



The management of small and nutritionally at-risk infants under six months and their mothers (MAMI)

Introduction to MAMI

The management of small and nutritionally at-risk mothers and infants under six months (u6m) and their mothers (MAMI) is a multisectoral approach to support the identification, assessment, and management of small and nutritionally at-risk infants u6m and their mothers. The MAMI approach was created in response to the high numbers of infants u6m who fail to survive and thrive due to a lack of nutrition and of health services equipped to support them. About 1 in 5 infants u6m is small and nutritionally at-risk (1). These infants are at higher risk of sickness, death, and poor development. Despite their vulnerability, small and nutritionally at-risk infants u6m are not always identified and/or managed appropriately.

The MAMI vision is that every small and nutritionally at-risk infant under six months & their mother is supported to survive and thrive

History of the MAMI Global Network

The MAMI initiative began in 2007 in response to concerns raised by frontline practitioners encountering challenges identifying and managing small and nutritionally at-risk infants u6m. The lack of information on infants u6m catalysed the Management of Acute Malnutrition in Infants project (2008-2010) that analysed global burdens, case management, and programme outcomes. The project identified a high burden of small and nutritionally at-risk infants u6m, alongside a lack of programme data and treatment guidance. To fill these gaps, the [MAMI Global Network](#) (previously the MAMI Special Interest Group) was established in 2010 to drive research, policy, and practice for small and nutritionally at-risk infants u6m. The MAMI Global Network is coordinated by the Emergency Nutrition Network (ENN) and co-led by ENN and the London School of Hygiene and Tropical Medicine (LSHTM). The Network has had some key successes since its conception:

- Supporting normative policy guidance change. The 2013 World Health Organisation update for the management of acute malnutrition guideline recommended community-based management for infants u6m for the first time (2).
- Putting policy into practice through the development of the [MAMI Care Pathway Package](#) (outlined below).
- Building the evidence base on assessment of at-risk infants u6m.
- Stop-gapping guidance for critical programme questions.



The vision for the MAMI Global Network is that local, national, and international collaborators work together to improve policy, programmes, and practice for small and nutritionally at-risk infants under six months and their mothers.

Our mission is to build an effective and energetic network to enhance mutual capacity, bridge disciplines, address evidence gaps, and champion MAMI care.

Small and nutritionally at-risk infants u6m

Small and nutritionally at-risk infants are defined by a broad set of criteria that may differ according to setting and context. The criteria that should be used to best identify at-risk infants in need of intervention is the subject of intense current research (3).

Currently, common criteria include:

- Low weight-for-age (4)
- Infants whose weight is faltering (i.e. not increasing in weight or dropping across centiles on a growth chart)
- Infants born low birthweight (less than 2500g) or small-for-gestational age
- Low weight-for-length (e.g. less than -3 z-scores) (5)

Criteria with growing evidence include:

- Low mid-upper-arm circumference (MUAC) (6-8)
- Addition of clinical or other criteria to supplement anthropometric criteria (e.g. multiple birth, adolescent mother)

These infants are at increased risk of morbidity, mortality, and suboptimal development compared to their well-grown, well-nourished counterparts. If these infants do not receive the support they need, short term risks include infection and mortality, which are higher among this age group than in older children (9-11). Infants who experience wasting in the first six months of life are at increased risk of later episodes of wasting and linear growth failure (12). Poor early life nutrition has also been linked with adverse long-term outcomes, such as impaired cognitive development and higher risk of non-communicable diseases later in life (13-17).



The MAMI Care Pathway Package

Despite their vulnerability, small and nutritionally at-risk infants ≤ 6 months do not receive the care and support they need to survive and thrive. Neonatal services often have limited involvement after six weeks of life, while services for the management of wasting do not start until the infants reach six months of age. In addition, other health services and interventions that may be available for these infants lack tools to identify and care for small and nutritionally at-risk infants ≤ 6 months specifically (e.g. integrated management of childhood illnesses (IMCI), paediatric and primary health care, and infant and young child feeding (IYCF) services).

[The MAMI Care Pathway Package](#) (2021) (an update of [C-MAMI Tool V2](#)) aims to contribute to the continuum of care for infants by filling the care gap from birth (or six weeks) to six months of age. The package is a set of resources and materials to help practitioners identify, assess, and manage small and nutritionally at-risk infants ≤ 6 months and their mothers. It applies an integrated care pathway approach to manage clinical issues, growth faltering, infant feeding problems, and maternal mental health across different parts and levels of a health service. The resources centre on case management delivered at primary-level health services (outpatient and community). Assessment and support of the infant and mother pair is integral to case management. The health, nutrition, and wellbeing of one directly affects the other. Successful outcomes therefore depend on both the infant and mother being well-managed and well-supported. This is reflected in assessment and action regarding the nutritional, physical, and mental health of the mother in the MAMI Care Pathway.

Guiding principles of the MAMI Care Pathway:

- Uses existing health system contact points to identify and enrol infants and mothers (e.g. community-based screenings, vaccination visits).
- Works with and strengthens existing health and nutrition services.
- Bridges interventions across relevant disciplines (including nutrition, health, maternal mental health, reproductive health, and early childhood development).
- Signposts and connects patients to relevant services through referral pathways.
- As with any care pathway, the MAMI Care Pathway Package requires refinement and adaptation in different settings to be as contextually relevant, appropriate, and effective as possible. Implementation will depend on existing services and human resources available in the context.
- Designed particularly for use in low- and middle-income countries and is applicable in both humanitarian and development settings.

**Expected benefits:**

The MAMI Care Pathway Package is expected to reduce the risk of death, illness, and malnutrition for infants u6m while improving development and long-term health.

MAMI Care Pathway Package in the context of wider guidance:

Core contents of the MAMI Care Pathway Package are based on and are intended to help operationalise the 2013 WHO guidelines for the management of infants u6m with wasting. An update to these guidelines is currently underway. The MAMI Care Pathway Package's overall approach and format are modelled on and support the implementation of IMCI already widely used in low- and middle-income countries (18-20).

Evidence:

The MAMI Care Pathway Package builds on a broad range of accumulated evidence and experience. It consolidates learnings from an original version developed in 2015 as a first step to fill a gap in programming guidance and catalyse case management (21). Version 2.0 was produced in 2018 (22). This current, third review process was initiated in 2020 and was informed by: operational research that includes service user experiences (23); programme evaluations (24, 25); systematic and other literature reviews (9, 26-29); and collated practitioner experiences (29-32).

The area of MAMI is a developing field of practice that requires a stronger evidence base. Between 2021-2024 the [MAMI Care Pathway will be tested in a randomized control trial in Ethiopia](#) by a research consortium led by LSHTM, comprising Jimma University, GOAL, and ENN. Additional formal research, implementation research, operational testing, and documentation of programming in a range of contexts is required and encouraged.



References

1. Lelijveld N, McGrath M, Mertens A, Mwangome M, Talbert A, Rana R, et al. Growth failure in infants younger than 6 months: a scoping review. Submitted to WHO scoping consultation on growth failure in infants under six months: ENN; December 2020.
2. World Health Organization. Updates on the management of severe acute malnutrition in infants and children. Geneva: World Health Organization. 2013;2013.
3. Lelijveld N, Kerac M, McGrath M, Mwangome M, Berkley J. A review of methods to detect cases of severely malnourished infants less than 6 months for their admission into therapeutic care Emergency Nutrition Network; 2017.
4. de Onis M, Onyango AW. Worldwide practices in child growth monitoring. *Journal of Pediatrics* 2004;144:461-5.
5. World Health Organization. Updates on the management of severe acute malnutrition in infants and children (Guideline) 2013.
6. Mwangome M, Ngari M, Bwahere P, Kabore P, McGrath M, Kerac M, et al. Anthropometry at birth and at age of routine vaccination to predict mortality in the first year of life: A birth cohort study in Burkina Faso. *PloS one*. 2019;14.
7. Mwangome M, Ngari M, Fegan G, Mturi N, Shebe M, Bauni E, et al. Diagnostic criteria for severe acute malnutrition among infants aged under 6 mo. *The American journal of clinical nutrition*. 2017;105.
8. Mwangome M, Fegan G, Fulford T, Mulberg A, Berkley J. Mid-upper arm circumference at age of routine infant vaccination to identify infants at elevated risk of death: A retrospective cohort study in the Gambia. *Bulletin of the World Health Organization*. 2012;90:887-94.
9. Grijalva-Eternod C, Kerac M, McGrath M, Wilkinson C, Hirsch J, Delchevalerie P, et al. Admission profile and discharge outcomes for infants aged less than 6 months admitted to inpatient therapeutic care in 10 countries. A secondary data analysis. *Maternal and Child Nutrition*. 2016;13.
10. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet*. 2013;382(9890):427-51.
11. Wang H, Bhutta ZA, Coates MM, Coggeshall M, Dandona L, Diallo K, et al. Global, regional, national, and selected subnational levels of stillbirths, neonatal, infant, and under-5 mortality, 1980&2013;2015: a systematic analysis for the Global Burden of Disease Study 2015. *The Lancet*. 2016;388(10053):1725-74.
12. Mertens A, Benjamin-Chung J, Colford JM, Coyle J, Laan vdM, Hubbard AE, et al. Causes and consequences of child growth failure in low- and middle-income countries. *medRxiv*. 2020:2020.06.09.20127100.
13. Hanson MA, Low FM, Gluckman PD. Epigenetic epidemiology: the rebirth of soft inheritance. *Annals of Nutrition and Metabolism*. 2011;58(Suppl. 2):8-15.
14. Hales CN, Barker DJ. Type 2 (non-insulin-dependent) diabetes mellitus: the thrifty phenotype hypothesis. *Diabetologia*. 1992;35(7):595-601.
15. Lelijveld N, Seal A, Wells JC, Kirkby J, Opondo C, Chimwezi E, et al. Chronic disease outcomes after severe acute malnutrition in Malawian children (ChroSAM): a cohort study. *The Lancet Global Health*. 2016.



16. Grantham-McGregor S, Powell C, Walker S, Chang S, Fletcher P. The Long-Term Follow-up of Severely Malnourished Children Who Participated in an Intervention Program. *Child development*. 1994;65(2):428-39.
17. Grey K, Gonzales GB, Abera M, Lelijveld N, Thompson D, Berhane M, et al. Severe malnutrition or famine exposure in childhood and cardiometabolic non-communicable disease later in life: a systematic review. *BMJ Global Health*. 2021;6(3):e003161.
18. World Health Organization, UNICEF. Integrated Management of Childhood Illness: management of the sick young infant aged up to 2 months. IMCI chart booklet. <https://www.who.int/publications/i/item/9789241516365>; 2019.
19. World Health Organization. Integrated Management of Childhood Illness: Chart booklet: Geneva: World Health Organization; 2014.
20. World Health Organization. What is Integrated Management of Childhood Illness (IMCI): World Health Organization,; 2018 [Available from: https://www.who.int/maternal_child_adolescent/child/imci/background/en/].
21. ENN, LSHTM. A simple IMCI-style tool for assessing, identifying/classifying and managing uncomplicated acute malnutrition in infants < 6 months of age in the community - the "c-MAMI" tool 2016 [Available from: <http://www.ennonline.net/c-mami>].
22. ENN, LSHTM, Children St, GOAL, Collaborators. C-MAMI tool v2 - Management of At Risk Mothers and Infants (MAMI) 2021 [Available from: <https://www.ennonline.net/ourwork/research/mami>].
23. Arafat Y, Islam MM, Connell N, Mothabbir G, McGrath M, Berkley J, et al. Perceptions of Acute Malnutrition and Its Management in Infants Under 6 Months of Age: A Qualitative Study in Rural Bangladesh. *Clinical Medicine Insights: Pediatrics*. 2018;12:117955651877169.
24. Butler S CN, Barthorp H. C-MAMI tool evaluation: Learnings from Bangladesh and Ethiopia. *Field Exchange*. 2018.
25. Keuter A, Burrell A, Butler S, Sarwar M, Rahaman H. Piloting the C-MAMI approach in the Rohingya response in Bangladesh. *Field Exchange*. 2018.
26. Brugaletta C, Le Roch K, Saxton J, Bizouerne C, McGrath M, Kerac M. Breastfeeding assessment tools for at-risk and malnourished infants aged under 6 months old: a systematic review [version 1; peer review: 3 approved]. *F1000Research*. 2020;9(1310).
27. Rana R, McGrath M, Gupta P, Thakur E, Kerac M. Feeding Interventions for Infants with Growth Failure in the First Six Months of Life: A Systematic Review. *Nutrients*. 2020;12(7).
28. Champion-Smith TJ, Kerac M, McGrath M, Berkley JA. Antimicrobial and micronutrient interventions for the management of infants under 6 months of age identified with severe malnutrition: a literature review. *PeerJ*. 2020;8:e9175.
29. Beck K, Kirk CM, Bradford J, Mutaganzwa C, Nahimana E, Bigirumwami O. The Paediatric Development Clinic: A model to improve outcomes for high-risk children under-five in Rwanda. *Field Exchange*. 2018.
30. Read S. Improving community management of uncomplicated acute malnutrition in infants under six months (C-MAMI): Developing a checklist version of the C-MAMI tool. *Field Exchange*. 2017.
31. Read S, McGrath M. Community management of uncomplicated malnourished infants under six months old: barriers to national policy change. *Field Exchange*. 2018.



32. ENN, LSHTM, Children St. Management of At risk Mothers and Infants under six months (MAMI) Special Interest Group (SIG) meeting. 2018.