of the growth curve, where distinguishing between one growth centile and another is challenging.

For those infants whose gestational age is known, an mHealth application has been developed through a collaboration with Dtree International. This tool assists PDC nurses in the calculation of corrected age and chronological age. Additionally, it calculates interval growth and z-scores for all children, regardless of availability of gestational age. The decision-support tool links nutritional calculations to further nutritional assessments and/or counselling through messages to the provider. Staff in one of the PDC catchment areas have been trained and effectiveness of the tool will be assessed before scaling up to the remaining PDCs. The hope is that this tool will aid PDC nurses with earlier recognition of growth faltering/failure and appropriate guidance on how to manage it.

Infant feeding assessment and breastfeeding support

Adequate and safe exclusive breastfeeding starts in neonatology and continues in the home and outpatient setting. In the two district hospitals from where PDC patients are referred, at baseline (October-December 2017), only 6% of infants born VLBW, 60% of infants born LBW, 72% of infants with HIE, and 65% of neonates overall were exclusively breastfed from the breast at time of discharge (compared to a national breastfeeding prevalence of 87%). Adequate growth in these infants during admission was also a challenge: average interval growth during admission was 0.6 grams/day for VLBW infants, 5.0 grams/day for LBW infants, and 15.4 grams/day for infants with HIE, compared to the recommended 15 grams/day.

Knowledge and practice in addressing feeding challenges in this population is a challenge in PDCs and the challenges often increase after hospital discharge, when there are fewer opportunities to receive counselling and support at home. Accurately and comprehensively assessing feeding difficulties requires expertise (often lacking at community level), as does the provision of counselling to mothers in this population, which also requires time to 'trial and error' positioning and other interventions. Often infant formula was provided in PDCs to mothers experiencing difficulties with breastfeeding; however, provision of artificial milk, particularly in rural, LMIC settings, may pose risks to the infant that outweigh any benefit, including use of unclean water, expense of infant formula and the burden of preparing artificial milk feedings, in addition to missing the well established benefits of exclusive breastfeeding.

To address these issues a partnership was formed with MAITS, a UK-based non-governmental organisation (NGO) that aims to improve the lives of individuals living with disabilities through access to family support, quality healthcare and education. MAITS teams of healthcare and education experts travel to low-resource settings to share their skills with other health providers. In February 2018 two speech and language therapists, who are international MAITS trainers, travelled to Rwanda to train 24 nutritionists, neonatal nurses and midwives working in maternity and post-partum wards and PDC nurses and social workers on their self-developed two-day training, Working with Infants with Feeding Difficulties in Low Resource Settings. The purpose of the training is to improve the knowledge and skills of healthcare providers working with infants with feeding difficulties, and their caregivers, to support breastfeeding and nutrition. Through a training-of- trainers model, three local 'Master Trainers' were trained to be able to continue delivery of this training in Rwanda and continue to be supported by MAITS trainers through ongoing phone calls and case studies. To date, the three Master Trainers have gone on to train 36 additional healthcare providers from seven district hospitals in Rwanda.

In addition, a new position has been created in both district hospital NCUs in the PDC catchment areas called, 'Umujyanama mu konsa' or 'Expert Mothers.' These are women who had a baby discharged from the hospital NCU who is now enrolled in PDC and serve as peer counsellors to other mothers, helping them learn how to breastfeed and promoting early and exclusive breastfeeding through counselling, education and emotional support. The Expert Mothers have been trained by the Master Trainers in a three-day version of the MAITS training and components of the WHO Breastfeeding Counselling training course. They continue to receive on-going mentorship from the Master Trainers.

Other strategies to promote early and exclusive breastfeeding include availability of refrigerators in the hospital NCUs for breastmilk storage, KMC chairs and breastfeeding u-shaped pillows to support comfortable breastfeeding positions, privacy screens for mothers who do not want to breastfeed or express breastmilk in an open ward, and education materials, including tablets and projectors to play Global Health Media Videos for mothers. The impact of these measures will be assessed through ongoing and continuous monitoring and evaluation.

Addressing both the issue of accurate nutritional assessment and feeding assessment, in August 2017 the PDC protocol was revised to include more clear and comprehensive guidance on assessing and managing malnutrition in infants <6m old and their caregivers through integration of the Community Management of Malnutrition in Infants and At-Risk Mothers (C-MAMI) tool into the PDC protocol. This shifted treatment of uncomplicated acute malnutrition in infants <6m old to PDC, instead of referring these infants to the district hospital. A complementary algorithm was developed to guide nurses and social workers in growth failure and malnutrition assessment and management. The C-MAMI counselling tool was translated into the local language, Kinyarwanda, and staff were trained in September 2017. Ongoing facility-based mentorship has continued since that time by PDC mentors and nutritionists.

Conclusion and way forward

This experience demonstrates that LBW/premature/disabled infants are at high-risk of malnutrition, and that active follow-up and intervention is necessary to address this. In this rural Rwandan context, PDCs are a medical-home model that are being implemented in the Ministry of Health system with additional external support (PIH and supplementary funding from donors). While nutrition outcomes from initial implementation of this model were not satisfactory, we have identified critical areas for improvement among this high-risk population that are being acted on through several strategies. Ongoing assessment of PDC interventions will continue in all clinic sites, with continuous quality improvement to enhance the nutritional, medical, and developmental outcomes of infants admitted to PDCs. We will continue to develop and share our model for outpatient follow-up in a rural setting of infants born preterm, LBW, or with other conditions, and to raise awareness of the special needs of this population in developing policies and practices to meet their needs. There are ongoing research studies to assess the factors associated with malnutrition in PDC patients <6m, as well as those 6-59 months, cost-effectiveness, and overall impact of PDC on children's health, nutrition and development to further inform the way forward.

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Piloting the C-MAMI approach in the Rohingya response in Bangladesh

A MAMI counsellor measures the MUAC of a mother whilst she holds her baby at a C-MAMI site, Cox's Bazar, Bangladesh, 208

Daphnee Cook/ Save the Children

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The C-MAMI programme in Cox's Bazar, Bangladesh, was made possible with the generous funding of DFID (through UNOPS) and UNICEF.

Location: *Bangladesh*

What we know: Community-based management of uncomplicated severe acute malnutrition in infants under six months is recommended by WHO; the community-based management of at risk mothers and infants less than 6 months (C-MAMI) Tool was developed to help put this into practice.

What this article adds: A pilot programme was implemented by Save the Children and UNICEF in the Rohingya response to identify and manage nutritionally vulnerable infants <6m using an adapted C-MAMI Tool. Seven C-MAMI sites were established between November 2017 and July 2018, integrated/aligned with existing programmes. Infants <6 months and their caregivers were referred via multi-sector community mobilisers for screening and management or referral. By mid-June 2018, 1,964 infant-mother pairs were referred to C-MAMI sites, of whom 762 were enrolled in outpatient care and 78 complicated cases referred for inpatient treatment. Programme challenges included lack of baseline caseload data (anthropometry of infants <6m not included in surveys conducted); the recruitment of suitably qualified staff (MAMI counsellors); high caseload numbers; assessment difficulties (including of low birth weight infants and maternal mental health problems); harsh conditions; data collection difficulties linked to Commcare platform; and some limitations in adaptation of the C-MAMI Tool for this context (discharge criteria). Developments planned include management of simpler cases by existing infant and young child feeding (IYCF) programme to reduce MAMI caseload and transfer to KOBO platform for data collection. Experiences have informed the latest C-MAMI Tool (Version 2). Plans are to scale up MAMI across the Rohingya response.

Background

Acute malnutrition in infants under six months old

In 2017, wasting (both moderate and severe) continued to threaten the lives of an estimated 50.5 million (7.5% of) children under five years old globally. Of these, 16 million were severely wasted (UNICEF/WHO/World Bank Group, 2018). It is estimated that malnutrition was an underlying factor in almost half of the 5.6 million under-five child deaths in 2016 (UNICEF, WHO and World Bank, 2017). These global estimates are largely based on country-level data sets comprised of representative household surveys, within which disaggregated data for infants under six months (infants <6m) are not always available or usually presented. Infants <6m have traditionally been considered less vulnerable to malnutrition due to the protective factors of exclusive breastfeeding; however, only two in five infants <6m are exclusively breastfed globally (UNICEF, 2018) and infants in this age group are often exposed to risky feeding practices (such as unsafe artificial feeding, pre-lacteal feeds and early introduction of complementary foods).

There is now evidence that acute malnutrition is a serious public health concern in the <6m age group. A 2011 secondary data analysis in 26 high-burden countries estimated that 23% of overall SAM cases were infants <6m (Kerac et al, 2011), while a recent secondary data analysis found that infants <6m were at greater risk of death during inpatient treatment than older age groups (Grijalva-Eternod, 2017). Commonly used survey methodologies, such as SMART, typically only collect anthropometric data for children 6-59 months old. One of the complications in getting data for the <6m age group is that there is no internationally agreed cut-off threshold for MUAC to identify at-risk infants. Weight-for-length z-score (WLZ) is the current recommended anthropometric criterion for severe acute malnutrition (SAM) in infants <6m. However, weight and length are more difficult to measure accurately in younger infants and WLZ is not available for lengths under 45cm;

therefore this age group is often overlooked in community screenings and nutrition surveys (Lopriore et al, 2007).

Community based management of acute malnutrition in infants

Over the last decade, the management of acute malnutrition in children aged 6-59 months has greatly improved following the introduction of Community-based Management of Acute Malnutrition (CMAM). However, management of acute malnutrition in infants <6m has not kept pace. The 2013 World Health Organization (WHO) Updates on the Management of Severe Acute Malnutrition in Infants and Children recommends for the first time that infants <6m with uncomplicated malnutrition are managed as outpatients, while also acknowledging the low level of evidence to identify and manage cases.

Save the Children pioneered research on the management of acute malnutrition in infants <6m at the community level in Bangladesh from 2013-2016. In 2015 Save the Children collaborated closely with ENN and the London School of Hygiene and Tropical Medicine (LSHTM) in the development of an innovative C-MAMI (Community Management of At risk Mothers and Infants) Tool to help harmonise and catalyse case management (Box 1). The need to address infants <6m in the Rohingya response, coupled with Save the Children's experience with C-MAMI in Barisal District, Bangladesh, led to the piloting of the C-MAMI approach in this emergency from 2017 to 2018, the results of which are described in this article. These experiences were used to inform the development of the recently released version 2.0 of the C-MAMI Tool[1] (see article in this issue).

C-MAMI in the Rohingya response in Bangladesh

Nutrition situation in the Rohingya population in Bangladesh

According to the Inter Sector Coordination Group report from June 2018, 706,364 Rohingya people have crossed into Bangladesh since 25 August 2017, fleeing large-scale violence in Rakhine State, Myanmar. The Rohingya people have sought safety in Cox's Bazar (where the total Rohingya population is now 914,678) and are concentrated within Ukhia and Teknaf, where most refugees live in makeshift shelters in congested camps and settlements. SMART surveys conducted between October and November 2017 measured the prevalence of acute malnutrition in children aged 6-59 months by WHZ and found a prevalence of SAM of 7.5 % (95% CI 4.9-11.2) in Kutupalong camp; 3.0% (95% CI 2.2-4.2) in the Makeshift camps; and 1.3% (95% CI 0.5-2.9) in Nayapara camp. WHZ was not measured in infants <6m; however MUAC was assessed to help build the evidence base for this indicator in this age group . Average MUAC for infants <6m was 118 mm in Kutupalong, 119 mm in makeshift camps, and 118mm in Nayapara. IYCF indicators assessed during the SMART surveys were found to be poor, with only 56.1% of infants <6m being exclusively breastfed in makeshift camps. In Nayapara, exclusive breastfeeding rates for infants <6m were found to be slightly better at 72.2%. The results of the SMART surveys showed that the high levels of malnutrition and poor IYCF practices were further compounded by poor care practices and micronutrient deficiencies.

An estimated 8,129 infants <6m were among the Rohingya camp population, according to a UNHCR family count in late 2017. Despite the absence of survey data on infants <6m to estimate the actual caseload, the relatively high number of infants <6m in the population, coupled with poor IYCF practices and the lack of interventions addressing this particular group, led the Nutrition Sector in Cox's Bazar to identify the management of vulnerable infants <6m as a gap. A pilot of the C-MAMI approach was endorsed to address this. In November 2017 Save the Children, in partnership with UNICEF, began to implement C-MAMI to address the need for outpatient treatment of nutritionally vulnerable infants <6m, starting with a pilot phase to adapt the methodology to this particular emergency context.

Intervention

The key objectives of the C-MAMI pilot were to test the suitability of the existing tools for use in the Rohingya response to get a better understanding of specific breastfeeding challenges in this context and to determine staffing needs to further inform the training package needed. Supervision visits and lessons-learned meetings were held at each of the C-MAMI sites.

During the original pilot phase (November 2017 to February 2018), four C-MAMI sites were established by Save the Children in Cox's Bazar. The implementation of the C-MAMI project continued beyond the pilot phase and an additional three C-MAMI sites were opened between March and May 2018, bringing the total of active C-MAMI sites to seven (as of July 2018). All C-MAMI sites are integrated within Save the Children's wider health and nutrition programme; all sites were set up within mother-baby areas (MBAs) and adjacent to outpatient therapeutic programmes (OTPs) (in all but one of the sites) and health posts. This integrated set-up facilitated the identification and referral of infants <6m and their mothers at facility level; for example, referral of infants and their mothers to the C-MAMI sites from postnatal care services.

The C-MAMI project in Cox's Bazar is managed by an international senior programme manager and two national programme managers, with support from an international technical adviser. Each C-MAMI site is staffed by two MAMI counsellors (all female) and each site has a MAMI supervisor (both male and female). MAMI counsellors are responsible for screening, anthropometry (weight-for-length (to identify acute malnutrition) and MUAC (for data purposes)), enrollment and registration of mother-infant pairs, and management of enrolled cases including one-to-one counselling. MAMI supervisors are responsible for daily supervision, quality monitoring and on-the-job training and support, as well as reporting of data. An initial training of trainers (ToT) was conducted by an experienced Save the Children staff member from the research project in Barisal. Staff trained during this ToT were then responsible for training new staff as new sites opened.

Identification and referral of nutritionally vulnerable infants <6m and their mothers at the community is supported by multi-sector community mobilisers. Due to the high workload of the community mobilisers and difficulty in identifying vulnerable infants <6m (lack of MUAC cut-off threshold to identify acute malnutrition in infants <6m and assessment of mother-infant pairs for nutritional vulnerability being time-consuming), it was decided that community mobilisers should refer all infants under <6m in the catchment areas of the C-MAMI sites for assessment at facility level. Infants <6m and their mothers were also referred from the health and nutrition posts, especially from the reproductive health units and MBAs. Maternal and child health and nutrition (MCHN) promotors supported the MAMI counsellors with home visits, follow-up, and community health and nutrition education.

Identified nutritionally vulnerable/at risk infants <6m and their mothers were enrolled in the C-MAMI programme. Low-risk infants and their mothers were referred to the IYCF services in the MBAs. In areas where blanket supplementary feeding programmes (BSFP) were available, caregivers of infants <6m were referred to enroll for a supplementary food ration. When infants in the C-MAMI programme turned six months of age they were referred to the appropriate nutrition services (CMAM) for further treatment if necessary.

Results

From November 2017 until mid-June 2018, 1,964 infants <6m old across the seven sites in Save the Children's catchment area were referred for rapid assessment at the C-MAMI sites . A total of 847 infants <6m underwent the full mother-infant pair assessment, from which 762 mother-infant pairs were enrolled in the C-MAMI programme. See Tables 1, 2 and 3 below for further details.

Box 1 C-MAMI Tool in Bangladesh

The C-MAMI Tool was developed to identify vulnerable infants <6m and their mothers at risk of malnutrition. Assessment and classification of vulnerability do not solely rely on anthropometry as seen in older children, but include feeding, clinical and maternal mental health status to reflect associated risks of mother-infant pair and wider scope of interventions needed to cater for/support them.

Save the Children's C-MAMI project uses a mobile based application called Commcare to collect and transfer data from the C-MAMI sites to a central, cloud-based database. This application is used for case screening, step-by-step case management and reporting for real-time data collection and monitoring.

The mobile-based system for the assessments automatically classifies the infant and mother according to four colour-coded categories, from severe problem (pink) to moderate and some problem (yellow 1 and yellow 2) to not urgent (green). Infants and mothers classified as pink are referred for inpatient care. Yellow cases are enrolled in the C-MAMI programme and green cases are discharged with general advice only.

[1] Available at www.ennonline.net/c-mami

Table 1 Classification of mother-infant pairs who underwent full assessment

Classification	Male	Female	Total
Pink*	47	31	78
Yellow 1	382	377	759
Yellow 2	2	1	3
Green	3	4	7
Total	434	413	847

* Mother-infant pairs classified as pink (identified with severe problems) were referred for inpatient care at the nearest stabilisation centre.

Table 2 Number of infants per age group and average MUAC per age group of infants <6m who underwent full assessment

Age group	Number	Average MUAC (mean)
Less than 8 weeks	419	102.6
9 to 16 weeks	271	115.3
17 to 24 weeks	157	121.5
Total	847	110.1

Table 3 WLZ of infants <6m who underwent full assessment

Category	Number	Percentage
SAM	76	9.0%
MAM	95	11.2%
Normal	676	79%
Total	847	100%

Until mid-June, 65 mother-infant pairs enrolled recovered, where recovery was based on having all components of the assessment for both infant and mother classified as green (clinical, feeding and anthropometric assessment for both infant and mother, and additional mental health assessment for mother). Recovery was low due to discharge criteria not being fit for the emergency response (see Challenges below). A total of 43 mother-infant pairs defaulted and one infant died.

From 78 infants referred for inpatient care, 14 were identified with SAM and eight with MAM based on WLZ criteria (remaining 58 cases had other clinical complications necessitating inpatient care).

All but one of the 847 infants were breastfed; however common breastfeeding problems such as infants not being well attached and not suckling well and infants receiving less than eight breastfeeds a day were commonly reported and contributed to a large proportion of mother-infant pairs being classified as having a 'moderate' problem. According to the assessment of maternal mental health, 3.1% (n=26) of mothers showed signs of depression/anxiety and 3.9% (n=33) indicated having a marital conflict contributing to poor mental health.

Challenges

Field teams identified several challenges during the pilot phase of the C-MAMI approach in the Rohingya response. Firstly, it was challenging to recruit qualified staff – MAMI counsellors in particular – who had to be experienced IYCF counsellors, female and able to speak the local language. Competition with other NGOs for qualified staff further hampered this process and led to a delay in opening of some sites. To help overcome this, during later stages of the project when new C-MAMI sites were opened, Save the Children 'transferred' high-performing IYCF counsellors from the IYCF programme to become MAMI counsellors.

High caseload numbers per site were challenging for the MAMI counsellors, especially because of the time needed for close follow-up and weekly monitoring. Enrollment was often found to be due to breastfeeding issues that could be addressed through less intensive IYCF programming in MBAs; i.e. one-to-one breastfeeding counselling providing skilled support with good positioning and attachment. Referral of severe cases was hampered by lack of accessible inpatient services and a general unwillingness of caregivers to stay in the stabilisation centres.

Specific challenges were identified related to the assessment of both mothers and infants. It was difficult to measure/identify low birth weight (LBW) infants due to the lack of health cards and the lack of a growth-monitoring programme, especially at the beginning of the response. MAMI counsellors had limited capacity (knowledge and experience) to identify risk of HIV and tuberculosis and integrated management of childhood illness (IMCI) danger signs. It was also challenging for MAMI counsellors to conduct depression/anxiety assessments and classify this appropriately; some of the standard classifications were felt to be inappropriate for this emergency context. At the time of the pilot, few mental health and psychosocial support (MHPSS) services had been put in place, limiting referral pathways for at-risk mothers. It was sometimes difficult to measure mothers' MUAC due to a lack of sufficiently private space to remove clothing.

The harsh conditions in the camp (sun, heat, dust during the dry season, and rain and mud during the monsoon season) affected the electronic weighing scales and good-quality anthropometric equipment was not available in the local market.

Despite good community mobilisation, the programme suffered from high numbers of absentees due to the programme not providing any material goods or incentives and it was often difficult for the community mobilisers and MCHN promoters to locate and follow-up all absentees/defaulters (reliable data on defaulters are unavailable due to data errors).

Commcare software was used in the programme to gather MAMI data. However, the free version of the software used did not facilitate easy analysis of data and created discrepancies with the other nutrition programmes, which all used KOBO for data entry and reporting. Additionally, the level of data collected through the Commcare system was excessive for an emergency response, with the extensive variables collected on a weekly basis for each mother and infant more suited to a stable/research setting.

In adapting the C-MAMI Tool for the response, several limitations of the tool itself were identified. The C-MAMI Tool did not accommodate the registration of orphaned infants; the only option provided is to register the infant as 'with mother'. Re-enrollment is not recorded in the C-MAMI Tool. The discharge criteria were unclear and difficult to implement in the context of this emergency. For example, the C-MAMI Tool specified that the mother's nutritional status needs to be improved before the mother-infant pair can be discharged; however, food and nutrition security was a problem in the Rohingya response, which was beyond the scope of the C-MAMI programme (aside from education and messaging). This meant that infants and their mothers were kept in the programme for a long period of time. The requirement for an infant to be feeding at least eight times per day pre-discharge also extended stay. This meant it was challenging for the MAMI counsellors to decide when to discharge and contributed to long lengths of stay, which increased risk of defaulting.

More broadly, a key challenge with the C-MAMI intervention is lack of baseline caseload data for this age group. WHZ was not assessed in this age group in the SMART surveys (it is highly challenging for community-level assessment in this age group), and while MUAC is practical and was measured, there are no recommended MUAC thresholds for infants<6m. No additional anthropometric data have been collected on this age group in the latest SMART survey. An in-depth IYCF-E assessment is being planned for September/October 2018, looking at both qualitative and quantitative indicators; there may be potential to gather data that can inform the C-MAMI plans and programmes.

Lessons learned

Despite the gaps in quantitative caseload information, the number of SAM cases identified (9.2% of infants <6m who underwent a full assessment) and the number of mother-infant pairs at high risk who were referred for inpatient management

A MAMI counsellor admits an infant to the C-MAMI programme, Cox's Bazar, Bangladesh, 2018

Daphnee Cook/ Save the Children

clearly showed the need for an intervention at community level for this vulnerable age group.

The pilot revealed the need to adapt the C-MAMI programme to work alongside an IYCF programme with prioritisation of cases needing specialised support for enrollment in the C-MAMI programme, and other simpler cases managed under the IYCF programme.

Due to several issues with the CommCare platform during the pilot phase, the programme is transferring to KOBO Collect, a more user-friendly platform for which there existed in-house expertise and which is already used in Save the Children's nutrition programme.

The pilot in the Rohingya response in Bangladesh has directly informed adaptations to the C-MAMI Tool, now reflected in version 2.0, to address gaps (such as discharge criteria), and to help to adapt and apply the tool in an emergency setting. Version 2.0 will be used to simplify the database to gather only crucial data found useful during the pilot phase and for future emergency response settings.

Ways forward

The goal of the pilot phase was to develop a context-specific approach for the identification, management and follow-up of nutritionally vulnerable infants <6m in the Rohingya response. Given the burden identified through the pilot programme, Save the Children in collaboration with UNICEF are planning a response-wide roll-out of the C-MAMI approach across the Rohingya refugee camps, including identification of other health and nutrition actors capable of implementing C-MAMI. To facilitate this, a Save the Children C-MAMI consultant will design a comprehensive roll-out strategy in line with Cox's Bazar Nutrition Sector priorities, including plans for response-wide monitoring and evaluation, and develop and conduct a ToT for partner staff adapted to the C-MAMI Tool Version 2 and to the emergency context, based on the lessons learned from the pilot phase. The consultant will also document lessons learnt from Save the Children's ongoing C-MAMI programme and provide suggestions to improve quality.

An outstanding critical impediment to programming planning, monitoring and scale-up is lack of community-friendly indicators to identify at-risk infants in the community, both in surveillance and for assessment by community-level workers.

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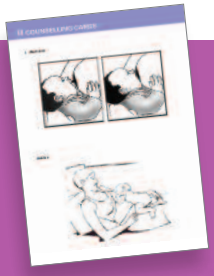

News

Updated C-MAMI Tool now available

The C-MAMI (Community Management of At risk Mothers and Infants under six months of age) Tool provides a health worker with a format to assess and manage at risk mothers and infants under six months of age in the community[1] who are nutritionally vulnerable. Version 1 was developed by ENN, LSHTM, Save the Children and collaborators in 2015 to help fill a gap in programming guidance and catalyse case management. It has been used in several contexts since; these experiences and expert peer review have informed an update by ENN, LSHTM, Save the Children, GOAL and collaborators[2] to produce Version 2.0 (July 2018), funded by Save the Children and ENN (Irish Aid).

The format of the tool is modelled on the Integrated Management of Childhood Illness (IMCI) approach to facilitate integration. It may require adaptation, development of programme-specific materials and different levels of training for implementation. It is applicable in both humanitarian and development settings.

Guiding principles governing the C-MAMI Tool management approach include:

- **The term 'enrolment' rather than 'admission' is used, to avoid medicalising community level support to these infants.**
- **Feeding support and social support is central to outpatient management.**
- **The MAMI approach always considers the mother-infant pair.**
- **Anthropometric criteria are useful but have limitations in this age group. Feeding, clinical and maternal factors are more important to assess, guide actions and to determine discharge.**
- **Clinical status of infants and their medical management is particularly critical; first line action is triage to identify and refer 'complicated' cases.**
- **The terms 'severe' and 'moderate' acute mal nutrition are not applied to this age group.**
- **Skilled breastfeeding support, is critical to case management. Non-breastfed infants need special support and follow-up.**
- **Currently there are no agreed MUAC cut-offs for infants < 6 months. The tool recommends collecting MUAC data to help build the evidence base.**

The C-MAMI package comprises:

- **C-MAMI Tool v2.0**
- **Counselling and support actions booklet**
- **Counselling cards**
- **C-MAMI enrolment and management card**

The C-MAMI Tool is available in English at: https://www.ennonline.net//c-mami A word version, to facilitate adaptation, is available on request. Please contact us with feedback and experiences of using the tool, and if you are interested in/planning field testing or translation. Contact: Marie McGrath, ENN, email: marie@ennonline.net

[1] In 2017, MAMI was redefined from 'management of acute malnutrition in infants U6m' to 'management of at risk mothers and infants U6m' to reflect the profile of infant-mother pairs being identified, their associated risks, and consequently the wider scope of interventions needed to cater for/support them; these include but are not limited to nutrition.

[2] Content update was coordinated by ENN (Marie McGrath), led by Save the Children consultants (Mary Lung'aho & Maryanne Stone Jimenez (Nutrition Policy and Practice)), in close collaboration with Marko Kerac (LSHTM); Nicki Connell, Sarah Butler (Save the Children), Hatty Barthorp (GOAL) and with input from working groups formed within the MAMI Special Interest Group and expert contributors, namely: Alice Burrell (Save the Children), Alison Talbert (KEMRI-Wellcome, Kenya), Cecile Bizouerne (ACF), Elizabetta Dozio (ACF), Indi Trehan, Jay Berkley (KEMRI-Wellcome, Kenya), Karine le Roch (ACF), Katie Beck (Partners in Health), Kirrily de Polnay (MSF), Louise Day (LSHTM), Martha Mwangowe (KEMRI-Wellcome, Kenya), Natalie (MSF), Nigel Rollins (WHO), Robert Stewart (University of Edinburgh), Zita Weise Prinzo (WHO).

The cost of implementing the C-MAMI tool to treat nutritionally vulnerable infants in Bangladesh

Monera and her infant Samiba, Barisal, Bangladesh, 2016

Save the Children

By Natasha Lelijveld, Mostofa Sarwar, Golam Mothabbir, Sarah Butler and Nicki Connell

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Nicki Connell is currently the Eleanor Crook Foundation's Nutrition Technical Director. Nicki was previously an Emergency Nutrition Advisor for Save the Children, and served as Project Manager for this work. She has ten years' experience in emergency nutrition, with much experience in the management of at-risk mothers and infants (MAMI).

The authors would like to thank Dr Marko Kerac from London School of Hygiene and Tropical Medicine for his academic support, Save the Children for hosting the fieldwork within their programmes, and the in-kind expertise provided by the No Wasted Lives initiative at Action Against Hunger UK.

Location: *Bangladesh*

What we know: The C-MAMI tool was developed to guide the community-based management of uncomplicated cases of severe acute malnutrition (SAM) in infants under six months, as per the WHO 2013 guideline.

What this article adds: Save the Children carried out a calculation of the cost-efficiency of a protocol based on the C-MAMI tool in Bangladesh, compared to the standard, inpatient-based protocol. Costs were identified for both protocols, including inputs, health system costs, efficiency data (such as number of admissions/month), scale-up costs and costs to caregivers. The cost of C-MAMI to the healthcare provider (per clinic/month) was higher than the standard (USD1,007 vs USD466); however, it was found to be more cost efficient per infant treated (USD289 vs USD685). If fully integrated into the national health system, the cost of C-MAMI would reduce to an estimated USD536 per clinic/month and USD154 per infant treated. The cost for caregivers was found to be lower for C-MAMI compared to the standard (USD53 vs USD74 per caregiver/six months). Overall, the societal costs (healthcare provider + caregiver) were significantly lower in C-MAMI compared to standard (USD342 vs USD759), although both were judged to be cost-efficient.

Background

Current treatment guidelines for severe acute malnutrition (SAM) in infants under six months are based on very weak evidence and focused on inpatient care; WHO guidance recommends community-based management for uncomplicated cases (WHO, 2013). To help a fill a gap in programming guidance, the C-MAMI tool (www.ennonline.net/c-mami) was developed to help catalyse community-based case management. Save the Children (SC) recently tested a protocol based on the C-MAMI tool for the treatment of "nutritional at-risk" infants in Barisal district, Bangladesh, estimating its effectiveness compared to the current standard inpatient protocol (results pending).

A secondary aim of the research was to calculate the cost and cost-efficiency of this new treatment method. This economic sub-study aimed to highlight major considerations in cost differences between standard inpatient protocol and the C-MAMI model from a societal prospective, considering costs to both the healthcare provider and caregivers.

Method

The C-MAMI model (intervention) and standard inpatient protocol (control) were implemented in 24 community clinics in Barisal district within the Ministry of Health (MoH) system, with support from SC staff. All infants receiving C-MAMI support were requested to attend weekly counselling appointments at the clinic and received home visits as necessary.

To estimate costs, programme inputs ("ingredients") were identified and quantified and costs were assigned against these, informed by the study protocol, accounting data and expert observation. A simple decision tree was built to map the various treatment pathways in each study arm and guide the mapping of major resources for

Table 1 Summary of cost to the health provider for the intervention and the control models

	Cost per clinic per month USD		Cost per infant screening USD		Cost per infant treated USD	
	C-MAMI N=12	Standard N=12	C-MAMI N=630	Standard N=595	C-MAMI N=251	Standard N=49
Staff at clinic	778.13	306.06	14.82	6.17	223.21	449.72
Hospital admission	80.88	102.8	1.54	2.07	23.20	151.09
Supplies	26.58	22.06	0.51	0.44	7.62	32.41
Buildings and equipment	80.86	35.07	1.54	0.71	23.20	51.53
Specialist Training	40.45	0.00	0.77	0.00	11.60	0.00
Total	**1006.91**	**466.02**	**19.18**	**9.40**	**288.83**	**684.76**

Table 2 Estimated cost of a fully integrated MoH C-MAMI intervention model

	Cost per clinic per month USD	Cost per infant screening USD	Cost per infant treated USD
Staff at clinic	347.56	6.62	99.70
Hospital admission	40.08	0.76	11.50
Supplies	26.58	0.51	7.62
Buildings and equipment	80.86	1.54	23.20
Training	40.45	0.77	11.60
Total	**535.53**	**10.20**	**153.62**

* Assumes that the same level of screening and treatment rates are achieved as in the current SC-supported intervention.

Table 3 Cost to caregivers of the intervention vs control treatment protocols

Activities	Cost to Caregivers from 0-6 months USD			
	C-MAMI protocol		Standard protocol	
	Maximum*	Average per child treated	Maximum*	Average per child treated
Transport to clinic	6.51	5.41	3.77	3.16
Cost of time spent at clinics	8.03	3.01	3.57	1.33
Cost of admission for SAM	119.28	3.94	119.28	9.82
Cost of other health seeking	13.97	2.80	26.02	5.08
Cost of BMS	159.03	38.17	159.03	54.07
Total	**306.82**	**53.33**	**311.67**	**73.95**
Total (excluding BMS)	147.79	15.17	152.63	19.88

* Maximum describes the scenario for a mother who is not exclusively breastfeeding and is admitted for inpatient SAM treatment. The "averaged" costs cannot be applied to individual cases as they represent the average across the whole group of mothers, including those with healthier infants who required limited intervention.

inclusion in cost calculations (Figure 1). Due to the integrated nature of the programmes, other health system costs were estimated through key informant interviews and published WHO-CHOICE values (www.who.int/choice/costs/en/)[1]. Efficiency data, such as the number of admissions per month, were calculated from interim values at the time of costing data collection.

Using information from the FANTA II Profiles results for Bangladesh, we also present the estimated cost for scaling up the implementation of the tool within an integrated health system, and this cost in relation to published government spending (Howlader, 2012).

Costs to caregivers, including direct costs and indirect time costs, were estimated through informal, anonymous interviews with a range of caregivers; programme defaulters are likely underrepresented.

Results

There are several key differences between the C-MAMI model and the standard protocol which need to be considered from a cost perspective. The C-MAMI model has a wider range of admission criteria, including maternal health indicators, and the treatment consists largely of weekly counselling and specialised lactation advice, compared to inpatient-feeding based on infant anthropometry only in the standard protocol.

Cost to healthcare providers

For the healthcare provider, the cost of the C-MAMI intervention was higher than the standard intervention (USD1007 vs USD466 per clinic per month), due to additional staff, staff training, tablet computers (for the MAMI app which accompanied the protocol), and capital costs of creating breastfeeding corners (Table 1). However, when this cost is applied to the number of children treated by each clinic each month (3.5 vs 0.7), the C-MAMI intervention becomes more cost-efficient than the standard model (USD289 vs USD685 per child treated).

Estimated cost if the C-MAMI intervention was fully integrated with national MoH

The above costs are based on the current system, which is supported by SC staff. If the C-MAMI protocol were to be fully integrated into the national health system, it would streamline and save costs. These hypothetical cost calculations include more Community Health Volunteers (CHVs) in place of Field Officers for screening, training Health Assistants to make referrals and home visits, and utilising Family Welfare Assistants to replace the role of SC Technical Officers as lactation specialists. The tablet computers would still be necessary to use the C-MAMI app. High-level staff training is still required; although associated cost and time is high, it is fundamental to the successful treatment of infants <6m and could be more cost-effectively implemented if conducted on a larger scale. Table 2 presents the summary of costs for this hypothetical "streamlined" and "fully integrated" intervention model.

If considering the scale-up to national level, based on an estimate of 17,700 community clinics in Bangladesh, the cost of implementing C-MAMI for one year at a national level would be USD114 million.

Cost to caregivers

Despite the additional time and money spent on weekly clinic visits, the overall cost is lower for caregivers in the C-MAMI intervention than the standard protocol (average USD53 vs USD74 per caregiver for six months). The C-MAMI programme saved some caregivers the high cost of lengthy inpatient admissions and the need to seek additional private health advice. Successful relactation through the C-MAMI lactation support also saved the cost of breastmilk substitute (BMS) where applicable.

Costs from a societal perspective

The societal cost per child treated (health provider + caregiver) by either the C-MAMI intervention (USD342) or the standard protocol (USD759) was less than the Bangladesh 2016 per capita GDP (USD1,358.8), which suggests that both models are "cost-effective". Based on estimates from a FANTA report, the cost of implementing the "integrated" C-MAMI protocol for one year at a national level (USD114million) is approximately 11% of the Bangladesh 2012 Health Promotion and Nutrition budget, which seems attainable.

This study could not calculate any additional cost-savings of the intervention in potentially preventing infant SAM cases, preventing child stunting, and reducing the burden of severe wasting in children aged 6-59 months; however, these factors should be considered by policy-makers. In addition,

[1] The WHO-CHOICE project (CHOosing Interventions that are Cost-Effective) has a database of region-specific costs for common health interventions to help policy-makers assess cost-effectiveness of health programmes, including for Bangladesh specifically.


Field research officers measure the weight of an infant under six months in Barisal, Bangladesh, 2016

Save the Children

it will be important to calculate the "cost per recovered" once the main study results have been analysed.

Conclusion

The absolute cost per clinic of the C-MAMI intervention is higher from a healthcare provider perspective than the cost of the standard control protocol, but is more cost-efficient per child treated and less costly to caregivers. A national, integrated C-MAMI intervention is potentially viable at scale. It is important to reassess cost-effectiveness of treatment approaches in light of potential SAM cases averted, if data is available. Additional cost-savings in preventing malnutrition and in reducing severe wasting burden in children aged 6-59 months should also be considered when evaluating the cost-effectiveness of the C-MAMI intervention.

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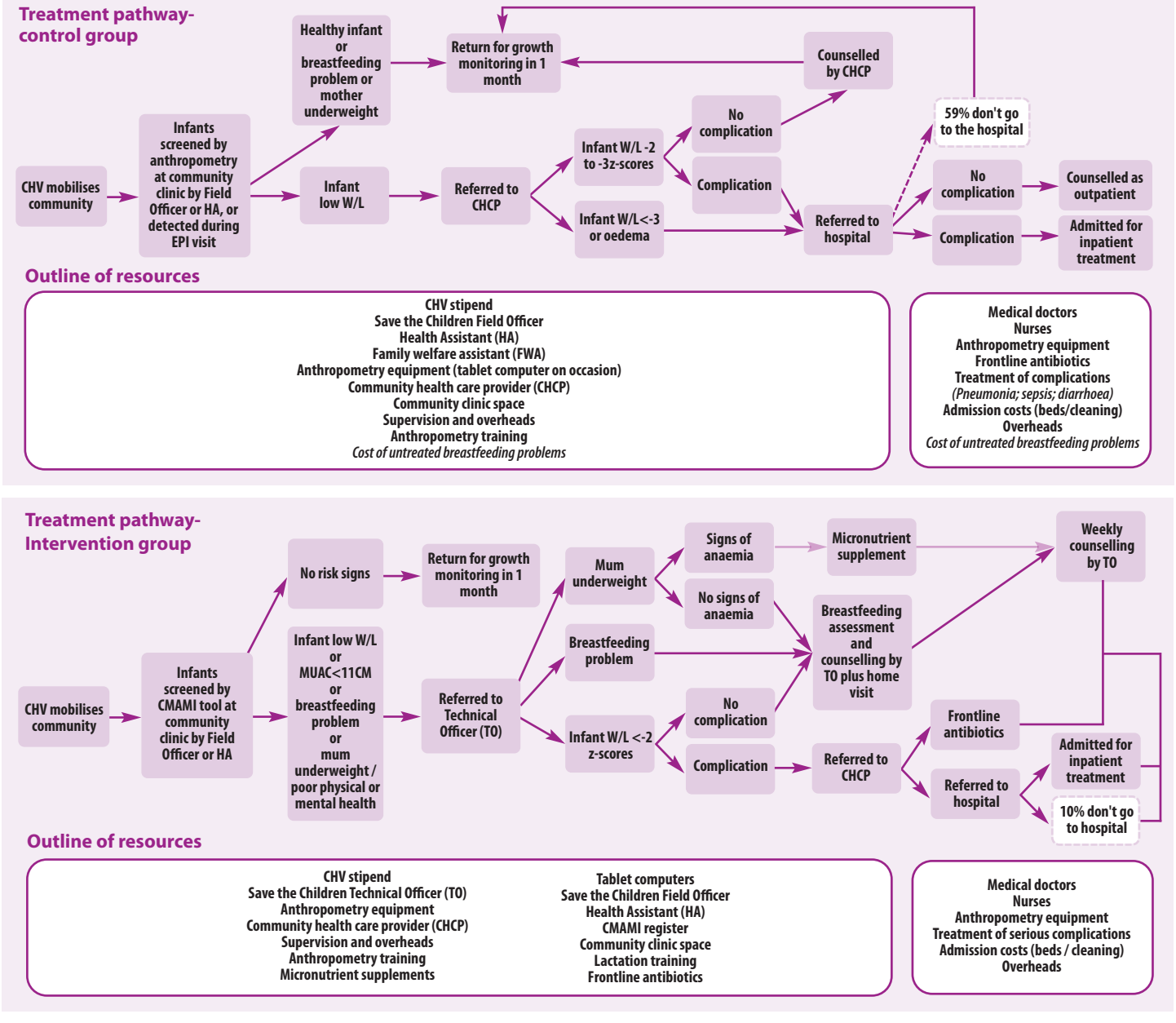
Figure 1 Decision trees for the control treatment model and the intervention treatment model



Severe malnutrition in infants under six months old: outcomes and risk factors in Bangladesh

Summary of research [1]

Location: *Bangladesh*

What we know: The World Health Organization (WHO) recommends that infants under six months with uncomplicated severe acute malnutrition (SAM) are treated in the community.

What this article adds: A prospective cohort study was undertaken on infants under six months (<6m) in Barisal district, Bangladesh, of one group of 77 infants with SAM (weight for length z-score <-3 and/or bipedal oedema) and 77 non-SAM infants, all enrolled at four to eight weeks of age and followed up at six months. Maternal education and satisfaction with breastfeeding were among factors associated with SAM. Duration of exclusive breastfeeding was shorter at enrolment (3.9 ±2.1 vs. 5.7 ± 2.2 weeks, P < 0.0001) and at age six months (13.2 ± 8.9 vs. 17.4 ± 7.9 weeks; P = 0.0003) among SAM infants. Despite referral, only 13 (17%) reported for inpatient care and at six months 18 (23%) infants with SAM still had SAM and 3 (3.9%) died. In the non-SAM group, one child developed SAM and none died. Current inpatient-focused treatment strategies have limited practical effectiveness due to poor uptake of inpatient referral. WHO recommendations of outpatient-focused care for malnourished but clinically stable infants <6m must be tested. Breastfeeding support must be central to future interventions but may be insufficient alone. Better case definitions are needed in this age group.

Severe acute malnutrition (SAM) affects around four million infants under six months old (infants <6m) worldwide, but evidence underpinning their care is of very low quality. To inform future research, the objectives of this study were to identify risk factors for infant <6m SAM and describe the clinical and anthropometric outcomes of treatment with current management strategies. A prospective cohort study was undertaken involving two groups of infants aged four to eight weeks (the age when future interventions to treat infant <6m SAM will be anticipated to begin). One group comprised 77 infants with SAM (defined as weight-for length z-score (WLZ) <-3 and/or bilateral nutritional oedema); the other comprised 77 age- and sex-matched infants who were not severely malnourished. Exclusions were infants from twin/multiple pregnancies and those with obvious congenital anomalies that could affect feeding. The primary outcome was the proportion of infants who died or who had SAM at follow-up at age six months. Secondary outcomes were changes in and absolute values of WLZ, weight-for-age z-score (WAZ) and length-for-age z-score (LAZ). SAM 'case' infants and non-SAM infants were identified by household visits in Barisal district, Bangladesh; anthropometric measurements were taken according to standard guidelines and were recorded electronically.

By six-month endline, statistically significant differences were apparent between SAM and non-SAM infants: daily weight gain was better among the SAM group (8.6 vs 4.3 g/kg/day, P<0.0001) and mid-upper arm circumference (MUAC) increase was greater (35.7 vs 13.2mm, P <0.0001), WLZ change was greater (2.0 vs -0.24, P<0.0001) and WAZ change was greater (0.9 vs -0.4, P<0.0001). However, there was a similar decline in LAZ of 0.6 z-scores in both groups. Maternal education and satisfaction with breastfeeding were among factors significantly associated with SAM, as well as age at time of enrolment into the study, years of maternal schooling and access to household electricity. Duration of exclusive breastfeeding was shorter at enrolment (3.9 ±2.1 vs. 5.7 ± 2.2 weeks, P < 0.0001) and at age six months (13.2 ± 8.9 vs. 17.4 ± 7.9 weeks; P = 0.0003) among SAM infants. Despite referral, only 13 (17%) reported for inpatient care and at six months, 18 (23%) infants with SAM still had SAM and 3 (3.9%) died. In the non-SAM group, one child developed SAM and none died. Maternal mental health was worse among mothers of SAM infants with a higher mean self-reporting questionnaire (SRQ) score at baseline (8.4 ± 3.6 versus 6.8 ±3.8, P = 0.003).

Results show that most infants identified as having SAM at four to eight weeks of age did not access inpatient treatment when referred as per national protocol. Deaths in this age group were higher than in the control group, but not as high as have been previously reported in inpatient studies. Although only one quarter of those with SAM at enrolment still had SAM at six months, other anthropometric deficits were marked, including significantly more stunting (62% vs. 15%), more severe stunting (40% vs. 0%) and more underweight (68% vs. 7%). The authors discuss the fact that few of the SAM infants who were referred to inpatient care actually accessed that care is reminiscent of past experiences with older SAM-affected children. Before community-based management of acute malnutrition (CMAM), when only inpatient-based care was available, coverage for such programmes was poor due to the high direct and opportunity cost of treatment. However efficacious such inpatient-only treatments might be, their overall effectiveness and public health impact is severely limited by the low numbers of eligible patients accessing care they need. Also reminiscent of the shift from inpatient-only care to CMAM outpatient-focused models, some professionals now are concerned about the safety of outpatient care for SAM infants <6m. Addressing this concern, it is reassuring that despite the minimal (or no direct) treatment, over three quarters of infants with SAM at four to eight weeks baseline no longer had SAM at age 6 months. This may represent catch-up growth, as suggested by greater rates of weight gain in the SAM group, and emphasises infancy as a dynamic and important period of life. Nevertheless, interventions are needed: ex-SAM infants had considerably more other anthropometric deficits than infants who did not have SAM at baseline, suggesting ongoing vulnerability.

The authors conclude that the current inpatient-focused treatment approaches to infant <6m SAM are sub-optimal. Some form of treatment is needed, as suggested by infants in the SAM group being more underweight and more stunted than non-SAM controls. However, the fact that many showed weight catch-up and no longer had SAM by six months suggest that it is reasonable to classify infants in the same way as older children with SAM, recognising that some are sufficiently clinically stable ("uncomplicated SAM") to be safely managed in community-based programmes, as recommended by WHO.[2] In terms of risk factors, sub-optimal breastfeeding is key and breastfeeding support is likely central to future interventions, but may be insufficient alone. Further interventions should evaluate the effectiveness of a package of interventions which also addresses wider issues, such as home environment and maternal support/maternal mental health. Finally, the authors call for better ways of identifying at-risk infants. Current case definitions of SAM are widely used, but do not fully capture the many possible reasons why an infant may be small. Improved classification and understanding of underlying aetiology in individual cases may allow more tailored treatments with greater probability of success.

[1] Islam MM, Arafat , Connell N, Mothabbir G, McGrath M, Berkley JA, Ahmed T and Kerac M. (20180). Severe malnutrition in infants <6 months – Outcomes and risk factors in Bangladesh: A prospective cohort study. Maternal Child Nutrition.2018:e12642 https://doi.org/10.1111/mcn.12642

[2] WHO (2013) Updates on the management of severe acute malnutrition in infants and children. Available from: www.who.int/nutrition/publications/guidelines/updates_management_SAM_infantandchildren/en/

C-MAMI tool evaluation: Learnings from Bangladesh and Ethiopia

C-MAMI room with a private screened area for one to one counselling, Gambella, Ethiopia, 2018

Hatty Barthorp/GOAL

By Sarah Butler, Nicki Connell and Hatty Barthorp

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Nicki Connell is the Eleanor Crook Foundation's Nutrition Technical Director. Nicki previously was an Emergency Nutrition Advisor for Save the Children and served as Project Manager for this work. Nicki has ten years' experience in emergency nutrition, with a large proportion of her work focused on the management of at-risk mothers and infants (MAMI).

Hatty Barthorp is the Global Nutrition Advisor at GOAL. She has more than 15 years' experience in emergency and development nutrition programming and has been advising the GOAL Ethiopia team since GOAL began implementation of C-MAMI in 2016.

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Location: *Bangladesh and Ethiopia*

What we know: Community-based management of uncomplicated severe acute malnutrition in infants under six months is recommended by WHO; the community-based management of at-risk mothers and infants less than six months old (C-MAMI) tool was developed to help put this into practice.

What this article adds: An evaluation was carried out of a GOAL pilot C-MAMI project in two refugee camps in Ethiopia and a Save the Children pilot C-MAMI project in Bangladesh to test the C-MAMI approach and C-MAMI tool (Version 1). An inter-agency evaluation team conducted key informant interviews and focus group discussions and employed questionnaires, observations of assessment and management, case scenarios and a quiz for tool users. Overall findings were positive: respondents reported that infants received quicker and better treatment than previous standard care (inpatient referral). Areas for development include strengthening mother support and clarity on linkages with infant and young child feeding (IYCF) programming. The C-MAMI tool was found to have provided a necessary, comprehensive framework; areas for improvement, such as admission and discharge criteria, were identified and have informed Version 2. To support implementation, development of standard operating procedures, monitoring tools and sensitisation is needed. To aid scale-up, more research is needed to test this approach.

Background

In 2013 the World Health Organization (WHO) released updated guidance for the identification and management of severe acute malnutrition (SAM) in infants under six months of age (U6m), including outpatient management of uncomplicated cases (WHO, 2013). To operationalise this, in 2015 the MAMI Special Interest Group (an ENN-led collaboration of researchers, practitioners and experts) developed Version 1.0 of the Community-based Management of Acute Malnutrition in Infants under six months (C-MAMI) tool. This was based on risk factors identified from studies in Bangladesh, which were led by Save the Children (Islam et al, 2018) and in Malawi, which were led by the London School of Hygiene and Tropical Medicine (LSHTM). In 2016, LSHTM led a project to adapt and test the C-MAMI tool and developed a simplified, easy-to-use checklist and supporting documentation to operationalise the C-MAMI package (www.ennonline.net/ourwork/mami). GOAL and Save the Children initiated C-MAMI pilots to test the approach and assist in the revision of these tools.

In February 2016 GOAL began integrating C-MAMI into nutrition programming in two refugee camps in Gambella region, Ethiopia. In June 2017 Save the Children began piloting C-MAMI in government health services in the disaster-prone area of Barisal, Bangladesh, as part of an implementation research project. In November 2017 Save the Children funded an evaluation of the C-MAMI tool Version 1.0 to capture lessons learned and inform an update of the tool. To add greater value to the evaluation, GOAL funded additional data collection from Ethiopia. This article summarises the methodology, findings and recommendations of that evaluation.

Study location and methodology

Save the Children's pilot project in Barisal Sadar, Bangladesh, was implemented by C-MAMI counsellors with either a nutrition or agriculture background who received a seven-day classroom training. GOAL's pilot project in the refugee camps of Terkidi and Kule in Gambella, Ethiopia, relied on C-MAMI nurses with either infant and young child feeding (IYCF) and/or community-based management of acute malnutrition (CMAM) experience, who received 0.5-5 days of training through a mix of classroom and on-the-job orientation. Table 1 provides a short description of nutrition programming in the implementation sites.

The evaluation was designed and carried out by an inter-agency evaluation team (see acknowledgments) using a mixed-methods approach to obtain information on user experiences with the C-MAMI programme and tool. The fieldwork con-

Table 1 Description of implementation sites

	Bangladesh	Ethiopia
IYCF Context	Government workers trained, limited implementation	Strong maternal and IYCF programme for pregnant women and mothers with children under two years of age[1]
Management of Acute Malnutrition	Inpatient SAM treatment (medical college); Outpatient SAM treatment (No ready-to-use therapeutic food (RUTF) used); no supplementary feeding	CMAM by GOAL, including stabilisation centres; outpatient therapeutic programme (with RUTF); and targeted and blanket supplementary feeding.
Growth Monitoring and Promotion	No supply of growth monitoring cards	Cards supplied but not filled in

sultant worked with in-country focal points and visited both field locations for seven days each in November and December 2017. Data were collected through key informant interviews, focus group discussions (FGDs), questionnaires, observation of mother-infant assessments and management, case scenarios and an 'open book' quiz for trained tool users. The evaluation team selected 48 respondents (32 Bangladeshi and 16 Ethiopian). These included enrolled and discharged beneficiaries of the programme, trained C-MAMI tool users, community outreach workers, programme supervisors and context experts, including non-governmental organisation (NGO) and government staff and stakeholders with local programming expertise.

Evaluation findings

C-MAMI programme

Overall, respondents expressed appreciation of the C-MAMI programme. Senior managers in both locations agreed that the programme addresses a need that was not necessarily perceived previously. *"There are less babies under six months admitted (to Stabilisation Centre) with complications because now C-MAMI prevents them getting so severe."* (SC nurse: Ethiopia). There was agreement in both Bangladesh and Ethiopia that infants treated through C-MAMI recover more quickly than older children treated in CMAM (IYCF counsellor, Ethiopia; Supervisor/Manager, Ethiopia and Bangladesh).

At the same time, progress in terms of support for mothers' recuperation is needed. Respondents noted that mothers were more motivated to adhere to treatment for their infants than themselves. One respondent in Ethiopia commented that C-MAMI is perceived to be only for infants; not for mothers. In general, respondents stated that the support for mothers (nutritional and non-nutritional) needs to be strengthened. The quiz identified more misclassified cases of mothers than infants, underscoring the need to improve guidance on this section of the tool.

A consistent theme raised by respondents was the relationship between C-MAMI and IYCF programming. Many community members, outreach workers and programmers expressed confusion about the distinction between the two, saying that they were unclear as to which infants were eligible for screening and management in one programme versus the other. The quiz reinforced this finding with C-MAMI tool users, who were sometimes unclear when to assign a case among the three case management options (referral to a facility, C-MAMI enrolment or linkage with IYCF support). However, misidentification of programme enrolment does not equate with mismanagement (there is intentional overlap between these programmes), although it does highlight that distinctions, connections and synergies need to be resolved between C-MAMI and IYCF programming.

Even with the need to clarify the roles of the two programmes, respondents underscored the importance of strong relationships between IYCF and C-MAMI programmes. *"The focus should be on IYCF; IYCF is for all"* – with C-MAMI added alongside IYCF programming to ensure 'at-risk' mothers and infants receive appropriate care. Some implementation staff reported that an advantage of C-MAMI is the increased likelihood that IYCF concerns will be addressed. *"IYCF is meant to be integrated into many service points. Because IYCF is everyone's responsibility, no one is accountable. Some doctors and sisters [nurses] are neglecting this type of task (IYCF counselling). Every provider should be oriented to the C-MAMI programme."* (Programme Manager, Bangladesh). Implementation staff responses varied when asked whether C-MAMI is best suited for incorporation in a health or nutrition programme. This is likely a reflection that breastfeeding counselling is included in both or either sectors in various settings.

C-MAMI tool

A focus of the evaluation was to gather feedback on the C-MAMI tool Version 1.0 to inform revisions. In general, respondents in both settings described the tool as "useful", "filling a gap", "comprehensive", "covers everything that the health worker needs to know to manage the infant U6m" and "user-friendly". In-depth feedback on the tool was provided by respondents and through observations of use. This feedback was incorporated in the creation of C-MAMI tool Version 2.0 (see news article in this issue).

A major area for C-MAMI improvement is related to admission and discharge criteria. Respondents discussed the need to revisit anthropometric measures and cut-offs for admission (mid-upper arm circumference (MUAC) cut-offs and use of weight-for-age (WFA)) and a need to define terms for infant assessment ('severe' vs 'moderate' weight loss; 'sharp' and 'moderate' drops across growth-chart centile lines). Respondents also noted the lack of clear discharge criteria (anthropometric measurements, minimum/maximum lengths of stay) and procedures (referral to additional nutrition services, follow-up and monitoring of outcomes).

Respondents also commented on the monitoring tools associated with the C-MAMI tool. Currently there are no standardised reporting and recording formats for C-MAMI. In Ethiopia, all forms are paper-based, while Save the Children's programme in Bangladesh uses both a tablet-based C-MAMI app and paper forms for assessment, classification and programme monitoring. In all locations respondents requested data collection processes and tools to be streamlined and duplications eliminated.

Feasibility of scale-up

In relation to the feasibility of scale-up and sustainability, stakeholders in both settings requested more evidence to support the C-MAMI approach, including the underlying need and programme objectives, component interventions and a monitoring strategy. Several senior managers mentioned that confusion had been caused by the lack of standard operating procedures, protocols, procedural manuals and standardised operational tools (i.e. training curricula and reporting formats). In both contexts, senior-level respondents emphasised the need to pilot C-MAMI with government health workers (described by one respondent as the real target users). Respondents also indicated that sensitisation is needed from national to community levels to increase the understanding and buy-in for C-MAMI.

Recommendations

The following key recommendations emerged from the evaluation, some of which were incorporated into C-MAMI tool Version 2.0:

1. Create a simpler, user-friendly C-MAMI tool; unify and streamline triage, assessment, classification and management of the infant-mother pair.
2. Develop guidance on the use of the C-MAMI tool; include greater guidance on counselling and describe changes from Version 1.0 to 2.0.
3. Clarify admission and discharge criteria, as well as follow-up procedures once discharged.
4. Strengthen guidance on maternal depression/anxiety/distress.
5. Develop a standardised C-MAMI training curriculum.
6. Simplify and standardise monitoring guidance, including a minimum set of monitoring indicators.
7. Conduct further research on the burden of malnutrition in U6m and key operational questions (anthropometric thresholds and non-nutrition issues, such as maternal depression and adolescent pregnancy); advocate for routine data collection on infants U6m in national and sub-national prevalence surveys.
8. Consider an advocacy and sensitisation campaign to mobilise support for C-MAMI.

Partners are now seeking to pilot the revised tool to gather user feedback for continued improvement.

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[1] The programme is delivered in a '1,000 days room': a dedicated, quiet and comfortable area within the CMAM programme; mothers can relax to feed, discuss concerns and be supported as a group or individually, through counselling and practical support.