Severe acute malnutrition affects 20 million children aged under 5 years old worldwide. Medical complications and death are common, but nutritional and medical treatment can result in good outcomes. Randomized trials of treatment after in-patient stabilization have shown community-based treatment to have similar outcomes to hospital-based treatment, at lower cost. Community-based ambulatory treatment, with in-patient care reserved for the most severe cases, is increasingly being implemented in Africa but has not been evaluated in randomized trials. Community-based treatment programs have shown favorable outcomes. Economic evaluations of community-based treatment have included cost analyses, cost and consequence analyses and decision analyses. Treatment costs have been consistently lower than for institution-based treatment. Costs of ambulatory community-based treatment of severe acute malnutrition have ranged between US$46 to $453 per child, depending on the type of care provided and the costing methods used. Recent studies have reported on costs and outcomes of similar large-scale African programs covering geographically defined populations, with ambulatory care for most children, and initial in-patient stabilization for the minority with most severe disease. In these studies the costs ranged from US$129 to $201 per child, and mortality rates ranged from 1.2 to 9.2%, depending on length of follow-up. A decision tree model based on such a program in Zambia estimated that community-based treatment of severe acute malnutrition in primary-care centers, with hospital access, cost US$203 per case treated, US$1760 per life saved, and US$53 per disability-adjusted life year gained, compared with no treatment. This latter cost per disability-adjusted life year gained suggests that community-based treatment of severe acute malnutrition is cost effective compared with other priority health interventions in low-income countries, and compared with such countries’ national incomes.
low-protein formula known as F75. Stabilization usually takes up to 1 week. The rehabilitation phase is intended to rebuild wasted tissues, and is based on frequent feeding with a high-energy milk formula known as F100. Rehabilitation usually ends when a child reaches at least 85% of their expected weight for height and has no other severe complications. Rehabilitation typically takes at least 2 weeks. Children are then discharged from hospital and followed up to ensure that they do not relapse. According to the WHO’s 1999 guidelines, during stabilization and rehabilitation phases up to ensure that they do not relapse. According to the WHO’s guidelines, during stabilization and rehabilitation phases, children are treated as in-patients in hospitals or other facilities. But lack of access to hospital-based treatment, especially for populations and families with the greatest need, restricts the scope of this method. Hospital-acquired infections are also a risk with in-patient care, especially in settings with high HIV prevalence.

Ambulatory community-based treatment of SAM (CBTSAM) is increasingly being used in low-income countries to avoid these problems with in-patient care. It has been estimated that 80% of children with SAM could be treated without admission to hospital, with hospitalization reserved for stabilization of those with particularly severe SAM or its complications[1]. In 2007 the WHO, together with the World Food Program, the United Nations System Standing Committee on Nutrition and the United Nations Children’s Fund adopted a model of CBTSAM that included early detection of SAM in community settings, nutritional treatment with ready-to-use therapeutic food (RUTF), and medical treatment if necessary[2]. RUTF is a nutrient-dense food with a nutrient content per 100 kcal that is similar to F100 milk formula, but has the additional advantage of containing little water, making it resistant to microbial contamination, and suitable for storage without refrigeration[3]. This makes it suitable for treatment in ambulatory primary-care settings. Once SAM is diagnosed, children need to be assessed by a health worker to decide whether they need hospital admission or whether they can be treated in the community with regular health center visits. An increasingly popular model of CBTSAM is known as community-based therapeutic care, or community-based management of acute malnutrition (CMAM), which includes simplified clinical protocols, decentralized provision of care, RUTF provision and community mobilization, resulting in high population coverage[4]. Children with severe edema, or concurrent edema and low weight, still need to be admitted to in-patient stabilization centers, before being discharged to outpatient care once they are able to eat RUTF, their medical complications are controlled and their edema has started to resolve. Organizations, such as Valid International and Concern Worldwide, have helped implement this model in several African settings, providing some of the recent evidence reviewed later.

As SAM invariably occurs in settings with severe poverty and scarcity of resources, the cost and cost-effectiveness of strategies to manage it are crucial. Previous reviews have highlighted the lack of such economic evidence[6–8]. The purpose of this study is therefore to review existing evidence on the cost and cost-effectiveness of CBTSAM. This article will begin with an overview of the evidence on effectiveness, outcomes and costs, and will then examine cost-effectiveness analyses in greater detail.

Methods
I conducted a systematic review of evidence on cost and cost-effectiveness of CBTSAM, identified by searching the electronic databases, PubMed and Google Scholar. PubMed search terms were ‘(cost-benefit analysis) [MeSH Terms] OR (cost-benefit) [All Fields] AND ‘analysis’ [All Fields]) OR ‘cost-benefit analysis’ [All Fields] OR (‘cost’ [All Fields] AND ‘effectiveness’ [All Fields]) OR ‘cost–effectiveness’ [All Fields] AND (‘malnutrition’ [MeSH Terms] OR ‘malnutrition’ [All Fields]). Google Scholar search terms were ‘cost’ and ‘malnutrition’. I read the titles of all articles identified, and the abstracts of articles whose titles appeared relevant. For those articles that still appeared relevant I read the full papers, read their references, searched for related articles in PubMed, and searched for articles that had cited them in Google Scholar and Web of Science electronic databases. Studies that reported costs and outcomes were included. I wrote to subject experts asking them to identify relevant studies, including unpublished studies, thus identifying two unpublished postgraduate research dissertations.

Evidence of effectiveness of CBTSAM was not systematically reviewed but was based on two major review articles[7,8], their references and articles that cited them. Treatment of moderate acute or chronic malnutrition, population-based nutritional interventions, such as micronutrient supplementation, facility-based treatment and prevention of malnutrition, were beyond the scope of this article.

Effectiveness
Evidence on the effectiveness of community-based treatment comes mainly from observational studies, with few relevant randomized trials. Collins and colleagues reviewed the outcomes of 21 emergency programs that treated SAM using RUTF. Of a total of 23,511 children treated, 4.1% died[9]. However, as that review did not compare treatment outcomes with outcomes of alternative or no treatment, treatment effectiveness could not be evaluated directly. In 2008, Ahmed and colleagues systematically reviewed evidence of the effectiveness of different methods for treating acute severe malnutrition in children[8,10]. They found nine studies that were either randomized trials or high-quality comparative observational studies and that included mortality as an outcome. Their meta-analysis of these studies estimated that treating malnutrition according to WHO guidelines reduced mortality by 48%. The review also identified three randomized trials of community-based treatment during rehabilitation, after stabilization in hospital, compared with hospital-based rehabilitation. The trials compared dietary treatment using RUTF with dietary treatment using F100 or maize and soy flour. All three trials showed greater weight gain with RUTF, although for the largest trial the effect was not statistically significant.

Ashworth reviewed 33 studies of nonhospital rehabilitation in Africa, Asia and South America[7]. Treatment was based in primary-care clinics in seven studies, in day-care nutrition centers in six studies, in residential nutrition facilities in four, and at home in 16. Rehabilitation followed hospital-based treatment in all 16 of the studies of home-based treatment. Of these, ten
were randomized trials and seven met the review's criteria for effectiveness, that is, with mortality rates less than 5% and with average weight gain of at least 5 g/kg bodyweight per day. Five of the latter seven programs were located in Africa and provided RUTF, and two were in Bangladesh and did not provide food. All six day-care nutrition centers had poor outcomes, which was attributed to insufficient food and poor attendance. One of the four residential nutrition facilities and two of the seven primary-care clinic treatments were considered effective. There was wide variation in the care provided in these 33 programs, with the exception of programs providing home-based treatment with RUTF, which provided similar care. The scientific quality of these studies for evaluation of effectiveness was generally poor. The review suggested that the strongest evidence of effectiveness came from controlled trials of home-based treatment using RUTF in Africa, during rehabilitation and after stabilization. However, these programs reported widely varying rates of weight gain.

**Costs & outcomes**

The latter review identified seven studies that reported costs and outcomes of treating SAM, six of which evaluated home-based treatment [7]. The characteristics of these studies and the reported costs and outcomes are summarized in Table 1. Costs reported in the original article have been converted to year 2009 US$, based on the currency exchange rates applicable at the times of the studies and the USA inflation rate since then [102]. Average treatment costs ranged widely from US$25 to $453 per child, due partly to differences in the treatment provided and to differences in costing methods. The least costly treatments excluded food and were based in Asia. In studies comparing home-based treatment with in-patient or other facility-based treatment, costs of home-based treatment were invariably lower and outcomes were similar or better. For nonrandomized studies these differences were likely to be partly due to systematic differences between the types of patients treated.

The largest controlled trial, in Niger, compared three cohorts of patients who either received all their treatment in a therapeutic feeding center, or were initially treated at the therapeutic feeding center and completed treatment at home, or were exclusively treated at home [10]. However, the second and third groups necessarily included only patients who had not died in the therapeutic feeding center, and treatments were allocated by a physician based on each child's perceived risk, so treatment comparison is likely to be biased.

The evidence that home-based treatment was more cost effective than in-patient treatment was clearest for two randomized trials conducted in Bangladesh. In the first of these trials, after treatment of acute illnesses 225 children with SAM were randomized to home-based nutritional rehabilitation with follow-up at home, follow-up at an outpatient clinic, or hospital-based nutritional rehabilitation (Table 1) [11]. They were followed up until their weight for length exceeded 80% of the standard. The mean rates of weight gain were 9.9, 7.5 and 11.9 g/kg per day, respectively, and the mean days to achieve edema-free weight for length of greater than 80% were 20, 37 and 17 days. For both outcomes the differences between home-based and hospital-based rehabilitation were not statistically significant, but the mean cost of the latter was over three-times as high. This study was only reported as a conference abstract so a thorough critical appraisal was not possible.

The second Bangladesh study was the only economic evaluation of CBTSAM conducted alongside a randomized trial and published in peer-reviewed journals (Table 1) [12,13]. The trial compared in-patient management, day care (spending 9 h/day in a nutritional facility) and domiciliary (ambulatory home-based) care. Patients assigned to domiciliary care received day care for the first week before being discharged, when they were given iron and vitamins but no food supplements. In all three groups, treatment continued until patients reached 80% of median expected weight for height. The trial excluded patients who were critically ill or had tuberculosis or died, were aged less than 12 or more than 60 months, or lived more than 10 km away. Health service and household costs were estimated for each individual, showing that staff, facilities and tests cost much more than medicines and food for all three groups. Household costs were greater for domiciliary care than for day or in-patient care, and household costs were much lower than health service costs in all groups. Compared with health service costs of in-patient care, average costs of day care and domiciliary care were 38 and 19% as high, respectively. The average health service cost of domiciliary care was US$29.40 per child, of which staff salaries accounted for 35%, utilities and depreciation 16%, diagnostic tests 34%, medicines and supplies 6%, children's food 4% and parents' food 5%. The average parental cost of domiciliary care was US$9.40, of which transport accounted for 19%, lost earnings 17% and food 64% [12].

A limitation of the study was that, of 573 children randomized, 24% were excluded from analyses because they had tuberculosis or blood transfusions, died, or received care different from their allocation. Exclusions due to severe illness or nonprotocol care differed between groups, although mortality rates were similar in all three groups. Costs were only compared for patients who achieved the predefined outcome, that is, reaching at least 80% of expected weight for height. This study can therefore be viewed as a cost or cost-minimization analysis, given equal outcomes, rather than a cost-effectiveness analysis comparing outcomes and costs simultaneously. It differs from the evaluations of the community-based treatments/CMAM discussed below, because all patients received treatment in facilities for at least a week, and patients in the domiciliary-care group did not receive food after discharge.

A detailed patient-level comparison of costs and outcomes of inpatient treatment of SAM with community-based treatment (including access to a stabilization center) of SAM was carried out in Ethiopia in 2007 [Tekeste A. Unpublished Data]. A total of 328 patients who had received either type of treatment were randomly sampled, their medical records were reviewed, and the caregivers of 306 of them were interviewed. As the severity of SAM probably differed between patients treated in the community or in health facilities, comparisons of costs and outcomes could be biased. At admission, patients who received community-based treatment, compared with those treated in in-patient facilities,
Table 1. Studies reporting costs and outcomes of community-based treatment of malnutrition.

<table>
<thead>
<tr>
<th>Author†</th>
<th>Country</th>
<th>Delivery</th>
<th>Children (n)</th>
<th>Treatment/food</th>
<th>Duration</th>
<th>Outcomes</th>
<th>Cost per child (year reported)</th>
<th>Cost per child (2009 US$)</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gabouland et al.</td>
<td>Niger</td>
<td>a) In-patient only b) Home with RUTF c) Hospital then home</td>
<td>2209</td>
<td>a) Hospital care b) RUTF c) Hospital care then RUTF</td>
<td>6–59 days</td>
<td>Mortality during rehabilitation: a) 18.9%; b) 1.7%; c) 0%</td>
<td>€91–105 (2004) Not reported by subgroup</td>
<td>126–145</td>
<td>Cited in [7] [20]</td>
</tr>
<tr>
<td>Khanum et al.†</td>
<td>Bangladesh</td>
<td>a) In-patient b) Day care c) Early discharge</td>
<td>437</td>
<td>Food until ≥80% weight for height and no edema</td>
<td>a) 18 days† b) 29 days† c) 35 days†</td>
<td>Mortality at 12 months: a) 6.9%; b) 6.5%; c) 5.0%</td>
<td>a) US$156 (1991) b) US$59 c) US$29</td>
<td>a) 246 b) 93 c) 46</td>
<td>[13]</td>
</tr>
<tr>
<td>Ahmed et al.‡</td>
<td>Bangladesh</td>
<td>a) In-patient, b) Home and home visits c) Home and clinic</td>
<td>225</td>
<td>Food until ≥80% weight for height and no edema</td>
<td>a) 17 days† b) 20 days† c) 37 days†</td>
<td>Mortality during rehabilitation: a) 1.3%; b) 0%; c) 0%</td>
<td>a) US$76 (2002) b) US$21 c) US$22</td>
<td>a) 91 b) 25 c) 26</td>
<td>[11]</td>
</tr>
<tr>
<td>Verkley et al.</td>
<td>Kenya</td>
<td>Home with home visits</td>
<td>32</td>
<td>Maize, millet &amp; oil</td>
<td>6 months</td>
<td>0% mortality during rehabilitation: 3.1% later</td>
<td>Ksh 496 (1982)</td>
<td>104</td>
<td>[10,21]</td>
</tr>
<tr>
<td>Gueri et al.</td>
<td>Trinidad</td>
<td>Home</td>
<td>86</td>
<td>a) Food and eight or more home visits/month b) Less food and monthly home visit</td>
<td>16 weeks</td>
<td>Mortality during rehabilitation: a) 0%; b) 0%</td>
<td>a) US$227 (1985) b) US$55</td>
<td>a) 453 b) 110</td>
<td>[22]</td>
</tr>
<tr>
<td>Roy et al.</td>
<td>India</td>
<td>Residential center</td>
<td>112</td>
<td>Vegetarian food</td>
<td>5 weeks§</td>
<td>5.4% mortality at 3 months</td>
<td>Rs 3.3/day (1978)</td>
<td>46</td>
<td>[23]</td>
</tr>
<tr>
<td>Fronczak et al.</td>
<td>Bangladesh</td>
<td>Day-care center</td>
<td>161</td>
<td>High-protein and high-energy food</td>
<td>5 weeks§</td>
<td>Mean weight-for-height 93% of expected at 12 months</td>
<td>US$140 (1993)</td>
<td>208</td>
<td>Cited in [7]</td>
</tr>
</tbody>
</table>

† All studies reviewed in [7].
‡ Randomized controlled trial.
§ Mean.
RUTF: Ready-to-use therapeutic food.
Cost–effectiveness of community-based treatment of severe acute malnutrition in children

were more likely to have both marasmus and kwashiorkor (13 vs 4%), but were less likely to have infections (17 vs 35%). The cure rate was higher for community-based treatment than for facility-based treatment (93 vs 89%). Average health service and caregiver costs were US$129 and $6 per patient, respectively, for community-based treatment and US$262 and $21 for facility-based treatment. No in-patients died and 1.2% of children getting community-based treatment died.

Another study reported on costs and outcomes of two programs treating SAM in Malawi during 2007 [Mwase M, Unpublished Data]. One program provided community-based treatment to 2750 patients in one province, and the other program treated 656 patients in nutritional facilities in another province. For community-based treatment 2% died, 92% were cured and 6% were not cured. For facility-based treatment 10% died, 80% were cured and 10% were not cured. The average cost per case treated in 2007 was US$201 for community-based treatment and US$344 for facility-based treatment. A cost–effectiveness decision analysis model was based on these observations, but it was methodologically flawed because it modeled life expectancy after recovery using a mortality rate, which was assumed to be the same throughout each person’s lifespan. This assumption resulted in implausibly low life expectancies and invalidated the cost–effectiveness estimates.

An overview of the costs of three programs providing CBTSAM in southern Sudan, Malawi and Ethiopia estimated that the costs per case were US$281, $283 and $331, respectively [14,15]. Although these estimates excluded costs of hospitalization for the minority with severe complications, they were relatively high because they included the initial costs of setting up community programs, with substantial contributions by international nongovernmental organizations. The authors showed how average costs should decrease with increasing scale, as a large proportion of costs in the short term were the high cost of setting up the program, which would be spread across larger numbers of beneficiaries.

Cost–effectiveness decision analysis models

The studies discussed previously provide original evidence regarding the costs, outcomes and effectiveness of CBTSAM in a variety of settings. In general they show that CBTSAM can result in similar or better outcomes than facility-based treatment, at lower cost. However, the comparative studies that were not randomized trials could have been biased by systematic differences between the types of patients treated as in-patients or as out-patients. None of these studies reviewed so far was strictly a cost–effectiveness analysis, simultaneously considering the comparative effectiveness and costs of two or more alternative ways of managing SAM. For resource allocation purposes it would be desirable to compare provision of CBTSAM with no such provision, as well as to compare different methods of provision. Not providing treatment once SAM has been diagnosed is not a realistic or ethical option, but considering this option hypothetically permits estimation of the absolute cost–effectiveness of providing treatment, and comparison of the cost–effectiveness of CBTSAM with that of any other health intervention [6]. Given the limitations of existing evidence, it is necessary to integrate and apply this evidence using cost–effectiveness models.

The only cost–effectiveness analysis based on a decision tree model and published in a peer-reviewed journal was carried out by the author of this article [16]. It compared the cost and outcomes of an existing program in Lusaka, Zambia with the outcomes that would be expected with no treatment at all. The program had treated 2523 SAM patients in municipal primary healthcare centers over 2 years. The cost of no treatment was assumed to be zero. The effect of CBTSAM was defined as the difference in mortality rates within 1 year, between the program and no treatment. Cases that survived 1 year were ascribed 33.3 expected disability-adjusted life years (DALYs), to make the study comparable with the most comprehensive recent review of child survival strategies [8] and with other cost–effectiveness analyses.

The model’s decision tree is shown in Figure 1. For the treatment option, the expected death rate was a combination of the observed death rate during treatment, and assumed death rates among those referred to hospital or who defaulted. The hospital death rate was based on data from the local referral hospital. The death rate among defaults was unknown, and defaulters could include both 

![Figure 1. Decision tree for Zambia study.](image-url)
children who recovered as well as children who died. However, their prognostic characteristics at entry were the same as those of all other children, so mortality among defaulters was assumed to be the same as among all other children. As treatment lasted 5 weeks on average, for those who recovered it was necessary to add the probability of dying within 1 year, based on Zambia’s under 5 mortality ratio. For the ‘do nothing’ option, the mortality rate within 1 year was based on published cohort studies conducted in sub-Saharan Africa during the 1980s, when minimal care was available. Since then, however, approximately 15% of under-5s in Zambia had become infected with HIV, so the increased mortality rate due to HIV was included in the model. The study then estimated the cost of community-based treatment per child, including RUTF provision, primary healthcare, hospitalization, community mobilization and international agency support. From these data, the numbers of lives saved, the expected numbers of DALYs gained, and the average cost of each of these effects were estimated. This showed that the average cost of treatment was $201 per child, the average cost per life saved was US$1760 and the average cost per DALY gained was US$53 (i.e., US$1760/33.3 DALYs per life saved). Two types of sensitivity analysis quantified the robustness of the results, given the uncertainty about the assumed values of the model’s parameters. One- and two-way sensitivity analyses entailed repeating calculations to explore how the cost per life saved or per DALY gained changed when the values of each parameter were changed. This showed that the cost–effectiveness estimates were most sensitive to assumptions about death rates without treatment, duration of treatment and price of RUTF.

A probabilistic sensitivity analysis was carried out to quantify the combined uncertainty about all of the parameters. This entailed randomly sampling values of each parameter, based on probability distributions of each parameter that expressed uncertainty about its true value, then estimating the costs, effects and cost–effectiveness of different interventions, and repeating this process thousands of times. The resultant variation in costs, effects and cost–effectiveness estimates was then expressed as confidence intervals. The estimated 95% confidence intervals were $592–10,142 per life saved and $18–306 per DALY gained, showing substantial uncertainty, especially about the upper limits of these cost–effectiveness ratios. This variation was also expressed as cost–effectiveness uncertainty curves (Figure 2), as follows. Each sample of parameter values results in an estimate of costs and effects, and an intervention is defined as cost effective if its extra cost is less than its effect multiplied by a range of monetary values that society might be willing to pay for such an effect. In this study the cost–effectiveness uncertainty curves showed that treatment was at least 80% likely to be cost effective if society was willing to pay at least $3000 per life saved (Figure 2), or at least $88 per DALY gained. In other words, in 80% of the samples the cost per life saved was less than $3000 and the cost per DALY gained was less than $88.

**Discussion**

The studies reviewed in this article evaluated a wide range of different methods of providing CBTSAM and included heterogeneous mixes of patients. This variation in methods of delivery and case mix, as well as variation in costing methods and study designs, partly accounts for the wide range of cost estimates. However, since 2007 when a more standard method of delivery was adopted by WHO and others [1], the types of healthcare and RUTF being costed have also been relatively standardized. This has resulted in less variation in cost estimates, especially in low-income countries in Africa where costs ranged from $129 to $331 per child treated [Mwase M, Unpublished Data; Tekeste A, Unpublished Data] [14,16].

A key determinant of the cost of CBTSAM is the cost of RUTF. The Zambia study costed RUTF according to the price of the imported product, which was $6.10/kg in 2009. However, local production of RUTF using local ingredients can substantially reduce costs. Manary reported in 2005 that RUTF produced in Malawi using local ingredients cost just $2.60/kg, of which ingredients cost $1.40/kg ($0.63 for milk, $0.17 for sugar, $0.18 for peanut butter and $0.26 for vitamins and minerals), packaging cost $0.50 and labor, rental and utilities cost $0.70 [17]. More recently, Valid Nutrition estimated that its production of RUTF in Malawi cost $4.65/kg [Mkumbula P, Pers. Comm.]. Milk powder and peanut butter made up 74% of the cost of ingredients. Average costs should decrease after Valid Nutrition’s Malawi plant is accredited by UNICEF, as it was currently producing at 50% of capacity. Costs of RUTF imported from outside Africa ranged from $4.5/kg to $6/kg.

![Figure 2](image-url)
Methodological reasons for variation in cost estimates include how staff time was costed and whether household or parental costs were included. No study measured the precise amount of staff time used to treat each child, with most studies making assumptions regarding the average costs of staff time, in-patient days or ambulatory consultations. As reported earlier, only two studies estimated household costs in detail, using questionnaires [Mwase M. Unpublished Data] [12]. Both studies showed that while household costs were less than health service costs, they were still substantial considering that such households would usually be poor.

WHO categorizes interventions as cost effective if they cost less per DALY gained than a country’s gross domestic income per capita [18]. The Zambian cost–effectiveness analysis, with CBTSAM costs approximately $50 per DALY gained, thus compares favorably with Zambia’s gross national income per person per year (purchasing power parity-adjusted), which in 2008 was $1230. The equivalent figure for all sub-Saharan African countries was $1991 and that of South Asia was $2734 [19]. These cost–effectiveness estimates also compare favorably with other priority health interventions in low-income countries, such as measles vaccination, oral rehydration therapy for diarrhea, diagnosis and treatment of pneumonia, and provision of micronutrients, which have been estimated to cost between $20 and $200 per DALY gained [6]. The existing evidence base would be strengthened by rigorous economic evaluations from a range of settings that compare both costs and outcomes of alternative methods of implementing CBTSAM while avoiding or accounting for differences in case mix.

Expert commentary
Ambulatory CBTSAM is increasingly being adopted by development aid agencies and governments of low-income countries. Although there is limited experimental evidence of its effectiveness and cost–effectiveness, there is substantial observational evidence suggesting that it can achieve good outcomes at lower cost and with better access than hospital-based treatment. Decision analytic models have recently been used to synthesize observational evidence and to quantify cost–effectiveness estimates. Currently, the most popular service delivery model, at least in African programs and in policy documents, is diagnosis and treatment through primary healthcare services, use of RUTF, and treatment in hospitals or stabilization centers only for the minority with severe SAM and its medical complications.

Five-year view
Over the next 5 years the incidence and severity of SAM in low-income countries is unlikely to decrease. Current trends suggest that CBTSAM will increasingly be implemented through primary healthcare, alongside public health interventions to prevent and treat chronic malnutrition. Funding of CBTSAM programs should include funding for rigorous evaluation. There is a growing interest in evaluation using controlled trials and decision analytic models, so the evidence base will increase. Future evaluations will probably shift from comparisons between hospital-based and community-based treatment to comparisons between different ways of delivering CBTSAM. Cluster randomized trials will be increasingly employed to evaluate complex CBTSAM interventions that include organizational and educational initiatives delivered to entire villages or primary-care centers. As RUTF costs are a major component of total costs, development and evaluation of cheaper formulations using indigenous food sources will become increasingly important. Costs per child could decrease with the increasing scale of programs and less dependence on costly expertise from high-income countries. However, as CBTSAM could potentially overload or weaken comprehensive primary healthcare delivery, it needs to be carefully integrated with other aspects of primary care. Expansion of access to CBTSAM should be accompanied by broader efforts to strengthen primary healthcare and food security in low-income countries.

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The author received payment and support from Valid International for carrying out one of the studies reviewed [16], is collaborating with Valid International and Valid Nutrition on a RUTF trial, and was employed by the University of East Anglia while writing this article. The author has no other relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript apart from those disclosed.

No writing assistance was utilized in the production of this manuscript.

Key issues
- Severe acute malnutrition in children aged under 5 years in low-income countries is common and often fatal.
- Ambulatory diagnosis and treatment in community settings based on ready to use therapeutic food and primary healthcare can obtain good outcomes at affordable cost.
- Experimental evidence of cost–effectiveness is scarce but there is growing evidence that community-based treatment of severe acute malnutrition is among the most cost-effective health interventions in low-income countries.

References
Papers of special note have been highlighted as:
- of interest
Review


• The only published study of cost–effectiveness conducted alongside a randomized controlled trial, although it does not evaluate completely community-based treatment of severe acute malnutrition.


• Only published cost–effectiveness analysis of community-based treatment of severe acute malnutrition based on primary care and using primary data.


• Only published cost–effectiveness conducted alongside a randomized controlled trial, although it does not evaluate completely community-based treatment of severe acute malnutrition.


Websites


• Major review of evidence, especially about effectiveness.