EME Evidence Review for Severe Acute Malnutrition Strategy

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CIFF
CHILDREN'S INVESTMENT FUND FOUNDATION

SAM Treatment Guidelines

WHO Statement from 2009 explains why we use the cut-offs in Box 1, for **diagnosing** SAM. Either:

- children with a **weight-for-height** below -3 standard deviations (SD) based on the WHO standards have a high risk of death exceeding 9-fold that of children with a weight-for-height above -1 SD.
- Children with **mid-upper arm circumference (MUAC)** less than 115mm also have an increased risk of death.

Reasons for **discharge criteria** in Box 2:

- Using **% weight gain** has the advantage of being easy to apply to children admitted based on MUAC as well to those admitted on weight-for-height (otherwise, some children selected using MUAC already fulfil these weight for height discharge criteria on admission into the programme).

BOX 1. DIAGNOSTIC CRITERIA FOR SAM IN CHILDREN AGED 6–60 MONTHS

Indicator	Measure	Cut-off
Severe wasting (*2*)	Weight-for-height (*1*)	< -3 SD
Severe wasting (*2*)	MUAC	< 115 mm
Bilateral oedema (*3*)	Clinical sign	

1 Based on WHO Standards (www.who.int/childgrowth/standards)
2,3 Independent indicators of SAM that require urgent action

BOX 2. SAM MANAGEMENT

Independent additional criteria	• No appetite • Medical complications	• Appetite • No medical complications
Type of therapeutic feeding	**Facility-based**	**Community-based**
Intervention	F75→ F100/RUTF And 24 hour medical care	RUTF, basic medical care
Discharge criteria (Transition criteria from facility to community-based care)	Reduced oedema Good appetite (with acceptable[a] intake of RUTF)	15 to 20% weight gain

[a] Child eats at least 75% of their calculated RUTF ration for the day

Performance indicators

The coverage rate

- Definition: Proportion of cases with severe acute malnutrition receiving treatment (Numerator: # of cases with SAM receiving treatment; Denominator: total # of cases with SAM)
- Target: >50% for rural; >70% for urban; >90% for displaced persons living in a camp (as per Sphere minimum standards*)
- Notes: coverage can be affected by the acceptability of the programme (incl. location and how easy it is for the population to access the programme site), security situation, frequency of distributions, waiting time, extent of community mobilization, etc.

The recovery rate (cure rate)

- Definition: % of SAM children who have reached the discharge criteria of complete recovery from SAM (based on 15% weight gain)
- Target: >75% (as per Sphere minimum standards)

The non recovery rate (failure to recover)

- Definition: Proportion of discharged cases with severe acute malnutrition who non-recovered. Non-response to treatment should be identified and acted upon with the full medical investigation
- Target: < 15% (as per Sphere minimum standards)

The default rate

- Definition: % SAM children who are absent for two consecutive weighings
- Target: < 15% (as per Sphere minimum standards)
- Notes: A high default rate is significantly associated with factors related to poor accessibility, poor satisfaction with staff and system, and factors related to treatment and acceptability of treatment services ➔ Expansion of treatment services and training of staff on SAM treatment protocols are highly recommended (Al Amad M et al, 2017).

*Sphere minimum standards are evidence-based programme performance indicators and represent sector-wide consensus on best practice (Sphere, 2018)

How many SAM children would die, without treatment?

- WHO estimates SAM case fatality rate for untreated SAM to be between **10%-20%** (WHO, 2007).
- **However, this is based on five, very old cohort studies** from the DRC (1993), Bangladesh (1987), Senegal (1983), Uganda (1992) and Yemen (1989). These studies were done at a time when child mortality was considerably higher than now. They mostly included children attending health facilities, 4 out 5 were done in African countries vs. only 1 in South Asia, and many studies did not differentiate between children with and without medical complications. Extrapolating this 10-20% case fatality rate to the contemporary global situation is therefore probably flawed.
- In 2013, the Lancet Undernutrition series authors reviewed studies on SAM case fatality rates published from 1994 onwards and found them ranging from 3.4 to 35% (the upper estimates were from children in hospitals in Malawi, where HIV is prevalent) (Lenters et al, 2013). There was such heterogeneity in estimates that **the authors did not produce a single average case fatality rate for SAM**
- LiST model can estimate the impact of wasting on *post-neonatal* cause-specific mortality due to infectious causes (diarrhoea, pneumonia, meningitis, measles, pertussis), and assumes that SAM and MAM treatment essentially move children 1SD upwards (e.g. from WHZ<-3 to WHZ>=-3 to <-2, or to WHZ>-2)
- Using LiST, the Lancet 2013 authors estimated that achieving 90% coverage of SAM treatment would save 348,264 children under five years (lower bound: 285,996 – upper bound: 364,878. Saving 348,264 children through treatment would mean saving 2% of the 17 million children under five years with WHZ<-3 today.

Without treatment … Cont’d

Taking India as an example:

- Half of all SAM children live in India (9/17m), 21% of children are born low birth weight, 50% of all child deaths occur in the neonatal period, and the highest proportion of nutrition-related DALYs in children under five years are from LBW and short gestation (44%). Four recent studies found SAM case fatality rates < 6% among children older than 6 months.
- In sum, in India, focusing on SAM treatment for children > 6 months is likely to be too little and too late to avoid many deaths linked to undernutrition: a more holistic approach combining treatment and prevention is required.

More recent studies on what happens without treatment are not available/feasible because it is now unethical not to provide treatment to children with SAM (so we cannot have a cohort of untreated SAM children to observe).

Conclusion on SAM without treatment: We do not recommend the use of a global CFR estimate such as WHO 10-20% (data are too old and there are huge variations between geographies) and instead, country/regional level recent estimates may be appropriate (using LiST modelling for example).

SAM Mortality Rate, with treatment

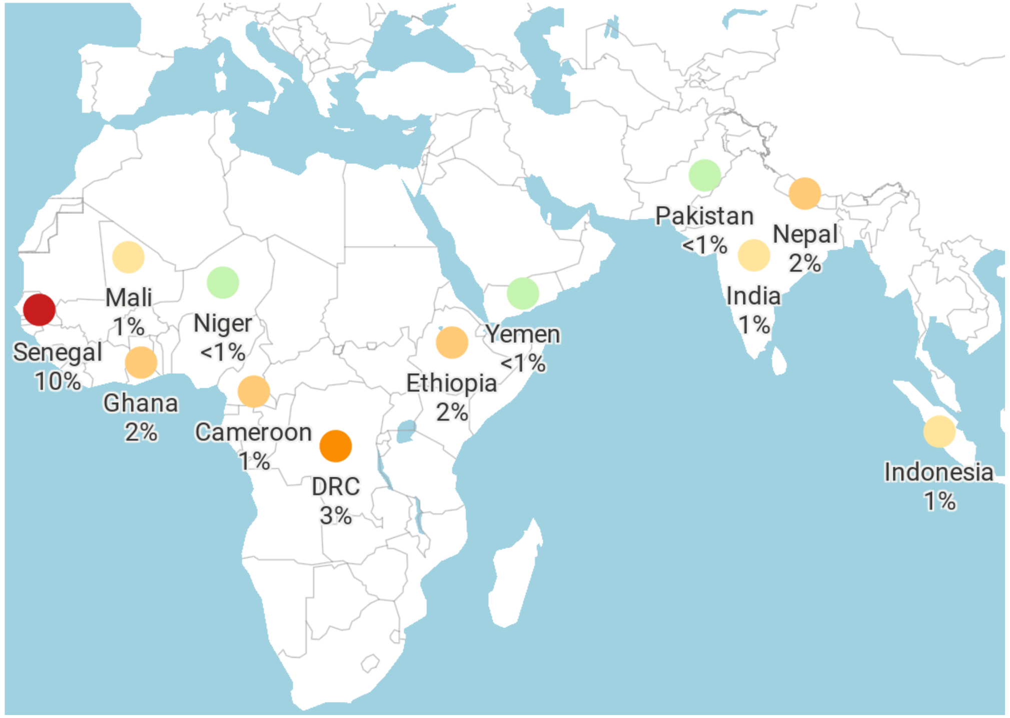
It depends on the type of treatment: facility-based (hospitalized) or community-based. Hospitalized children have complications so their risk of death is higher.

We reviewed additional studies, published in the last 10 years (2009-2019), and found that:

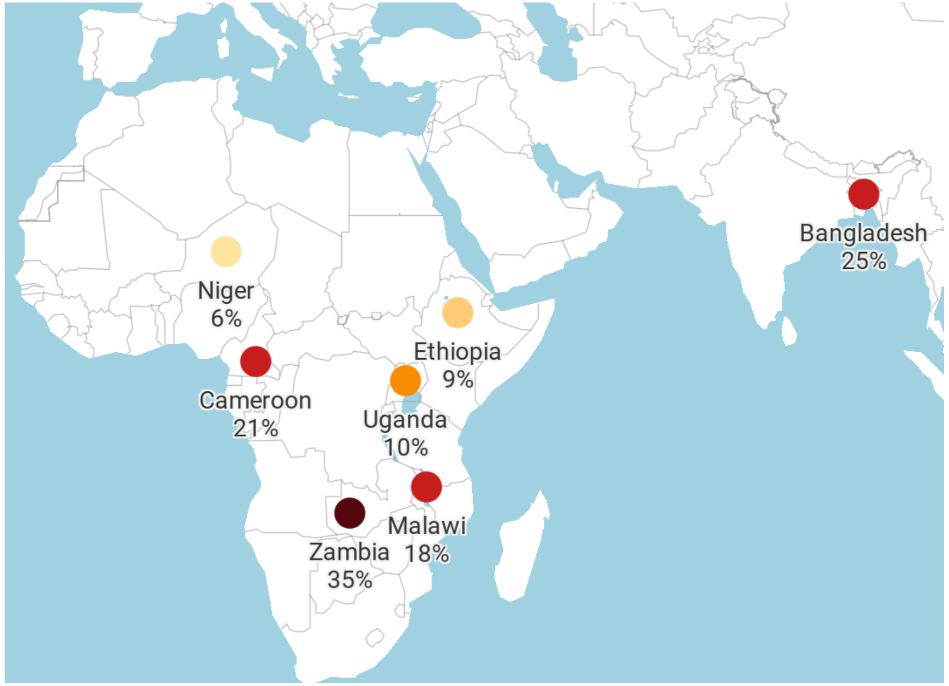
- **Hospitals settings – Mortality rate ranges between 4% to 35%, average of 13%**
- **Community settings – Mortality rate ranges between <1% to 9%, average of 2%** (benchmark acceptable target used by programmes is Mortality <10%)

Clearly, there are key drivers behind these wide ranges, indicative of the performance and efficiency of any given programme.

Community Treatment CFR



Hospitalised Treatment CFR



Comorbidities

Underlying illnesses greatly affect the mortality rate of SAM children

The increased risk of death for SAM children with HIV and/or TB is well documented:

- SAM children who are **HIV** infected are 80% more likely to die than those who are HIV uninfected (Munthali T et al, 2015)
- Children with SAM and **TB** are 40% more likely to die than SAM children with without TB (Munthali T et al, 2017)

In addition, most commonly reported co-morbidities are: diarrhoea (11/19 studies) and pneumonia (7/19 studies). Children with SAM need to be treated for diarrhoea, dehydration and anaemia at the primary point of care to reduce mortality.

Overall, the probability of recovery is greatly reduced in children who have comorbidities at admission – by as much as 84% (Desyibelew HD et al, 2017)

Study	Country	Morbidities reported (% of children)
Chisti MJ et al, 2015	Bangladesh	Severe pneumonia (27%)
Altmann M et al, 2018	Chad	Diarrhoea (28%), vomiting (5%), fever (11%), cough (20%), conjunctivitis (20%)
Derseh B et al, 2018	Ethiopia	Pneumonia (55%), diarrhoea (42%) and rickets (21%)
Desyibelew HD et al, 2017	Ethiopia	Pneumonia (39%), diarrhoea (36%), anaemia (30%), and gastrointestinal tract infections (30%), TB, HIV
Fikrie A et al, 2019	Ethiopia	Pneumonia (42%), diarrhoea (47%), TB (23%), anemia (75%)
Wagnew F et al, 2019a	Ethiopia	Dehydration (33%), pneumonia (21%), TB (16%)
Wagnew F et al, 2019b	Ethiopia	Diarrhoea, dehydration, anemia
Wagnew F et al, 2018	Ethiopia	TB, HIV
Akparibo T, 2017	Ghana	Malaria (17%), fever (18%), vomiting (14%)
Chaturvedi A et al, 2018	India	Coughs & colds (68%), fever (40%), diarrhoea (35%)
Mathur A et al, 2018	India	Either diarrhoea or respiratory complaints or both (70%), fever (7%), seizures (5%), severe anaemia (5%), septicaemia (4%)
Attia S, et al, 2016	Malawi	Diarrhoea (58%)
Van den Heuvel et al, 2017	Malawi	HIV (23%), preexisting neuro-disabilities (18%)
Versloot CJ et al, 2017	Malawi	Diarrhea (33%)
Oldenburg CE et al, 2018	Niger	Malaria (55%), diarrhoea (32%), coughing (16%)
Adler H et al, 2017	South Africa	TB (26%)
Nabukeera-Barungi N et al, 2018	Uganda	Diarrhoea (61%), pneumonia (17%), HIV (12%)
Munthali T et al, 2017	Zambia	TB (2%) – suggesting under detection
Munthali T et al, 2015	Zambia	HIV, septicaemia, diarrhoea, pneumonia

Relapse

Why relapse is important - children who have had one episode of SAM are less likely to survive a second one. So eliminating relapse could save many lives. The relapse rate points to the inefficiency in programmes and is an unnecessary burden on the individual child.

Relapse following treatment of SAM is poorly defined and scarcely measured across programs and research.

Reported relapse ranges from 2% to 37% of children following SAM treatment, with the **highest proportions occurring within 6 months post-discharge**.

The data across studies are largely not comparable due to different treatment protocols, various follow-up periods, and inconsistent reporting of relapse as a point prevalence (not cumulative), cumulative prevalence, and incidence rate.

Lower anthropometric measurements on admission to and discharge from SAM treatment are consistent risk factors for relapse. **Illness** is frequently observed at the time of relapse.

Study	Country	Relapse rate	Follow-up at
Bandhari et al (2017)	India	37%	16 weeks
Tadesse et al (2017)	Ethiopia	35%	14 weeks
Begashaw et al (2013)	Nigeria	25%	6 months
CIFF outcome study (2019)	Nigeria	24%	6 months
Menghesa et al (2016)	Ethiopia	22%	2 months
Ashraf et al (2012)	Bangladesh	18%	6 months
Altmann et al (2018)	Chad	3%	6 months
Altmann et al (2018)	Chad	18%	2 months
Goudet et al (2018)	India	18%	12 months
Somasse et al (2015)	Burkina Faso	11%	6 months
Dale et al (2018)	Pakistan	7%	6 months
Singh et al (2016)	India	4%	1.5 month
Bahwere et al (2008)	Malawi	3%	3 months
Burza et al (2016)	India	3%	6 months
Binns et al (2016)	Malawi	2%	3 months

What prevents children from becoming Wasted/SAM?

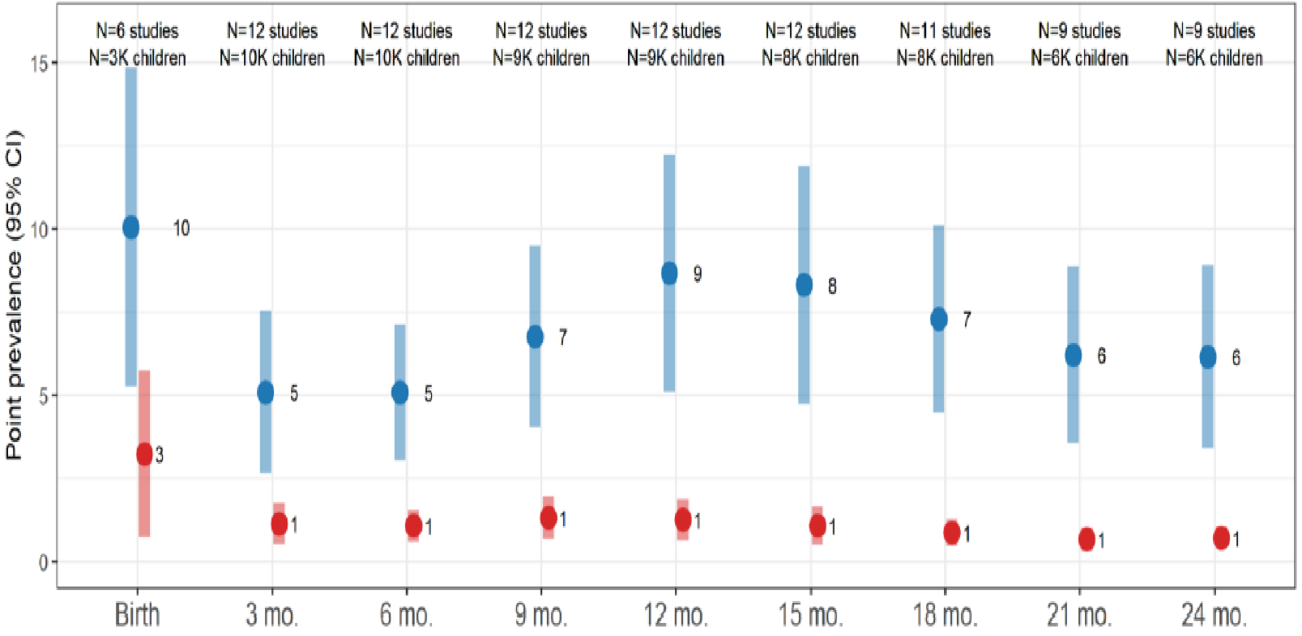
Birth

12 month old children

1- 5 years old children

Level of risk

- **Low birth weight** is associated with a 3.1 times higher risk of wasting
- **Low maternal weight** is associated with 2.6 times higher risk of wasting
- **Mothers over 35** have children at a 25% higher risk of wasting
- **Thirdborn or later children:** have a 55% higher risk of wasting than first born children
- **Maternal education:** mothers with higher education have children with 42% lower risk of wasting
- **Boys** have a 20% higher risk of any wasting from 6-24 months:



The level of risk is highest at birth and 12 months of age

Prevention is critical, to avert further cases from arising

Many deaths to wasted children occur **in the first six months of life**, especially in the neonatal period. These deaths are concentrated among infants born low birth weight and/or premature, for whom RUTF is not relevant. Preventing these early deaths would amplify the impact of SAM treatment and requires a more holistic approach.

This would involve a lifecycle approach with a focus on:

1. Adolescent health and wellbeing including staying in school and avoiding early marriage
2. Increasing access to family planning
3. Strengthening the prevention of maternal undernutrition and infections
4. Interventions to support LBW and premature babies (e.G. Kangaroo mother care and breastfeeding counselling)
5. Strengthening treatment and feeding support for infants under six months with acute malnutrition.

Example Interventions	Number of under 5 deaths averted
Vitamin A supplementation	21,631
Multiple micronutrient supplementation	43,715
Balanced energy supplementation	57,922
Folic acid supplementation/fortification	59,405
Management of MAM	86,946
Appropriate complementary feeding	99,952
Promotion of breastfeeding	120,743
Zinc supplementation	123,793
Management of SAM	348,264

(Bhutta et al, 2013)

Evidence on prevention

Risk Factors

Adverse birth outcomes: low birthweight, small for gestational age, and preterm births	Lbw, SGA, and preterm births are associated with a 2-fold increased risk of developing wasting. Lbw in particular is associated with between 2.5 to 3.5-fold higher odds of wasting, stunting and underweight. The risk of SGA on outcomes of childhood stunting and wasting is 20% and 30%, respectively.
Maternal age < 20 years or > 35 years	Both younger and older maternal age are associated with lower birthweight, gestational age, child nutritional status. In Nepal the odds of having SAM were 3 times higher among children whose mother's age at birth was less than 20 years old.
Close birth intervals	Malnutrition status in infants has been shown to diminish with an increase in the length of the previous birth interval. A longer duration between births reduces sharing problems among living siblings, does not shorten the duration of breastfeeding, and parents can take better care of their children.
Large family size	In Ethiopia, a large family size with the number of children greater than 3 was strongly associated with severe acute malnutrition.
Poverty	Poverty remains an important underlying cause of malnutrition in children.
Maternal illiteracy	Maternal illiteracy and low levels of maternal and parental education, are often described as significant risk factors for wasting, as a result of poor child feeding.
Poor access to health services	Women who deliver in childbirth facilities in Uganda are 60-80% less likely to have a child with low WAZ, LAZ or WHZ. In Ethiopia, children whose mothers lacked access to health facilities (within 10km radius) were almost twice as likely to be wasted.
Lack of mutual decision making on the care/treatment of children	Children in Ethiopia whose parents did not make joint decisions on the treatment of the sick child were nearly twice more likely to be wasted. This could be because the provision of joint care by biological parents requires joint decision on the care or treatment of their children. Such decisions might also require women's autonomy to participate in the decision making process of the household equally with the men.
Inadequate child feeding practices	The association of IYCF practices with wasting has been reported many times. A Lancet study found that 10% of the wasting burden is attributable to sub-optimal breastfeeding practices, in particular lack of exclusive breastfeeding between 0-6 months of age.
Residence in rural areas	The place of residence was strongly associated with acute malnutrition in Ethiopia, Vietnam and Bangladesh: ex children living in rural kebele were almost 2.5 times more likely to be acutely malnourished than children living in urban kebele.
Incomplete immunisation	Lack of complete immunisation has been found to contribute significantly to the occurrence of SAM, which can be explained by the fact that unimmunized children suffer from various infections which retard their growth.

Preventive Interventions vs available evidence

Intervention	Effect on preventing wasting	Evidence Quality
Food supplementation (including LNS, RUTF, RUSF, meat, egg, milk etc.) for children	Strong	Strong
Cash transfers	Medium	Strong
Complementary foods for children	Strong	Weak
Insecticide treated bednets for infants	Strong	Weak
Nutrition counselling and nutrition education for mothers, caregivers and communities	Medium	Strong
Micronutrient supplementation for children	Medium	Medium
Micronutrient supplementation for pregnant women	Medium (High for preventing lbw)	Medium
Mother's education and women's empowerment	Medium	Weak
Maternal mental health	Medium	Weak
Family planning	Medium	Weak
General food distribution	Medium	Weak
Breastfeeding promotion and support	Weak	Medium
Deworming for children	Weak	Medium
WASH	Weak	Medium
Vaccination campaign	Weak	Medium
Agriculture	Weak	Weak

How can a gender lens accelerate impact on SAM reduction?

Improving pre-natal nutrition & health of women → improves health of newborns

- Women and adolescent girls are at greater risk of malnutrition due to the increased nutritional needs associated with menstruation, pregnancy, and lactation. This is reflected in the **high rates of anemia** which affects 33% of women of reproductive age globally (~613 million women) – this rate has barely changed since 2000 (IFPRI, 2018).
- **Maternal MMS** has been shown to impact birthweight and birth length (reducing lbw between 11%-14%) (Dewey, 2016).
- **Maternal infections** are responsible for 46% of preterm births globally (CIFF-commissioned Johns Hopkins analysis, 2019).

Empowered, educated women and girls → better nutrition for families

- **Early marriage and early pregnancy:** adolescent girls who marry early are less likely to know about and advocate for their own nutritional needs and have less optimal feeding practices for their children. Pregnancy during adolescence risks the survival and health of both the adolescent mother and her baby. By 2030, there will still be 119 million stunted children, a majority of them children of young mothers (Save the Children, 2019).
- **Education**: data from 25 developing countries suggest that 1-3 years of maternal schooling reduced child mortality by 15% (Levine et al, 2009). Improved female education was responsible for nearly 43% of the total global reduction in undernutrition between 1971 and 1995 (Smith et al, 2000).
- **Decision-making power**: mothers provided with low-cost ($0.06) MUAC tapes are able to screen their children frequently—allowing for early diagnosis and treatment of wasting thereby becoming the focal point in scaling-up community management of acute malnutrition (Blackwell et al, 2015).
- **Maternal mental health** can prevent wasting because it improves caregiving. Maternal depression has been associated with child malnutrition, including wasting (Ashaba et al, 2015).

Multiplying effect of addressing gender inequality – more powerful than GDP growth

The Gender Inequality Index (GII), a widely accepted indicator of women's disadvantages in reproductive health, empowerment and labour market participation, was modelled alongside the prevalence of LBW, child malnutrition (stunting and wasting) and mortality under 5 years in 96 countries. **The GII displaced GDP as a predictor of LBW**, explaining 36% of the variance. Independent of GDP, the GII explained 10% of the variance in wasting and stunting and 41% of the variance in child mortality.

Simulations indicated that **reducing GII could lead to major reductions in LBW (by half), child malnutrition (decrease wasting & stunting by half) and child mortality (by more than a third)** in low- and middle-income countries, independent of national wealth (Marphatia et al, 2016).

Cost-effectiveness

CMAM					
Country	Study	Cost/child treated	Cost/DALY averted	Cost/death averted (life saved)	Cost/child recovered*
Ethiopia	Tekeste et al, 2012	$135			$145
Malawi	Wilford et al, 2012		$42	$1,365	
Zambia	Bachmann et al, 2009	$203	$53	$1,760	
Bangladesh	Puett et al, 2013	$165	$26	$869	$180
Nigeria	Ali et al, 2017		$48	$1,778	
Nigeria	Frankel et al, 2015		$30	$1,117	
India	Goudet et al, 2018 (treatment and prevention)		$23	$13,977 *(due to lower cure rate)*	
Niger	Isanka et al, 2017	$85			
Pakistan	Rogers et al, 2019	$291			$382
Mali	Rogers et al, 2018	$244			$259
	Averages	**$187**	**$37**	**$1,378** *(excl. India outlier)*	**$242**

In-patient – overall more expensive					
Country	Study	Cost/ child treated	Cost/ DALY averted	Cost/death averted (life saved)	Cost/child recovered*
Ethiopia	Tekeste et al, 2012	$285			$320
Bangladesh	Puett et al, 2013	$1,344	$1,344	$45,688	$9,149
Mali	Rogers E et al, 2018	$442			$501
Niger	Isanka et al, 2017	$152			
Pakistan	Rogers et al, 2019	$301			$363
Mali	Rogers et al, 2018	$442			$501
	Averages	**$494**	**$1,344**	**$45,688**	**$2,167**

* As per the evidence presented previously, some recovered children relapse. So, **child recovered ≠ life saved**

Blanks mean indicator is not reported in the study

Cost-effectiveness - what does good look like?

The WHO-CHOICE model threshold for cost-effectiveness suggests that if the cost per DALY averted is below the value of gross domestic product (GDP) per capita then the intervention is 'very cost-effective' (WHO, 2005)

CMAM			
Country	**Study**	**Cost/DALY averted**	**GDP per capita (World Bank, 2018)**
Malawi	Wilford et al, 2012	$42	$389
Zambia	Bachmann et al, 2009	$53	$1,540
Bangladesh	Puett et al, 2013	$26	$1,698
Nigeria	Ali S et al, 2017	$48	$2,028
Nigeria	Frankel et al, 2015	$30	$2,028
India	Goudet et al, 2018	$23	$2,010

Conclusions:

- **Delivery of treatment by community health workers is a cost-effective intervention**, provided that good coverage is achieved. A major benefit of this strategy is the lower cost incurred by the beneficiary household when treatment is available in the community. This provides a basis to recommend that CMAM should be considered by policy-makers and funding institutions as interventions that offer value for money in terms of improving child health outcomes.
- **Higher coverage level is likely to make the interventions even more cost-effective** – this is because the fixed costs (such as high-level administrative expenditure) per child tends to reduce with increase in coverage due to economies of scale.
- Some studies suggest that lowering prices of medical treatments and therapeutic food would have limited effect on total costs per child, while **increasing program size and decreasing use of expatriate staff support** could reduce total costs per child substantially (Goudet S et al, 2018; Isanaka et al, 2017; Rogers et al, 2019)
- To further improve cost-effectiveness of CMAM, **programmes should also aim to reduce default rates among children enrolled**, which will improve survival rates. While this may require additional resources, the expected health gains in treatment completers will likely outweigh the additional costs.

Thank you

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