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# Community Case Management of Severe Acute Malnutrition in Southern Bangladesh

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PEPSICO FOUNDATION

gain Global Alliance for Improved Nutrition

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## Study team and acknowledgements

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# Contents

## LIST OF ACRONYMS

| | |
|---|---|
| ARIs | Acute Respiratory Infections |
| CCM | Community Case Management |
| CHW | Community Health Worker |
| CMAM | Community-based Management of Acute Malnutrition |
| CSAS | Centric Systematic Area Sampling |
| DALY | Disability-Adjusted Life Year |
| FGD | Focus Group Discussion |
| FIC | Feinstein International Center, Tufts University |
| GDP | Gross Domestic Product |
| GMP | Growth Monitoring Program |
| GoB | Government of Bangladesh |
| IGDs | Informal Group Discussions |
| IMCI | Integrated Management of Childhood Illness |
| IYCF | Infant and Young Child Feeding |
| IPHN | Institute of Public Health Nutrition |
| MUAC | Mid-Upper Arm Circumference |
| ORS | Oral Rehydration Solution |
| PSU | Primary Sampling Units |
| RUTF | Ready-to-Use Therapeutic Food |
| SAM | Severe Acute Malnutrition |
| SC US | Save the Children USA |
| SQUEAC | Semi-Quantitative Evaluation of Access and Coverage |
| UHC | Upazila Health Complex |

## SUMMARY

Bangladesh has the fourth-highest number of children (*circa* 600,000 at any one time) suffering from severe acute malnutrition (SAM) in the world. Currently, ongoing national programs (such as the National Nutrition Program) do not include an effective mechanism of identifying or treating young children who suffer from SAM. ***This was a prospective cohort study that aimed to examine the effectiveness and feasibility of adding the diagnosis and treatment of SAM to the community case management (CCM) package delivered by community health workers outside health facilities in Barisal, Bangladesh.***

Results show that when SAM is diagnosed and treated by community health workers (CHWs) a very high proportion of malnourished children can access care and they are very likely to recover. The main outcome measures including the high recovery rate (92%) and low mortality and default rates (0.1% and 7.5% respectively) are all considerably better than the Sphere international standards for therapeutic feeding programs and compare favorably with other community-based management of acute malnutrition (CMAM) programs across the world, as well as with previous work that has examined the outpatient rehabilitation of children suffering from SAM in Bangladesh. The level of coverage seen in this program was 89% (CI 78.0%–95.9%) by April 2010; this is one of the highest rates of coverage ever recorded for similar programs. In contrast, monitoring data in a comparison Upazila (an administrative subdivision of a district), where the standard of care (facility-based treatment) was the only mechanism for treating SAM, showed that most children referred never made it to the facility or, if they did, they went home before completing treatment.

There are a number of reasons that explain these positive findings. First, results show that CHWs were able to identify and treat SAM very early in the course of the disease. This meant that children presented with fewer complications, were easier to treat and there was rarely a need to refer a child for inpatient treatment. The program design supported this early identification of cases through decentralized and multiple pathways to treatment including the use of mid-upper arm circumference (MUAC) bands by CHWs at monthly growth monitoring sessions and during home visits to sick children and the use of a "watch-list" of sick children by CHWs in their villages. In addition, study findings show that there was a good interface between the community and the program. Mothers and community-level health practitioners such as village doctors and other community-based stakeholders were aware of SAM, trusted CHWs to provide effective treatment, and referred their own children and others in their villages when they were sick or losing weight. Second, study findings demonstrate a very high quality of care delivered by CHWs. When assessed against a treatment algorithm they achieved, on average, a rate of 100% error-free case identification and management.

Cost effectiveness was also analyzed as part of this study. The CCM of SAM in Bangladesh cost $165 per child treated and $26 per DALY (disability-adjusted life year) averted. This is a similar cost-effectiveness ratio to other priority child health interventions such as immunization and treatment of infectious tuberculosis. It is also at a level considered "highly cost-effective" according to WHO's definition that defines an intervention as cost effective if it averts one DALY for less than the per capita GDP of a country.

To our knowledge, the use of CHWs for this type of program has been documented by only one other program in Malawi and has never been documented in Asia. This study has demonstrated that such a model of care in Bangladesh is feasible and could be an effective and cost-effective strategy to ensure timely and high quality treatment for a condition that is typically associated with high levels of mortality. This is an important finding in a country that has the fourth-highest number of children suffering from SAM in the world yet to date has had no effective mechanism of identifying and treating them.

Severe acute malnutrition (SAM) is the severest form of acute malnutrition (wasting) and is associated with very high rates of morbidity and mortality. Bangladesh has the fourth-highest number of children (*circa* 600,000 at any one time) suffering from SAM in the world (National Institute of Population Research and Training, 2007). Currently, ongoing national programs (such as the National Nutrition Program) do not include an effective mechanism of identifying or treating young children who suffer from SAM. At present the "standard of care" for SAM detailed in National guidelines is focused solely on the inpatient management of the condition, which is commonly linked to problems including low coverage and insufficient capacity for good quality treatment (Collins et al., 2006a). It is likely therefore that a large proportion of cases of SAM in Bangladesh go undiagnosed and untreated. Such problems with the identification and treatment of SAM are seen across large parts of the developing world.

Recently, community-based management of acute malnutrition (CMAM), that uses mid-upper-arm circumference (MUAC) and oedema to identify children suffering from SAM and specialized ready-to-use therapeutic foods (RUTF) to treat them as outpatients has been endorsed by the WHO, UNICEF, and UNHCR (WHO et al., 2007). This model of care has been widely adopted by governments and international agencies across Africa, with identification and treatment delivered from primary health care facilities by primary health care practitioners (Linneman et al., 2007; Collins et al., 2006b). However, recent work has shown that even where the quality of facility-based services is improved, children from the poorest families are significantly less likely to be brought to health facilities, and may receive lower quality care once they arrive (el Arifeen et al., 2004; Victora et al., 2003). A household and community component of the integrated management of childhood illness (IMCI) is now being rolled out in Bangladesh for conditions such as diarrhoea and acute respiratory infections (ARIs), with the identification and treatment of these conditions being delivered by community health workers (CHWs) in villages, outside health facilities (Winch et al., 2005). This model of care aims to treat the large number of sick children who never reach any kind of health facility and has been shown to increase the number of children who receive treatment as well as contribute to reductions in under-five mortality (Dawson et al., 2008). The addition of the identification and treatment of SAM to the activities of a cadre of CHWs could be an effective mechanism of addressing this common condition.

**Study goals and objectives**

This was a prospective cohort study that aimed to examine the effectiveness and feasibility of adding the diagnosis and treatment of SAM to the community case management (CCM) package delivered by CHWs outside health facilities in Barisal, Bangladesh.

Research goals included:

1. To compare the effectiveness (i.e. the rate of recovery) of treatment of SAM provided by CHWs with that provided by the standard of care for SAM in Bangladesh.
2. To compare the cost effectiveness of CCM of SAM provided by CHWs with that of the standard of care for SAM in Bangladesh.
3. To estimate the coverage of CCM of SAM provided by CHWs.
4. To examine the quality of care (error-free case management) delivered by CHWs for cases of SAM.

**Ethical approval**

Ethical approval was obtained for this study from the Institutional Review Board of Tufts University, USA and from the Bangladesh Medical Research Council (BMRC). Approval was also been obtained from the Director General for Health Services (DGHS) in Dhaka, Bangladesh.

## Study setting

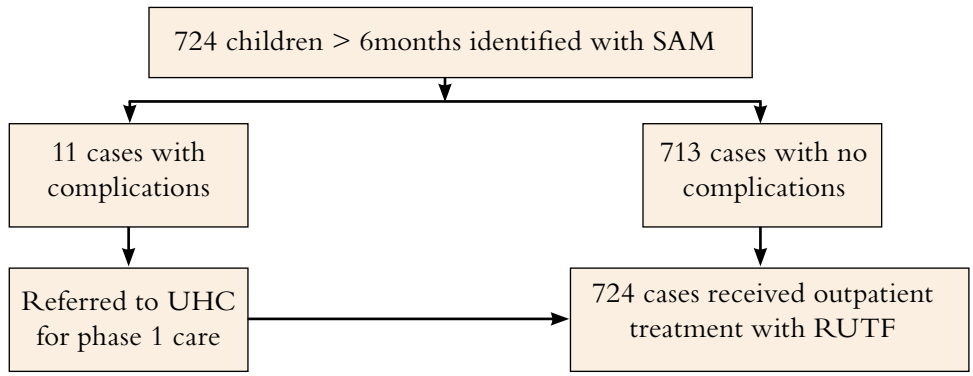
**Barisal Division, in southern Bangladesh**, with about eight million people and six Districts, is among the poorest in the country, with alarmingly high rates of acute malnutrition[1] among children under five. Save the Children USA (SC US) have been working in the Division since June 2004 and between 2004 and 2010 have implemented a six-year Development Assistance Program named "Jibon o Jibika" ("Life and Livelihoods" in Bangla) in three Districts. As part of this program SC US employed[2] a cadre of community health workers (CHWs), all local women educated to grade eight, to deliver preventive and curative care to children in the target Districts. Interventions included community case management (CCM) of basic childhood illnesses such as diarrhoea and acute respiratory infection (ARI), monthly growth monitoring and promotion (GMP) sessions, and household-level education and counseling around infant and young child feeding, health, and sanitation.

SC US and FIC Tufts University were given permission by the Government of Bangladesh (GoB) and the Institute of Public Health Nutrition (IPHN) to pilot the community case management of SAM (CCM of SAM) in Burhanuddin Upazila[3] in one of the JoJ target Districts (Bhola District). **Annex 1** shows a map of the study area. Rollout to additional Upazilas was planned for a phase 2 if results supported this.

In a neighboring Upazila (Lalmohan) in the same District, the Upazila Health Complex (UHC)[4] was supported to provide inpatient treatment for children with SAM according to National Guidelines and to compile monitoring data on referrals and outcomes of treatment. This Upazila received exactly the same support by the "Jibon o Jibika" program apart from support for the CCM of SAM.

In both Burhanuddin (the intervention Upazila) and Lalmohan (the comparison Upazila) a mid-upper arm circumference (MUAC) measure

**Figure 1: Intervention participants, Burhanuddin Upazila**




*Note: Complications were defined as any one or more of the following: poor appetite; not able to drink or breastfeed; vomits everything; convulsions; lethargic or unconscious; severe pneumonia; diarrhoea with severe dehydration.*

[1] The most recent DHS (Demographic and Health Survey) (2007) recorded a global acute malnutrition rate of 18% and a severe acute malnutrition rate of 3.4% for this Division. In this survey acute malnutrition was defined by weight for height < -2 z scores and/or oedema.

[2] CHWs were all paid a small stipend of 800 taka per month ($11.8 USD)

[3] Barisal Division contains six Districts. Each District is divided into between four and ten Upazilas. Each Upazila contains a population of *circa* 205,000 and 25,000 children under five years.

[4] The UHC is the hospital referral unit located in the middle of each Upazila. In Lalmohan the UHC served a population of 252,000, contained 31 beds in the pediatric ward and was staffed by five doctors, one child health consultant, four medical assistants, and four nurses.

and an oedema check for all children < three years old was introduced into all routine CHW activities. These included the monthly GMP sessions and household visits for counseling and treatment of sick children. CHWs also discussed SAM and its consequences with different groups of community members in ongoing counseling and mobilization activities.

**Intervention participants: admission and discharge**

This study ran between June 2009 and June 2010. All children more than six months in age that were identified as suffering from severe acute malnutrition (SAM) by one of the 261 CHWs working under the SC US program in Burhanuddin Upazila were eligible for the intervention. SAM was defined as either the presence of bilateral pitting oedema and/or a mid-upper arm circumference of < 110 mm according to WHO (2007) criteria. Any child identified with SAM with appetite and no medical complication was treated directly by the CHW with RUTF. Any child with SAM with medical complications such as the absence of appetite was referred to the Upazila Health Complex to receive inpatient stabilization care.

In the comparison Upazila all children identified with SAM by CHWs were referred to the UHC.

Informed consent was obtained from all participating caretakers before recruitment. This involved the CHW discussing a verbal consent form with groups of mothers before each growth monitoring session and with individual caretakers at household visits. This form explained the objective of the study and the procedures for any child identified with SAM.

Children were discharged from treatment as recovered once MUAC was assessed as more than 110 mm and they had gained at least 15% of their admission weight for two consecutive weeks (WHO et al., 2007). Children admitted with nutritional oedema were discharged once oedema was absent for two consecutive weeks and their MUAC was assessed as more than 110 mm.

**Training and supplies**

All CHWs in the intervention and the comparison Upazilas participated in a two-day training which covered the causes and consequences of SAM, the standardized measurement of MUAC,[5] and how to check for nutritional oedema. CHWs in the intervention Upazila were also trained on the classification of SAM and the use of nutritional and medical protocols for its treatment. Subsequently, CHWs in the intervention Upazila met with their supervisors every month to discuss problems, submit monthly reports, and receive a new stock of therapeutic food and medicines.

At the UHC in both the intervention and the comparison Upazilas, core medical staff participated in a two-day training that covered the causes and consequences of SAM, the standardized measurement of MUAC and how to check for nutritional oedema, and the nutritional and medical protocols for the inpatient treatment of SAM. In both Upazilas SC US supplied the equipment and all ingredients for therapeutic milk. In the comparison Upazila SC US also provided one additional care assistant whose sole job was to care for children with SAM and counsel caregivers on child feeding and caring practices.

**The classification of SAM**

In the intervention Upazila CHWs were trained to use a simple algorithm that classified children into two groups: SAM with complications and SAM without complications (see **Figure 2**). Any child with SAM with complications was referred to the UHC to receive one to four days of inpatient treatment with therapeutic milks and medication. Once complications were under control children were referred back to the CHW to complete treatment. Any child with SAM

[5] MUAC measurement was standardized, using the methods laid out by Habicht, for all CHWs against a "gold standard" trainer to improve accuracy and precision (Habicht, 1974).

without complications was seen weekly in their homes by a CHW and treated with RUTF.

**Intervention diet and medical treatment**

All dietary treatment for any child admitted to the UHC was administered according to the Bangladesh National Guidelines for inpatient management of SAM (IPHN, 2008). In the intervention Upazila, for children suffering from SAM with complications, this included an initial phase (phase 1) of treatment in the UHC. Locally- prepared Formula 75 containing 75 kcal/100 ml/day was given over 12 feeds per day. The child was discharged back to their CHW where treatment continued with RUTF at home when the following conditions were satisfied:

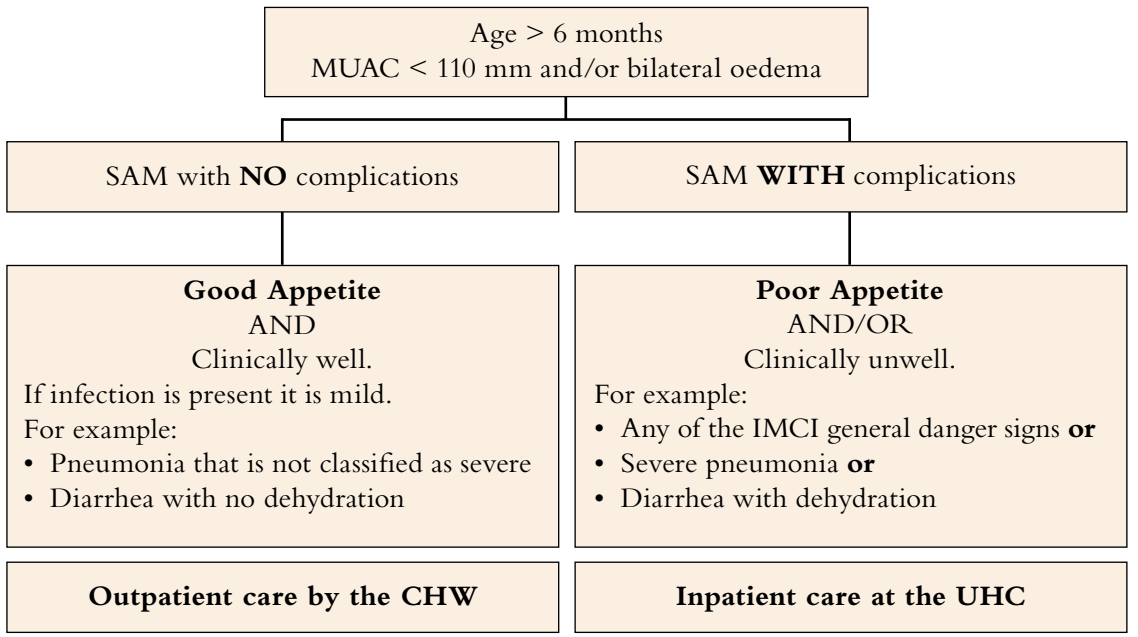
- good appetite
- oedema reducing
- infection under control

For all children treated by the CHW, RUTF was provided as a weekly ration in proportion to a child's weight. The CHW used a simple chart to calculate the correct ration size which provided 175-200 kcal $kg^{-1}/day^{-1}$ and 4-5g protein $kg^{-1}/day^{-1}$.

All medical treatment followed protocols as specified in the "National Guidelines for the Management of Severely Malnourished Children in Bangladesh." This includes a single oral dose of folic acid (5 mg) and the broad-spectrum antibiotic Cotrimoxazole oral (Trimethoprim 5 mg/kg and Sulphamethoxazole 25 mg/kg) given twice a day for five days. Albendazole and vitamin A were only given where there was no record of the child receiving these treatments during the twice yearly Vitamin A+ campaigns that are common in the target area. All medication was prescribed by the UHC staff during inpatient management and by the CHW during outpatient management.

For cases of SAM without complications in the intervention Upazila, the antibiotic was administered by the carer at home. The CHW instructed each carer on when and how to give the drug. For cases of SAM with mild pneumonia in either the intervention or the comparison Upazila, the trained CHW provided treatment with Cotrimoxazole following CCM of ARI and Diarrhoea guidelines (SC USA, 2008).

**Figure 2: Classification of SAM in the intervention Upazila**



## Data collection and analysis

### *Effectiveness data*

In the intervention Upazila the CHW used a "child monitoring card" to record demographic, socioeconomic, and anthropometric data for each child. Thereafter the child was reassessed weekly by the CHW, and anthropometric, dietary, and medical data was recorded on the same card.

Monitoring data was compiled from the GMP sessions in the comparison area on the numbers of children with SAM identified and referred to inpatient care and from the UHC on the numbers of children treated and the treatment outcomes of this group.

Children discharged from SAM treatment were categorized according to one of the following outcomes:

**In the intervention Upazila:**

| | |
|---|---|
| Recovered: | MUAC > 110 mm and 15% weight gain compared to admission weight for two consecutive weeks. For children admitted with oedema: absence of oedema and MUAC > 110 mm for two consecutive weeks |
| Died: | Died whilst registered with the program |
| Default: | Absent for two consecutive weeks |
| Non-responder: | Did not meet discharge criteria after ≥ four months of treatment |

**In the comparison Upazila:**

| | |
|---|---|
| Recovered: | MUAC > 110 mm and 15% weight gain compared to admission weight for two consecutive weeks. For children admitted with oedema: absence of oedema and MUAC > 110 mm for two consecutive weeks |
| Died: | Died whilst registered with the program |
| Default: | Any child who left the UHC before inpatient treatment was complete |
| Non responder: | Did not meet discharge criteria after ≥ six weeks of inpatient treatment |
| Non-treated: | Any child that attended the UHC or another health facility and received medical (outpatient) treatment only |
| Refused referral: | Any child whose caretaker refused to attend the UHC |

Data from the child monitoring cards were entered into SPSS® (SPSS Inc., 2009) and checked by the SC US Bangladesh country office. For data cleaning, manipulation, analysis, and graphics, the data were exported into STATA® (StataCorp, 2009). Data manipulation included defining new variables such as "length of stay" (the time period between the last day in the program and the admission day), "weight gain" (weight (g)/original weight (kg)/average length of stay (d), and "MUAC gain" (MUAC (mm)/average length of stay (d)).

Demographic and anthropometric data distributions approximated to a "normal" distribution and means were used to express population averages. Variables such as rate of weight gain were compared using the student t-test with Sphere International Standards (SPHERE project team, 2004). Logistic and multivariate linear regressions for all outcome variables were run to determine if demographic variables (age, sex, admission status, etc.) had an effect on outcomes and rates of weight gain.

***Coverage data***

A Semi-Quantitative Evaluation of Access and Coverage (SQUEAC) was conducted in the intervention Upazila in April 2010. This method is an enhanced version of the method described in more detail in the following documents: **http://www.brixtonhealth.com/SQUEAC.Article.pdf** and **http://fex.ennonline.net/33/low.aspx**

It was implemented in two stages:

**STAGE 1** aimed to identify areas of low and high coverage as well as reasons for coverage failure using routine program data, already available data, and anecdotal data. The following routine program data were collected and analyzed according to the SQUEAC framework:

- Admissions over time
- Standard program monitoring data:
  - Proportion of exits discharged as cured
  - Proportion of exits who died during treatment
  - Proportion of exits discharged as non-responders
  - Proportion of exits who defaulted during treatment
- Distribution of MUAC at admission

This was complemented by the collection of qualitative data that aimed to discover reasons for both non-attendance and defaulting. This consisted of a series of semi-structured interviews and informal group discussions with:

- Eight carers of children with SAM in three different unions.[6] The intention of these interviews was to investigate local terminologies and etiologies for SAM (to identify potential mismatches between program messages/case-finding activities and local terminologies and etiologies), awareness of SAM, pathways to treatment, CHW activity, and program coverage (using the standard SQUEAC "coverage questions" regarding knowledge of uncovered cases).
- Eight CHWs in three different unions. The purpose of these interviews was to investigate case-finding activities and how changes in CHW activities had impacted on SAM program activities.
- Short, structured interviews with health personnel (potential sources of referrals) and community leaders took place in two unions. Two groups of subjects were selected for interview:
  - Health personnel: Health assistants (two), village doctors (two), and traditional birth attendants (three)
  - Community leaders: Teachers (one), imams (three), and elected representatives (one)

  The purpose of these interviews was to investigate the interface between community-level health practitioners and the program and between the community and the program.
- Nine informal group discussions (IGDs) with community members took place in two unions. These discussions aimed to investigate knowledge of SAM and the SAM program in the general population. Attempts to locate nomad settlements (see below) in order to facilitate subsequent data collection were made during these discussions as well as during travel between the data collections sites. The findings of these IGDs prompted a second round of nine IGDs in two different unions. Groups were male only (seven groups), female only (five groups) or mixed sex (six groups).

**STAGE 2** used a Bayesian technique (Beta-Binomial Conjugate Analysis) to estimate program coverage with the prior probability density (the prior) created by combining the routine data and qualitative data collected during stage 1. A prior was constructed by accounting for the probable range of impacts on coverage associated with the "negative" findings in the routine and qualitative data. Small-area surveys were used to confirm or deny the hypothesized level of coverage.

The sample size for the likelihood (small-area surveys) was calculated, using simulation with the SQUEAC Coverage Estimate Calculator, to provide a coverage estimate with a 95% CI of better than about ±10% using the Beta (35, 4.4) prior. The minimum sample size required was found to be n = 8 current or recovering SAM cases. It was estimated, from routine program data and prior survey work, that between 12 and 14 EPI/GMP site catchment areas would need to be exhaustively sampled in

[6] Each Upazila is divided into several unions.

order to find eight current or recovering SAM cases. A Centric Systematic Area Sampling (CSAS) grid sampling method was used. Fourteen 3 km by 3 km quadrats were used to locate primary sampling units. Primary sampling units (PSUs) were the catchment areas of the EPI/GMP site located closest to the center of each quadrat (see **Figure 6**). Active and adaptive case-finding was used to locate SAM cases within the selected PSU.

### *Quality of care data*

"The quality of care for children with SAM delivered by CHWs was measured by 19 surveyors, who were also CHW supervisors. They were selected for their existing relationship with CHWs, and were expected to put CHWs at ease compared to an unfamiliar third party observing their work. They observed 55 CHWs treat SAM during household visits and used a previously piloted observation checklist, developed specifically for this study, for recording findings.

The quality of routine preventive tasks, including follow-up of children with any feeding problems and use of the SC US "Promise Sheet"[7] for counseling mothers on IYCF (Infant and Young Child Feeding) and other health and caring practices, was also measured by the surveyors in two groups of CHWs. One hundred forty-one CHWs that were implementing only CCM of childhood illness were observed, as well as 195 CHWs that were implementing CCM of childhood illness *and* CCM of SAM. Again, a previously-piloted observation checklist, developed specifically for this study, was used to record findings. Surveyors completed a total of 336 observation checklists.

In order to ensure that quality of care was measured in a reliable way among surveyors, standardization training was conducted before data collection started. During the training, each data collection tool was reviewed and simulations conducted with surveyors. After each simulation, surveyors shared their impressions and agreed on how best to standardize and define "good" versus "poor" practice for each step in the checklists. Training also included a discussion of the importance of "negative" outcomes in research to reassure surveyors that negative scores from CHWs would not reflect poorly on their own job performance.

Standardization was particularly critical for the measurement of preventive care at household visits. There is no internationally-accepted method to measure quality of CHWs' counseling and service delivery during a routine household visit for a non-sick child (i.e., one not requiring treatment for illness, for which there are more standardized treatment indicators). For this, many of the tasks on the household visit checklist focused on the qualitative aspects of the interaction between CHW and caretaker, including non-verbal communication, clear counseling, problem-solving, and negotiation skills.

### *Cost data and cost-effectiveness model*

Program cost data was collected in both the intervention and the comparison Upazila. All costs were converted from Bangladesh taka to US dollars using the exchange rate of 1 USD to 67.941 BDT.

This cost analysis was activity-based, with costs organized by activity into cost centers for analysis (Fiedler et al., 2008; Waters et al., 2001). Cost centers are comprehensive and mutually exclusive, providing a total cost of SAM treatment in intervention and comparison areas avoiding double-counting any resources. As this was not a cost analysis of the overarching SC US community health and nutrition program (of which the CCM of SAM activities are one component), only those activities related to the treatment of SAM were considered.

#### *Provider costs*

Provider costs were collected via semi-structured key informant interviews with program officials and administrative staff at SC US, clinical and accounting staff at the UHC, and review of key program, administrative, and financial documents. All relevant key informants were identified both at SC US and the UHC, with a total of 31 interviews conducted. Costs included:

[7] The "Promise Sheet" communication tool developed by SC US aided CHWs' communication with caretakers by tracking progress and roadblocks to adapting desired health and feeding practices. Each Promise Sheet recorded the history of that caretaker's interactions with the CHV, providing helpful visual aids for the process of negotiating feasible improvements in a caretaker's practices.

*Personnel costs:* Salary information for SC US program staff involved in the intervention and in the follow-up of children in the comparison Upazila was collected by key informant interview with administrative and accounting staff at SC US. Salary information for staff involved in the management of SAM in the comparison area was collected through interviews with administrative staff at the UHC. The average amount of time that each level of staff spent on the identification, management and follow-up of children with SAM was also collected by interview. Where possible, salary estimates were averaged to get one composite wage estimate for each different level of staff. Interview data was triangulated with estimates from supervisory staff where possible. Whilst all CHWs were paid an honorarium of 800 taka per month (equal to less than five taka per hour), unskilled labor (usually public works) was available to all women who participated in this program. Therefore, the average wage for this work (20 taka/ hour) was used as the shadow wage for CHWs.

*Program supplies:* Costs of all supplies and equipment including the RUTF for the intervention and the therapeutic milks in the UHCs were taken from program budgets where available and interviews with administrative/finance staff.

*Program delivery:* Costs incurred for transport (including motorbike rental fees, average monthly fuel, and maintenance costs), trainings, and rent and utilities were gathered by discussion with SC US and UHC staff, and a review of financial records, budgets, and training plans. Where total monthly or annual costs were given they were multiplied by a proportion that represented usage by this program.

***Participant costs***

Participant cost estimates were obtained during focus group discussions (FGDs) with caretakers of SAM children receiving treatment in the intervention and comparison Upazilas. Four and seven FGDs were conducted respectively in each area. For calculation of direct costs, such as cost of transport to treatment site for example, the median value from each group was used. To estimate the indirect cost in terms of time spent accessing SAM treatment, the shadow wage used for CHWs (discussed above) was multiplied by the median time allocated for various activities.

***Allocation to cost centers***

Cost centers were developed and finalized with support from relevant SC US staff. **Table 1** below describes the cost centers to which all the costs described above were allocated for analysis.

**Table 1: Activity-based cost centers**

| Description of cost centers |
|---|
| 1. **Monitoring:** Personnel costs incurred while monitoring and supervising CHWs during community case management of SAM. |
| 2. **Trainings:** Technical instruction in SAM management at community and facility level, both initial and refresher trainings. |
| 3. **Supervision:** Personnel and overhead costs for program supervision at all levels of the program. |
| 4. **GMP sessions:** Shadow costs for CHW wage and site rental for additional time at GMP session attributable to SAM activities. |
| 5. **Household visits:** CHW time spent visiting households of SAM children, and all printed materials and supplies used for SAM case management. |
| 6. **Curative care:** All curative care for SAM, including medicines and therapeutic foods (including its transportation and storage) for community management, and equipment, medicines, food, bed, and personnel costs at inpatient facility. |
| 7. **Household costs:** Direct costs to household and value of caretaker's time caring for SAM child or accessing SAM care from CHW, UHC, or elsewhere, including treatment-seeking, medicines, and additional food purchased for child. |

### *Cost-effectiveness ratio and DALY calculation*

Cost effectiveness was calculated using the program outcome data described in **Table 3 and 4** as both cost per child treated and cost per child recovered for both the intervention Upazila and the comparison Upazila.

Cost-effectiveness was also calculated in terms of cost per disability-adjusted life year (DALY) averted. DALYs are a standard measurement for disease outcomes combining the years of life lost due to premature mortality and the years lived with disability (Murray, 1994).

DALYs averted were calculated using the following key assumptions:

- Age at death: assumed death would occur within a mean of 6 months after admission (range = 21 days to 21 months; Gamma with shape = 6 used).
- Life expectancy: based on local life-tables separated by gender for age group 1-4 (World Health Organization, 2009)
- Age of onset: the mean age at admission observed which was 19.4 months (range = 6 months to 42 months; Gamma with shape = 19.4 used)
- Duration of disability: 6 months on average (range = 21 days to 21 months; Gamma with shape = 6 used)
- Discount rate: 0.03
- Age weight: 0.04
- Disability weight: Death = 1, wasting = 0.053 (WHO, 2004)
- Deaths and survivals in absence of treatment: A value appropriate for our mean admission MUAC (106.7 mm) was calculated using linear interpolation and published data with cohorts of patients similar to those in our program (Briend et al., 1987; Briend & Zimick, 1986; Vella et al., 1994). Taking into account a baseline mortality risk of 1/10,000/day, the expected mortality rate was estimated at 207 deaths per 1,000 cases per year. That is, 20.7% of the cohort of SAM cases would be expected to have died within 12 months of admission.

**Table 2: Demographic and nutritional characteristics on enrollment of children treated by CCM of SAM (n = 724)**

| Characteristics | (n=724) |
|---|---|
| **Demographic information** | |
| Age (Month ±sd) | 19.4±1.2 |
| Female (%) | 62.3% |
| Breastfed (%) | 79.9% |
| **Admission category** | |
| Only Oedema (%) | 0.8% |
| Only Wasting (%) | 98.2% |
| Both Wasting and Oedema (%) | 1.0% |
| **Admission Status** | |
| New Admission | 95.6% |
| Return after Default | 1.9% |
| Return after Relapse | 2.5% |
| **Complications** | |
| Pneumonia (%) | 3.3% |
| Diarrhoea (%) | 1.7% |
| Diarrhoea with Dehydration (%) | 0.1% |
| **Nutritional indicators** | |
| Weight (kg ±sd) | 6.4±0.04 |
| MUAC (mm ±sd) | 106.7±0.1 |
| **Household Socioeconomic Status** | |
| Natural Roof Jute/Bamboo/Mud (%) | 12.2% |
| Rudimentary Roof Tin (%) | 87.1% |
| Finished Roof Cement/Concrete (%) | 0.7% |

Definitions:
*Wasting:* MUAC < 110mm; *Pneumonia:* < two months: 60 breaths or more/minute, 2 months to 12 months old: 50 breaths or more/minute, 13 months to 5 yrs old: 40 breaths or more/minute; *Diarrhoea:* 3 or more loose stools per day; *Diarrhoea with Dehydration:* Diarrhoea in addition to some or all of the following signs: lethargic or unconscious, restless or irritable, sunken eyes, thirst, poor skin elasticity.

**Effectiveness**

**Table 3: Outcomes of children treated by CCM of SAM (n = 724)**

| | Treated (n = 724) | Sphere Standards |
|---|---|---|
| **Outcome** | | |
| Cure % (n) | 91.9% (665) | 75%★ |
| Defaulter % (n) | 7.5% (54) | 15%★ |
| Death % (n) | 0.1% (1) | 10%★ |
| Non-responder % (n) | 0.6% (4) | |
| **Treatment Response★★** | | |
| Weight gained (g/kg/day) | 6.7±0.1 | 8g/kg/day★ |
| MUAC gained (mm/day) | 0.4±0.01 | |
| Length of stay (days) | 37.4±0.6 | |

★ Difference statistically significant at $p < 0.0001$ level

★★ Treatment response is calculated only for those children who were discharged cured (recovered)

This intervention treated 724 severely malnourished children (**Table 2**). Almost all of the children were wasted characterized by a MUAC of < 110 mm. Only 13 (1.8%) had nutritional oedema. No child had either an adverse reaction or symptoms suggestive of allergy to the ready-to-use therapeutic food nor to the antimicrobial used (Cotrimoxazole oral). Six hundred and sixty-five children (91.9%) recovered, 54 (7.5 %) defaulted, four children (0.6%) had not responded to treatment after four months of treatment and one child (0.9 %) died (**Table 3**). For children who recovered the mean weight gained was 6.7 g/kg/day (SD = 0.1), mean MUAC gained was 0.4 mm/day (SD = 0.01) and the average length of stay was 37.4 days (SD = 0.6). The rate of recovery, default, and death and the average weight gain were all significantly better than the standard stipulated by Sphere for each of these outcomes.

The only admission characteristic that was significantly associated with increasing likelihood of recovery was absence of pneumonia. After controlling for age, sex, oedema, nutritional status at admission, breastfeeding status, and roof material (proxy for socioeconomic status), children who were admitted without pneumonia were 2.9 times (95% CI: 1.1, 8.6) more likely to recover.

**Table 4: Outcomes of children referred to inpatient care (n = 633)**

| Outcome | Referred (n = 633) % (n) |
|---|---|
| Cure | 1.4% (9) |
| Defaulter | 7.9% (50) |
| Non-responder | 0.3% (2) |
| Refused hospital referral | 52.9% (335) |
| Non-treated | 37.4% (237) |

In the comparison Upazila 633 children were identified with SAM. Whilst CHWs referred all children identified to the UHC, 335 carers (of children with SAM without medical complications) refused to take their children to the hospital (see **Table 5**). Two hundred and thirty-seven of the children identified with SAM without medical complications were seen at the UHC as outpatients only and were not admitted for inpatient treatment according to WHO protocol. All children who either refused referral or were given outpatient treatment for medical complications but not for SAM were monitored in their households by SC US CHWs who provided community case management (CCM) of childhood illness and other support.

Of the 62 children with SAM that were admitted to inpatient treatment, nine children (1.4% of the total sample) recovered, 50 (7.9%) defaulted, and two children (0.3%) had not responded to treatment after more than six weeks of inpatient care (see **Table 4**).

In the second phase of the CCM of SAM rollout all children identified with SAM in the comparison Upazila are now eligible for treatment by CHWs with RUTF.

**Coverage**

Coverage in Burhanuddin was assessed with a SQUEAC investigation during April 2010.

***Examining admissions***

**Figure 3** shows the number of admissions over time for the period June 2009–February 2010. The pattern of admissions shows a typically high number in the first few months of program operation as both prevalent and incident cases are found and admitted. This peak coincides with the period of highest prevalence of low weight for age (from historic GMP program data) and diarrhoea (from locally produced disease calendars). After September 2009 the pattern of admissions stabilizes at just over fifty cases

**Table 5: Reasons for mothers refusing to travel to the UHC for inpatient treatment of their child with SAM (n = 25 mothers)**

| Aspect | S1.# | Description |
|---|---|---|
| Social and cultural | 1 | No one to carry on and look after household activities |
| | 2 | Husband was not present at home |
| | 3 | Husband did not give permission to go to hospital |
| | 4 | Faith in traditional healer and treatment |
| Economic | 5 | No adequate money to meet the transport expenses |
| | 6 | No money for purchasing medicine |
| | 7 | Hospital was far away from household |
| Governance & Management | 8 | Hospital does not provide adequate treatment |
| | 9 | Dirtiness on the hospital |
| | 10 | No bed facilities |
| | 11 | Doctors and Nurses do not behave well |
| | 13 | Hospital does not provide hygienic food (Quality) |
| | 14 | Hospital does not provide adequate food (Quantity) |
| | 15 | Low quality medicine are provided |
| | 16 | Doctors and Nurses are not available in time |
| Others | 17 | Do not know the way to hospital |

recruited per calendar month. This coincides with the introduction of community-based case-management (CCM) of diarrhoea and ARI (also delivered by the SAM program CHWs) into the program area. Locally-produced disease calendars show an expected period of increased incidence of both diarrhoea and ARI in November and December that would normally lead to an increase in the incidence of SAM. This expected increase in admissions was not observed. Components of the SQUEAC investigation reported here found that this is most likely due to timely treatment of diarrhoea and ARI and nutritional counseling given to carers of such cases, which had the effect of reducing the incidence of SAM.

**Figure 4** shows the MUAC at admission for 718 admissions between June 2009 and June 2010. This is all admissions for the period excluding six cases admitted with bilateral pitting oedema and MUAC ≥ 110 mm. 73% of children (525/718) were admitted with a MUAC between 110–108 mm. This distribution of MUAC at admission is consistent with timely case-finding and recruitment by the program and/or timely recognition of SAM and timely treatment-seeking by carers. It is also consistent with a high temporal coverage (i.e., frequent screening) of case-finding activities. Program staff and CHWs reported that the bulk of admissions with MUAC < 100 mm admitted after the first three months of program operation were in children with SAM arriving from outside of the program area.

***Examining program outcome data***

The program outcome data reported in **Table 3** below are consistent with a well-performing therapeutic feeding program. High defaulting rates are indicative of coverage failure. The observed default rate for this intervention (7.5%) is well within international norms for therapeutic feeding programs. Low rates of mortality and non-response are also associated with good program coverage because this indicates a high-quality program that is implementing timely case-finding and recruitment. The mortality and non-response rates observed here are very low.

**Figure 3: Admissions for the period June 2009–February 2010**

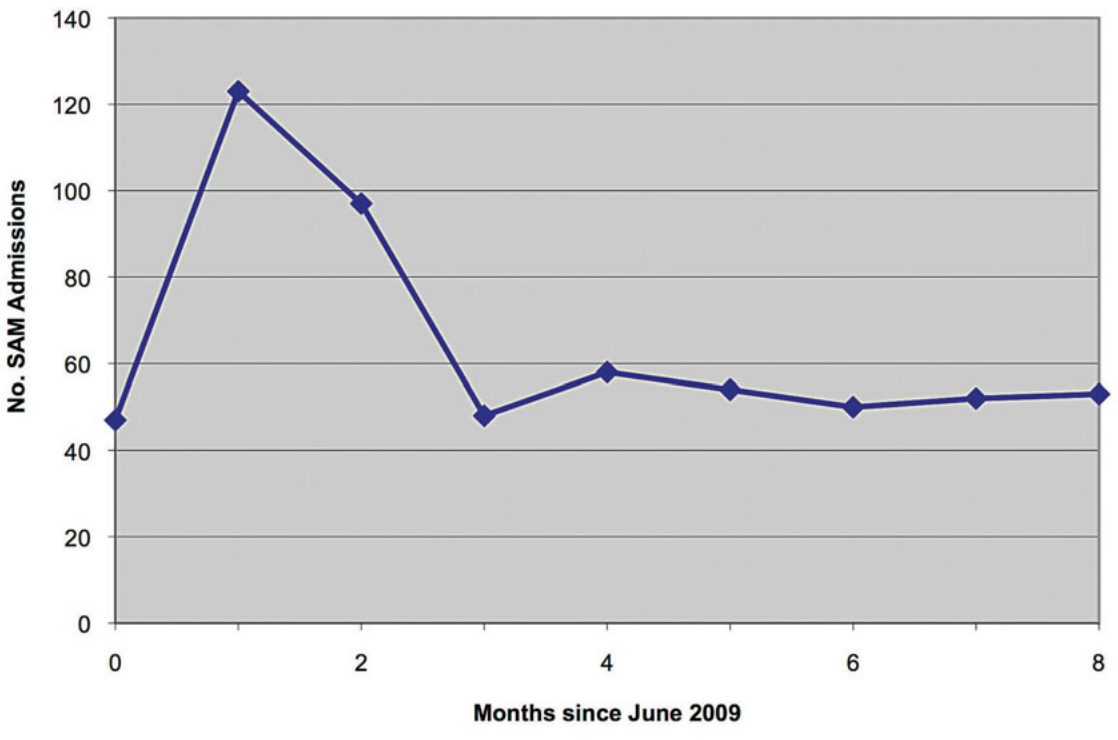
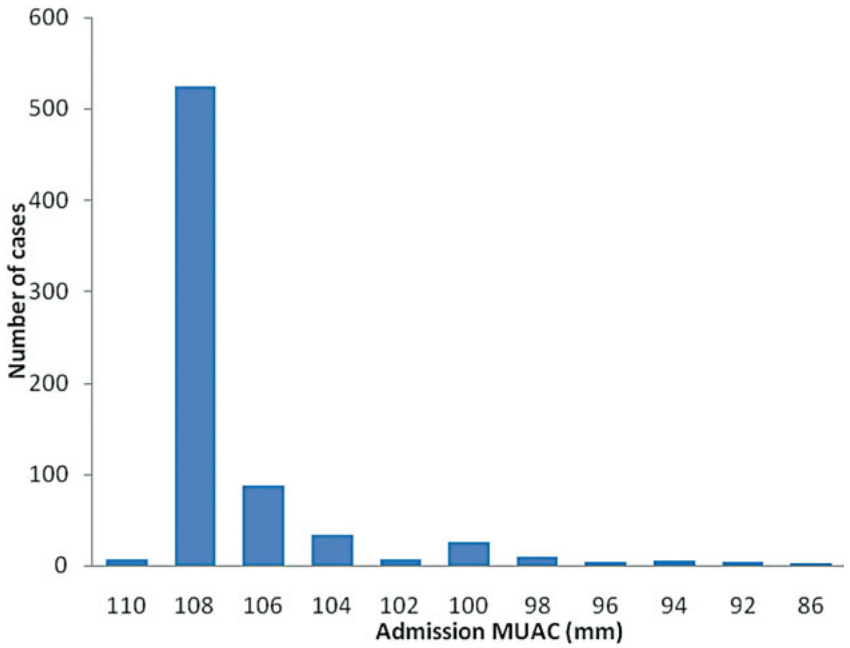


**Figure 4: Distribution of MUAC at admission for the period June 2009–June 2010 (n = 718)**




*Note: The program used the "numbers in boxes" style of MUAC strap with a two mm graticule. With this design of strap a measured value of (e.g.) 108 mm corresponds to a MUAC between about 108 and 110 mm.*

***Examining qualitative data***

*Discussion with carers:*
Semi-structured interviews with carers (usually mothers) of current and previous SAM cases in their homes took place with eight carers in three different unions. The following table (**Table 6**) highlights the key information revealed by these interviews.

**Table 6: Findings from semi-structured interviews with carers of children with SAM**

| Question Topic | Findings |
|---|---|
| Screening | All carers stated that CHWs undertook regular screening at monthly GMP sessions and by home visits. |
| Watch-list | Carers stated that children at risk (losing weight or sick, for example) were "watched" by the CHW and visited frequently. |
| Case-finding | All of the carers reported that their child had been identified by the CHW at either a GMP session or a home visit. Carers understood that the CHWs welcomed self-referrals and recruited carers to look for and refer suspected cases of SAM |

*Table 6 continued on next page*

*Continued from previous page*

| Question Topic | Findings |
|---|---|
| Case-finding *(continued)* | to them. One carer reported that she had referred three children. |
| Perception of CHWs | All carers described CHWs favorably. |
| Carers' awareness of SAM | The etiologies of SAM volunteered by carers matched program messages. Identified etiologies included infection, care practices, and household economy. All carers interviewed felt capable of identifying cases of SAM and understood the MUAC case-definition ("thin arms") and could use it to identify children who had SAM or were at risk of SAM. They also reported that they now understood SAM to be a preventable and a treatable condition citing early treatment of diarrhoea and ARI, hygiene, care practices, and "eating well" (usually defined in terms of both diversity and quantity) as important preventive measures. |
| Interface between the UHC and the program | One child, who was admitted to the UHC for 12 days, was discharged with a MUAC of 92 mm. No information on this discharge was passed from the UHC to the CHW at village level. This appeared to be indicative of a poor interface between the UHC and the program. |
| The "coverage question" | All carers stated that all of the children with SAM in their village were being treated by the program. Children suffering from SAM that were "away from home" were highlighted as most at risk from being missed by the program. If displacement occurred into or within the program area, then it was likely that cases were detected and admitted. If cases moved outside the program area they were probably missed. Two carers reported that they believed that it was possible that some SAM children were being "hidden" from the program because of a rumor that NGOs kidnapped children. Some women indicated that there was some mistrust generally of the program and of its objectives. These rumors were also reported by the local CHW. However, such rumors appeared to have had little impact on coverage as the CHW in this area had a relatively high caseload (11 cases). |

*Discussion with CHWs:*
Semi-structured interviews with community health workers (CHWs) in their homes took place with eight CHWs in three different unions.

**Table 7** highlights key information from the interviews.

**Table 7: Findings from semi-structured interviews with CHWs**

| Question Topic | Findings |
|---|---|
| Case-finding exhaustivity | All of the CHWs interviewed believed that case-finding was exhaustive (i.e., all children < three years were screened once per month or more frequently). The reasons given for this included: a local catchment area that is small enough for them to know everyone in it and to know of new people arriving; high GMP coverage, so when children are absent they are found and screened at home; cases of diarrhoea and ARI are found and followed-up through the CCM of illness activities; mothers bring children to the CHW's homes to be measured; health assistants (HAs) and village doctors refer cases to the CHWs; and the community is aware of SAM and know that it can be treated freely and effectively. All CHWs stated that the small numbers of cases admitted with very low MUACs were likely to be cases arriving (or returning) from outside of the program area. |
| Sources of referred cases | CHWs reported that they found the majority of SAM cases through GMP and home-visits. All CHWs reported operating a watch-list system for borderline cases identified through GMP, home-visits, and CCM of illness. All CHWs reported that they believed that CCM of illness may have improved case-finding since it encouraged the frequent screening of cases of diarrhoea and ARI. CHWs also reported that some carers of sick and/or thin children bring the child to the CHW's home to be screened. |
| Program logistics | No problems with SAM program logistics were reported. No drug or RUTF stock-out was reported (where this does happen it can have a very negative impact on coverage). Supplies for the CCM of illness (ORS and antibiotics) had not been received from the UHC for the previous three months. This meant that CHWs were seeing and treating fewer cases of diarrhoea and ARI and they felt that this may be impairing their ability to find SAM cases early. |
| CHW workload | CHWs reported that the SAM program added about 1½ hours to the monthly GMP session and 20-30 minutes of work each day for community-based work. The cumulative SAM caseload for most of the interviewed CHWs ranged between two and four cases. |

*Table 7 continued on next page*

*Continued from previous page*

| Question Topic | Findings |
|---|---|
| Awareness of SAM and the program | All CHWs understood the etiologies of SAM. They felt that the use of MUAC both at GMP sessions and during community-based work had raised awareness of malnutrition in the community and that RUTF was now seen as an effective treatment for SAM. Previously SAM was considered to be non-treatable or a normal part of child development. They stated that this increased awareness of malnutrition and the CCM of illness may have led to a decrease in the incidence of SAM cases in their catchment area. CHWs felt that there was now enthusiastic acceptance of the SAM program in their communities. |
| CHW morale | The morale of the CHWs appeared to be good. |

*Discussion with key informants*
Short, structured interviews with health personnel (potential sources of referrals) and community leaders took place in two unions.

All health personnel and community leaders interviewed knew of the program and as a result of it were able to recognize and identify SAM. All key informants interviewed stated their willingness to refer suspected cases of SAM to the CHWs; some of the health assistants, village doctors, traditional birth attendants, and imams interviewed had recently referred suspected cases. They were all happy to promote the program within their communities. One village doctor had previously referred cases of severe wasting to the UHC but did not like doing this as treatment at the UHC did not seem to be effective. This discussion, as well as a side discussion with a group of men in this doctors' village, highlighted a number of problems (that reiterated those detailed in **Table 5**) that meant that seeking care there was very unpopular among community members.

*Informal group discussions held in the community*
Nine informal group discussions (IGDs) with community members took place in two unions. The findings of these IGDs prompted a second round of nine IGDs in two different unions. Groups were male only (seven groups), female only (five groups) or mixed sex (six groups).

*Informal group discussion with mothers of children in the SAM program in Burhanuddin.*

Generally, men were not well-informed about SAM (i.e., about its causes and treatment) or about child health issues but did know of the existence of the SAM program. This is unlikely to be a serious barrier to access in this program as decisions about child-care are usually taken by female household elders (i.e., "mothers-in-laws," "grandmothers") rather than by husbands/ fathers. All females included in these discussions had good knowledge about the causes of SAM and were aware of the program. In one union (Hassan Nagar) the CHW did not visit several sub-villages in which the women lived and the GMP sessions at the local school (about 100 m

from the women's homes) had stopped some months earlier. The nearest GMP station was now a thirty-minute walk away. This was considered inaccessible (i.e., too far for unaccompanied women to travel) in this union. Discussions with program staff highlighted that distances between CHWs and the distances that carers were required to walk to attend GMP sessions were considerably larger in Hassan Nagar than in any other program areas. This is reflected in a higher-than-average rate of default in this union. This issue (the effects of distance from the SC US program office and distance from program delivery sites on community awareness of SAM and the SAM program) was taken up in a second round of IGDs. Discussions provided evidence that these factors do influence both knowledge of the SAM program and awareness of SAM. The distance considered "acceptable" for women to walk to access GMP services varied. In more "conservative" areas (i.e., those areas where women tended to hide from the view of male surveyors) this distance appears to be no more than about 500 meters. In less "conservative" areas (i.e., areas where women would converse openly with male surveyors on the threshold of their dwellings) this distance may exceed 1500 meters. This has implications for the program (and other programs such as EPI) as the more "conservative" areas tend to be the less-densely populated areas and it is in these areas that women must walk the longer distances to access services. There is, therefore, a risk of sub-optimal coverage in less-densely populated "conservative" areas.

*Discussion with nomads*

During the SQUEAC investigation it was observed that a small proportion of the population lives outside of towns and villages in tented communities. These communities consist of nomads (*baday*) reported to work as casual laborers and culturally distinct from the sedentary population. Short interviews with program staff revealed that the program had made no efforts to cover this population. All children under 100 cm in height in the tented community were screened using MUAC. The lowest MUAC found was 132 mm in a four-year-old boy recovering from diarrhoea. The anthropometric and health status of the children appeared to be superior to that of the sedentary population. The low numbers of nomads residing in the program area at any one time and the good nutritional status of the children seen means that the exclusion of this group from the program is unlikely to have had a large negative effect on overall program coverage.

***Estimating the coverage proportion***

It was assumed that the program coverage proportion could be 100%. A prior was constructed by accounting for the probable range of impacts on coverage associated with the "negative" findings in the routine and qualitative data reported above.

- Exclusion of nomads: This was considered to have the effect of dropping coverage slightly (i.e., due to the small number of nomads in the program area at any one time). The impact was assessed to be a 0% to 1% drop in coverage.
- Less than 100% GMP coverage: SC US and government sources estimate the coverage of EPI/GMP services to a little over 90% and non-covered sub-villages were found in the SQUEAC investigation. Distance from GMP site may be an issue in less-densely populated and /or more "conservative" areas. However, cases are recruited by means other than screening by CHWs at GMP and EPI sessions. It was thought likely that some SAM cases could remain undetected in outlying traditional areas where GMP coverage is poor. The impact was assessed to be a 2% to 5% drop in coverage.
- Effect of CHW catchment size: The survey team deliberated this issue at some length and decided that the observed negative relationship between CHW catchment size and the number of cases found was probably due to better service provision in more densely-populated unions but that a negative effect of catchment size on case-finding could not be ruled out. The impact was assessed to be a 0% to 5% drop in coverage over the entire program area.
- Anti-NGO agitation: This was considered to have the effect of dropping coverage slightly. The impact was assessed to be 0% to 1% drop in coverage.
- Problems with UHC referrals: Program staff

felt confident that all SAM cases discharged or defaulting from UHC would be identified and admitted to the program shortly after their return home. The impact was assessed to be a 0% to 1% drop in coverage.

- Problems with ORS supply from UHC: It was considered that this might have some effect on the timeliness of case-finding and recruitment. The impact was assessed to be a 0% to 1% drop in coverage.
- Lack of male awareness of SAM and the SAM program: Since care decisions are usually made by the mother and grandmother of the case, this was considered to have a small effect on coverage. The impact was assessed to be a 0% to 1% drop in coverage.
- Migration: The survey team was confident that cases entering the area would be picked up by most CHWs shortly after their arrival in the program area. It was considered that migration might have some effect on the timeliness of case-finding and recruitment. The impact was assessed to be a 0% to 1% drop in coverage.

The prior density had a range of 84% to 98% with the mode located at 91% (i.e., the mid-point between 84% and 98%). The probability density Beta (35, 4.4) was used to describe this prior. This prior is presented graphically in **Figure 5**.

The sample size for the likelihood (survey) was calculated to provide a coverage estimate with a 95% CI of better than about ±10% using the Beta (35, 4.4) prior. The minimum sample size required was found to be to be n = 8 current or recovering SAM cases. It was estimated, from routine program data and prior survey work, that between 12 and 14 EPI/GMP site catchment areas would need to be exhaustively sampled in order to find eight current or recovering SAM cases. A centric systematic area sample (CSAS) grid sampling method was used. Fourteen 3 km by 3 km quadrats were used to locate primary sampling units. Primary sampling units (PSUs) were the catchment areas of the EPI/GMP site located closest to the center of each quadrat (see **Figure 6**). During the small area surveys six children (cases and non-cases) were found to be

**Figure 5: Prior, likelihood, and posterior densities for the analysis presented in the text**

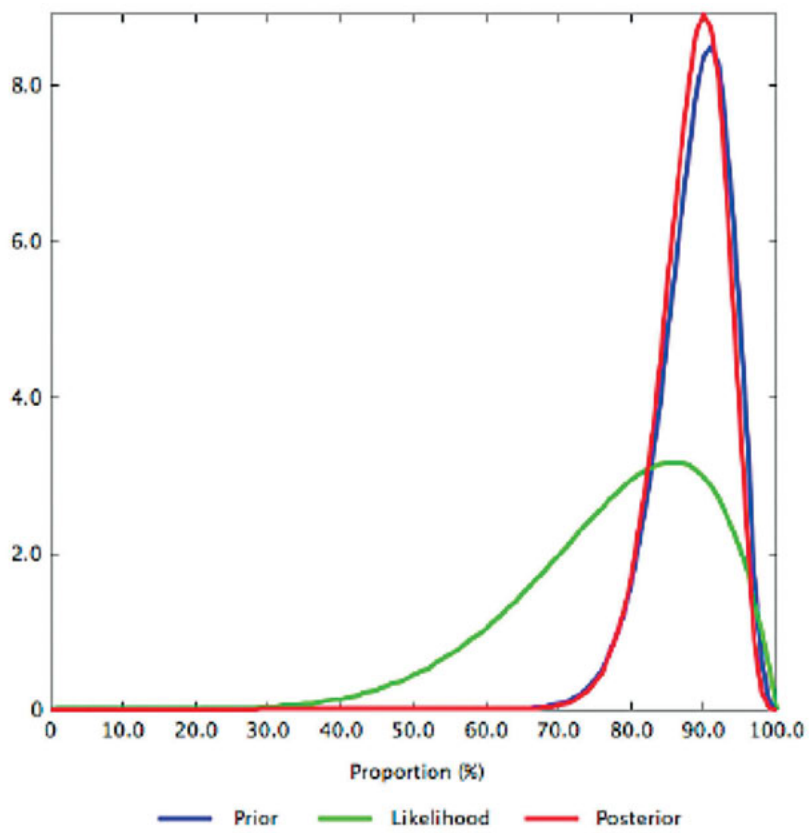
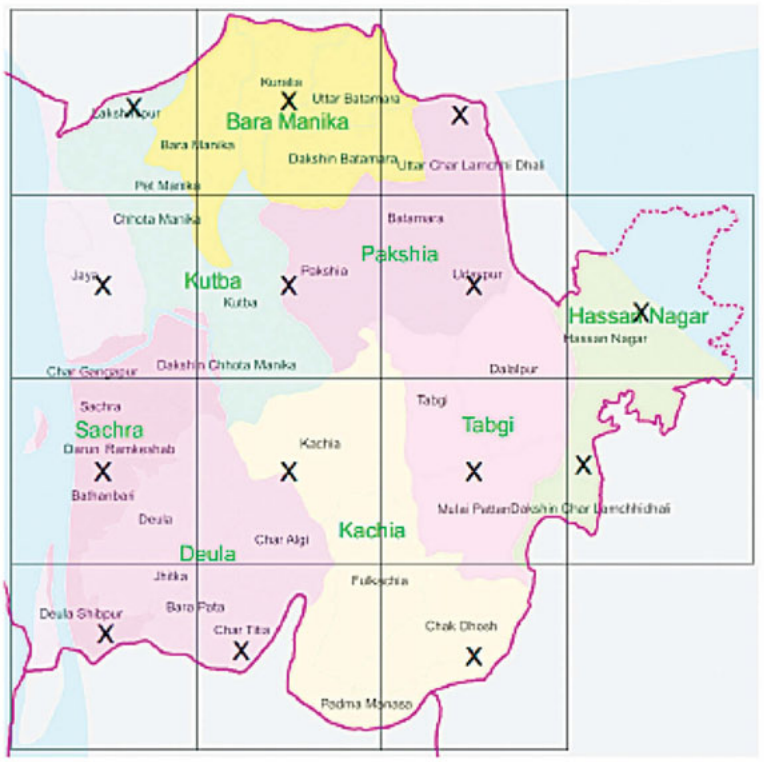


**Figure 6: CSAS (grid) sample of EPI / GMP sites**




currently attending the program and one case was found that was not attending the program. This case was a male aged "five months and twenty-eight days" with a MUAC of 104 mm (and dropping). He was under observation by the CHW but not admitted to the programs. The case was a maternal orphan whose mother had died during childbirth. The father's second wife, acting as a wet-nurse, was breast-feeding the case as well as her own older girl. The case was not exclusively breastfed. This case was included as uncovered in this analysis as it was considered to have been excluded by an overly-legalistic interpretation of the program admission criteria. The child was admitted to the program on the day he was found by the survey.

The period coverage was calculated with the SQUEAC Coverage Estimate Calculator:

Numerator = Number of respondents (cases and non-cases) attending the feeding program
= 6

Denominator = Total number of current cases not attending the feeding
+ Number of respondents (cases and non-cases) attending the feeding program
= 1 + 6 = 7

**Coverage was estimated to be: 89.0% (95% CI = 78.0%–95.9%)**

## Quality of care

**Table 8: Quality of the management of cases of SAM with no complications**

| Checklist item | N†, % correct |
|---|---|
| ***Overall % error-free case management: N, median (range)*** | **55, 100%★★★ (66.7-100)** |
| ***1. Type of child:*** | |
| • New SAM case | 32, 58.2 |
| • Follow-up SAM case | 23, 41.8 |
| ***2. MUAC measurement:*** | |
| • Keep work at eye level. | 55, 100 |
| • Remove clothing covering arm. | 55, 100 |
| • Find approximate midpoint of child's arm. | 55, 100 |
| • Make sure arm is relaxed at child's side and wrap tape around arm. | 55, 100 |
| • Make sure tape is flat and not too tight or loose. | 55, 96.4 |
| • Read measurement number on MUAC strip. | 55, 96.4 |
| ***3. Oedema check (in sick children only):*** | |
| • Press firmly on top of child's feet for 3 seconds. | 24, 100 |
| • Release, and feel pressed spot for indentation. | 24, 95.8 |
| ***4. SAM diagnosis:*** | |
| • MUAC < 110 | 55, 98.2 |
| • Presence of oedema | 45, 100 |
| • Check for SAM with or without complications according to algorithm. | |
| a. Check for danger signs. | 55, 100 |
| b. Check for chest indrawing. | 55, 100 |
| c. Count respiratory rate according to protocol. | 55, 100 |
| d. Take temperature. | 55, 98.2 |
| e. Examine for dehydration. | 55, 92.7 |
| ***5. Check appetite:*** Give packet of RUTF to child. | 55, 98.2 |
| ***6. If SAM without complications identified:*** | |
| • Antibiotic given according to protocol. | 55, 89.1 |
| • Folic acid given according to protocol. | 55, 92.7 |
| • RUTF given and amount calculated according to protocol. | 55, 96.4 |
| ***7. Delivery of education messages:*** | |
| • RUTF should replace the regular diet (except for breast milk). | 55, 92.7 |
| • RUTF should not be shared with siblings or other children. | 55, 96.4 |
| • Give frequent feedings with small amount of RUTF (up to 8 x/day). | 55, 98.2 |
| • Any child 6-12 months who is breastfed should receive breast milk first then RUTF. | 54, 87.3 |
| • Give adequate amounts of safe water with RUTF. | 55, 96.4 |
| • Do not mix water in the RUTF packet. | 55, 92.7 |
| • Give the medicine provided by your CHW 2 x per day for five days. | 55, 92.7 |
| • Seek immediate advice from the CHW if your child experiences any allergic reactions after consuming RUTF. | 55, 92.7 |

† Because some items were designated "not applicable" for a particular case, not every CHW implemented every measure on this checklist and therefore for some items N<55.

★★★ $p < .001$; for significance of difference between reported median score and a hypothesized median score of 90% (Wilcoxon signed-rank test).

**Table 8** summarizes the results of 55 observation checklists completed for CHWs managing a new or follow-up child with SAM during a household visit. Of the 55 checklists completed, 32 of them were completed for a new case of SAM and 23 for a follow-up case.

Overall, CHWs' management of uncomplicated SAM cases according to algorithm was of high quality, with 58.2% of the sample achieving a perfect score. The median score of 100% is significantly different from 90% ($p < 0.001$, Wilcoxon signed-rank test), representing a hypothetical high-quality comparative score.

**Table 9: Quality of routine preventive tasks during household visits**

| Checklist item | Overall | CHW Group % correct (N) | |
|---|---|---|---|
| | | CCM ARI & Diarrhoea | CCM SAM+ |
| ***Overall % error-free case management: Median; range (N)*** | **100; 15.4-100 (336)** | **93.3; 53.8-100 (141)** | **100; 15.4-100 (195)⋆** |
| 1. Announce objective of visit. | 95.8 (333) | 95.0 (140) | 96.4 (193) |
| 2. Try to involve key family members, if appropriate. | 80.2 (253) | 69.5 (105) | 87.8 (148)⋆⋆⋆ |
| 3. Discuss with the caretaker about commitments made on the "Promise Sheet." | 98.2 (335) | 97.1 (140) | 99.0 (195) |
| 4. Enquire about what the caretaker is already doing at home for this child. | 94.3 (335) | 92.2 (141) | 95.9 (194) |
| 5. Listen to the caretaker in order to understand her situation and concerns regarding caring for her child. | 95.8 (333) | 97.9 (141) | 94.3 (192) |
| 6. Use encouraging non-verbal communication and simple language. | 96.4 (334) | 95.0 (140) | 97.4 (194) |
| 7. Recognize and praise what she is doing correctly before suggesting changes. | 88.8 (331) | 87.1 (140) | 90.1 (191) |
| 8. Provide clear, focused counseling and feeding information. | 98.7 (317) | 97.9 (140) | 99.4 (177) |
| 9. Make recommendations by which the caretaker can improve the care and feeding of her child. | 94.7 (319) | 93.0 (129) | 95.8 (190) |
| 10. Clear up doubts when a caretaker says that the recommendation is complicated. | 94.6 (148) | 92.7 (55) | 95.7 (93) |
| 11. Answer any questions about the advice. | 89.9 (159) | 89.3 (75) | 90.5 (84) |
| 12. Troubleshoot any problems (or potential problems) with complying with the advice. | 93.0 (158) | 94.4 (72) | 91.9 (86) |
| 13. Negotiate what is feasible for the caretaker in terms of the advice given. | 95.5 (291) | 94.9 (138) | 96.1 (153) |
| 14. Confirm commitments made on the "Promise Sheet" and encourage caretaker to put recommendations into practice. | 97.0 (333) | 97.1 (139) | 96.9 (194) |
| 15. Inform caretaker of next GMP, EPI, Courtyard session, or household visit as appropriate. | 84.3 (325) | 84.4 (141) | 84.2 (184) |

⋆ $p < .05$, ⋆⋆ $p < .01$, ⋆⋆⋆ $p < .001$; for significance of difference between CHW groups (Wilcoxon Mann-Whitney test, Pearson's Chi Square or Fisher's exact test as appropriate).

**Table 9** summarizes the results of 336 observation checklists completed by surveyors during a routine household visit in which CHWs counseled caretakers regarding any feeding problems with an otherwise well child, and negotiated feasible solutions using the SC US "Promise Sheet." One hundred forty-one of these checklists were completed for CHWs that were implementing CCM of childhood illness only. One hundred ninety-five checklists were completed for CHWs that were implementing CCM of illness *and* CCM of SAM.

Each item on the checklist had a possible response of "yes" or "no" reflecting performance on completed items, or "not applicable" if a checklist item did not apply during that visit. For example, if a caretaker had no questions then a CHW would not need to undertake items 10-12. A maximum possible score was calculated for each individual CHW as total correct responses divided by total applicable items. Each individual score is therefore calculated with a different number of items in the denominator.

Scores for quality of routine preventive tasks by CHWs implementing CCM of SAM are clustered towards the high end of the distribution, with 63% achieving a perfect score. Scores for CHWs implementing CCM of ARI and Diarrhoea exhibit a broader range with nearly half (48%) scoring 100%. A non-parametric test shows the distribution of scores for these two groups of CHWs to be significantly different ($p = 0.013$), with SAM CHWs scoring higher overall.

**Costs and cost effectiveness**

**Table 10: Costs by cost center for the management of SAM in the intervention and the comparison Upazila**

| Cost center | Community treatment | Inpatient treatment |
|---|---|---|
| **Monitoring:** | | |
| Monitoring of CHWs | 16,075 | 7,685 |
| TOTAL | **16,075** | **7,685** |
| **Trainings:** | | |
| For SC US staff & CHWs | 13,900 | 9,370 |
| For UHC Staff | 523 | 559 |
| TOTAL | **14,423** | **9,929** |
| **Supervision:** | | |
| SC US coordination meetings | 413 | 413 |
| Field supervisor time | 22,436 | 10,218 |
| Higher-level & support staff time | 12,742 | 6,370 |
| Overhead, institutional costs, capital depreciation | 12,131 | 7,044 |
| TOTAL | **47,721** | **24,046** |
| **GMP sessions:** | | |
| CHW time (shadow wage) | 1,383 | 721 |
| Rent of GMP site (shadow cost) | 1,660 | 1,082 |
| TOTAL | **3,043** | **1,803** |

*Table 10 continued on next page*

*Continued from previous page*

| Cost center | Community treatment | Inpatient treatment |
|---|---|---|
| **Household visits:** | | |
| *CHW time in visits (by case result):* | | |
| – Recovered | 990 | 5 |
| – Default | 80 | 265 |
| – Non-response | 18 | 11 |
| – Non-admitted | -- | 1,256 |
| – Refused referral | -- | 1,578 |
| – Death | 2 | -- |
| CHW supplies & printing | 892 | 408 |
| TOTAL | **1,981** | **3,522** |
| **Curative care:** | | |
| *Community treatment:* | | |
| Cost of RUTF | 26,336 | |
| RUTF shipment & storage costs | 2,521 | |
| SAM medicines from CHW | 471 | |
| *Inpatient treatment:*[1] | | |
| UHC setup equipment | 689 | 689 |
| Medicines | 8 | 92 |
| Food for mothers[2] | 13 | 270 |
| Bed costs | 17 | 361 |
| Therapeutic milk ingredients | 7 | 148 |
| *Staff salary and Facility Health Worker:* | | |
| – Admission | 8 | 100 |
| – Daily care | 40 | 846 |
| TOTAL | **30,109** | **2,505** |
| **Household costs for SAM care and treatment:** (by type of treatment) | | |
| *Community treatment:* | | |
| Transportation | -- | |
| Time[3] | 6,226 | |
| Medicine and doctor's fees | -- | |
| Food | -- | |
| *Inpatient treatment:*[1] | | |
| Transportation[4] | 24 | 1,404 |
| Time[5] | 48 | 1,379 |
| Medicine and doctor's fees[6] | -- | -- |

*Table 10 continued on next page*

*Continued from previous page*

| Cost center | Community treatment | Inpatient treatment |
|---|---|---|
| Food[2, 7] | 20 | 838 |
| Visitors[8] | 26 | 518 |
| *Other outpatient care*[9] | | |
| Transportation | -- | 551 |
| Time[10] | -- | 7,103 |
| Medicine and doctor's fees | -- | 4,768 |
| Food | -- | 16,273 |
| TOTAL | **6,345** | **32,834** |
| **Total cost** | **$119,697** | **$82,324** |

[1] Inpatient costs in the community treatment group are for stabilization care at UHC for complicated cases of SAM, which was used by only 5 children in the study.
[2] Costs for caretakers' meals during UHC stay were split between UHC and caretaker, based on evidence from FGDs.
[3] Includes time spent meeting with CHW and feeding child RUTF according to CHW's advice.
[4] Costs incurred when traveling to UHC for admission.
[5] Includes time traveling to UHC, meeting with CHW, waiting for admission, and staying at UHC.
[6] Costs were zero on average, although some bribes or outpatient medicine costs were reported.
[7] Includes food purchased for caretaker and accompaniment during travel to UHC, and food purchased by caretaker for self and child during UHC stay.
[8] Includes direct costs for visitors assisting with child care (food and transportation).
[9] Costs incurred for other outpatient care for defaults, non-response, non-treated, and refused referral cases. This includes follow-up at home by the CHW and costs of CCM of common childhood illness.
[10] Includes value of caretakers' time treatment seeking, meeting weekly with CHW, and extra time feeding child according to CHW's advice.
Totals may not match added figures due to rounding.

**Table 10** details the costs expended by the program and participants by cost center for CCM of SAM in the intervention area and for the standard of care for children with SAM (i.e., referral to inpatient treatment) in the comparison area. The total cost was $119,697 in the intervention Upazila and $82,324 in the comparison area. Detailed notes on the costs included in each of these cost centers are presented in **Annex 2**. Using the monitoring data presented in **Table 3**, cost per child treated is $165 and $1,344 for the intervention and comparison area respectively.

**Figure 7** breaks down the total cost for each type of treatment by cost center. These figures show that two costs predominate in the CCM of SAM: management (at 53% of total, combining monitoring and supervision cost centers, including salaries and overhead) and curative care, which includes RUTF and related storage and transport. When RUTF-specific costs are isolated, they represent 24% of total program costs. Household costs incurred by caretakers of children with SAM make up only 5% of total program costs. The highest proportion of costs for the standard of care in the comparison Upazila is made up of those borne by the household in seeking treatment for children with SAM (40% of the total program cost).

**Figure 7: Breakdown of cost centers as a percentage of total program cost in both areas**

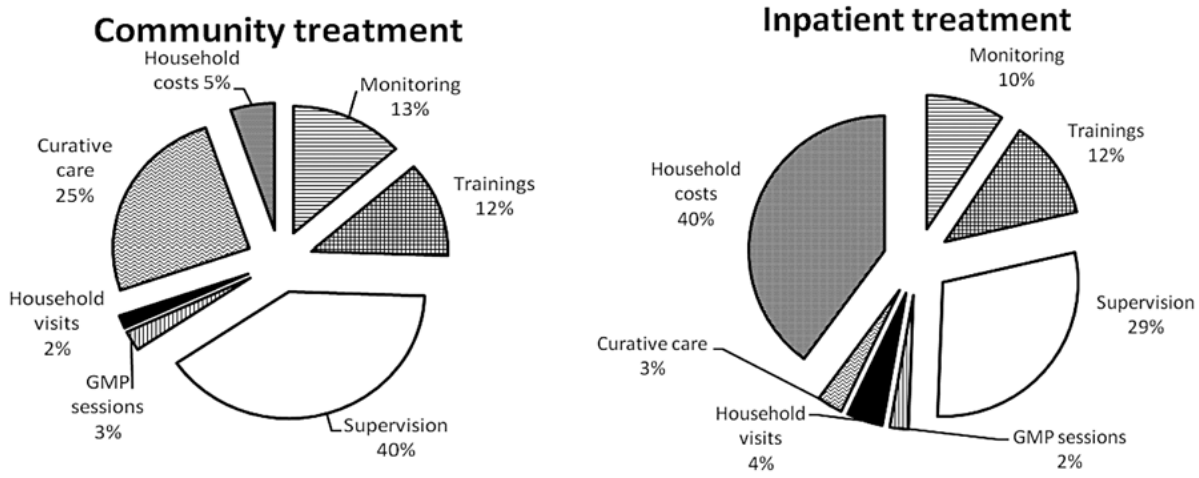



**Table 11: Cost effectiveness of the management of SAM in the intervention and the comparison Upazila**

| | Intervention Upazila CCM of SAM | Comparison Upazila Inpatient care |
|---|---|---|
| Total cost USD | $119,697 | $82,324 |
| Cost per child treated USD | $165 | $1,344 |
| Cost per child recovered USD | $180 | $9,149 |
| Number of DALYs averted (95% CI) | 4,683 (3,913; 5,501) | 67 (0; 172) |
| Cost per DALY averted USD (95% CI) | $26 ($21; $31) | $1,344 ($445; $3,788,726) |

**Table 11** above presents the main cost effectiveness outcomes for this study: cost per child treated, cost per child recovered from SAM, number of DALYs averted, and cost per DALY averted.

***Effectiveness of CCM of SAM***

This study has demonstrated that community-case management of SAM in Bangladesh is feasible and could be an effective and cost-effective strategy to ensure timely and high quality treatment for a condition that is typically associated with high levels of mortality. This is an important finding in a country that has the fourth highest number of children suffering from SAM in the world (Gross and Webb, 2006), yet to date has had no effective mechanism of identifying and treating them. Results show that when SAM is diagnosed and treated by CHWs at the community level a very high proportion (89% CI 78.0%–95.9%) of malnourished children can access care and they are highly likely to recover. The main outcome measures including the high recovery rate (92%) and low mortality and default rates (0.1% and 7.5% respectively) are all considerably better than the Sphere international standards for therapeutic feeding programs (SPHERE project team, 2004) and compare favorably with other community-based management of acute malnutrition (CMAM) programs across the world (Collins et al., 2006b; Linneman et al., 2007; Gaboulaud et al., 2007) as well as with previous work that has examined the outpatient rehabilitation of children suffering from SAM in Bangladesh (Khanum et al., 1994). The level of coverage seen in this program was 89% by April 2010; this is one of the highest rates of coverage ever recorded for CMAM programs (Collins et al., 2006b; Guerrero et al., 2010). In contrast, monitoring data in the comparison Upazila, where the standard of care was the only mechanism for treating SAM, showed that most children referred never made it to the facility or, if they did, they went home before completing treatment.

*Late presentation of SAM in Burhanuddin.*

*Early presentation of SAM in Burhanuddin.*

***How program design supported effectiveness***

The innovation in this program's design was the use of a network of CHWs that were supported to deliver a package of preventive and treatment interventions at the village level that included promotion of IYCF and early identification and management of common childhood illness like diarrhoea and pneumonia, as well as the identification, assessment, and treatment of children suffering from SAM. It was this innovation that supported the high recovery and coverage, the short lengths of stay, and the very low mortality seen in this study. Results show (see **Figure 4**) that CHWs were able to identify SAM very early in the course of the disease. This meant that children presented with fewer complications, were easier to treat, much less likely to die, and there was rarely a need to refer a child for inpatient care. In addition, study findings demonstrate a very high quality of care (see **Table 8**) delivered by CHWs. This ensured that children were identified correctly and the treatment delivered allowed the highest chance of a successful outcome. All of these program characteristics are linked in a kind of "virtuous cycle" whereby each support and reinforce each other (see **Annex 3**). The addition of the treatment of SAM to the CHW workload did not appear to reduce quality of other actions delivered by CHWs, including those focused on the prevention of malnutrition (see **Table 9**) and in fact may improve the quality of a well-supervised CHW's work. This package of services that included counseling and support for

> *"I am very happy to have this program. We can treat the SAM children. Before this we had no idea. We used to go to the health assistant but he also had no proper idea. We all thought it was a strange disease. No knowledge. No prevention. No treatment. Now we prevent SAM and now we treat SAM."*
>
> — CHW, Burhanuddin

IYCF and the early identification and treatment of common childhood illness such as pneumonia and diarrhoea is likely to have considerably reduced the risk of children with SAM presenting with medical complications even further.[8] This study did not continue to follow children after recovery from SAM. Future studies and/or programs should attempt to do this in order to evaluate the longer-term outcomes of children that have graduated from community-based care.

There were several mechanisms that supported the early identification and presentation of children with SAM. CHWs were decentralized; each one covering no more than 200 households and one monthly growth monitoring session. This meant that the catchment area for each CHW was small enough for them to know everyone in it and to know of new arrivals. We know from SC US data that the growth monitoring program covered a high percentage of children < two years in each community; the addition of a MUAC and an oedema check to this program ensured that any child with SAM in this program was identified quickly. MUAC was also used during home visits to sick children and CHWs implemented a "watch-list" system whereby any child seen in the GMP or at home who was sick or losing weight was monitored more frequently. In addition, the SQUEAC investigation documented a good interface between the community and the program and excellent mobilization around the condition. All of the CHWs interviewed stated that the use of MUAC had raised the awareness of malnutrition in the community, particularly when it was used away from GMP sessions so its use could be observed by members of the community other than the mothers. This meant that mothers, community-level health practitioners such as village doctors, and other community-based stakeholders were aware of SAM and had a good understanding of its signs and symptoms. They trusted CHWs to provide effective treatment and referred their own children and others in their villages when they were sick or losing weight.

Lastly, program quality, a key factor in promoting high program participation, was good. CHWs were motivated by the program and enabled, through feasible workloads and good supervisory support, to deliver a high quality of service provision. It is clear that the supplement provided was appropriate for the rapid rehabilitation of SAM; the average weight gain (6.7g/kg/day) is among the highest ever recorded for this type of program (Sadler, 2009; Linneman et al., 2007) and much higher than programs that have attempted to treat similar groups of children with local foods and education (Ashworth, 2006; Dewey and Adu-Afarwuah, 2008). Rapid recovery is important for a condition that is associated with such high morbidity and mortality risk. The SQUEAC assessment also highlighted that the rapid weight gain of children receiving treatment acted as a motivating factor for parents with thin children yet to present to the program. Lastly, there were no drug or RUTF stock-outs. Where these do occur they are known to increase default and reduce rates of presentation hugely (Guerrero et al., 2010).

In the comparison Upazila most children referred for facility-based care never made it to the hospital or went home before completing treatment. Discussions with carers of malnourished children highlighted prohibitive costs and high opportunity costs as a major barrier to attending hospital based treatment. **Figure 7** shows that, in contrast to CCM of SAM, the households containing children with SAM in this Upazila bore the large majority of

[8] An end-of-program evaluation in the study areas shows that the JoJ program supported improved IYCF practice. The rate of exclusive breastfeeding for example, increased from 46% at baseline in Burhanuddin to 68% (Save the Children (US), 2010).

the cost of this intervention. This is neither a new problem nor a problem that is specific to Bangladesh but has been documented regularly as a problem of facility-based care over several decades (Cook, 1971; Collins, 2001; Bryce et al., 2005). In addition, there was a general level of mistrust of the staff and of the quality of care provided at the UHC. High levels of default, such as those seen here, among children admitted for treatment is often reflective of both high opportunity costs of staying in care and of the poor quality of care being delivered. There was also an issue with limited capacity at Lalmohan UHC: five beds in total allocated for SAM admissions and a nursing staff that were under-resourced and over-burdened. Whilst the training, materials, and therapeutic milks for SAM treatment and additional staff member provided by SC US served to increase this capacity somewhat, it came nowhere near that required to cover all those that needed treatment. All this taken together with the analysis of admission data presented in **Table 4** reflects very low coverage of treatment for children with SAM in the comparison area. Coverage is unlikely to have exceeded 4% during December 2009 and January 2010 when case-finding was likely to have been more exhaustive than at any other time. The true coverage achieved in the comparison area is likely to have been even lower than this.

***Cost Effectiveness of CCM of SAM***

Cost effectiveness was also analyzed as part of this study. **Table 11** shows that the CCM of SAM in this particular context in Bangladesh cost $180 per child who recovered from SAM and $26 per DALY averted. According to the World Bank anything less than about $150/DALY (adjusted for inflation) is considered to be cost effective for low- to middle-income countries (Bobadilla et al., 1994). It is also at a level considered "highly cost effective" according to WHO's definition that defines an intervention as cost effective if it averts one DALY for less than the per capita GDP of a country (Commission on Macroeconomics and Health, 2001). The GDP was $520 per capita in Bangladesh in 2008 (World Bank, 2008).

The costs and cost effectiveness of CCM of SAM in Bhola are similar to those presented for other CMAM programs (**Table 12**).

In Ethiopia Tekeste calculated a cost per recovery of $145 (Tekeste, 2007); in Zambia Bachman calculated a cost per treatment of $203 and a cost per DALY of $53 (Bachmann, 2009); and in Malawi Wilford et al. calculated a cost per DALY averted of $42 (Wilford et al., 2009). Ashworth and Khanum's analysis from Bangladesh shows domiciliary (home-based) care of SAM to cost $29 per recovered child. However, this study did not use RUTF but admitted all children eligible for home-based care to day care for the first week of treatment where they received milk feeds and rice-based meals; thereafter the mothers themselves were expected to provide the foods required for rehabilitation of their child at home. The meals recommended included rice pudding, rice with dhal or pumpkin, oil, meat, and fish. It is unlikely that all of these foods would have been available to many of the poorest study participants in the rural setting examined here (Ashworth and Khanum, 1997). Additionally, Ashworth and Khanum did not include costs such as training and supervision. These were included in the analysis presented here.

**Table 12: Comparison of cost-effectiveness results for CMAM**

| Cost outcome | Bhola (this study) | Bangladesh | Ethiopia | Malawi | Zambia |
|---|---|---|---|---|---|
| Per recovery | $180 | $29★ | $145 | | |
| Per treated case | $165 | | | | $203 |
| Per DALY | $26 | | | $42 | $53 |

★ Results from this study are difficult to compare with results presented here due to different methods and foods used in the study. See discussion for details. Data cited are from the following sources: Ashworth and Khanum, 1997; Bachmann, 2009; Tekeste, 2007; Wilford et al., 2009.

- Combined drug/psychosocial therapy for depression $1,699
- SAM treatment at UHC (observed) $1,344
- Multivalent drug therapy for prevention of heart disease/stroke $409
- SAM treatment at UHC (improved) $214
- Improved emergency obstetric care (SE Asia) $127
- DOTS (Directly Observed Treatment Short Course) for epidemic infectious TB $102
- Community-based SAM treatment by CHW $26
- EPI vaccine package $7

If the cost effectiveness of CCM of SAM is compared to the cost effectiveness of other lifesaving interventions as presented by Jamison, it appears to be a good investment (Jamison et al., 2006). The interventions underlined in the list below are those tested by this study:
In this context, the CCM of SAM was considerably more cost-effective than the standard of care for SAM in the comparison Upazila (cost per DALY averted $26 vs. $1344). The inpatient unit (Upazila health complex) in the comparison Upazila was supported with training, staff, money, milk, drugs, etc. and can be said to have been "improved." However, for all the reasons discussed above, utilization of the UHC here was particularly low. This results in a very high cost per child treated and a very poor cost- effectiveness ratio. Other studies, which have examined the effectiveness of treatment of SAM in inpatient units that were considerably better resourced than those involved in this study, have demonstrated better outcomes than those presented here (Ashworth et al., 2004; Ahmed et al., 1999). To this end, a "best case" scenario was modeled by applying a modest improvement of 20% to the coverage, recovery, and default rates observed at facility level in the comparison Upazila. **Table 13** below presents the revised cost-effectiveness ratios for this "best case" (improved) scenario.

This table shows that even if it were possible, with all the constraints, to improve quality of care for SAM at the UHC, the CCM of SAM remains over eight times more cost effective than inpatient care alone. Previous studies have also found home-based management of SAM to be more cost effective than facility-based care. In

**Table 13: Revised cost-effectiveness outcomes for a modeled "best case" for inpatient management of SAM in the comparison Upazila**

| | **Intervention Upazila CCM of SAM** | **Comparison Upazila Inpatient care *observed*** | **Comparison Upazila Inpatient care *improved*** |
|---|---|---|---|
| Total cost USD | $119,697 | $82,324 | $90,973 |
| Cost per child recovered USD (95% CI) | $180 (164; 196) | $9,149 (7,582; 10,712) | $1,491 (1,249; 1,733) |
| Number of DALYs averted (95% CI) | 4,683 (3,913; 5,501) | 67 (0; 172) | 418 (203; 713) |
| Cost per DALY averted USD (95% CI) | $26 ($21; $31) | $1,344 ($445; $3,788,726) | $214 ($124; $467) |

Bangladesh, Ashworth et al. found facility-based care to be five times as costly as home-based treatment, and in Ethiopia Tekeste found facility care to be twice as costly (Ashworth and Khanum, 1997; Tekeste, 2007).

***Implications for policy and practice***

This study has demonstrated that the management of SAM at the village level by CHWs can achieve extremely high recovery rates and high coverage and is cost effective in comparison to both inpatient care for SAM and other lifesaving interventions. Even with high levels of NGO support, it proved to be suited to inclusion in basic health packages such as growth monitoring and community case management of childhood illness. That CHWs were able to identify and treat SAM very successfully shows that, with the right training and support, this cadre of workers provides an essential capacity in the fight against acute malnutrition in Bangladesh and beyond. To our knowledge, use of community-based health workers for this type of program has been documented by only one other program in Malawi (Amthor et al., 2009) and never in Asia. On the other hand, the use of CHWs for the successful management of childhood illness such as pneumonia has been well documented (Winch et al., 2005) and has recently been supported with policy statements from WHO and UNICEF.

This study used a network of CHWs to deliver both preventive and curative actions for common childhood illness *and* acute malnutrition. This recognizes the substantial overlap in the etiologies and clinical presentation of these conditions and holds great potential for prevention of serious illness and mortality. In an area that experiences frequent natural disasters, improving the capacity of a network of local women to deal with acute malnutrition also holds promise for improving effectiveness of disaster response in the future.

With the high levels of acute malnutrition and childhood illness and the low rate of access by the rural poor to other forms of health care in Bangladesh, there is clearly a need to replicate and scale up the model of care tested here. Key to this process will be integration of CCM of SAM into the national guidelines for the treatment of SAM in Bangladesh. These guidelines should include a comprehensive strategy for community-based management, as well as facility-based management for the few cases of SAM that present with medical complications. An appropriate platform for this policy change exists in the form of the National Nutrition working group led by UNICEF which works with the Institute of Public Health Nutrition to advocate nutrition issues. Such a change in policy will help pave the way to exploring feasible mechanisms for replication of this model in other parts of the country. Two of the main challenges to such replication include ensuring a network of well-supported CHWs that effectively engage with communities such as that used for this study and accessing a supply of an appropriate food supplement for the treatment of SAM. A community-based cadre of workers is included as part of the National Nutrition Program and C-IMCI (Community-Integrated Management of Childhood Illness) in the country but is not yet widely available. However, the recently-developed five-year national plan for the health, nutrition, and population sector in Bangladesh has revitalized a "community clinic initiative" which includes plans for community-based service providers and holds potential for scale-up of this tested model. We envisage the findings of this work will contribute to the development of programming and resource allocation under this strategy. This study used a food supplement (Plumpynut©) that was imported from Nutriset in France. There is a real need for a local alternative to be developed and tested such as that recently described in a special issue of *Indian Pediatrics* (Beesabathuni and Natchu 2010). Institutions such as the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDRB) and UNICEF are discussing possibilities here that could bring down the costs of programming described above and further improve cost-effectiveness ratios such as the cost per DALY averted by this model of care.

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## ANNEX 1: MAP OF STUDY AREAS: BURHANUDDIN AND LALMOHAN UPAZILAS

## ANNEX 2: DETAIL ON COSTS INCLUDED IN EACH COST CENTER PRESENTED IN TABLE 10

### Table 14: Details on included costs by cost center

| Cost Center | CCM of SAM area | Comparison area | Assumptions |
|---|---|---|---|
| Monitoring | •Salary: 12 x Field Officer (FO) @ 30% time<br>•Transportation: motorbike rental fees, average fuel and maintenance | •Salary: 11 x FO @ 15% time<br>•Transportation: motorbike rental fees, average fuel and maintenance | •Partner FOs:<br>- 5% less time allocation<br>- One common salary estimate<br>- Used public transportation |
| Trainings | •3-day facilitator training: CCM of SAM<br>•11 batches x 3-day CHW training<br>•Monthly refresher trainings @ 25% time<br>•2-day training UHC staff in WHO guidelines for SAM | •2-day facilitator training: CCM of SAM<br>• 9 batches x 2-day CHW training<br>•Monthly refresher trainings @ 25% time<br>•2-day training UHC staff in Nat'l guidelines for SAM | (None) |
| Supervision | •Monthly district coordination meetings @ 5%<br>•Monthly sub-district coordination meeting @ 10%<br>•Program staff salary: 2 x Program Officer (PO) @ 100% time, 1 supervisor @ 2/3 time, plus motorbike costs for these staff; other program mgmt. staff @ 17.5%<br>•Support staff salary (shared with comparison area) District Admin & IT Officers @ 12.5%, Finance Officer @ 7%, Division level: deputy finance manager and admin. manager @ 5%; Central level program manager@ 100% first 5 months, 50% afterward, Country director @ 1.5% during program planning and setup<br>•Overhead costs (i.e., rent, utilities) for SC US offices allotted according to time allocation of staff (Table 15)<br>•Capital depreciation of cars and computers | •Monthly district coordination meetings @ 5%<br>•Monthly sub-district coordination meeting @ 10%<br>•Program staff salary: 1 x PO @ 100% time, 1 supervisor @ 1/3 time, plus motorbike costs for these staff; other program mgmt. staff @ 12%<br>•Support staff salary (shared with CCM of SAM area) District Admin. & IT Officers @ 12.5%, Finance Officer @ 7%, Division level: deputy finance manager and admin. manager @ 5%; Central level program manager @ 100% first 5 months, 50% afterward, Country director @ 1.5% during program planning and setup<br>•Overhead costs (i.e., rent, utilities) for SCUS offices & UHC allotted according to time allocation of staff (Table 15)<br>•Capital depreciation of cars and computers | (None) |
| GMP sessions | •261 CHWs x shadow wage for 1.5 additional hours per month at GMP sessions in one-year project<br>•261 x shadow cost for renting GMP site for 1.5 additional hours per month | •245 CHWs x shadow wage for 1 additional hour per month at GMP sessions in one-year project<br>•245 x shadow cost for renting GMP site for 1 additional hour per month | •Each CHW has one GMP session per month |

*Annex 2 continued on next page*

*Continued from previous page*

| Cost Center | CCM of SAM area | Comparison area | Assumptions |
|---|---|---|---|
| Household visits | • CHW shadow wage for 1 hour per week x all children enrolled in program<br>• Cost of materials used by CHW in visits (e.g., flip charts, MUAC strips) | • CHW shadow wage for 1 hour per week x all children enrolled in program<br>• CHW shadow wage x 1 hour pre- & 1 hr post-UHC follow-up visit for all cases attending UHC<br>• Cost of materials used by CHW in visits (e.g., flip charts, MUAC strips) | • CHWs make one visit to each child with SAM per week<br>• CHWs in comparison area visit each child with SAM once before and after they attend UHC<br>• Children recovering at UHC did not receive additional visits from CHW |
| Curative Care | • RUTF + shipping and storage costs<br>• Medicines given by CHWs (Cotrimoxazole & folic acid) x all enrolled children<br>• UHC setup equipment (e.g., height board, refrigerator) | • UHC setup equipment (e.g., height board, refrigerator)<br>• Medicines, food, and bed costs at UHC<br>• Therapeutic milk ingredients<br>• Salary (% time): 1 doctor (4.4%), 2 nurses (6%, 7.3%), 2 medical assistants (0.4%, 1.8%), 1 facility health worker (100%) | • One-half of costs for refrigerator & installation included as it was also used for other medicines<br>• UHC food estimates comprise one-half daily food provided by UHC & one-half median value of daily food purchased reported by caretakers<br>• Facility health worker spent 3 hours a day per child at UHC<br>• Comparison area estimate includes no costs for drugs given by CHW for CCM of ARI & diarrhoea<br>• Average length of stay used for each outcome category |
| Household costs | • Shadow cost of caretakers' time meeting w/CHW each week, extra daily time feeding child RUTF | • Shadow cost of caretaker's time spent with CHW during visits, and in responsive feeding of child<br>• Costs for food, transportation, and caretaker time traveling to UHC and waiting for admission<br>• Costs for UHC stay include caretaker's time, visitor's time @ 50% + their transportation and travel food costs<br>• Medicine, doctor's fees and travel to seek treatment for SAM | • In CCM of SAM area, costs of medicines, doctor's fees, and other foods purchased were negligible on average and therefore not included<br>• Average length of stay in program for each outcome category comes from community discussions<br>• Outpatient care costs include weekly time, medicine, doctor's fees, and food expenditures, and one-time cost for travel to seek treatment for child outside own village |

See Table 16 for summary of additional personnel time allocated for treatment and management of SAM.

**Table 15: Allocation of overhead costs to intervention and comparison area**

| Office | % costs allotted | Area allotted |
|---|---|---|
| Intervention Upazila office | 30% | Intervention |
| Comparison Upazila office | 15% | Comparison |
| UHC in comparison Upazila | 4% | Comparison |
| Bhola District office | 10% | 2/3 Intervention, 1/3 Comparison |
| Barisal Division office | 5% | 2/3 Intervention, 1/3 Comparison |
| Dhaka office | 5% | 2/3 Intervention, 1/3 Comparison |

**Table 16: Summary of additional personnel time allocated for treatment and management of SAM**

| Category | Overall | |
|---|---|---|
| | Community program | Facility program |
| **SC US staff** | | |
| Community health workers (CHWs): | | |
| Extra time for GMP session/month | 1.5 hours | |
| Extra household visits/week/SAM child | 1-3 @ 45 min. | 1-3 @ 75 min |
| District Staff (Bhola): | | |
| Monthly District Coordination meetings | + 15 min. | |
| 1 Senior Program Officer–SAM | 100% | |
| | 66% | 33% |
| 3 Program Officers–SAM | 100% x 2 | 100% x 1 |
| 15 MCHN FOs: CHW SAM activities | 30% x 7 | 15% x 8 |
| 8 Partner FOs: CHW SAM activities | 25% x 5 | 10% x 3 |
| 1 Administrative & 1 IT Officer | 12.5% | |
| 1 Finance Officer | 7% | |
| Division Staff (Barisal) | | |
| 1 Finance & 1 Administrative Officer | 5% | |
| Country Office Staff (Dhaka) | | |
| 1 HR Officer | 25% | |
| 1 IT Officer | 10% | |
| 1 Driver | 100% | |
| DPM-Nutrition | 50% @ 19 mos. (avg.) | |
| DCD-Health & Nutrition Programs | 1.5% @ 7 mos. | |

*Table 16 continued on next page*

*Continued from previous page*

| Category | Overall | |
|---|---|---|
| | **Community program** | **Facility program** |
| **Health Facility staff (time per child)** | | |
| Medical Assistants: | | |
| Admission | | 15 min. |
| Daily care | | -- |
| Nurses: | | |
| Admission | | 30 min. |
| Daily care | | 18 min. |
| Doctors: | | |
| Admission | | 10 min. |
| Daily care | | 10 min. |
| Facility Health Volunteer | | |
| Admission | | -- |
| Daily care | | 3 hours |

The times stated here reflect the *additional* time, on top of existing workload, required for the management of SAM.

## Table 17: Average household cost per child for SAM care and treatment by area#

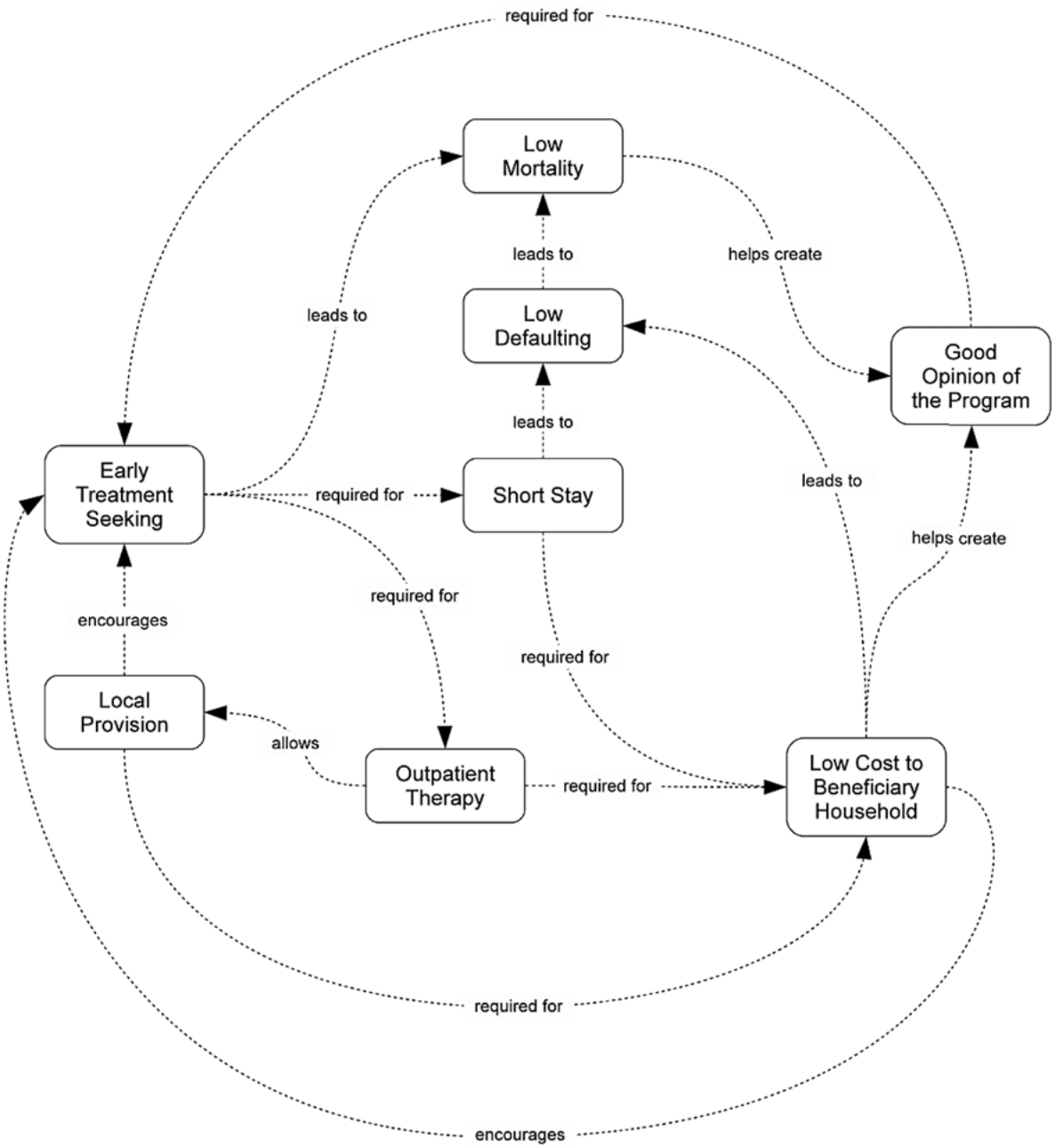
| Cost by outcome | USD | USD | USD | USD |
|---|---|---|---|---|
| **Community case management of SAM** | **Recovered N = 665** | **Default N = 54** | **Non-response N = 4** | **Death N = 1** |
| Total costs for *(n)* weeks average stay: | *(4.8)* | *(4.8)* | *(14.6)* | *(7.0)* |
| Time in weekly follow-up meeting with CHW* | 1.06 | 1.06 | 3.21 | 1.54 |
| Extra time per day to feed child RUTF* | 7.44 | 7.44 | 22.63 | 10.85 |
| **Total household costs per child in Borhanuddin** | **$8.50** | **$8.50** | **$25.84** | **$12.39** |
| **Facility-based management of SAM** | | | | |
| **UHC referral and stay** | **Recovered N = 9** | **Default N = 50** | **No inpatient care N = 237** | |
| One-time costs:[9] | | | | |
| Time in CHW household visit pre- & post- UHC* | 0.44 | 0.44 | 0.44 | |
| Caretaker transportation to UHC | 2.35 | 2.35 | 2.35 | |
| Caretaker travel time* | 1.18 | 1.18 | 1.18 | |
| Caretaker travel food | 1.47 | 1.47 | 1.47 | |
| Accompaniment food | 0.74 | 0.74 | 0.74 | |
| Accompaniment travel | 2.35 | 2.35 | 2.35 | |
| UHC Admission wait time* | 0.59 | 0.59 | 0.59 | |
| Total daily costs for *(n)* days average stay: | *(14)* | *(7)* | *(0)* | |
| Food purchased by caretaker | 5.18 | 2.59 | -- | |
| Caretaker wage loss per day* | 20.58 | 10.29 | -- | |
| Cost for visitors assisting with child care | 14.84 | 7.42 | -- | |
| Total inpatient costs | $49.72 | $29.42 | $9.12 | |
| **Outpatient care** | | **Default** | **No inpatient care** | **Refused referral N = 335** |
| One-time treatment-seeking costs: | | | | |
| Transportation to doctor | | 0.88 | 0.88 | 0.88 |
| Caretaker's travel time* | | 0.29 | 0.29 | 0.29 |
| Total weekly costs for *(n)* weeks average stay: | | *(16)* | *(16)* | *(16)* |
| Extra time feeding SAM child* | | 7.52 | 7.52 | 7.52 |
| Time in weekly follow-up meeting with CHW* | | 3.52 | 3.52 | 3.52 |
| Medicine and doctor's fee costs | | 11.04 | 11.04 | 4.64 |
| Extra food purchased for child | | 23.52 | 23.52 | 28.32 |
| Total outpatient costs | | $46.76 | $46.76 | $45.17 |
| **Total household costs per child in Lalmohan** | **$49.72** | **$76.18** | **$55.88** | **$45.17** |

* Costs for caretaker's time are calculated using median reported time allocation multiplied by the shadow wage rate: 20 Tk ($0.29) per hour or 100 Tk ($1.47) per day.

# These estimates are from focus group discussions and the sample may not be representative of all caretakers in the program area. These provide a summary of the median value and ranges for key variables experienced by caretakers enrolled in the program.

[9] In two out of four focus groups, caretakers also reported paying bribes to UHC staff for items such as meals, mosquito nets, admission, beds, and therapeutic milks used for treatment. Median values for these bribes ranged from 10 to 60 Tk, with median total bribes equaling 45 Tk.

## ANNEX 3: THE VIRTUOUS CYCLE CREATED BY THE CCM OF SAM PROGRAM IN BANGLADESH

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