ENABLING TREATMENT OF SEVERE ACUTE MALNUTRITION IN THE COMMUNITY:

Study of a Simplified Algorithm and Tools in South Sudan
June 2018

EXECUTIVE SUMMARY

FINAL REPORT

BACKGROUND

Malnutrition in South Sudan is omnipresent due to factors such as widespread disease (particularly malaria, diarrhea and pneumonia), poor health infrastructure and access to timely and effective treatment, prevalent non-recommended infant and young child feeding practices and inconsistent availability and accessibility to a diverse diet. In Aweil South County, the global acute malnutrition (GAM) prevalence remains above the national average and above the emergency threshold of 15% at 17.7%. A survey conducted by the International Rescue Committee (IRC) in Aweil South County showed that nearly 60% of severely malnourished children were not receiving treatment for severe acute malnutrition (SAM) through static facilities, with caregivers identifying the main barriers to accessing care as distance to facilities, inaccessibility due to the rainy season and high opportunity costs.

The IRC has been developing innovative approaches to increase access to treatment for acute malnutrition. Recognizing that long travel distance to facilities leads to high opportunity costs for caregivers, the IRC developed simplified tools and a simplified SAM treatment protocol to enable low-literate community-based distributors (CBDs) to treat children for malnutrition closer to the home. This included developing a modified mid-upper arm circumference (MUAC) tape with smaller color zones for monitoring progression, regression and stationary cases and a visual decal on the balance when weighing children to count out the number of sachets of ready-to-use therapeutic food (RUTF). Previous studies from Bangladesh have shown promising results with regard to how community-based models to treat SAM can be. However, models for low-literacy, crisis-affected settings have not yet been studied.

STUDY OBJECTIVE

To assess the feasibility of community-based distributors in South Sudan providing treatment for uncomplicated cases of severe acute malnutrition in their homes.

STUDY PERIOD

March - September 2017

STUDY METHODOLOGY

A total of 60 CBDs from four payams in Aweil South County were selected for training through simple random sampling. All selected CBDs were female, had no formal education, lived more than 5km from the nearest health facility and were accessible during the rainy season. After confirmation of distance from the health facility, three CBDs were excluded and fifty-seven CBDs remained to participate in a six-day training on the simplified tools and SAM treatment protocol. Immediately after training completion, CBDs participated in an assessment where they were evaluated on their performance of treating a SAM case using a standardized performance checklist. Only CBDs who scored higher than the a-priori determined cut off score of 80% qualified to pilot treatment in the community. Based on their performance scores, 44 CBDs were selected for study implementation.

Between March and September 2017, 44 CBDs admitted and treated 320 children with uncomplicated SAM between 6-59 months of age. Study staff conducted bi-weekly supervision visits during which they observed CBDs while they provided SAM treatment to admitted children. During each performance check, the study staff filled out a standardized performance checklist to monitor the CBD's ability to correctly use the simplified tools and follow the simplified treatment protocol. Data on child progress and treatment outcomes were extracted from the patient register, including weekly MUAC measurement and the number of sachets of RUTF distributed per week.

Image 1
CBDs reviewing their work together
Photo credit: Elburg van Boetzelaer / The IRC

RESULTS

Performance scores calculated from the standardized checklist were collected for all 57 CBDs immediately following the training. The participants had a mean performance score of 94%, 91% of the participants passed at the a priori determined cut-off of 80% and 49% had a perfect score. For the 44 highest-performing CBDs selected for study implementation, the mean score dropped from 97% immediately after the training to 82% during the first supervised home treatment, but by the last supervised visit, the score had increased up to 94%. Of key CBD characteristics (CBD age, number of years working as CBD, performance checks conducted), only the number of performance checks had a statistically significant association with the performance score of the last supervisory visit completed (for each visit made, there was an increase in performance score of 2%).

The rate of children treated by CBDs that recovered from SAM to the moderate acute malnutrition (MAM) cut-off was 91%, surpassing the 75% Sphere standard and the remaining 9% defaulted. The median length of treatment among those who recovered to MAM was five weeks. The recovery rate of children that were admitted by CBDs for treatment from SAM to full recovery was 75%. The median length of treatment among SAM cases who recovered fully was 8 weeks. Fifteen percent defaulted and 9% did not respond after 16 weeks of treatment. No deaths were reported. Thirty-seven percent of children admitted were referred, the majority (94%) for a protocol safeguard that the study team added for children staying in one MUAC color for four consecutive weeks (as proxy for potential underlying health conditions). Twenty-nine percent of children admitted for CBD treatment fell into the more severe red MUAC zone (9.0 – 10.25 cm) on admission versus the pink MUAC zone (10.25-11.5 cm). A significantly lower proportion of admitted children were in the red zone at the outpatient therapeutic program during the same period.

DISCUSSION

This study demonstrated that low-literate CBDs in South Sudan were able to treat SAM children in their homes with high accuracy using a simplified protocol and tools and achieve acceptable recovery rates. The performance scores were higher among those who received more supervision visits. The recovery rate for children enrolled in treatment met the Sphere humanitarian minimum standards despite treating children with lower MUAC on admission as compared to the facility, showing promise that deploying CBDs to treat SAM in areas with high prevalence and low treatment access may lead to earlier treatment seeking and timely case finding. Based on the percentage (84%) of children claiming to not have received treatment recently and the proportion of children with low MUAC on admission, we suspect that the CBD delivery of treatment increased access to timely care. A larger operational research study will be necessary to assess the most effective and efficient supervisory and supply chain mechanisms to operationalize the scale-up of CBD treatment and to quantify the cost-efficiency of such a program and its impact on access and coverage.

CONTENTS

ABBREVIATIONS

ACT	Artemisinin-based Combination Therapies
CBD	Community-based Distributor
CHW	Community Health Worker
CMAM	Community-based Management of Acute Malnutrition
CNV	Community Nutrition Volunteer
ENA	Emergency Nutrition Assessment
FGD	Focus Group Discussion
FSNMS	Food Security and Nutrition Monitoring Systems
GAM	Global Acute Malnutrition
GFD	General Food Distribution
iCCM	Integrated Community Case Management
IDI	In-depth Interview
IPC	Integrated Food Security Phase Classification
IQR	Interquartile Range
IRC	International Rescue Committee
MAM	Moderate Acute Malnutrition
MoH	Ministry of Health
MUAC	Mid-Upper Arm Circumference
NGO	Non-Governmental Organization
ORS	Oral Rehydration Solution
OTP	Outpatient Therapeutic Program
RUTF	Ready-to-Use Therapeutic Food
SAM	Severe Acute Malnutrition
SMART	Standardized Monitoring and Assessment of Relief and Transitions
TSFP	Targeted Supplementary Feeding Program
WHO	World Health Organization

ACKNOWLEDGMENTS

Study Team:
Naoko Kozuki
Elburg van Boetzelaer
Annie Zhou
Casie Tesfai

1. BACKGROUND

Pneumonia, diarrhea and malaria are the leading causes of post-neonatal under-five deaths worldwide. Integrated community case management (iCCM) of childhood illness is a strategy that utilizes community health workers (CHW) to deliver treatment for uncomplicated cases of these illnesses. Currently, malnutrition, which underlies half of these cases, is only addressed by iCCM as a referral trigger rather than direct treatment. South Sudan is one country that has adopted the iCCM strategy at the national level, deploying Community-Based Distributors (CBDs), South Sudan's CHW cadre.

Acute malnutrition in South Sudan is omnipresent and is due to factors such as widespread disease (particularly malaria, diarrhea and pneumonia), poor health infrastructure and access to timely and effective treatment, prevalent non-recommended infant and young child feeding practices (on breastfeeding, hygiene and complementary feeding), inconsistent availability and accessibility to a diverse diet and limited access to safe drinking water. The National Bureau of Statistics in 2017 reported an annual increase in the price index of food and non-alcoholic beverages of 124%, mainly driven by an increase in bread and cereals.[1]   Moreover, recurring food insecurity and conflict have cut off access to health services while increasing their demand especially for children under five and women, as well as strained the humanitarian community's capacity to respond to the immediate basic needs of the most vulnerable.

In February 2017, the Integrated Food Security Phase Classification (IPC) for South Sudan declared a Phase 5 famine in parts of the country where an estimated 4.9 million people (more than 40% of the population) were in urgent need of nutrition assistance. The updated IPC in September 2017 showed that Aweil South County in Northern Bahr El Ghazal State was classified as Phase 4 – Emergency between May and July 2017 (see image), meaning that "even with humanitarian assistance one in five households have large food consumption gaps resulting in very high acute malnutrition and excess mortality."[2]

Map 1
IPC Classification map for South Sudan
for May-July 2017

1 World Food Programme. South Sudan monthly market price monitoring bulletin August 2017. Accessed from: https://reliefweb.int/report/south-sudan/south-sudan-monthly-market-price-monitoring-bulletin-august-2017

2 Integrated Food Security Phase Classification for the Republic of South Sudan. Key IPC findings: January – July 2017. Accessed from: https://reliefweb.int/report/south-sudan/key-ipc-findings-january-july-2017

During the peak lean season in July 2017, a Food Security and Nutrition Monitoring Systems (FSNMS) survey showed a global acute malnutrition (GAM) prevalence of 17.7% in Northern Bahr el Ghazal State, which exceeds the World Health Organization (WHO) emergency threshold of 15%.[3] The most recent coverage survey for Aweil South on record, conducted by the International Rescue Committee (IRC) in 2015, showed only 41% of severely malnourished children had access to treatment programs. Caregivers identified distance to health facilities, inaccessibility due to the rainy season and high opportunity costs as the primary barriers to access.[4]

To address the lack of access to acute malnutrition treatment in remote communities, the IRC developed an approach to bring acute malnutrition treatment to these communities by capitalizing on the existing CBD cadre. The IRC has been implementing iCCM in South Sudan since 2005 and has demonstrated that low-literate CBDs can deliver timely and effective iCCM treatment – even in remote, emergency affected areas– if protocols are appropriate to the capacity of the provider and CBDs are effectively trained and supported. In South Sudan, where most CBDs are low-literate and each covers approximately 50 households, CBDs provided 10 times more treatments for diarrhea than the health facilities.[5]
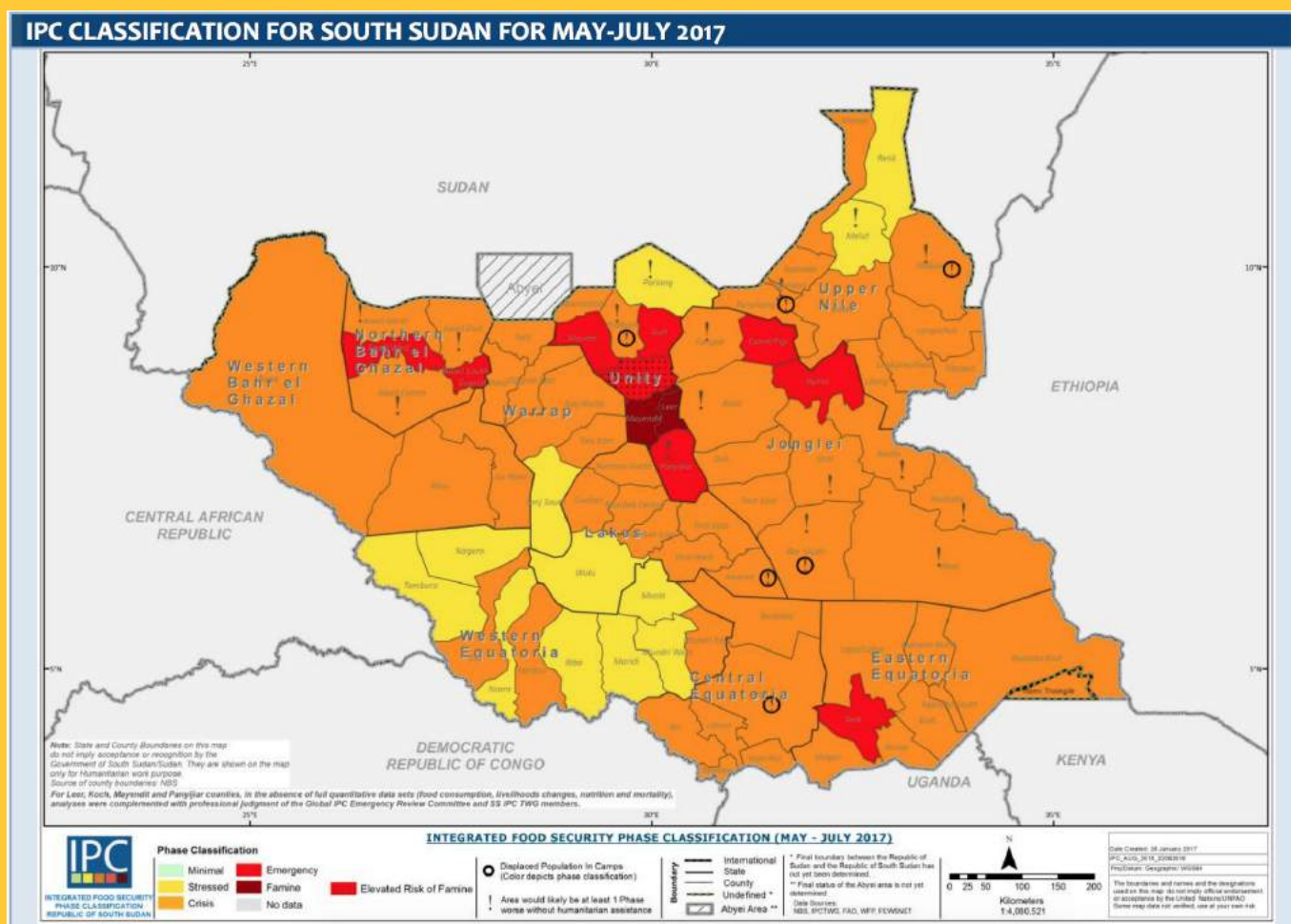
3 UNICEF. South Sudan situation report 30 September 2017. Accessed from: https://reliefweb.int/sites/reliefweb.int/files/resources/UNICEF%20South%20Sudan%20
   Humanitarian%20SitRep%20%23113%20_%2030%20September%202017.pdf
4 International Rescue Committee. Coverage Assessment: Semi-Quantitative Evaluation of Access & Coverage. Aweil South County, Republic of South Sudan. March 2015.
5 Barbera Lainez Y, Witcoff A, Issa Mohamud A, Amendola P, Perry HB, D'Harcourt E. Insights from Community Case Management Data in Six Sub-Saharan African Countries. Am. J. Trop. Med. Hyg., 87(Suppl 5), 2012, pp. 144–150.

Studies from Bangladesh have shown promising results with regard to how community-based models can effectively treat Severe Acute Malnutrition (SAM).[6] However, models for low-literate, crisis-affected settings have not been studied. There are major knowledge gaps, particularly around how to simplify the SAM treatment protocol so that low-literate CBDs can adequately treat and monitor children.[7]

To address this gap, the IRC developed a simplified SAM treatment protocol and a set of low-literacy-adapted tools that could be used as part of the iCCM program. The research and development phase took two years. In initial stages in 2015, the IRC conducted several key-informant interviews with iCCM providers and iCCM and nutrition staff in South Sudan to design the overall vision for an integrated program and provide consensus on potential tools. All informants agreed that tools needed to be extremely simple to apply, should follow the Ministry of Health (MoH) SAM treatment protocol for admission and discharge by mid-upper arm circumference (MUAC) and should not require literacy or numeracy. The IRC worked with Quicksand, a user-centered design firm and the IRC's Airbel Center to create and field test with CBDs several rounds of prototypes in Mali, Chad, South Sudan and India. After each round of testing, modifications were made and re-tested with the final round of field testing with CBDs completed in November 2016 in Aweil South.

The IRC conducted a study to assess the feasibility, acceptability and effectiveness of the simplified SAM treatment algorithm and low-literacy adapted tools used by CBDs to treat uncomplicated SAM. The study sought to determine if, using a simplified treatment algorithm and tools, the existing iCCM program infrastructure and CBDs can deliver treatment for acute malnutrition. In addition, financial costs, challenges and strengths of the strategy were assessed. The study followed a mixed-methods approach to evaluate their performance through observations of case management practice and investigate the feasibility and acceptability of the simplified protocol and tools from the perspectives of key stakeholders, including the CBDs themselves.

6 Puett C, Coates J, Alderman H, Sadler K (2012). Quality of care for severe acute malnutrition delivered by CHWs in Southern Bangladesh. Maternal & Child Nutrition 9(1): 130-142.

7 Friedman L & Wolfheim C. (2014) Linking Nutrition and (integrated) Community Case Management (iCCM/CCM): A Review of Operational Experiences (London, 2014)

1.1 SIMPLIFIED TOOLS

1.1.1 Modified MUAC Tool

CBDs were instructed to admit children using the MUAC-based criterion, in contrast to outpatient programs that also admit based on a weight-for-height z-score and oedema (grade 1 or 2). A study by Binns, Dale and Hoq et al demonstrated that changes in weight and MUAC occur similarly over the continuum of treatment and particularly during illness, introducing the possibility that MUAC could be used to follow up children as an alternative to weight.[8] We have modified the standard MUAC tape to include more colors (and shorter zones). Splitting the traditional red zone (<11.5cm) into three colors (dark red for <9cm, red for 9-<10.25cm, pink for 10.25-<11.5cm) allows for easier, visual monitoring of child progression and regression in treatment.

Image 2
Modified MUAC Tool
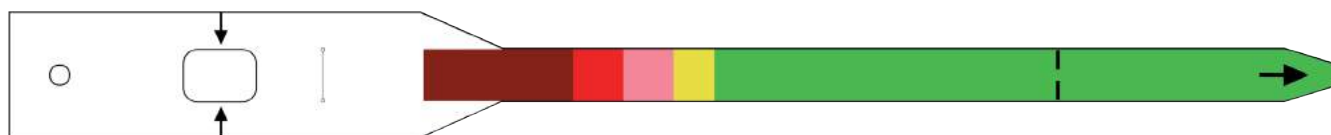
Based on Outpatient Therapeutic Program (OTP) data in Aweil South, the study team created a safeguard for any critically low MUAC below 9.0 cm to be referred immediately since these children usually develop medical complications that require inpatient care. The dark red zone therefore became a danger sign. For admission criteria, a MUAC measure between 9.0-<11.5cm (red or pink zone) with no danger signs (medical complications) and a good appetite are treated by the CBD. Discharge is attained if the child has two consecutive MUAC measurements at ≥12.5 cm (green), which is in line with global recommendations. Children found to have a MUAC measurement between 11.5-<12.5cm (yellow) on admission are referred to a Targeted Supplementary Feeding Program (TSFP). Any child with bilateral pitting oedema or any of the iCCM danger signs is immediately referred by CBDs to a health facility.

1.1.2 Simplified weight scale and Ready-to-Use Therapeutic Food (RUTF) dosage calculator

The next tools aimed to address correct calculation of the daily and weekly dosage of RUTF by CBDs. CBDs used child weight to determine daily dosage of RUTF. We first simplified the standard RUTF look-up table, rounding down half-sachet daily doses to whole numbers. The decision to round down was based on findings from a secondary data analysis that showed child caloric needs would be sufficiently met with the rounded-down dosage.[9] This created fewer dosage zones, as shown in the table below.

8 Binns P, Dale N, Hoq M., Band C, Myatt M.(2015).Mid upper arm circumference and weight changes in children aged 6-59 months. Archives of Public Health 73(54).

9 Bailey J, Chase R, Kerac M, Briend A, Manary M, Opondo C, Gallagher M, & Kim A (2016). Combined protocol for acute malnutrition study (ComPAS) Report for Stage 1. Emergency Nutrition Network. Accessed from: https://www.ennonline.net/fex/53/thecompasstudy.

Table 1
RUTF dosage table for simplified SAM treatment protocol

Child's Weight (kg)	# of Sachets per day (OTP)	# of Sachets per day (simplified protocol)
4.0 - 4.9	2	2
5.0 - 6.9	2.5	
7.0 - 8.4	3	3
8.5 - 9.4	3.5	
9.5 - 10.4	4	4
10.5 - 11.9	4.5	
≥ 12.0	5	5

Next, a weight scale decal was developed to place on the face of a Salter scale. The area between 0-4kg was colored black to represent immediate referral. The table above was converted into segments on the decal, with dots representing the number of RUTF sachets to be provided per day for children landing in the respective weight zones.

To calculate the weekly RUTF dosage based on the daily dosage determined using the decal above, a tool with seven rectangles representing one for each day of the week was developed (called the RUTF Dosage Calculator) which enabled CBDs to calculate the correct weekly quantity without needing to multiply as shown in the photo below. The CBD places each day's dosage onto each square. When the dosage has been placed on each of the seven squares, the total sachets equal the weekly dosage.

Image 3
Simplified weight scale decal
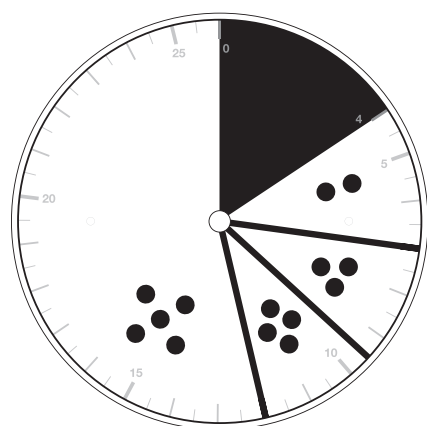
Image 5
RUTF Dosage calculator
Photo credit: Annie Zhou / The IRC

Image 4
Weight scale with simplified decal
Photo credit: Elburg van Boetzelaer / The IRC

1.1.2 Patient Register

Treatment was recorded in a patient register designed with visual icons and colors to record sex, age category, systematic drugs, the amount of RUTF and the color of the MUAC each week. On the left side of the register page, the demographic information and the systematic medication of the child is recorded. This includes the sex and age of the child (infant or toddler), whether the child received amoxicillin and what dosage (pink package for infants and green package for toddlers) and whether the child received albendazole and what dosage (half tablet for toddlers aged 12-23 months and 1 tablet for children above 24 months).

Image 6
Patient register page

In the middle section of the register page, the weekly MUAC measurement and RUTF dosage is recorded, as well as any week-specific reminders for the child's visit. Each horizontal row represents a week, with a maximum of 16 rows (or 16 total weeks of treatment) available. The house icon next to the row of week 8 is a reminder at 8 weeks that if a child still has a red MUAC, a home visit should be conducted by the CBD.

On the bottom are icons for the CBD to mark the discharge status of each child. Starting at the bottom left, recovery/cure is noted by a happy child and two consecutive green dots.[10] Defaulting is signaled by two consecutive absences (strikethroughs of two consecutive rows), non-respondent signaled by a child who is still malnourished at 16 weeks (the last row of the register) and transfer signaled by a health facility icon. Death is signaled by a dead bird.

Finally, on the right side is a vertical strip that is perforated and can be detached as an ID card. We recognized the need to enable a CBD who cannot read or write to link record and child correctly. To address this problem, we developed a counterfoil ID system. This system uses colored bars of different sizes to provide a unique identifier for each patient register sheet and matching patient ID card. When the patient card is torn off and given to the caregiver, she would return to the CBD with this card and the CBD would be able to match it to the correct record.

1.1.4 RUTF feeding messages flipchart

At the end of the visit, the CBD gives advice to the caregiver using a flipchart on the five key messages for feeding a child RUTF.

Image 7
RUTF Feeding messages
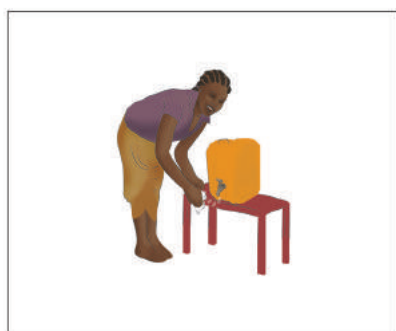
1. Wash your hands and your child's hands with soap and water before giving RUTF.
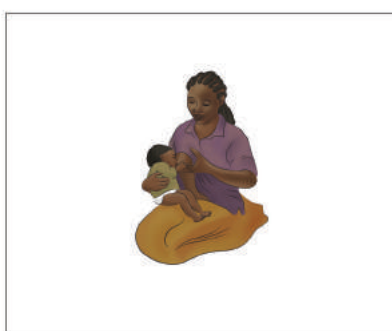
2. Before giving RUTF, breastfeed your child.
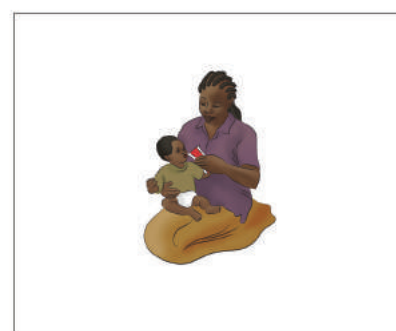
3. After breastfeeding, feed your child as much RUTF as she/he can eat
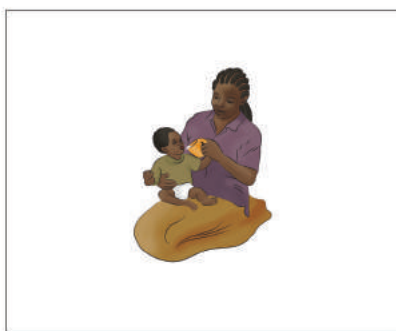
4. Give your child plenty of clean water to drink.
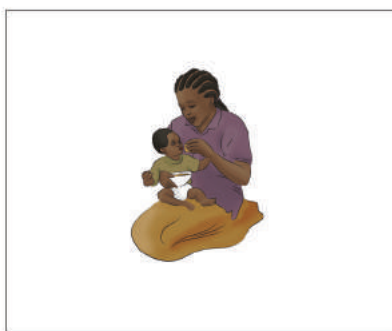
5. If your child is still hungry feed your child family food. Make sure your children eat the correct amount of RUTF before giving additional food.

10 Recovery and cure are used interchangeably throughout this report.

1.2 SIMPLIFIED SAM TREATMENT PROTOCOL

To enable low-literate CBDs to treat SAM in their community, the standard protocol for the community-based management of acute malnutrition (CMAM) had to be simplified while maintaining the most critical components necessary for assessing, treating and monitoring SAM children. For example, we replaced the standard CMAM assessment with the iCCM danger sign assessment since the two are very similar and CBDs are accustomed to the iCCM assessment through their iCCM responsibilities. Additionally, all SAM cases under the CBD's care use MUAC only for admission, follow-up and discharge, as opposed to CMAM where a more complicated weight-for-height measurement is also a criterion. Following CMAM protocol, CBDs were trained to administer the appetite test weekly using one sachet of RUTF to ensure that children would be able to take the required dosage of RUTF for recovery; however, the criterion for passing the appetite test was simplified to half a sachet due to accommodate numeracy challenges.

Image 8
Simplified SAM treatment algorithm

Simplified SAM Treatment Algorithm:

or
other danger signs

Referral to health facility

Appetite Test

Pass ✓   Fail ▲

Appetite Test

Pass ✓   Fail ▲

Referral to TSFP

Normal

Tell the caregiver their child is not malnourished and encourage them to continue feeding their child the same way.
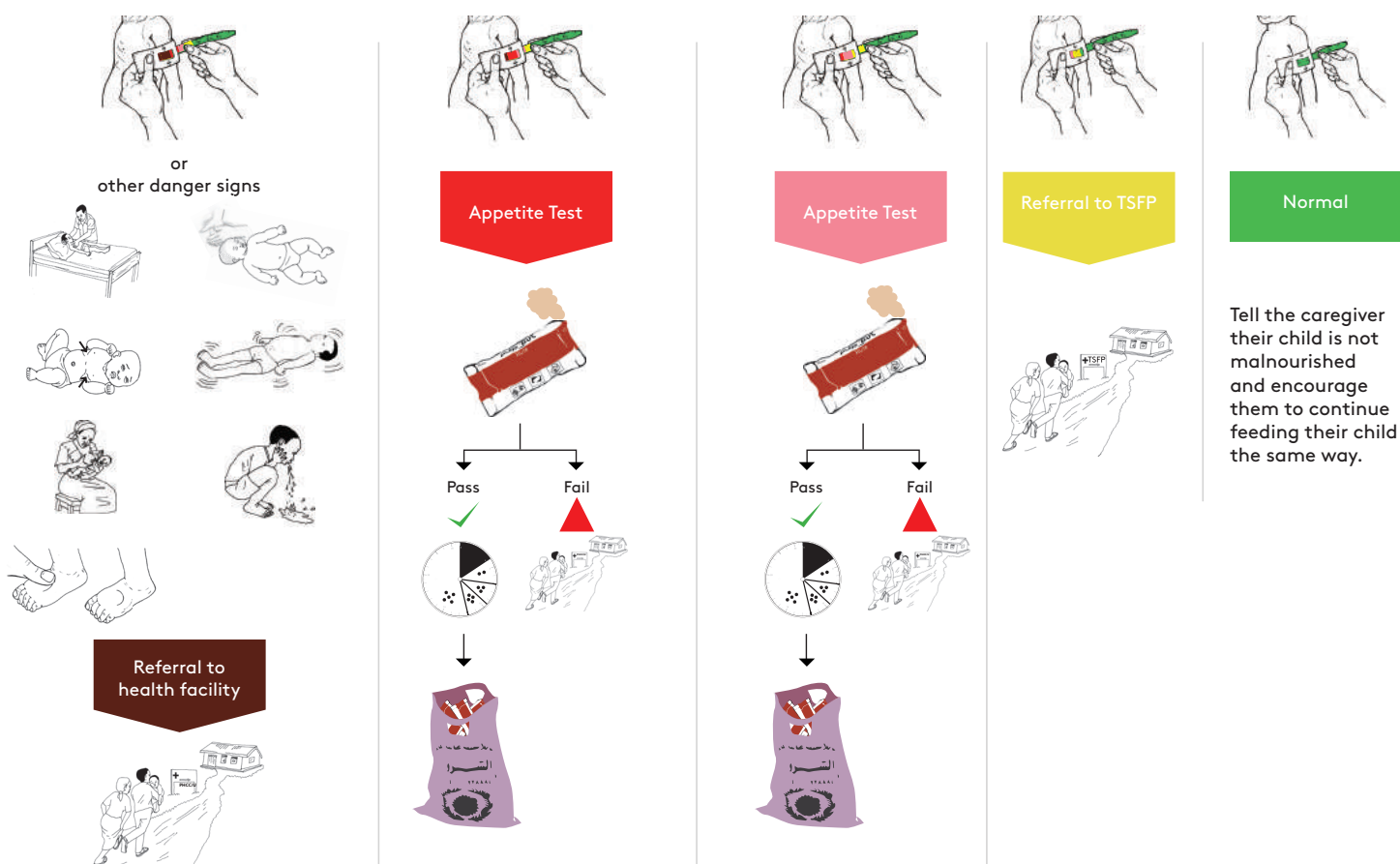
As this was the first time that low-literate CBDs were trained on the simplified tools and simplified SAM treatment protocol, certain safeguards were put in place. They were only trained to treat uncomplicated SAM so children with a dark red MUAC measurement or bilateral pitting oedema (any grade) were referred to the health facility as these children often develop serious complications. Children were under treatment for a maximum of 16 weeks before they were discharged as non-recovered and referred to the facility. Finally, if children were stationary in one MUAC measurement color for four consecutive weeks (i.e. child had red or pink MUAC measurement for four consecutive weeks), the child was referred to the out-patient therapeutic program to be conservative in identifying potential signs of underlying medical complications. The simplified treatment protocol on admission and any of the subsequent visits can be found in Annex 1.

According to South Sudan national guidelines, the child receives amoxicillin during the first visit and albendazole during the second visit. No other routine nutrition medication was given in subsequent visits. Vitamin A supplementation was not included since WHO now recommends low dose Vitamin A (5000 IU) given daily from admission to discharge through RUTF instead of high-dose supplementation.[11]

1.3 INTEGRATION OF SAM AND iCCM TREATMENT

If a child had a simple iCCM condition (malaria, diarrhea, or pneumonia without any danger signs) and SAM, CBDs treated both conditions according to the following protocol:

Table 2
Integrated iCCM and SAM treatment protocol

Fever (Proxy for malaria)	Treat both conditions according to the standard iCCM and SAM protocols with RUTF for SAM and Artemisinin-based Combination Therapies (ACT) for malaria
Cough and fast breathing (proxy for pneumonia)	Treat both conditions with RUTF for SAM and amoxicillin for pneumonia without doubling the antibiotic dose. The child should not receive antibiotics course for pneumonia and antibiotics course for SAM, rather just one antibiotics course for both conditions
Diarrhea	Oral Rehydration Solution (ORS) and zinc should not be provided to children with SAM. Children with SAM and simple diarrhea were given RUTF only.

11 WHO. Guideline: Updates on the management of severe acute malnutrition in infants and children. Geneva: World Health Organization; 2013.

1.4 CHILD ADMISSION AND DISCHARGE CRITERIA FOR SAM TREATMENT BY CBD

CBDs were responsible for assessing the sick child that presented at their house, screening for malnutrition and determining their eligibility for SAM treatment and study participation using the following criteria:

The Child:

- Is 6-59 months old; AND
- Has a red or pink MUAC measurement; AND
- Does not have bilateral pitting oedema; AND
- Does not have any danger sign; AND
- Is able to pass the appetite test; AND
- Weight does not fall in the black area on the weight scale

CBDs provided SAM treatment until discharge of the child. Definitions of discharge criteria can be found in Annex 2. Upon the discharge of a child, the CBD recorded the classification on the patient register.

Image 9
CBD measuring child's MUAC
Photo credit: Elburg van Boetzelaer / The IRC

2. STUDY OBJECTIVES

PRIMARY OBJECTIVE

We aim to study whether CBDs can use simplified tools to effectively treat SAM without medical complications.

SPECIFIC OBJECTIVES

1. To determine at what accuracy CBDs can follow a simplified treatment protocol to safely manage SAM cases in their communities;

2. To track what percentage of SAM children treated by CBDs recover and time to recovery;

3. To determine what percentage of caregivers of eligible SAM children agree to be treated by CBDs;

4. To assess what supply distribution and storage mechanisms need to be in place to support CBDs in sustaining a SAM treatment program;

5. To calculate the cost associated with enabling CBDs to treat SAM in their own communities;

6. To assess the CBD acceptability of the simplified algorithm and tools and caregiver acceptability of CBD-provided SAM treatment.

3. STUDY METHODOLOGY

The implementation of this study is divided in two phases as set out below:

PHASE 1: March - April 2017

Training of 57 CBDs on the simplified tools and SAM treatment protocol. After training completion, each CBD was observed conducting the treatment protocol from beginning to the end as a skills assessment evaluation. CBDs who demonstrated proficiency on the evaluation qualified to participate in phase 2 of the research. Proficiency was defined as at least an 80% score on the critical incidents of a performance checklist.

Training → **Observation of protocol** → **+80% score can participate in research**
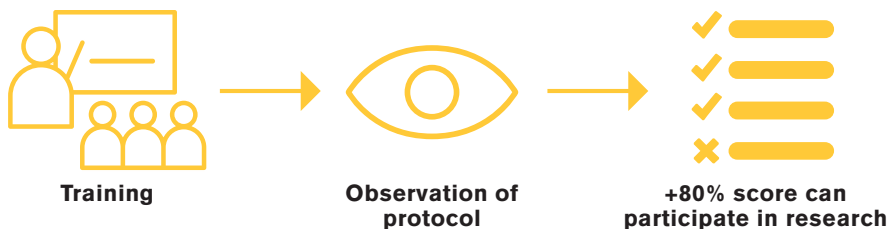
PHASE 2: April - September 2017

Study implementation. CBDs provided treatment for uncomplicated SAM in their communities. Four research officers conducted structured observations of CBD treatment of SAM children to monitor CBDs' performance. Qualitative research with CBDs, caregivers, community leaders and the IRC staff was conducted to understand CBDs' experiences providing treatment as well as to learn what maintenance (supply, systems and supervision) is required to enable CBDs to treat SAM in their own communities.

Treatment → **Observations** → **Qualitative research**
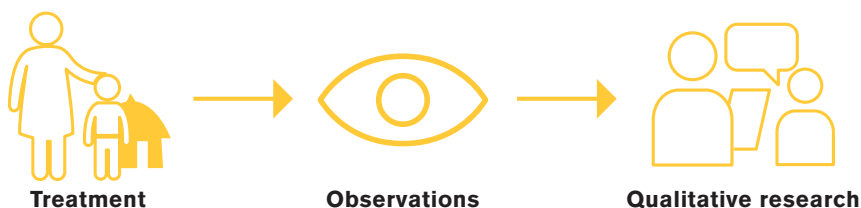
3.1 STUDY SITE

The study was conducted in Aweil South County, Northern Bahr El Ghazal State. Since 2013, the IRC has supported eight OTPs for the treatment of severe acute malnutrition without medical complications located at the health facility. Children are routinely screened in the community by a network of community nutrition volunteers (CNVs) supported by the IRC. The IRC also implemented an iCCM program in Aweil South from 2014 until April 2017 when the program in Aweil South was handed over to another Non-Governmental Organization (NGO).

The study area encompassed more than 600 female low-literate iCCM CBDs with a collective catchment area of 13,223 households in Aweil South. When working for the IRC's iCCM program, these women were trained, supervised and supplied with drugs to provide treatment for diarrhea, malaria and pneumonia to children under five in almost every village in Aweil South. Prior to this study, the CBDs were also tasked with screening patients for malnutrition by measuring the mid-upper arm circumference and checking for bilateral pitting oedema. Any malnourished child that was found was referred to the nearest OTP site. CBDs received a monthly incentive from the IRC but were not salaried employees.

Aweil South County has eight payams[12], three of which are inaccessible during the rainy season. Considering the necessity of accessing the payams for supply chain and supervision as a feasibility study, these three payams were excluded. Of the five remaining payams, only four were selected for the study based on the logistics of having four Research Officers. The excluded payam (Nyieth) was excluded based on it having the lowest average number of households covered per CBD. Based on the iCCM program records, 397 CBDs were available in the four payams selected for the study (Nyoc Awany n=92, Panthou n=105, Tiar Aliet n=120, Wathmuok n=80).

3.2 SAMPLE SIZE

The sample size for maximum SAM cases to enroll in the study was calculated to detect a statistically significant difference with the SAM cure rate of 75% which is the Sphere standard. With the assumption of precision of 10%, alpha of 5%, expected cure rate of 75%, a sample size of 72 SAM children per payam was needed. Accounting for a 10% loss-to-follow-up, we aimed to recruit 80 children per payam, for a total of 320 children.

12 Administrative sub-division of counties in South Sudan

3.3 SELECTION OF CBDS FOR TRAINING

CBDs with the following characteristics were excluded from eligibility of the 397 available (one person may contribute to multiple of the following categories): male (n=1), received any education (n=2), lives within 5km of the nearest OTP facility (n=171), CBD's house was not accessible during rainy season (n=9), participated in previous training or field testing of the simplified tools and SAM treatment protocol (n=19) and had travel time greater than 60 minutes to the farthest household in the catchment area (n=1) to ensure that supervision would be feasible. Also, with consideration for reaching the sample size of SAM cases, we limited selection to those who reported as serving 35 (the median value among all CBDs) or more households. The exclusion of these individuals left 106 CBDs eligible for inclusion in the study across the four payams that were selected for study implementation. Based on supervisory capacity of one Research Officer, 15 CBDs per payam were recruited for the training through simple random sampling, with the expectation to select a maximum of 11 CBDs per payam, the maximum number set based on logistical limitations of supervisory capacity.

Following the start of training, 3 of the 60 selected CBDs were later excluded, when it was discovered that one had participated in the formative phase of the study and two CBDs lived within 5km of the nearest OTP facility, leaving a total number of 57 CBDs.

Image 10
CBDs in training
Photo credit: Elburg van Boetzelaer / The IRC

3.4 TRAINING OF CBDS ON SIMPLIFIED TOOLS AND SIMPLIFIED SAM TREATMENT PROTOCOL

3.4.1 Initial Trainings

Research Officers

In March 2017, four Research Officers participated in a six-day training that was co-facilitated by the IRC's Technical Advisor for Health Research (Principal Investigator), Nutrition Specialist and Research Manager. The training was a combination of classroom learning, role plays and practical exercises. Research Officers familiarized themselves with the simplified tools and the simplified SAM treatment protocol and worked together to finalize the data collection tools and translate it into the Dinka language. The training also served as a 'Trainer of Trainers' workshop, as the Research Officers led the training of CBDs.

CBD Supervisors

All 31 CBD supervisors of the iCCM program, who were supervising one or more CBDs selected for training, participated in a two-day training that was facilitated by the Research Manager. CBD supervisors were trained on the simplified tools and the simplified SAM treatment protocol. In addition, the CBD supervisors were trained on the management and distribution of RUTF and drugs (amoxicillin and albendazole) and the correct tracking of the distribution from the re-stocking facility to the CBD home.

CBDs

In March and April 2017, 57 CBDs participated in a six-day training that was co-facilitated by four Research Officers with the support of CBD supervisors. In order to keep the training groups to a reasonable size that allowed for active participation and one-on-one training of participants, the trainings were organized per payam. The first day of training consisted of an iCCM refresher course, mainly focusing on the general and iCCM condition specific danger signs. The remaining five days of training were dedicated to the simplified tools and the simplified SAM treatment protocol. After the introduction of each simplified tool, participants engaged in many practical exercises, such as role plays, scenarios, as well as exercises in weighing a child from the community. On the first day after the training (day 7), CBDs were asked to demonstrate the entire simplified SAM treatment protocol using the simplified tools with a child seeking care at an OTP. During this demonstration, Research Officers observed and intervened when necessary to correct any errors and provided on-the-spot feedback. On the second day after the training (day 8), a skills assessment was conducted to assess the ability of the CBDs to correctly use the simplified tools and follow the simplified SAM treatment protocol.

Only those who scored 80% or above in this skills assessment were eligible to be selected for treating SAM children in the community. If there were more than 11 CBDs per payam who scored above 80% on the critical incidents, their general checklist score was used to select the highest performers. Subsequently, 44 of the highest scoring CBDs were selected for Phase 2 in which the CBDs provided SAM treatment in their community.

3.5 INFORMED CONSENT PROCEDURES

CBDs

Before the start of training, CBDs were asked for their consent for study participation, including the collection and use of their background characteristic data and their performance scores.

Eligible Children

Considering that the CBDs were not able to read or write, the IRC Institutional Review Board gave permission for an adapted informed consent procedure that was conducted in two steps, with the same procedure approved by the ethical committee of the MoH of the Republic of South Sudan. First, the CBD would ask permission from the caregiver to provide SAM treatment for the child. The CBD informed the caregiver that if s/he did not feel comfortable with SAM treatment provided by the CBD, s/he could take the child to the closest OTP site for SAM treatment. Only if the caregiver agreed to CBD provided SAM treatment did the CBD proceed with the treatment procedures. Following the child's admission visit, a Research Officer conducted a home visit to the caregiver to conduct an informed consent procedure in which the caregiver was asked to give permission for data collection of the child's treatment progress data.

Image 11
Research Officers explaining the weighing scale in training
Photo credit: Annie Zhou / The IRC

3.6 REFRESHER TRAININGS

After three months of study implementation, all 44 CBDs and 31 CBD supervisors participated in a one-day refresher training. The refresher trainings were organized per payam and were co-facilitated by the Research Manager and Research Officers.

Based on field observations and performance checklist results during the first three months of study implementation, areas for improvement and common mistakes were identified. A combination of classroom learning and practical exercises was used to facilitate the CBDs' learning and strengthen their abilities to correctly use the simplified tools and to correctly follow the simplified SAM treatment protocol.

4. STUDY IMPLEMENTATION

Image 12
CBD providing treatment in the community
Photo credit: Elburg van Boetzelaer / The IRC

4.1 START UP OF STUDY IMPLEMENTATION

The start of study implementation was staggered by payam to allow for the standardization of start-up activities. After the training and selection of CBDs, the Research Officers undertook the following activities in the selected communities to prepare for study implementation:

1. COMMUNITY SENSITIZATION MEETINGS

This study was implemented in collaboration with the national Ministry of Health as well as state Ministry of Health. Several meetings were held with Ministry of Health staff in Aweil and Juba to discuss the simplified tools, SAM treatment protocol and study methodology. Ministry of Health staff at the payam level were closely involved in different community sensitization activities described below. Prior to the start of study implementation and data collection, all communities with CBDs selected to deliver SAM treatment had an information session/community sensitization activity led by the Research Officers. The Research Officers informed them of the availability of SAM treatment in the community by the CBD and their right to participate or refuse participation in treatment from the CBD and the lack of consequences for either decision. The objective of the community dialogue was also to clearly communicate that the CBD has been well-trained on admission criteria and that she would not treat children who were not eligible for SAM treatment. Moreover, the Research Officers emphasized that the CBD only had a small amount of RUTF at her house, that RUTF is a medicine for children and community members should not pressure the CBD into giving out RUTF to community members who do not qualify for treatment.

2. DISTRIBUTION OF SIMPLIFIED TOOLS, RUTF AND DRUGS (AMOXICILLIN AND ALBENDAZOLE)

Before the start of study implementation, each CBD that was selected for study implementation received the simplified tools, a start-up quantity of RUTF and a quantity of drugs. In each payam, a restocking facility was identified close to the OTP site or the health facility to preposition RUTF and drugs.

4.2 SUPPLY CHAIN

CBD supervisors were responsible for the restocking of RUTF and drugs at the CBD house. Following the iCCM program protocol, the CBD supervisor conducted a weekly supervision visit at the CBD house, during which s/he verified the stock of the CBD and identified the quantity of RUTF and drugs that had to be re-stocked. At all times during study implementation, RUTF, amoxicillin and albendazole were prepositioned at the restocking facility of each payam, enabling the CBD supervisor to easily re-stock CBD sites when necessary. At the restocking facility, the RUTF, amoxicillin and albendazole were stored in metallic boxes that were locked with padlocks. For each payam, there was a 'Stock Monitor CBD supervisor' assigned, who was in charge of the weekly distribution of RUTF, drugs and soap from the restocking facility to the CBD supervisor. In general, the CBD supervisors used their bicycle to transport the RUTF and drugs from the restocking facility to the CBD house. However, as some CBD supervisors did not have a bicycle, they were also paid a transportation allowance that allowed them to rent a motorcycle to conduct the weekly RUTF and drug distribution.

Image 13
Weekly distribution chain of RUTF

Weekly distribution chain of RUTF

IRC Staff		CBD Supervisor		CBD	
General Store	→ Restocking Facility	→ CBD Home	→ SAM Child		
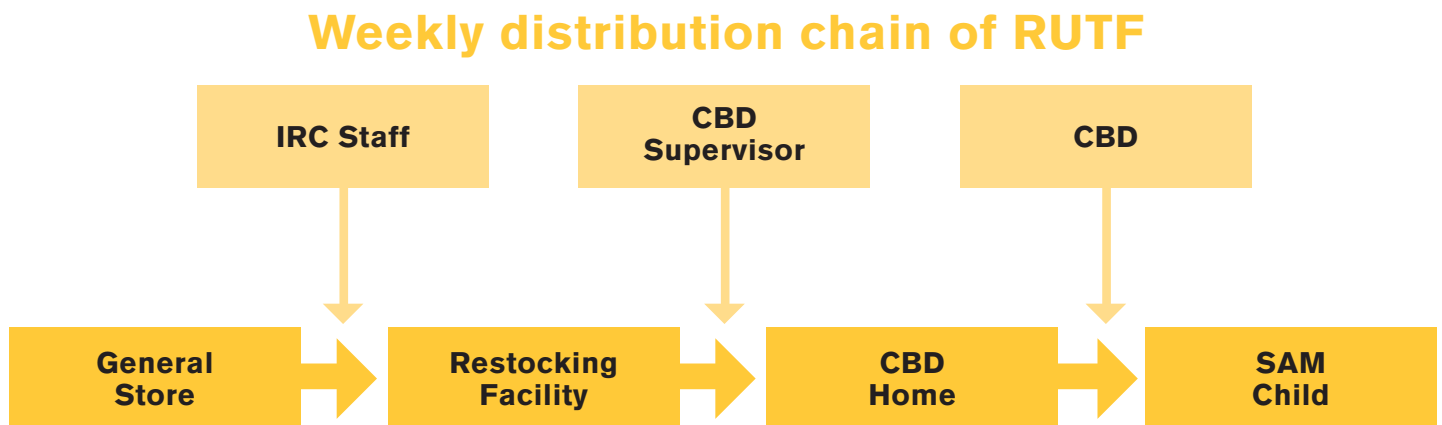
4.3 ADMISSION AND TREATMENT DAYS

In a similar system as the OTP, CBDs provided SAM treatment only one day per week in order to allow the Research Officers to conduct their supervision activities in an efficient manner and to minimize the chances of caregivers seeking malnutrition treatment from multiple locations. Each of the four payams had their own designated SAM treatment day. Research Officers were present in the payam during the SAM treatment day and circulated among the 11 CBDs in that payam to observe the CBDs providing SAM treatment. After reaching the sample size of 320 children (roughly 80 children per payam), all new admissions were stopped on 10 May 2017 and instead referred to the OTP.

4.4 SUPERVISION

CBDs were supervised biweekly by a Research Officer to confirm that they were assessing, diagnosing and treating SAM correctly. Every week on the designated SAM admission and treatment day, half of the CBDs received a full supervision visit (including observation of treatment using the performance checklist). The other half of the CBDs received a full supervision visit the following week. On the week that the CBD did not receive a full supervision visit, the Research Officer visited the CBD to update the child progress forms for children that are under treatment with the CBD and to verify the available RUTF stock.

To ensure proper enrollment, Research Officers performed an initial house visit for each child that had been admitted for SAM treatment by a CBD. During this visit, the Research Officer verified the age of the child and the MUAC measurement to make sure that only children that had a red or pink MUAC measurement had been admitted. If the Research Officer identified a child that was incorrectly admitted, the caregiver was informed that the CBD could not continue to provide SAM treatment for the child.

5. QUANTITATIVE DATA COLLECTION

Image 14
CBD practicing recording on a register during training
Photo credit: Annie Zhou / The IRC
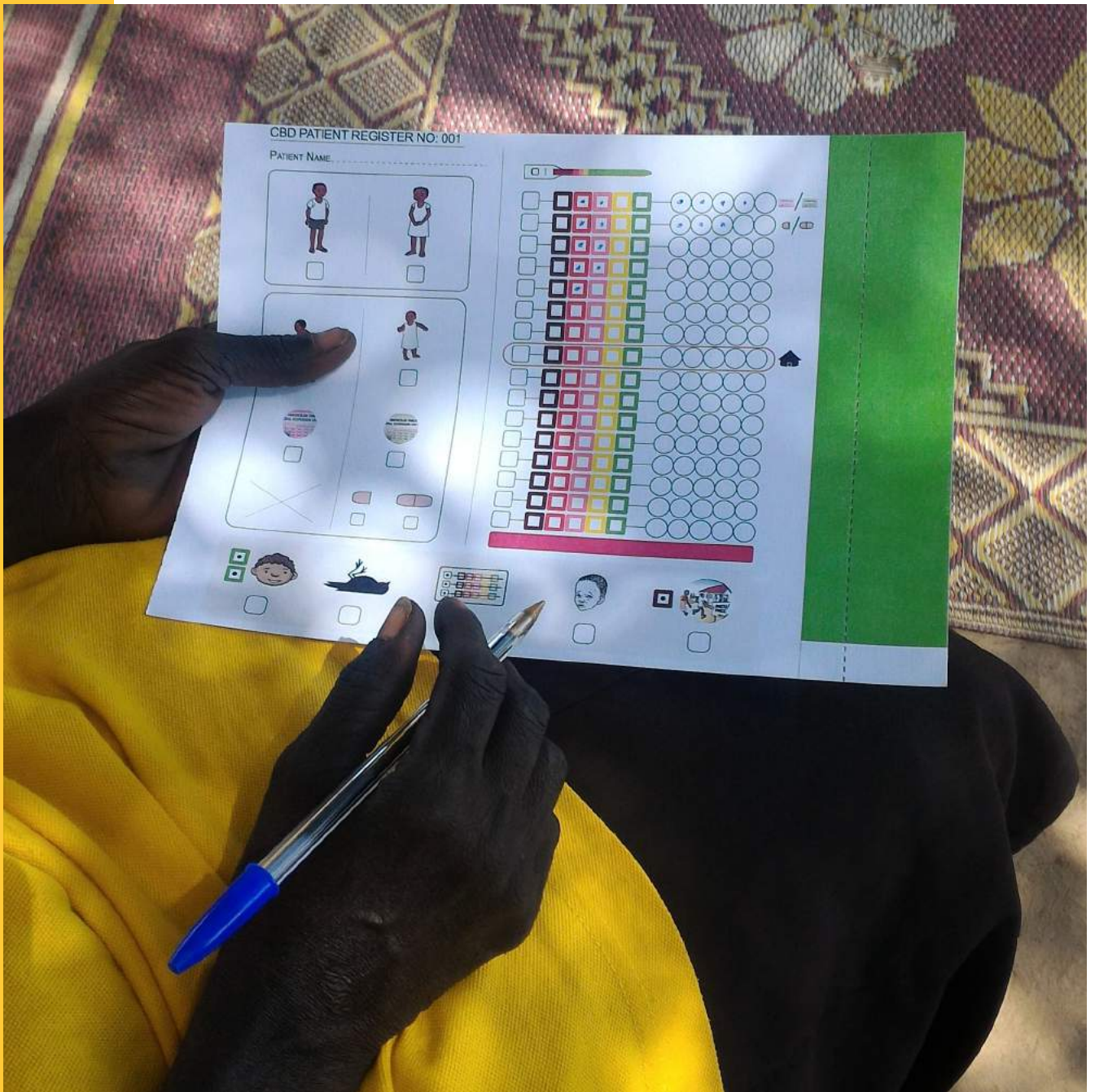
5.1 CBD CHARACTERISTICS

All 57 CBDs who participated in the training were asked a set of sociodemographic questions. From the IRC's iCCM database, information was extracted on the estimated number of households the selected CBDs serve.

5.2 CBD PERFORMANCE SCORES

5.2.1 General performance checklist and critical incidents

For the skills assessment after training completion and the CBD supervision visits that were conducted by the Research Officers during study implementation, a standardized performance checklist was developed. On the general performance checklist, 11 'critical incidents' were identified. Critical incidents were defined as malnutrition treatment-related checkpoints on which errors could lead to severe consequences that may put the child in danger and therefore should be weighed differently from the other checkpoints of the general checklist. Table 3 shows the critical incidents. For the full performance checklist, see Annex 3.

Table 3
Critical incidents for CBD supervision

#	# on CBD Supervision Checklist	Description of Critical Incident
1	1.1	CBD continued or stopped the protocol correctly depending on child's age
2	2.1 + 2.2	CBD correctly assessed the general and iCCM illness specific danger signs
3	2.3	CBD correctly assessed bilateral pitting oedema
4	2.4	CBD correctly took MUAC measurement
5	2.5	CBD correctly referred child if child had a danger sign
6	3.1	CBD conducted appetite test
7	3.3	CBD correctly conducted appetite test
8	4.2	CBD correctly identified weekly RUTF dosage
9	5.5	CBD gave correct amoxicillin dosage to child
10	6.4	CBD correctly referred stationary child
11	6.5	CBD correctly referred child with MUAC measurement below admission color

5.2.2 Inter- and intra-reliability

The performance checklist was pre-tested collectively with all four Research Officers to ensure they filled out the checklist consistently. Before the start of study implementation, the inter-rater reliability among the Research Officers was calculated. The Research Officers, in pairs, observed a CBD while she assessed and treated a child. Any discrepancies among the performance checklists that were filled out by the Research Officers were corrected. Each pair of Research Officers observed two different CBDs while she assessed and treated a child for SAM. The results of the inter-rater reliability can be found in Table 4.

Table 4
Inter-rater reliability of Research Officers

Research Officer	1	2	3	4
1		100%	100%	100%
2	100%		97.7%	100%
3	100%	100%		100%
4	100%	100%	97.7%	

As a part of the verification of the eligibility of children that are identified as SAM by the CBD, the Research Officers took the MUAC measurement of the child when conducting a home visit to the child after the child's admission for SAM treatment by the CBD. All Research Officers participated in a standardization test prior to the start of data collection to ensure inter- and intra-rater reliability of their MUAC measurements. During the standardization test, five children were measured twice by each Research Officer and the Research Manager and the results were analyzed using Emergency Nutrition Assessment (ENA) for Standardized Monitoring and Assessment of Relief and Transitions (SMART) software. Both inter- and intra-rater reliability was acceptable according to SMART standards.

5.3 CHILD CHARACTERISTICS

If a caregiver consented to the child's study participation, a sociodemographic questionnaire was administered by a Research Officer.

5.4 CHILD TREATMENT PROGRESS

For each child that received treatment from a CBD, the CBD monitored the child's treatment progress using the patient register. In addition, the Research Officers extracted child treatment data from the patient register weekly on a child progress data collection form. On the child progress form, the Research Officer recorded the weekly MUAC color of the child, the number of RUTF sachets that were distributed to the child by the CBD and whether or not the child was discharged during the treatment week. If the child was discharged, the Research Officer recorded the discharge status of the child and additional information regarding the discharge (e.g. length of stay, reason for default if child defaulted or reason for referral if child was referred, etc.).

5.5 SUPPLY AND STOCK OUT

Acknowledging the value of RUTF in the food insecure context of Aweil South and the risk of RUTF leakage, an extensive supply tracking mechanism was set up. The existing supply chain tracking forms used by the CBD supervisors and stock monitor CBD supervisors for the iCCM program were adapted to track the distribution of RUTF, amoxicillin, albendazole and soap.

Image 15
Boxes of RUTF at the storage facility
Photo credit: Annie Zhou / The IRC

5.6 COST

All project expenditures were tracked and recorded in the IRC's financial database, SUN Systems. This information was then imported into the IRC's Systematic Cost Analysis Tool for categorization (direct costs, support costs) and analysis using IRC's standardized methodology developed by the Best Use of Resources Team.[13]

5.7 ROUTINE DATA FROM OTP FACILITIES

The IRC's nutrition program regularly shared routine data from the OTP and TSFP facilities that are operated by the IRC in Aweil South. In addition, a data audit was conducted in November 2017 to collect treatment data from all children that were admitted for SAM treatment at the OTP facilities in the four payams between 1 March and 30 April 2017. Data that were extracted from the OTP registers and patient cards included admission MUAC measurement, length of stay and the treatment outcome of each child.

5.8 TRACKING OF CHILDREN RECEIVING SAM TREATMENT FROM MULTIPLE LOCATIONS

In order to detect whether caregivers were seeking malnutrition treatment for their children from multiple locations, the Research Manager conducted monthly visits to the OTP facilities in the four payams where this study was implemented to cross-check the names of children that were admitted by CBDs with children that were under treatment at the OTP facility. The Research Officers visited the caregivers of these children and discussed with them that it was not appropriate to receive double rations of RUTF from multiple locations and asked them to either continue the SAM treatment with the CBD or at the OTP facility.

5.9 QUANTITATIVE DATA ANALYSIS

Quantitative data which were collected using the CBD Supervision Checklist and the Child Progress Forms were entered in a database using Epidata.[14] All other quantitative data was entered using Microsoft Excel. After data entry, all quantitative data was analyzed using Stata.[15] Characteristics of the CBDs were tabulated and their performance scores summarized and stratified by the number of supervision visits received. Multivariate regression analyses were conducted with performance scores as the independent variables and because of the small number of CBDs, only CBD age, number of years working as CBD, number of pregnancies, number of treatment sessions and number of performance checks conducted were examined as dependent variables.

Child characteristics and treatment outcomes were also tabulated, with treatment outcomes examined as recovery from SAM to Moderate Acute Malnutrition (MAM) as well as SAM to full recovery and stratified by whether the child started in the red or pink MUAC zone. Univariate and multivariate log-binomial regression models, controlling for clustering at the CBD level, were run with recovery as the outcome variable of interest and with dependent variables of child age, child sex, MUAC color at enrollment, having not received malnutrition treatment in last 4 months, number of under-five children in the household and the last available CBD performance score.

---

14 Lauritsen JM & Bruus, M. Epidata version 4.2.2.0. A comprehensive tool for validation and documentation of data. The EpiData Association, Odense, Denmark, 2003-2005.

15 StataCorp. 2017. Stata statistical software: Release 15. College Station: TX: StataCorp LLC.

6. QUALITATIVE DATA COLLECTION

Image 16
Research Officer looks on while CBDs practice with the ID card during training
Photo credit: Annie Zhou / The IRC

6.1 METHODOLOGY

Qualitative data were collected through In-depth Interviews (IDIs) and Focus Group Discussions (FGD). The interviews conducted are described in Table 5. The Research Officers conducted all Dinka-language interviews and FGDs: a total of 12 IDIs with CBDs, caregivers of children who received SAM treatment from a CBD and community leaders and eight FGDs with CBDs, caregivers of children who received SAM treatment from a CBD, CBD supervisors, stock monitor CBD supervisors and the IRC's nutrition program staff. The Principal Investigator also conducted five IDIs, one with each Research Officer and one with the IRC's Nutrition Program Manager for the county, in English. Different interview guides were developed for each type of participant in the IDIs and FGDs.

Prior to the qualitative data collection, a six-day training of Research Officers was conducted on the qualitative research methodology and qualitative data collection tools that was co-facilitated by the Principal Investigator and the Research Manager. The training combined theoretical classroom learning with role plays and IDI and FGD practice sessions with CBDs and caregivers. Informed consent procedures were conducted with all participants prior to the IDIs and FGDs. The IDIs and FGDs took about one hour each and were recorded using audio recorders.

Due to the dearth of translators who could transcribe and translate the interviews from Dinka to English, the Research Officers responsible for facilitating and/or note taking in the relevant IDI or FGD listened to the audio recordings with the Research Manager and translated the content orally in real-time, the audio recording being stopped a few sentences at a time. Simultaneously, the Research Manager typed the oral translations to create transcripts and she confirmed any areas that lacked clarity. While these transcripts were extensive, they were not word-for-word translations.

6.2 QUALITATIVE DATA ANALYSIS

The qualitative data was analyzed using Dedoose, an online qualitative data analysis platform.[16] A semi-open coding process was used for analysis. Based on the semi-structured interview guides and initial data collection activities, a codebook was drafted. Six transcripts were double coded by the Research Manager and the Principal Investigator and any discrepancies in coding were discussed and the codebook was validated. After the double coding had been completed, the remaining transcripts were coded, continuously adding new codes to the codebook that emerged from the transcripts. After all transcripts had been coded, reoccurring patterns and themes were identified using Dedoose.

---

16 Dedoose Version 7.6.21, web application for managing, analyzing and presenting qualitative and mixed method research data (2017). Los Angeles, CA: SocioCultural Research Consultants, LLC www.dedoose.com.

Table 5
Selection of participants for qualitative data collection

Participants	# IDIs	# FGDs	Selection Procedure
CBDs	4	4	IDIs: Select 2 lowest and 2 highest scorers based on the most recent score available for each CBD. FGDs: Exclude CBDs who participated in IDIs. Select 8 CBDs randomly from each payam.
Caregivers	4	2	IDIs: Select 1 random caregiver out of the following four common treatment outcomes: cured, defaulted, non-response and referred specifically for stationary (four consecutive weeks in red or pink MUAC). FGDs: Select two payams randomly. In each payam, randomly select 8 caregivers of children that received SAM treatment from a CBD.
CBD Supervisors	-	1	Randomly select two CBD supervisors from each payam
Stock Monitor CBD Supervisors	-	1	Select each stock monitor CBD supervisor
Community Leaders	4	-	Selection of one village per payam that had multiple CBDs providing SAM treatment in their communities, IDI is conducted with the sub-chief of the village.
IRC's Nutrition Program Staff	-	1	Randomly select 2 Community Nutrition Workers from each payam
Research Officers	4	-	Select each Research Officer
IRC's Nutrition Program Manager	1	-	

7. QUANTITATIVE RESULTS

Image 17
CBD taking a child's MUAC measurement
Photo credit: Annie Zhou / The IRC

7.1 CBD CHARACTERISTICS

The 44 CBDs who were selected for the training and the 13 additional CBDs who completed the full training but were not selected had the following characteristics (See Table 6). There was no statistical evidence that those who performed well on the performance score and deployed for treatment were different in characteristics from those who were not selected.

Table 6
Characteristics of participating CBDs

Characteristics	N (%)		P
	Selected for treatment (n=44)	Not selected for treatment (n=13)	
Age 18-24 25-34 35-44 45-54 55+	7 (15.9) 15 (34.1) 9 (20.5) 8 (18.2) 5 (11.4)	1 (7.7) 2 (15.4) 5 (38.5) 3 (23.1) 2 (15.4)	0.518
Ability to read Yes No	1 (2.3) 43 (97.7)	0 13 (100.0)	0.583
Number of Pregnancies 0 1-3 4-6 7+	1 (2.3) 7 (15.9) 23 (52.3) 13 (29.6)	0 0 9 (69.2) 4 (30.8)	0.410
Religion Christian Traditional	31 (70.5) 13 (29.6)	6 (46.2) 7 (53.9)	0.107
Occupation None Farmer Commerce	2 (4.6) 38 (86.4) 4 (9.1)	0 13 (100.0) 0	0.371
Number of Years Working as CBD <1 1-2 3-4 5-6	0 1 (2.3) 25 (56.8) 18 (40.9)	0 0 7 (53.9) 6 (46.2)	0.828
Estimated Number of Households Served* Mean Median IQR Range	46.2 44 40-50.5 30-70	47.2 45 40-50 35-80	0.773

*Taken from IRC's iCCM program database.

7.2 CBD PERFORMANCE

Performance scores were collected for all 57 CBDs at baseline (immediately following the training). The participants (n=57) had a mean performance score of 94% (IQR: 86-100, range 68-100), 91% of the participants passed at the a prior determined cut-off of 80% and 49% of them had a perfect score.

For the performance scores collected as part of the direct supervision at the household, 40 CBDs had at least one of these performance scores collected during the study. The remaining 4 either did not treat a single child or had enrolled and discharged their children before a supervision visit could be made. The 40 CBDs had a median of 3.5 performance scores collected through supervision visits (IQR 2-5, range 1-7).

Table 7
Practical performance score of treating severe acute malnourished children in the community, stratified by number of formal supervisory checks conducted (n=40 CBDs, 141 supervision scores)

Total number of performance checks conducted		Immediately after training, at OTP*	Score during the first supervised treatment, at their home**	Score during their last supervised treatment, at their home***	Mean score across treatment period, at their home
Combined	Mean IQR Range %CBDs above 80%	97.4 97.5-100 80.0-100 N/A**	82.3 71.4-98.6 12.9-100 67.5	93.9 87.1-100 61.4-100 90.0	89.9 86.4-96.0 59.0-100 87.5
1-2 (n=15 CBDs)	Mean IQR Range %CBDs above 80%	96.8 96.3-100 93.8-100 N/A**	87.0 77.1-98.6 61.4-100 73.3	88.2 81.4-100 61.4-100 80.0	87.6 78.6-98.6 61.4-100 73.3
3-5 (n=19 CBDs)	Mean IQR Range %CBDs above 80%	97.2 97.5-100 80-100 N/A**	77.4 70.0-85.7 12.9-100 68.4	97.3 98.6-100 70.0-100 94.7	90.1 87.1-95.2 59.0-100 94.7
6-7 (n=6 CBDs)	Mean IQR Range %CBDs above 80%	99.4 98.8-100 97.5-100 N/A*	85.7 71.4-100 71.4-100 50.0	97.4 100-100 84.3-100 100	95.0 93.8-95.9 91.9-100 100

*All CBDs selected for the study needed to have a score at or above 80% at the end of the training.
**Time between training assessment and first supervised treatment: mean 27 days, median 23 days, range 7-55 days
***Time between training assessment and last supervised treatment: mean 94 days, median 95 days, range 23-140 days

The time between the baseline and first supervised treatment was mean 27 days, median 23 days, IQR 16-30 days and range 7-55 days. The time between post-training assessment and last supervised treatment was mean 94 days, median 95 days, IQR 71-120 days and range 23-140 days. The mean score dropped from 97.4% immediately after the training to 82.3% during the first supervised home treatment, but by the last supervised visit, the score had increased up to 93.9%. For the 20 CBDs who were randomly selected (5 from each payam) to conduct an endline performance check at an OTP, the mean was 94.3%, IQR 89.7-100, range 67.5-100, with 90% of the CBDs achieving a score over 80%.

The data for performance checks conducted during supervision, as well as the performance check conducted at an OTP at the beginning and end of the study, are available in Table 7. The scores are also stratified by the number of performance checks conducted for each CBD. The percent completion by task is available in Annex 4.

Because of the small number of CBDs, complex regression models with many covariates could not be run. Of key CBD characteristics (CBD age, number of years working as CBD, performance checks conducted), only the number of performance checks conducted during supervision visits had a statistically significant association with the performance score of the last supervisory visit completed (for each visit made, increase in performance score of 2.0%, 95% CI: 0.3-3.7%). Considering the correlation between the number of performance checklists and the number of treatment sessions completed by the CBD (r=0.7052), we ran a model controlling for the number of treatment sessions and the association between performance checklists completed and the final recorded score remained (3.0%, 95% CI: 0.6-5.4%).

Also, the CBDs were tested for recall before and after the refresher training and for a random sample of 20 CBDs at endline assessment, of the proper protocols for when an iCCM condition (uncomplicated pneumonia, diarrhea, or malaria) are found with SAM. This was not tested practically, as the CBDs had stockouts of iCCM drugs except amoxicillin. The percentage of CBDs who were able to orally report the proper treatment protocol is shown in Table 9.

Table 8
Association between CBD characteristics and performance score, reported in percentage points of performance score at the end of training and at the end of study

	Score after training	Performance score of last supervised treatment
Age	-0.1 (-0.2, 0.0)	-0.1 (-0.3,0.2)
Number of years working as CBD	0.2 (-0.1, 0.3)	-1.0 (-5.2, 3.3)
Performance checks conducted	---	2.0 (0.3, 3.7)

Table 9
Recall of proper treatment protocol for when iCCM condition is found with SAM

	% (95% CI)		
	Pre-refresher training (n=40 CBDs)	Post-refresher training (n=40 CBDs)	Endline assessment (n=20 CBDs)
SAM + presumed pneumonia	95.0 (91.6-98.4)	95.0 (91.6-98.4)	100
SAM + diarrhea	57.5 (49.7-65.3)	97.5 (95.0-100.0)	85.0 (77.0-93.0)
SAM + fever	82.5 (76.5-88.5)	100	95.0 (90.1-99.9)

7.3 CHILD CHARACTERISTICS

Three hundred and fourteen children were enrolled in the study. Four withdrew, all for being identified as receiving treatment from both a CBD and an OTP and subsequently choosing to seek care from the OTP. Two children were re-enrolled following discharge (one correctly, as in the child was eligible for treatment, one erroneously) and their second records were dropped for analysis, leaving a total of 308 children treated with an eligible outcome.

The 308 children had a median age of 24 months (IQR: 12-24 months). 84% of the participants self-reported not having received any malnutrition treatment in the last four months and belonged to households with median of 7 (IQR 6-8) individuals. We had no refusals for either receiving care from the CBD or participation in the study.

Table 10
Child characteristics (n=308)

Characteristic	n (%)
Sex	
Male	140 (45.5)
Female	168 (54.6)
Child age (in months)	
Mean	21.1
Median	24
IQR	12-24
Range	6-59
Received malnutrition treatment in last 4 months	
Yes	47 (15.3)
No	260 (84.4)
Don't know	1 (0.3)
Number of under-fives in the household	
Mean	2.2
Median	2
IQR	2-3
Range	1-6
Household size	
Mean	6.9
Median	7
IQR	6-8
Range	3-13
Religion	
Christian	239 (77.6)
Traditional	68 (22.1)
Don't know / missing	1 (0.3)
Maternal education	
No education	299 (97.1)
Literacy course	4 (1.3)
Primary education	4 (1.3)
Don't know / missing	1 (0.3)
Paternal education	
No education	282 (91.6)
Literacy course	2 (0.6)
Primary education	14 (4.5)
Secondary education and up	6 (1.9)
Don't know / missing	4 (1.3)
Enrolled in MUAC	
Red zone	90 (29.2)
Pink zone	218 (70.8)

7.4 TREATMENT OUTCOMES

Excluding the CBDs who did not treat any children, a CBD treated a median of 7 children (mean 7, IQR 6-9, range 1-15) over the course of the study. The maximum number of children treated by each CBD in a single week was a median of 7 children, mean 7, IQR 6-8, range 1-12).

The recovery rate from SAM to the moderate acute malnutrition cut-off[17] (MAM recovery rate) was 91% (95% CI: 88-95%), surpassing the 75% Sphere standard and the remaining 9% (95% CI: 5-12%) defaulted. The treatment outcomes are available on Table 11. There were no non-responders. The median length of treatment among those who recovered to MAM was five weeks (mean 5, IQR: 4-6 weeks, range 3-15).

The recovery rate from SAM to full recovery was 75% (95% CI: 69-81%). The median length of treatment among those who recovered fully was 8 weeks (mean 9, IQR: 6-11 weeks, range 3-16). Fifteen percent (95% CI: 10-20%) defaulted and 9% (95% CI: 5-13%) did not respond after 16 weeks of treatment. No deaths were reported. For default, the median time to default was 5 weeks (mean 6 weeks, IQR 4-7 weeks, range 3-13 weeks). A majority of the referrals (94%) were for a protocol safeguard that we had added for children staying in one MUAC color for four consecutive weeks (as proxy for potential underlying health conditions). Reasons for default and referral are available in Tables 12 and 13 respectively.

Table 11
Treatment outcomes of children treated by CBDs, accounting for clustering at CBD level

	Recovery from SAM to MAM (two consecutive weeks in yellow MUAC zone)			Recovery from SAM to full recovery (two consecutive weeks in green MUAC zone)		
	n	%, out of those discharged (95% CI)	%, out of all enrolled (95% CI)	n	%, out of those discharged (95% CI)	%, out of all enrolled (95% CI)
Recovered	222	91.3*(86.6-94.5)	71.8 (64.7-77.8)	147	75.4 (68.3-81.3)	47.8 (40.4-55.2)
Defaulted	21	8.8 (5.5-13.4)	6.8 (4.2-10.9)	30	15.4 (10.8-21.4)	9.7 (6.6-14.2)
Non-response	0	0	0	18	9.2 (4.8-16.9)	5.8 (3.1-10.7)
Death	0	0	0	0	0	0
Referred	65		21.4 (15.1-29.6)	113		36.7 (28.9-45.2)

*The Sphere humanitarian minimum standard for recovery is 75%.

17 MAM cut-off: ≥115mm and <125mm

Table 12
Reported reasons for default

Reason	Recovery from SAM to MAM (two consecutive weeks in yellow MUAC zone) (n=21)		Recovery from SAM to full recovery (two consecutive weeks in green MUAC zone) (n=30)*	
	n	%	n	%
Child moved away	12	57.1	12	40.0
Caregiver did not have time to bring child	3	14.3	10	33.3
Child went to OTP site	3	14.3	3	10.0
Admitted at health facility	0	0	1	3.3
Not available	3	14.3	4	13.3

*Includes the values from the SAM to MAM column.

Table 13
Reported reasons for referral

Reason	Recovery from SAM to MAM (two consecutive weeks in yellow MUAC zone) (n=65)		Recovery from SAM to full recovery (two consecutive weeks in green MUAC zone) (n=113)*	
	n	%	n	%
4 consecutive MUAC colors 　　Red 　　Pink 　　Yellow	8 54 ---	12.3 83.1 ---	8 54 44	7.1 47.8 38.9
iCCM specific danger signs	1	1.5	2	1.8
MUAC measurement below admission MUAC	2	3.1	3	2.7
Other	---	---	2	1.8

*Includes the values from the SAM to MAM column.

The treatment outcomes were stratified by the MUAC color at enrollment. Table 14 shows the breakdown. The recovery rate to MAM recovery for those enrolled at red was 87.7% and the recovery rate for those starting in pink was 92.9%. Full recovery for those enrolled at red was 71.2% and the recovery rate for those starting in pink was 77.5%. The median length of treatment among those admitted in red and recovered fully was 9 weeks (mean 10, IQR: 7-13 weeks, range 4-16). The median length of treatment among those admitted in pink and recovered fully was 7 weeks (mean 8, IQR: 6-9 weeks, range 3-16). There was no statistically significant difference in treatment outcomes between those enrolled in the red MUAC zone and those enrolled in the pink MUAC zone.

Table 14
Treatment outcome, stratified by red or pink MUAC at enrollment

	Red MUAC at enrollment			Pink MUAC at enrollment		
	n	%, out of those discharged	%, out of all enrolled	n	%, out of those discharged	%, out of all enrolled
Recovered from SAM to MAM (two consecutive weeks in yellow MUAC zone)						
Recovered	64	87.7 (78.5, 93.3)	71.1 (59.3, 80.6)	157	92.9 (87.8, 96.0)	72.0 (63.9, 78.9)
Defaulted	9	12.3 (6.7, 21.5)	10.0 (5.3, 17.9)	12	7.1 (4.0, 12.2)	5.5 (3.0, 9.9)
Non-response	0	0	0	0	0	0
Death	0	0	0	0	0	0
Referred	17		18.9 (10.2, 32.3)	49		22.5 (15.1, 32.1)
Recovered from SAM to MAM (two consecutive weeks in green MUAC zone)						
Recovered	47	71.2 (61.0, 79.7)	52.2 (39.9, 64.3)	100	77.5 (68.4, 84.6)	45.9 (38.1, 53.8)
Defaulted	11	16.7 (9.9, 26.8)	12.2 (7.1, 20.1)	19	14.7 (9.3, 22.6)	8.7 (5.0, 14.2)
Non-response	8	12.1 (5.4, 24.9)	8.9 (4.1, 18.3)	10	7.8 (2.9, 19.2)	4.6 (1.7, 11.7)
Death	0	0	0	0	0	0
Referred	24		26.7 (15.7, 41.5)	89		40.8 (32.1, 50.2)

Difference in treatment outcomes between red and pink enrollees: Chi-squared 6.8404, p=0.077

For comparative purposes, cases admitted at the OTPs in each of the study payams for the same enrollment period (Mar-Apr 2017) was examined. There was a significantly lower proportion of children enrolled in the MUAC red zone at the OTP (5.2% compared to 29.2% among CBD enrollees), suggesting that more severely malnourished children were accessing care from CBDs than from OTPs.

Table 15
Cases admitted at four OTPs in catchment area, Mar-Apr 2017

	Recovery from SAM to MAM (two consecutive weeks in yellow MUAC zone)			Recovery from SAM to full recovery (two consecutive weeks in green MUAC zone)		
	n	%, out of those discharged (95% CI)	%, out of all enrolled (95% CI)	n	%, out of those discharged (95% CI)	%, out of all enrolled (95% CI)
Recovered	260	81.3 (77.0, 85.5)	76.0 (71.5, 80.5)	70	72.9 (64.0, 81.8)	60.3 (51.4, 69.2)
Defaulted	38	11.9 (8.3, 15.4)	11.1 (7.8, 14.4)	17	17.7 (10.1, 25.3)	14.7 (8.2, 21.1)
Non-response	22	6.9 (4.1, 9.6)	6.4 (3.8, 9.0)	9	9.4 (3.5, 15.2)	7.8 (2.9, 12.6)
Death	0	0	0	0	0	0
Referred	22		6.4 (3.8, 9.0)	20		17.2 (10.4, 24.1)

When splitting the recovery rate by MUAC color on admission for children receiving treatment at the OTP, the red MUAC children had a MAM recovery rate of 35.7% (n=5 recovered, n=2 default, n=7 non-response, n=0 died) with additional 3 children referred. The pink MUAC children had a MAM recovery rate of 82.2% (n=236 recovered, n=36 default, n=15 non-response, n=0 died) with additional 16 children referred. The median length of treatment among those who recovered to MAM was 7 weeks. Graph 1 shows the number of weeks to MAM recovery for children enrolled at the CBD and at the OTP. For full recovery, only two red MUAC children had records and both recovered. Pink MUAC children had a full recovery rate of 71.3% (n=62 recovered, n=17 default, n=8 non-response, with additional 19 referred). The median length of treatment among those who recovered fully was 14 weeks. Graph 2 shows the number of weeks to full recovery for children enrolled at the CBD and at the OTP.

A direct statistical comparison of recovery rates between CBDs and the OTP was not made, as we suspect the children seeking care from CBDs versus OTPs would be fundamentally different in severity of illness, livelihood opportunities and other factors. For instance, children seeking care from CBDs instead of OTPs are likely from lower socioeconomic backgrounds due to distance from OTPs and other key village centers.

We ran multiple regression models to identify predictors of full recovery. Taking key child and CBD characteristic variables, there were no statistically significant predictors of recovery when including referrals in the reference group. When excluding referrals in the reference group, for every year older, the child had 7% increased chance of recovery (aRR 1.07, 1.02-1.13) and for each additional child under 5 years in the house, there were 10% increased chance of recovery (aRR 1.10, 1.00-1.21). Those children who had not received any malnutrition treatment in the last four months had an 18% decreased chance of recovery (aRR 0.82, 95% CI: 0.72-0.94).

Graph 1
Weeks to MAM recovery, CBD vs OTP treatment

Weeks to MAM recovery, CBD vs. OTP treatment
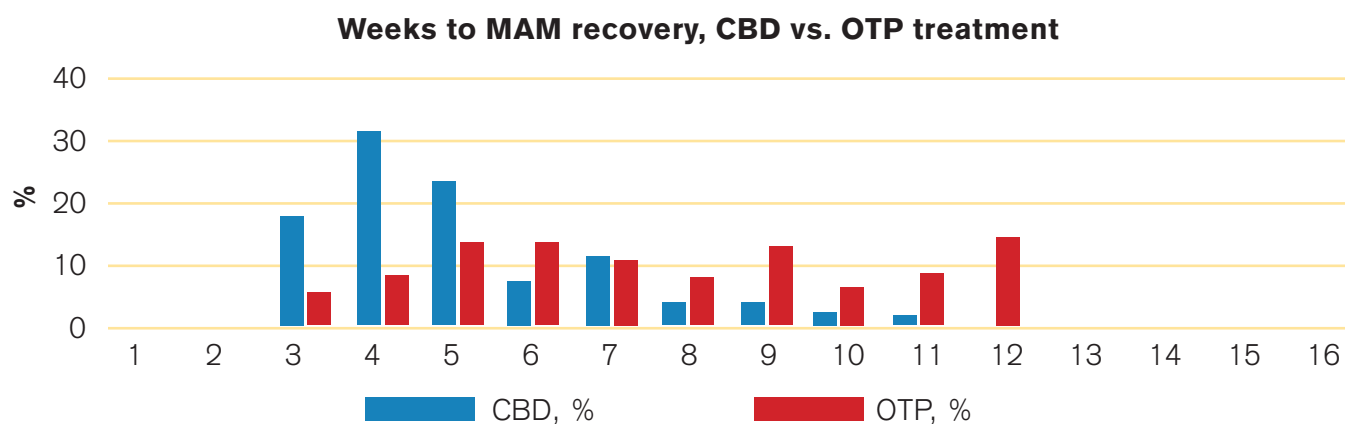
Graph 2
Weeks to full recovery, CBD vs. OTP treatment

Weeks to full recovery, CBD vs. OTP treatment
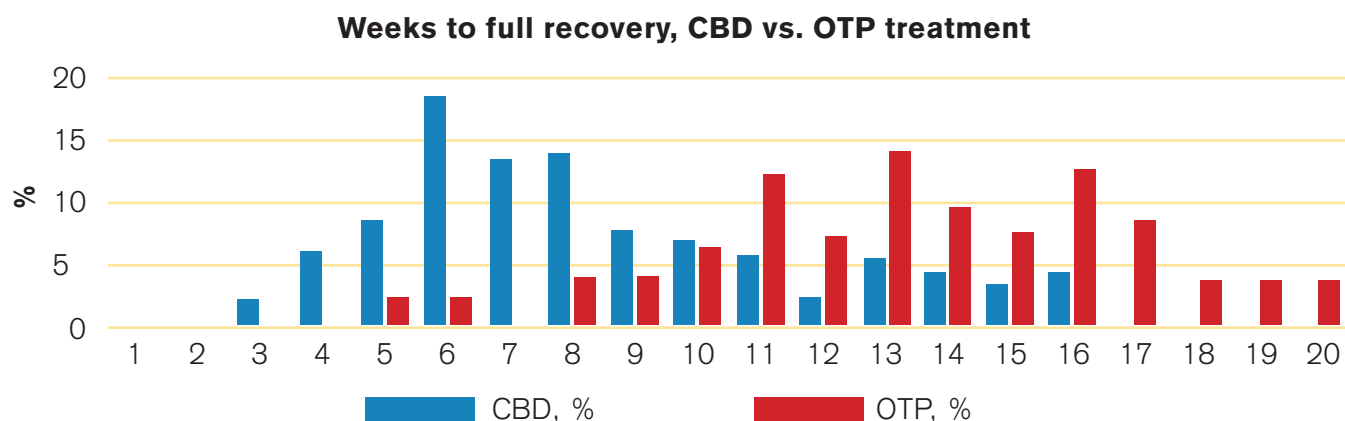
Table 16
Adjusted risk ratio of recovery, accounting for clustering at CBD level

	Recovery (including referrals in reference group) (n=308)		Recovery (excluding referrals in reference group) (n=195)	
	Unadjusted RR	**Adjusted RR**	**Unadjusted RR**	**Adjusted RR**
Age of child (in years, 0-5)	1.06 (0.96, 1.17)	1.10 (0.99, 1.21)	1.06 (1.01, 1.11)	1.07 (1.02, 1.13)
Sex of child	0.99 (0.79, 1.23)	0.96 (0.78, 1.20)	0.90 (0.77, 1.05)	0.89 (0.77, 1.02)
MUAC color at enrollment Referred	0.92 (0.71, 1.18)	0.89 (0.67, 1.18)	1.12 (0.96, 1.31)	1.15 (0.98, 1.34)
Has not received malnutrition treatment in last 4 months	0.77 (0.62, 0.96)	0.79 (0.60, 1.03)	0.81 (0.71, 0.93)	0.82 (0.72, 0.94)
Number of under-five children in the house	1.11 (0.93, 1.32)	1.11 (0.94, 1.31)	1.09 (1.00, 1.18)	1.10 (1.00, 1.21)
Final performance score, in 10-percentage point increments	1.13 (0.92, 1.38)	1.18 (0.96, 1.57)	1.01 (0.90, 1.14)	1.00 (0.90, 1.10)

7.5 RUTF LEAKAGE

A total of 340.1 cartons of RUTF were distributed to the restocking facilities in the four payams for the purposes of the study. According to child progress and treatment outcome data, study participants received a total of 292.3 cartons of RUTF, which means that a total of 47.8 cartons (14.1%) of RUTF have been leaked. There are different potential explanations for RUTF leakage during study implementation. First, as was explained by CBDs in the qualitative interviews, a few CBDs did not have sufficient RUTF at the beginning of study implementation to meet the unexpected high numbers of SAM children. They received pressure from the community to distribute RUTF to all children and therefore decided to give each child two sachets of RUTF instead of weighing each child to determine the accurate weekly dosage of RUTF. The situation was quickly remedied through supervision and no similar instances were observed later.

Second, there were two reported instances of RUTF theft: one where RUTF was stolen from the restocking facility where cartons of RUTF were prepositioned and one instance where the CBD reported that someone broke into her house and stole the RUTF that was kept in the metallic box. For the former, it is not anticipated that the theft specifically targeted the stock for the CBD treatment program, as they were stored similarly as the OTP stock. For the latter, after investigation both at the village level and by the IRC, no major tampering was found on the metallic box or the house, leaving the situation inconclusive as to whether the situation was truly theft.

7.6 COST

During the implementation period (March – August 2017), the program cost roughly $491 per child treated. Looking at cost per child cured, the value jumps to $681 for children achieving recovery to MAM and $1,028 for children achieving full recovery due to our conservative approach in referring children who were stationary or progressing slowly through one MUAC color zone. These values include only direct program costs (staff salaries and benefits, stipends for CBDs and CBD supervisors, transportation, RUTF, tools, other supplies and refresher trainings) and does not include support costs such as country office or field office costs. The cost per child treated is at the high end of the range compared to the IRC's traditional CMAM treatment programs.[18] This was primarily influenced by two factors. Firstly, cost efficiency increases as more children are treated and coverage improves. In the research project, admission was restricted to 320 children, which prevented CBDs who could have treated additional children from admitting them. Secondly, the intensive supervision model implemented under the pilot project resulted in the majority (around 60%) of project costs to be compensation costs. A larger scale program utilizing the CBD supervisor cadre for monitoring would likely reduce human resource costs and the overall cost per child treated.

---

18 Among 8 the IRC CMAM programs analyzed in Mali, Niger, Yemen and Kenya, cost per child treated ranged from $100-$500.

8. QUALITATIVE RESULTS

8.1 ACCESSIBILITY OF SAM TREATMENT

When asked about the positive aspects of CBDs providing SAM treatment in the community, all participants mentioned the decreased distance for caregivers. Caregivers did not have to travel as long in the heat and the burning sun during the dry season, or in the rain and through flooded areas during the wet season. Some caregivers mentioned that they had previously sought SAM treatment at the OTP site, or knew of neighbors that had received treatment at the OTP site. They explained that the caseload at the OTP site is often very high, which leads to a long waiting time. Caregivers said they sometimes arrived early in the morning at the OTP site and had to wait for the whole day for treatment and on some occasions would be sent home empty-handed if there were stockouts. Long waiting times due to an overwhelming caseload and shortage of OTP staff was confirmed by the nutrition program staff members. Caregivers expressed their relief that at the CBD site the waiting time was less and allowed them to conduct other activities in the afternoon.

One of the Research Officers and some nutrition program staff members noticed that the decreased distance to care may change care-seeking behavior. They shared that caregivers may be more likely to seek treatment in a timely manner if the treatment is offered nearby (instead of postponing care-seeking) which could lead to earlier identification of SAM.

"[The shortened distance] is good because it prevents the condition of the child to worsen, sometimes the condition may worsen if the caregiver has to travel a long distance with the sick child. And sometimes caregivers may not come to the OTP for one week because of the long distance or laziness. But when it [treatment] is near, it is easy for them to come. So it is a good thing that the research has done in the community."

FGD9,
Nutrition program
staff members

8.2 ABILITY OF CBDS TO ACCURATELY PROVIDE SAM TREATMENT USING SIMPLIFIED TOOLS AND SIMPLIFIED SAM TREATMENT PROTOCOL

Ability to treat children in community:

All CBDs conveyed that they liked to be able to treat children in their community for SAM. They repeatedly expressed how being able to help their children and take care of children in their community made them feel good and useful.

> "I feel proud when I have given treatment to a child and the child gets better. And then the community will appreciate you because you have done something good. If you came across a child and the child is not improving, then you can immediately refer the child and will get better treatment from there. That makes me feel good as well."
>
> *- IDI7, CBD*

In general, caregivers expressed trust in CBDs and their ability to provide SAM treatment. None of the participating caregivers questioned the ability or skills of CBDs to provide SAM treatment.

Only one CBD supervisor expressed that in his opinion, literate CBDs should be selected to provide SAM treatment in their communities because caregivers and community members would respect literate CBDs more. This sentiment was not expressed by any other CBD supervisors, nutrition program staff members or Research Officers.

One concern that was raised by two Research Officers was the effect of CBD´s age on their ability to learn and, most importantly, retain how to correctly use the simplified tools and follow the simplified treatment protocol when assessing and treating children for SAM. Research Officers said that the older the CBD was, the more difficult it was to train the CBD and the more mistakes the CBD made in the assessment and treatment of children as they had difficulty correctly remembering all the different steps due to their age. In the quantitative data, no association was seen between age and poor performance.

Simplified tools:

A majority of CBDs said that they had not encountered any challenges with the simplified tools; that after they were trained on the simplified tools, they were able to use the tool when assessing and treating children for SAM.

A few CBDs mentioned that their weight scales were not properly working at the beginning of the project, but after they were replaced with new weight scales they did not encounter any problems again. Other CBDs flagged that the material of the MUAC tapes was not strong enough and sometimes teared. These points were echoed by CBD supervisors and Research Officers in their interviews and discussions as well.

All CBD supervisors and Research Officers agreed that the simplified tools allowed low-literate CBDs to assess and treat children for SAM and that the tools were sufficiently simplified. When asked for suggestions on how to improve the simplified tools, one Research Officer suggested to increase the vertical spacing on the patient register to make the completion of the weekly child progress tracking (MUAC measurement and weekly RUTF dosage) easier.

Lastly, when asked whether there are any tools or job aids that could be added to facilitate the work of the CBDs, one Research Officer suggested to add a document that shows icons that represent all danger signs to help CBDs remember to assess/check for all the different danger signs. Another Research Officer suggested to print visual aids (posters and stickers) to help CBDs remember the child eligibility criteria, stating:

"I think if we can add anything, it's posters or stickers to show that [a child with] this MUAC color has to go to facility. So that if the CBD forgets what the meaning is of a color, she looks at that poster at the wall in her house. And because they will see the posters it will remind her what she needs to do."

- IDI15, Research Officer

Image 18
CBD explaining the key RUTF feeding messages to caregivers during the field test.
Photo credit: Annie Zhou / The IRC

Training:

CBDs expressed their appreciation for the initial six-day training and had no suggestions on how to improve the training. In one focus group discussion, CBDs shared that the training had brought them closer together and that they appreciated this.

Image 19
CBD taking a child's MUAC measurement
Photo credit: Annie Zhou / The IRC

> "The training was good because some things were difficult for us but now we understand. Also, the training made us to be a group like this. Because of the training we are able to know one another and if we meet on the road we are able to greet each other with the names [CBD got to know each other during the training]. So the training was not bad."
>
> *- FGD8, CBD*
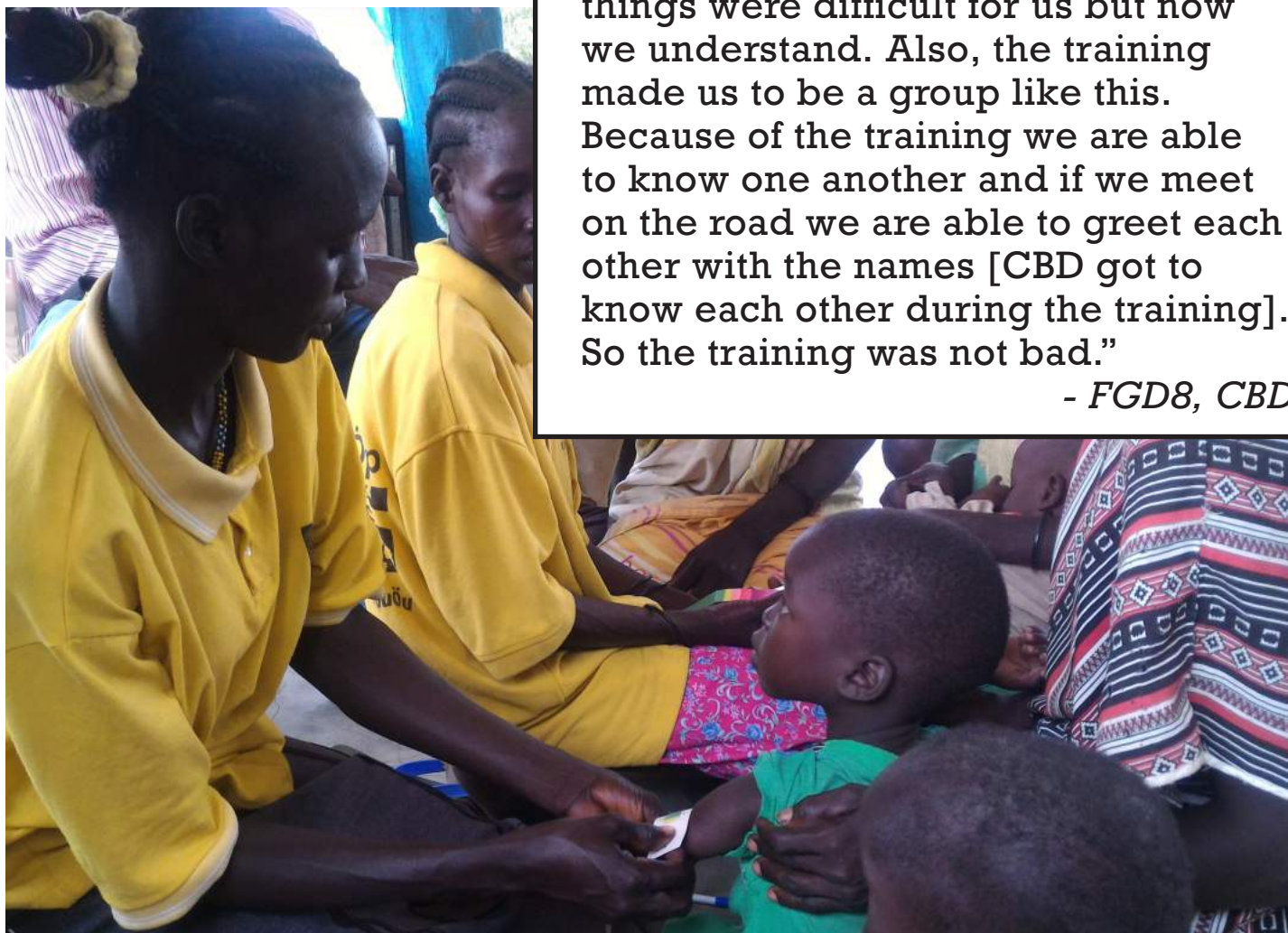
We were unable to identify through the interviews specific strategies used in the training that were particularly well-received by the CBDs.

The Research Officers said that the length of the training (six days of training plus two days of skills assessments) was sufficient but could be increased to nine days to allow CBDs to feel more comfortable with the simplified tools when they graduate. They also said that the training groups were manageable in size (15 participants per training group). One Research Officer explicitly appreciated the training method of splitting the training group up in two separate groups at relevant times, one for CBDs that learned faster and another group for CBDs who needed more time to familiarize themselves with the simplified tools and treatment protocol. One Research Officer explained that the use of songs, practical exercises and role plays were effective strategies during the training. In addition, Research Officers and CBD supervisors suggested to organize refresher trainings more frequently to address common errors and to allow CBDs to retain their skills and knowledge.

Supervision:

All CBDs said that the biweekly supervision visits had been very helpful and allowed them to correct any mistakes and strengthen their ability to correctly use the simplified tools and follow the SAM treatment protocol. The majority of CBDs said that the Research Officers always came on time and that they did not encounter any challenges with the supervision visits and were grateful for the support.

Some CBDs mentioned that it was sometimes challenging to convince caregivers to wait for the Research Officer to arrive at the CBD house before the CBD would start the treatment of the child. We were unable to identify through the interviews specific strategies used in the supervision that were particularly well-received by the CBDs.

All Research Officers and CBD supervisors stressed the importance of frequent supportive supervision visits to allow CBDs to strengthen their skills. All Research Officers said that biweekly supervision visits were sufficient to provide supportive feedback to the CBDs. In addition to the main objective of the supervision visit, namely to provide on-the-job training and support to the CBD, one of the Research Officers said that the supervision visit could also function as a deterrent for RUTF leakage:

"Supervision in the sense that you have to be monitoring them because they will be keeping in mind if I misuse this one [sachet of RUTF], the other person [Research Officer] is coming this week. So they will minimize the misuse of the PlumpyNut… it will minimize even the stealing of the PlumpyNut…"

- IDI14, Research Officer

Image 20
CBD calculating the weekly dose of RUTF
Photo credit: Annie Zhou / The IRC

Common errors:

When asked what were the most common errors observed by the Research Officers, they mentioned that during the first months of study implementation, some CBDs had difficulties remembering to assess all the danger signs. One Research Officer noted,

> "They remember the protocol, especially asking about the danger signs sometimes they don't ask all of them. They jump from here and when they capture about four or five then they continue, they forget others."
>
> *- IDI15, Research Officer*

Some CBDs encountered challenges when filling out the patient register, especially to distinguish between the different weeks of treatment and fill out the child´s progress information (MUAC measurement color and RUTF dosage) on the appropriate row.

Some CBDs had difficulty correctly classifying children that had to be discharged by applying the discharge criteria. After the provision of direct feedback by Research Officers during the supervision visits and the refresher training the CBDs were better able to correctly fill out the patient register and to apply the discharge criteria and identify the correct treatment outcome for children.

Workload:

CBDs said that, because SAM treatment only took place on the specific treatment day, providing the SAM treatment did not interfere too much with their other activities at home or income-generating activities. CBDs said they were only busy with the SAM treatment in the early morning hours of the SAM treatment day and that they were able to resume their usual activities and tasks in the afternoon.

> "I do manage this work. Simply because the work of malnutrition treatment, it can't take you the whole day. So in the morning, I have to deal with the malnutrition treatment, then afterwards when I finish them, I resume my normal work at home. Otherwise, I can tell someone to continue doing my house work and I continue treatment."
>
> *- IDI1, CBD*

Research Officers estimated that on average, a CBD spent 20 minutes to treat one child. They said that most CBDs treated all children early in the morning, so that they had time in the afternoon for their household responsibilities. When asked how many children Research Officers thought one CBD could treat on a weekly basis without overburdening the CBD, one research officer answered:

> "… They have to do like seven to ten so that you give them time to do their own work at home also because they are many that means they have to go for the whole day."
>
> *- IDI15, Research Officer*

8.3 CAREGIVERS' ADHERENCE TO SIMPLIFIED SAM TREATMENT PROTOCOL

Follow-up visit to CBD:

SAM treatment requires a caregiver to come back to the CBD every week. CBDs said they encountered some challenges with the weekly follow-up visits of the children they had under treatment. Firstly some caregivers delayed their follow-up visit due to competing activities. CBDs explained that this was challenging for them if they had planned to do their work in the household or their agricultural activities in the afternoon, with the intention to complete their treatment activities in the morning. However sometimes it happened that, despite instructions from the CBD to come on Monday morning, a caregiver showed up at the CBD house in the late afternoon because s/he was otherwise engaged during the morning hours.

"Some, they go do their different work, some go do certain jobs somewhere and leave the child behind. In such cases, I normally wait for the mother until the sun sets. If the mother hasn't come, I keep the record of that mother who did not come. If a mother came late, then the first question I ask is, where did you go, they say, I left the child behind and instructed my elder child to bring the child to you… Some women, they do not have anything to eat in their houses. So there, they decided to go and look for food and they delayed until the day is finished without coming back for the PlumpyNut. That is one of the reasons. Another person can move from a village to the market, there she will be busy selling tea or local brews to people, until the time will come and she may not know that it is the right time for their child to receive their PlumpyNut."

- IDI1, CBD

Image 21
CBD taking a child's MUAC measurement
Photo credit: Annie Zhou / The IRC

A second challenge CBDs identified were children that defaulted (two consecutive missed visits). CBDs explained that children defaulted because the caregiver needed to look for food or income and was therefore not able to return to the CBD for the follow-up visits, or because the child, caregiver, or other family member fell sick and had to be admitted at a health facility. Two caregivers who participated in the focus groups or individual interviews had a child who defaulted. When asked about the situation, one of the caregivers said:

> **"I didn't come back after seven days. I just stopped…I received the PlumpyNut then I went away with my children. You know, the CBD tells you that you have to come back if the child falls sick again. When I went home I gave the PlumpyNut and I found that my child was better, so I did not go back to the CBD."**
>
> *- IDI8, Caregiver*

Caregivers said that they did not encounter any problems related to the weekly follow-up visit to the CBD.

Sharing or selling of RUTF:

When the interviewer asked questions around the sharing and selling of RUTF, the first response of many caregivers was to defensively clarify that s/he had never shared or sold RUTF. When the interviewer emphasized that they wanted to learn more generally about sharing and selling of RUTF, caregivers and CBDs became more comfortable and open in their answering. Some caregivers and CBDs said that sharing or selling of RUTF never happened in their community, others said that it did happen but that it was only hearsay and that they had never directly witnessed. Finally, some CBDs and Research Officers had directly observed the sharing and selling of RUTF and could provide information on the motivation behind the sharing and selling of RUTF and provide suggestions on how to prevent sharing and selling of RUTF.

When caregivers and CBDs were asked why caregivers shared RUTF with other children or adults within the household, or sold RUTF, the persistent food insecurity in Aweil South was given as the main reason.

> **"When I asked the mother about the reason why the child stayed in pink, the mother said that there was no other food at home. So the child was only eating the PlumpyNut and did not eat other food. The older children were eating leaves from the trees. The mother said it was not good to give the leaves to the malnourished child."**
>
> *- FGD8, CBD*

The majority of caregivers and CBDs said that by selling RUTF in the market, caregivers are able to buy other food that can be shared within the household. Two CBDs mentioned that caregivers sell RUTF in the market to buy alcoholic beverages.

Specifically, when the child with SAM needs to receive the daily RUTF dosage, this can cause tension with other children in the household who are also hungry. One caregiver identified the following strategy to mitigate tension within the household:

> "If you care enough about the treatment of the child you don't share. Something happened to me once when my child was admitted and received the PlumpyNut. I hung the PlumpyNut in the roof of my house where the other children cannot go and pick the PlumpyNut. One time when I was not at home, one of the older children managed to pick the PlumpyNut. When I came back I noticed that this had happened and I called the child and I explained to him the reason why the PlumpyNut is not being shared…With the other children remaining at home, sometimes I would bring biscuits for them. So that when my child was eating the PlumpyNut, the other children were eating the biscuits."
>
> *- FGD4, caregiver*

In relation to the sharing and selling of RUTF, caregivers and CBDs mentioned the General Food Distribution (GFD) as both a cause and a potential solution. During the period of study implementation, many study caregivers reported that they did not receive their food ration so many households did not have sufficient food in the household to supplement the RUTF that was received for the malnourished child. Caregivers and CBDs suggested that the lack of food ration forced the caregivers to sell or share the RUTF among all household members and they suggested that increased coverage of the food ration would decrease the necessity to share RUTF with other household members or sell RUTF in order to buy other food items.

In addition, other suggestions that were made to prevent sharing or selling or RUTF included: continue asking caregivers to return the empty sachets of RUTF to the CBD, awareness raising and sensitization activities in the communities and increasing household food security through livelihood programming.

Seeking SAM treatment from more than one location:

A shared concern among the interviewees were caregivers who sought SAM treatment from more than one location. For example, caregivers who took their child to a CBD and an OTP site or to two different CBDs. All CBDs and Research Officers said that they had either observed this directly, or had heard from other people that this happened. CBDs, CBD supervisors, the IRC's nutrition program staff members and Research Officers identified household food insecurity as the main reason.

Image 22
Research Officer supervises a CBD as she assesses and treats a child
Photo credit: Elburg van Boetzelaer / The IRC
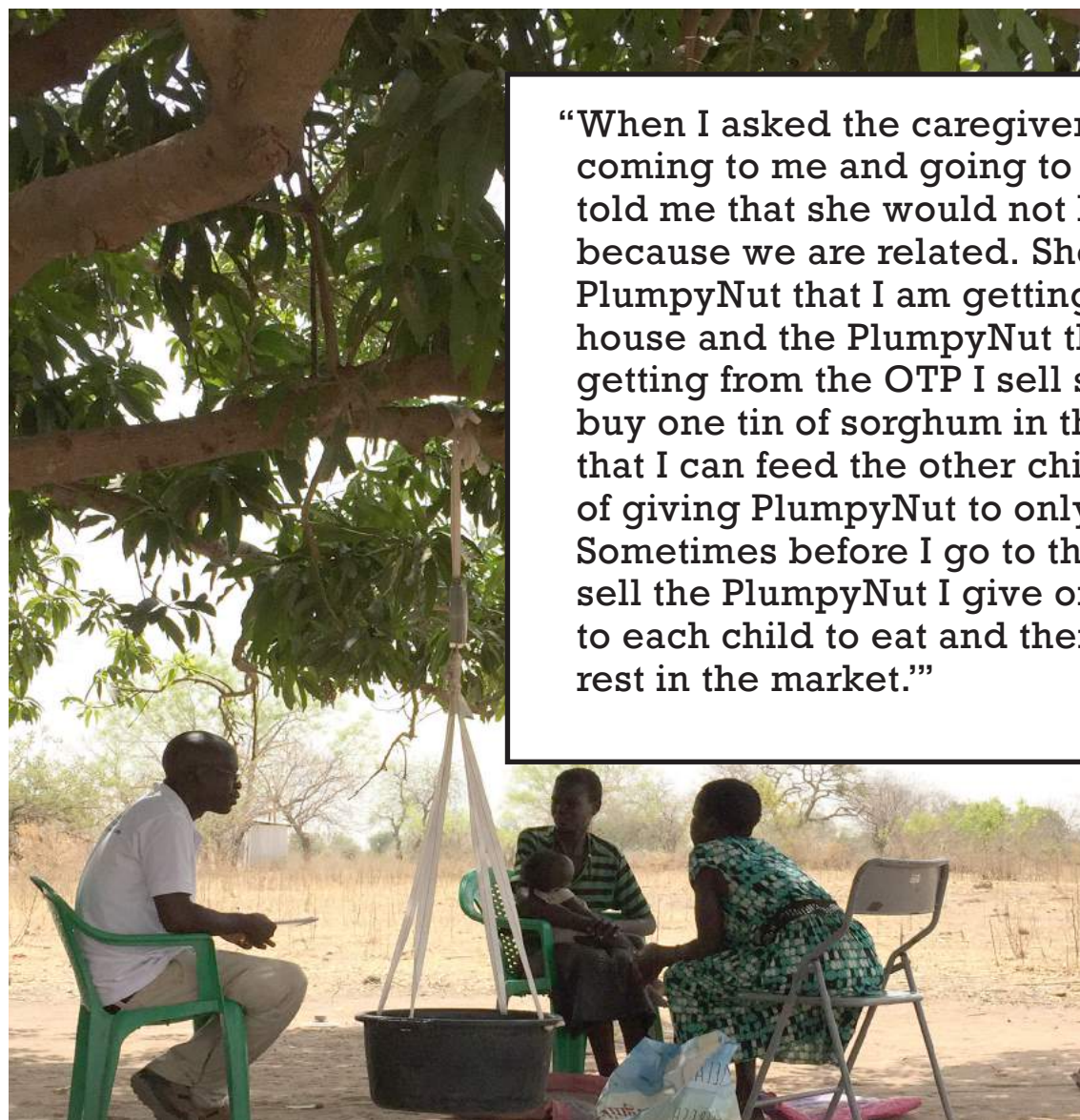
"When I asked the caregiver why she is coming to me and going to the OTP she told me that she would not hide anything because we are related. She said 'the PlumpyNut that I am getting from your house and the PlumpyNut that I am getting from the OTP I sell so that I can buy one tin of sorghum in the market. So that I can feed the other children instead of giving PlumpyNut to only one child. Sometimes before I go to the market to sell the PlumpyNut I give one PlumpyNut to each child to eat and then I sell the rest in the market.'"

- IDI8, CBD

CBD supervisors, nutrition program staff members and Research Officers suggested different strategies to prevent caregivers from seeking SAM treatment from multiple locations in the future. These strategies included awareness raising and sensitization activities in the communities, the use of indelible ink, sharing of lists of names of admitted children by CBDs with OTP sites, frequent cross-checking of CBD and OTP registers, appointment of a community member responsible for the tracking of children that are admitted by CBDs for SAM treatment and the use of bracelets to identify children that are admitted by a CBD or at an OTP site to prevent double enrollment.

8.4 CAREGIVERS' & COMMUNITY PERCEPTIONS OF CBD SINCE STARTING TO PROVIDE SAM TREATMENT

> "I missed one week when I did not bring my child to the CBD. The next week when I came with my child she [the CBD] blamed me a lot. She blamed because she was worried about the health of my child. A bad person will not blame you when you delay with your child. So I don't see anything bad with this CBD."
>
> *- FGD4, caregiver*

Image 23
Research Officer demonstrates to CBDs how to use the dosage calculator
Photo credit: Elburg van Boetzelaer / The IRC

Relationship between caregiver & CBD:

When asked to describe the relationship between caregivers and CBDs, all caregivers and CBDs mentioned that caregivers are satisfied when their child is cured by the CBD. In addition, several caregivers mentioned that they appreciated that their child´s progress was closely monitored by the CBD, for example through frequent home visits during which the CBD checked on the well-being of the child and treatment adherence. Caregivers said that the close involvement of the CBD in the treatment of the child gave them confidence in CBD´s treatment and that they appreciated this compared to the OTP sites.

In addition to these positive caregiver perceptions, caregivers and CBDs reported negative interactions between caregivers and CBDs as well. A most frequently-mentioned example occurred during the first admission visit of the child. Oftentimes, when the CBD determined that the child did not meet the eligibility criteria and told the caregiver that his/her child could not be admitted for SAM treatment the caregiver quarreled with the CBD.

Usually the caregiver expressed frustration and that s/he thought the CBD only provided treatment to preferred children:

"When I was visiting the CBD house other women came with their children who were not malnourished. And they asked the CBD to admit their children. And then the CBD told them that their children were not sick and that they had to go back home and continue to give food to their child. Then they [the other caregivers] got annoyed and went back to their houses feeling unhappy. Something I observed also is that sometimes the other caregivers wait for us, until the caregivers whose children were admitted come back. And then they begin to complain saying that 'you are friends with the CBD, which is why your child is admitted. And that is why she [CBD] did not accept to treat my child.' When I tried to explain that the CBD found that my child is sick, the other caregivers say 'we have seen that the CBD is not trained to help people, they only give PlumpyNut to the people they know, even if they come from a very far place like you.'"

- FGD4, caregiver

Some caregivers accused CBDs of eating the RUTF themselves. Even though CBDs classified some caregiver interactions as 'challenging,' all CBDs also said that they did not let caregivers' bad words or frustration get to them, but instead continued their work.

> "Although some people are talking about us, saying bad words about us in the community, you cannot answer you should just explain to them that this PlumpyNut should not be given to children who are not malnourished. If the child is not malnourished, there is no reason to give it [PlumpyNut] because the child is not sick. Although people are talking, you just have to keep quiet and explain that."

- FGD3, CBD

Image 24
CBD calculates weekly dosage of RUTF
Photo credit: Elburg van Boetzelaer / The IRC

Relationship between community & CBD:

Interviewees described that community members in general perceived CBDs to be able to provide SAM treatment and that community members were happy that SAM treatment was available in their own communities so that travel distance was decreased. Several CBDs mentioned that they had noticed a change in their relationship with their communities since they started treating children for SAM.

> "My relationship with the community members has changed a little bit. The way it has changed is when I put on these clothes [participant points to the IRC shirt] they call me a doctor. And if I meet someone on the road, that person will greet me: 'how are you, doctor?' That is a little change I have seen. So I am staying with the community, there are no complaints. I respect them and they respect me."
>
> *- IDI4, CBD*

Furthermore, one CBD said that even though community members know that the CBDs do not know how to read and write, because they are able to treat the community's children for SAM, they are treated with more respect:

> "The community now thinks that we are educated, but we are not, we do not know how to read or write. But the knowledge we know we learned through talking."
>
> *- FGD1, CBD*

In addition, several concerns were raised that had negatively affected the relationship between the community and CBD. Firstly, as aforementioned, the GFD was not well implemented during the study period and the majority of children that were admitted for SAM treatment by CBDs did not receive the food ration. Some CBDs reported that this led to strained relationships between the CBD and her community as community members expressed distrust for the CBD. It was explained by the IRC's nutrition program staff members that a big constraint is miscommunication between the NGO that implements the GFD and the communities and that communities do not understand the underlying mechanisms, eligibility criteria and decision-making procedures for the GFD which leads them to assume cheating by the CBD.

> "The only problem is with the General Food Distribution. The caregivers accused us that it was the CBD that were eating their food. Caregivers were told that they would receive their food through CBDs. When the food comes the CBD will come and receive food. Caregivers then said, so now you [CBDs] have received the food and you did not call us [caregivers]."
>
> *- FGD1, CBD*

8.5 COMPARISON AND LINKAGE BETWEEN CBD AND OTP SITES

When comparing treatment at the OTP site and at the CBD's house the majority of participants explained how the distance to the CBD was shorter and the waiting time at the CBD house was shorter. For this study, CBDs were distributing RUTF, amoxicillin, albendazole and soap according to the national SAM treatment guidelines for South Sudan. However, CBDs, caregivers and nutrition staff members confirmed that at the OTP sites, additional mosquito nets were also provided. Some caregivers and CBDs said that materials that were provided at the OTP site differed from those provided by CBDs and that this should be harmonized across OTPs and CBDs to prevent caregivers from going to multiple locations just to obtain a mosquito net and soap.

One nutrition program worker and one caregiver explained that they thought that some caregivers may feel embarrassed to take their child to the OTP for SAM treatment, but that caregivers would be less confronted with the stigma that surrounds malnutrition if they went to a CBD for SAM treatment. This was not brought up by any other caregivers.

> "Secondly, in our culture caregivers with malnourished children may feel shy to come to the OTP and that can lead to the death of the child. Sometimes caregivers feel shy because they are ashamed because at the OTP women gather and other women may say 'why is your child malnourished, it is because you don't take care of your child.' But now with this CBD treatment in the village, the caregivers do not feel shy because they are going to the CBD who they know and the CBD has seen their children before. With this treatment in the village, I can see that the gap of caregivers that are not coming to the OTP is less because there is treatment in the village."
>
> *- FGD9, nutrition program staff members*

One caregiver said that she preferred malnutrition treatment provided by the CBD over treatment provided at the OTP because of the more direct contact between the CBD and caregiver.

> "You know the treatment by the CBD is simple. You can sit with the CBD and she will give you advice. But when you go to the OTP you are given the PlumpyNut but no one will sit with you, the person will just talk to everyone."
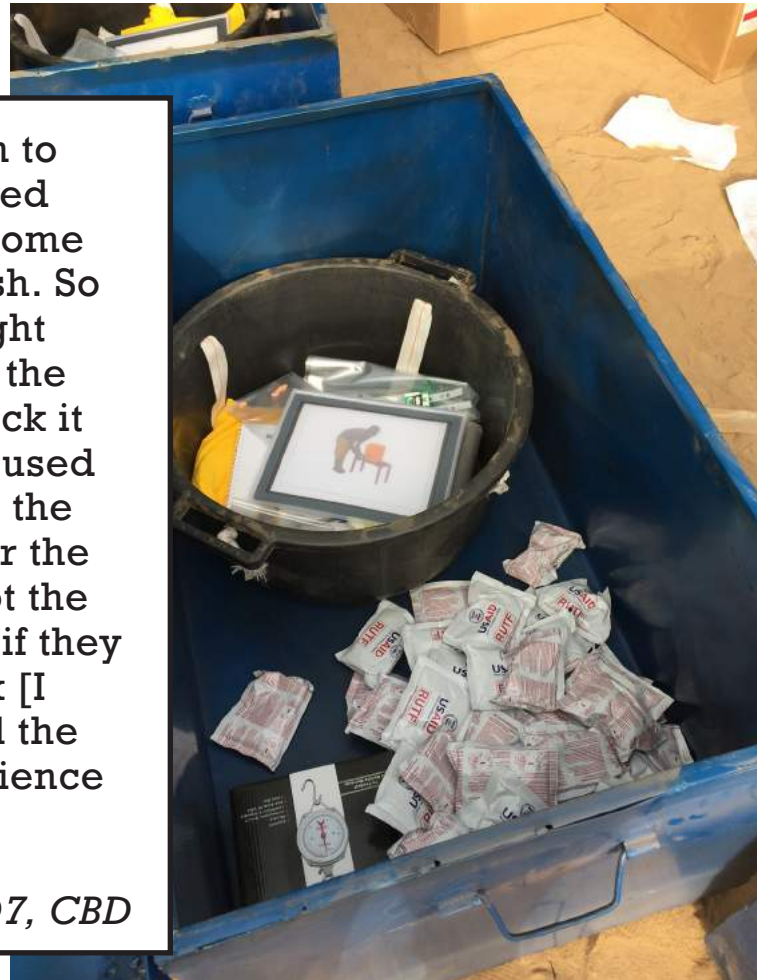>
> *- IDI12, caregiver*

8.6 RUTF SUPPLY CHAIN

Storage of RUTF at CBD house:

All CBDs said that the metallic box was easy to keep at their house, although some CBDs shared that they experienced some initial nervousness about keeping RUTF at their house.

Image 25
Inside of a storage box for treatment supplies
Photo credit: Elburg van Boetzelaer / The IRC

> "When the PlumpyNut was taken to my house I was a little bit worried because my husband is not at home and my house is near to the bush. So when the PlumpyNut was brought I fixed the door of the house on the same day. And then I used to lock it whenever I went somewhere. I used to move around with both keys, the keys for the metallic box and for the door. And the reason why I kept the PlumpyNut like that is because if they get lost it will come on my neck [I will be accountable for it]. Until the program closed I did not experience any problems with keeping the PlumpyNut in my house."
>
> *- FGD7, CBD*

One CBD mentioned that it was initially difficult for her to keep RUTF at her house because her children were constantly crying and begging to be given RUTF. She solved this by sending her children outside to play on treatment days and by giving her children biscuits.

> "Another problem was that my child would become crazy when it's time for me to give treatment…My little boy was terrible at my house and I was told during the training that we shouldn't be giving PlumpyNut to our kids. So when it's treatment, I ask my other children to take the boy away from me and then I'd later on start the work without the boy."
>
> *- IDI1, CBD*

Storage of RUTF at restocking facility:

During the period of study implementation there was one incident of theft of RUTF from a restocking facility reported. When asked to describe possible prevention strategies for RUTF theft from restocking facilities, participating stock monitor CBD supervisors (those responsible for the RUTF at the restocking facilities) suggested to hire an independent guard and to make sure that restocking facilities are located close to the community so that it is easier to monitor the facility.

Weekly distribution of RUTF by CBD supervisors:

CBDs reported that they did not encounter any challenges related to the weekly distribution of RUTF from the restocking facility to the CBD house by CBD supervisors. CBD supervisors however, who were responsible for conducting the distribution, identified several challenges. CBD supervisors mentioned the lack of means to transport the RUTF. It was assumed that CBD supervisors would have access to the bicycle through the iCCM program, however many CBDs claimed that their bicycles were either defective or that they had never received a bicycle. Many CBD supervisors said that it was difficult for them to conduct the weekly RUTF distribution without a bicycle, considering the weight and volume of the RUTF that needed to be distributed.

CBD supervisors agreed that in order to facilitate the weekly RUTF distribution, they should have been given backpacks, bicycles, gumboots and raincoats (during the rainy season). And if the distribution of bicycles would have been impossible, the transportation allowance should have been increased.

> "Last time we were hiring motorbikes to bring the PlumpyNut to the CBDs and it is now rainy season, so even the motorbikes cannot reach there [to the CBD houses]. So if the research continues, they should provide bicycles to the [CBD supervisors] because some areas are very swampy and some areas have rivers which makes it difficult for the motorbikes to get there. It is also good that if possible the research would provide backpacks to the [CBD supervisors] so that they can carry the PlumpyNut. If the research would continue I would like the money for all of us to be working to be increased. And transportation."
>
> *- FGD5, CBD supervisor*

8.7 FUTURE DIRECTIONS

Integration of iCCM and SAM treatment:

During the period of study implementation, CBDs were not treating for malaria and diarrhea due to a drug stock-out due to the iCCM implementing partner's delayed start-up in Aweil South. Thus, CBDs did not implement the full protocol with SAM management. Any questions around the integration of iCCM and SAM management were phrased as hypothetical questions. Participants said that adding the management of SAM to the CBD's existing iCCM responsibilities would have a positive impact on the health of children in the communities as it would make treatment for more different diseases readily accessible in the village.

"Addition is, iCCM drugs in the same box. So that we can also give treatment for the diseases. If a child comes with a fever, we can give the drug for the fever…Combining them together is good because if the child is suffering from fever, you can give the drugs for the fever and if the child is malnourished, it can be given drugs for the malnutrition. Then the child will be ok."

- IDI1, CBD

Image 26
CBDs practicing measuring MUAC on bamboo rods
Photo credit: Annie Zhou / The IRC

Considering that CBDs had already been trained on iCCM and SAM management, CBD supervisors and CBDs did not foresee any challenges in asking CBDs to treat iCCM conditions and SAM at the same time.

Based on their observations, CBD supervisors, CBDs and Research Officers said that they combined workload of iCCM and SAM management would be manageable for the CBDs considering that SAM management only took place on specific treatment days. However, the feasibility of the workload for CBDs depends on the number of admitted children for iCCM and SAM management.

Scale up of CBD provided SAM treatment:

All CBD supervisors and Research Officers said that a scale-up would not only be feasible, it would also be desirable considering the number of children that would benefit from a scale-up. All CBD supervisors and Research Officers urged to train more CBDs in order to increase program coverage in the most remote places and give these communities access to malnutrition treatment.

When selecting additional CBDs to provide SAM treatment in their communities, CBD supervisors and Research Officers recommended to only select those CBDs that are accessible during the rainy season for RUTF distribution and supervision. Two Research Officers suggested to have a phased scale up, in which at first 40 CBDs would be trained, then 40 CBDs would be added and later on another 40 CBDs would be added until all CBDs in Aweil South were trained (as opposed to training all CBDs at the same time). A phased scale-up would facilitate training and supervision activities. CBD supervisors and Research Officers made different suggestions around the logistical implications of increasing the number of CBDs. Several CBD supervisors and Research Officers suggested that the responsibility of technical supervision would have to shift from the IRC officers to the CBD supervisors. As the CBD supervisors are already responsible for the technical supervision of CBDs' iCCM activities, participants said that they should also be made responsible for the supervision of SAM management, especially if the number of CBDs would increase and the number of IRC officers would no longer be sufficient to conduct frequent supportive supervision visits. In order for the CBD supervisors to be able to provide high quality supportive supervision, additional training days should be incorporated in future programming.

As for the supply chain, notably the weekly distribution of RUTF from the restocking facility to the CBD house, CBD supervisors and Research Officers suggested to distribute bicycles or at least to increase the monthly transport allowance to assist CBD supervisors in the distribution.

9. DISCUSSION/ LESSONS LEARNED

Low-literate CBDs in South Sudan were able to follow the simplified treatment protocol for uncomplicated SAM with high accuracy, using adapted tools. The performance scores were higher among those who received more supervision. The recovery rate among the enrolled children met the Sphere humanitarian minimum standards despite treating children with MUAC on admission lower than seen at OTPs, showing promise that deploying CBDs to treat uncomplicated cases of SAM in areas with high prevalence and low treatment access may lead to earlier treatment seeking and timely case finding. Also, we suspect that treatment coverage also increased with the pilot project, based on the inclusion criterion of CBDs needing to live at least 5km from an OTP, observing more children treated with lower MUAC on admission than at OTPs and qualitative data from caregivers and CBDs.

In line with findings from previous studies assessing the feasibility of SAM treatment by community-based health workers,[19] this study shows an absolute 2.0% increase in performance score for each additional supervision visit received by a CBD. This shows the importance of frequent supportive supervision visits during which treatment is observed and any errors are corrected. For this study, four Research Officers were tasked with bi-weekly supervision visits of 44 CBDs. Considering that a ratio of one program staff to 11 CBDs is not feasible in a large-scale program, the expanded role and responsibilities of CBD supervisors will need to be further explored. As this was the first pilot of the protocol, the supervision was left to staff hired specifically for the study to assure quality control. The CBD supervisors' responsibilities were restricted to weekly distribution of RUTF and drugs to CBDs. In the IRC-supported iCCM program in Aweil South County, CBD supervisors conduct direct supportive, biweekly supervision visits to the CBDs to monitor the accuracy of treatment and the CBD supervisors are supervised by the IRC staff. In the current supervision structure for iCCM, one CBD supervisor supervises 10 CBDs. It is unclear without further investigation whether both the added workload for CBDs, the added supervision tasks for CBD supervisors and the current CBD supervisory frequency of every two weeks would be sufficient to maintain high quality of care for malnutrition treatment by CBDs.

19 Alvarez Morán J.L., Alé F.G.B., Rogers E., Guerrero S. (2017). Quality of care for treatment of uncomplicated severe acute malnutrition delivered by community health workers in a rural area of Mali. Matern Child Nutr.; e12449; Puett C., Coates J., Alderman H. and Sadler K. (2013). Quality of care for severe acute malnutrition delivered by community health workers in southern Bangladesh. Matern Child Nutr 2013, 9(1), 130-142; Puett, C., Coates, J., Alderman, H. et al (2012). Does greater workload lead to reduced quality of preventive and curative care among community health workers in Bangladesh? Food Nutr Bull 33, 273-287.

Though the recovery rate was acceptable and promising compared to Sphere humanitarian standards, we believe that several factors prevented the recovery rate (SAM to full recovery) from being higher. One, the food insecurity in Aweil South was severe during study implementation and there is reason to believe that the general food distribution program was not functioning at proper capacity during our study. Several participants in the qualitative study noted difficulty in receiving the additional food ration that is supposed to be provided by another NGO to a household with a child diagnosed with SAM. Many caregivers and CBDs indicated that the RUTF that was provided for the malnourished child was the only food that was available in the household. Two, as a new protocol, we took a more conservative approach than in CMAM programs by referring children who appeared to be stationary (remained in the same MUAC color zone for four consecutive weeks). In the middle of the study, we opted to allow for longer treatment among those who were stationary in the MUAC yellow zone (11.5-12.5cm), but we may later determine that children in the red zone (9-10.25cm) and the pink zone (10.25-11.5cm) should also continue in treatment longer before being referred. In order to make this determination, more data on child MUAC progression is needed. Data from this study show that the vast majority of referrals were not for medical complications, but because of the referral of stationary children. This may have been related to the previous point about food insecurity. Due to resource constraints, we were unable to follow these children to monitor their treatment outcomes. These questions should be explored in future research to determine the best protocol for referring children who are stationary or progressing slowly.

Qualitative data showed that although communities in general appreciated the program and the proximate availability of SAM treatment, CBDs also experienced tension. CBDs reported strained interactions with caregivers whose child was not eligible for SAM treatment. Secondly, some community leaders and caregivers expressed distrust of CBDs and suspected that CBDs were eating RUTF or the general food rations. Despite the community sensitization meetings that were held at the beginning of study implementation, these suspicions remained. There were no indications from supervisory cadres that such suspicions were valid. For future programming, community dialogue should be more extensive and should be more frequently conducted.

Supply monitoring data showed that the number of days of RUTF stock-out was negligible during study implementation. While this is an indication of a well-functioning supply chain, the potential for scale-up of the supply chain mechanism that was used for this study has to be further explored. With a ratio of 1 CBD supervisor to 1 or 2 CBDs, the weekly distribution of one carton of RUTF per CBD was manageable. However, if the ratio that is used in the iCCM program were to be followed (1 CBD supervisor to 10 CBDs) the mere volume and weight of RUTF that has to be distributed on a weekly basis may pose a challenge, especially considering the long distances that CBD supervisors have to travel and the inaccessibility of certain areas during the rainy season. The ideal number of CBDs to be deployed for malnutrition treatment will need to take into account this practical consideration and will likely be deployed with lower density than the iCCM CBDs. Future models to test may include having one iCCM CBD designated per certain number of CBDs as someone authorized to treat malnutrition as well, or having a separate cadre for malnutrition treatment that covers a larger number of households than an iCCM CBD does.

10. STUDY LIMITATIONS

This was the first time that the simplified tools and simplified SAM treatment protocol were piloted and the sample size of this study was relatively small (n=44 CBDs and n=320 children). We were able to assess the feasibility of CBD-provided SAM treatment on a small scale, but were not able to assess the logistical implications of a project at scale. This study involved less than 10% of the roughly 600 CBDs operating in Aweil South and was unable to include CBDs in areas inaccessible during the rainy season. Considering the small sample size, Research Officers were able to adhere to an intense supervision schedule and to closely monitor the distribution of RUTF. It remains to be further explored how to manage supervision and RUTF distribution if the number of CBDs were increased and if accessibility was more challenging. Because the sample size was limited to 320 children, the number of children that CBDs admitted for SAM treatment was capped and not all eligible children were admitted. In future research, with a larger sample size, the effect of workload (number of children under treatment) on the quality of care should be further explored.

Another limitation of the study was the lack of emphasis on community sensitization. Though one round of sensitization was held, the acceptable but slightly high percentage of defaults and median time to default of 5 weeks suggest poor adherence to the full course of treatment (through full recovery). With additional community sensitization and community level engagement, it is possible that some of these issues could have been mitigated. This might have also helped reduce leakage and incidents of CBDs facing community pressure to distribute RUTF at the beginning of the study.

Another NGO took over the implementation of the iCCM program in Aweil South starting very soon after study rollout in April 2017. Due to delays in their operation start-up, malaria and diarrheal drug stockouts were reported between May and September 2017. Therefore, we were unable to evaluate the feasibility of CBDs treating children for all iCCM conditions and SAM simultaneously. Furthermore, as one objective of this malnutrition treatment model was to allow for simultaneous treatment of uncomplicated illness and SAM and stem the cycle of malnutrition and infection, the resulting recovery rates may have been higher if the iCCM program had been operating properly. Questions around the integration of iCCM and SAM treatment at the community level, including the added workload of CBDs, CBD supervisors and the application of the combined treatment protocol remain for future research. Finally, the available resources did not allow for coverage surveys to be conducted before and after the study to assess any change.

Image 27
CBD practicing taking the MUAC measurement during training
Photo credit: Annie Zhou / The IRC

The qualitative component of this operational research also has limitations. Firstly, all interviews and focus groups were conducted by the IRC staff who were working for the operational research as Research Officers and were therefore responsible for the supervision of the CBDs during study implementation, meaning we expect some reactivity in interviewee responses. Participants may have had the tendency to answer questions more positively than what their actual feelings were. We were not able to recruit independent qualitative data collectors due to a lack of local qualitative health research expertise. All interviewers were male, which may have affected the interaction between the male interviewer and the female CBDs. As the interviewers had closely collaborated with and supervised the CBDs during study implementation, we do not expect that there was a lack of rapport, despite the gender difference. However, interviewers were less familiar with the caregivers that participated in the interviews and focus groups and the gender and power balance may have affected their responses. Also, as discussed in the methods section, the transcripts that were developed were not word-for-word translations, thus we expect that some content and nuance may have been lost.

11. WAY FORWARD

Image 28
Trucks bringing in CBD metal boxes
Photo credit: Elburg van Boetzelaer / The IRC

This study demonstrated that low-literate CBDs can provide uncomplicated SAM treatment in their homes using simplified tools and treatment protocol with high accuracy and achieve an acceptable SAM recovery rate that meets the Sphere standards. Based on the percentage of children claiming to not have received treatment recently and the proportion of children with low MUAC on admission, we suspect that the CBD delivery of treatment increased access to care.

Globally, this was the first time any organization assessed the feasibility of SAM treatment provided by low-literate CBDs. As this was conducted at small scale, there are programmatic considerations that remain to be explored in future studies with a larger sample size, including:

- The most effective and efficient supervisory mechanism if the program is scaled-up and the number of CBDs providing SAM treatment in their communities is increased;
- The most effective and efficient supply chain mechanism if the program is scaled-up and the number of CBDs providing SAM treatment in their communities is increased;
- Change in treatment coverage if program is scaled-up and the number of CBDs providing SAM treatment in their communities is increased;
- Cost-efficiency of CBD provided SAM treatment in relation to increase in treatment coverage and saturation models;
- Comparison of quality of care and treatment outcomes for care provided by CBDs with care provided by nutrition workers at static OTP facilities;
- Effect of integration of iCCM and malnutrition treatment on quality of care, workload and motivation of CBDs and child treatment outcomes;
- Effect on treatment coverage, supply chain, workload and motivation of CBDs if MAM is added as an admission criteria;
- Operational experience in deploying this approach in conflict and access-constrained environments

To build further evidence, the IRC is leading a global working group comprised of four NGOs interested in conducting similar pilot studies in Nigeria, Kenya and Malawi funded by the Eleanor Crook Foundation. These pilots will be implemented in 2018-2019 and learnings across all sites will be aggregated to determine if and how this community-based treatment model can be scaled up to improve access and coverage of malnutrition treatment. In a separate study, the IRC is also testing a combined protocol for the treatment of severe and moderate acute malnutrition with reduced dosage[20]. If the combined protocol shows favorable results, it could further simplify the treatment and logistics process for treatment of malnutrition by community health workers.

However, in order to improve access and coverage of nutrition treatment programs on a larger scale, global and national nutrition policies need to support treatment of severe acute malnutrition by CHWs. The current CMAM guidance is built around health facilities and isn't well designed to serve people living in places where health infrastructure is weak or access is limited. This research needs to be complemented by advocacy with national governments, international agencies and donors to include malnutrition treatment delivery by CHWs as an option, particularly in access-constrained environments. Operationalizing these ideas in a programmatic setting is key to enabling further evidence generation and learning. Only through a collaborative effort by all stakeholders will we be able to best leverage CHW skills and access to deliver life-saving malnutrition treatment to all children who are severely malnourished—regardless of distance to the health facility.

20 Bailey, J., Lelijveld, N., Marron, B., Onyoo, P., Ho, L. S., Manary, M., … Kerac, M. (2018). Combined Protocol for Acute Malnutrition Study (ComPAS) in rural South Sudan and urban Kenya: study protocol for a randomized controlled trial. Trials, 19, 251. http://doi.org/10.1186/s13063-018-2643-2

12. REFERENCES

Alvarez Moran, J. L., Ale, F. G., Rogers, E., & Guerrero, S (2017). Quality of care for treatment of uncomplicated severe acute malnutrition delivered by community health workers in a rural area of Mali. Matern Child Nutr. Jan;14(1). doi:10.1111/mcn.12449

Binns P, Dale N, Hoq M, Band C, & Myatt M (2015). Mid upper arm circumference and weight changes in children aged 6-59 months. Archives of Public Health 73(54). doi:10.1186/s13690-015-0103-y.

Bryce J, Friberg IK, Kraushaar D, Nsona H, Afenyadu GY, Nare N, Kyei-Faried S, & Walker N (2010). LiST as a catalyst in program planning: experiences from Burkina Faso, Ghana and Malawi. Int J Epidemiol. 39: i40–i47. doi: 10.1093/ije/dyq020.

Bailey J, Chase R, Kerac M, Briend A, Manary M, Opondo C, Gallagher M, & Kim A (2016). Combined protocol for acute malnutrition study (ComPAS) Report for Stage 1. Emergency Nutrition Network. Accessed from: https://www.ennonline.net/fex/53/thecompasstudy.

Bailey J, Lelijveld N, Marron B, Onyoo P, Ho LS, Manary M, Briend A, Opondo C, & Kerac M (2018). Combined Protocol for Acute Malnutrition Study (ComPAS) in rural South Sudan and urban Kenya: study protocol for a randomized controlled trial. Trials, 19(1). doi:10.1186/s13063-018-2643-2.

Dedoose Version 7.6.21, web application for managing, analyzing and presenting qualitative and mixed method research data (2017). Los Angeles, CA: SocioCultural Research Consultants, LLC.

Friedman L & Wolfheim C (2014). Linking Nutrition and (integrated) Community Case Management (iCCM/CCM): A Review of Operational Experiences. Accessed from: https://ccmcentral.com/wp-content/uploads/2015/02/nutritionICCM.pdf.

Integrated Food Security Phase Classification for the Republic of South Sudan (2017). Key IPC findings: January – July 2017. Accessed from: https://reliefweb.int/report/south-sudan/key-ipc-findings-january-july-2017

Lauritsen JM & Bruus, M. Epidata version 4.2.2.0. A comprehensive tool for validation and documentation of data. The EpiData Association, Odense, Denmark, 2003-2005.

Puett, C., Coates, J., Alderman, H., & Sadler, K (2013). Quality of care for severe acute malnutrition delivered by community health workers in southern Bangladesh. Matern Child Nutr, 9(1), 130-142. doi:10.1111/j.1740-8709.2012.00409.x

Puett, C., Coates, J., Alderman, H., Sadruddin, S., & Sadler, K (2012). Does greater workload lead to reduced quality of preventive and curative care among community health workers in Bangladesh? Food Nutr Bull, 33(4), 273-287. doi:10.1177/156482651203300408

StataCorp. (2017). Stata statistical software: Release 15. College Station: TX: StataCorp LLC.

UNICEF. (2017). South Sudan Situation Report 30 - September 2017. Accessed from: https://reliefweb.int/sites/reliefweb.int/files/resources/UNICEF%20South%20Sudan%20Humanitarian%20SitRep%20%23113%20_%2030%20September%202017.pdf

World Food Programme (2017). South Sudan monthly market price monitoring bulletin - August 2017. 8Accessed from: https://reliefweb.int/report/south-sudan/south-sudan-monthly-market-price-monitoring-bulletin-august-2017

ANNEX 1.
SIMPLIFIED SAM TREATMENT PROTOCOL BY WEEK

WEEK 1:
FIRST VISIT STEPS
(TO BE COMPLETED BY CBD)

1. Welcome caregiver and ask name of child
2. Ask reason for the visit
3. Ask the age of the child

> Continue if child age 6-59 months

4. Danger sign assessment
   a. iCCM danger signs
   b. Ask
   c. Look
   d. Assess for Bilateral Pitting Oedema
   e. MUAC measurement

MUAC color	CBD Action
Dark red	**Refer** to health facility
Red or pink	**Admit** and treat
Yellow	**Refer** to TSFP
Green	Child is okay

> Continue if no danger signs AND red or pink MUAC

5. Receive consent from caregiver

> Continue if caregiver consents

6. Appetite test

> Continue if child passes appetite test

7. Weigh child

> Continue if weight not in black zone

8. Calculate weekly dosage
9. Fill in Patient Register
10. Amoxicillin treatment
11. Give RUTF feeding instructions to caregiver
12. Give ID card and weekly RUTF ration to caregiver, explain she should return in one week with ID card and empty sachets

WEEK 2:
SECOND VISIT STEPS
(TO BE COMPLETED BY CBD)

Underlined sections are NEW for second visit

1. Welcome caregiver
2. Ask how the child is doing
3. Ask for ID card and empty sachets
4. Danger sign assessment
       a. iCCM danger signs
       b. Ask
       c. Look
       d. Assess for Bilateral Pitting Oedema
       e. MUAC measurement

MUAC color	CBD Action
Dark red	**Refer** to health facility
Red, pink, yellow, green	**Treat**

> Continue if no danger signs AND red, pink, yellow or green MUAC

5. Appetite test

> Continue if child passes appetite test

6. Weigh child

> Continue if weight is not in black zone

7. Calculate weekly dosage
8. Fill in Patient Register
9. Albendazole treatment
10. Give RUTF feeding instructions to caregiver
12. Give ID card and weekly RUTF ration to caregiver, explain she
      should return in one week with ID card and empty sachets

WEEK 3-16:
VISIT STEPS
(TO BE COMPLETED BY CBD)

1. Welcome caregiver
2. Ask how the child is doing
3. Ask for ID card and empty sachets
4. Danger sign assessment
  a. iCCM danger signs
  b. Ask
  c. Look
  d. Assess for Bilateral Pitting Oedema
  e. MUAC measurement

MUAC color	CBD Action
Dark red	**Refer, DISCHARGE**
Two greens in a row	Recovered, give final ration and **DISCHARGE**
Two missed visits in a row	Defaulted, **DISCHARGE**
MUAC is below admission MUAC	Deteriorated, **refer, DISCHARGE**
If 16th week and never had two greens in a row	Non-response, **refer, DISCHARGE**
Other	**Treat**

If MUAC progress is "other" > Continue treatment

5. Appetite test

> Continue if child passes appetite test

6. Weigh child

> Continue if weight is not in black zone

7. Calculate weekly dosage
8. Fill in Patient Register
9. Give RUTF feeding instructions to caregiver
10. Give ID card and weekly RUTF ration to caregiver, explain she should return in one week with ID card and empty sachets

ANNEX 2.
DISCHARGE CRITERIA OF ENROLLED CHILDREN

Classification	Criteria
Cured	MUAC measurement: two green MUAC measurements (≥12.5 cm) during two consecutive weeks
Referral (to nearest health facility)	Child develops 1 or more general danger signs
	Child presents with iCCM danger sign (fever > 7 days; cough >21 days; diarrhea >14 days; diarrhea with worms or blood in stool)
	Child develops bilateral pitting oedema
	MUAC measurement: Dark red (<9.0 cm)
	Child fails appetite test
	Weight of child in black area on Dosage Scale (<4kg)
	Red MUAC measurement for 4 consecutive weeks
	Pink MUAC measurement for 4 consecutive weeks
	MUAC measurement falling below MUAC color on admission
Defaulted	Child absent for two consecutive weeks
Non-Respondent	Child reaches 16-weeks of treatment without being cured
Death	Child dies during treatment period

ANNEX 3.
CBD SUPERVISION CHECKLIST

Form 05 - Supervision Checklist for CBD

Instruction: ROs to fill this form during each supervision visit of a CBD where the child is present.

Date ☐☐ ☐☐ ☐☐
dd mm yy

Research Officer ID ☐☐ **Payam** ☐☐ **CBD ID** ☐☐

Visit week # ☐☐ **Patient Number** ☐☐

SECTION 1: WELCOME

Instruction: Tick ONE response for each question.

		YES	NO
1.1	Did the CBD continue or stop the protocol correctly depending on the child's age? *(only on first visit, CONTINUE if child is 6-59 months, STOP if child is less than 6 months or older than 5 years)*		
1.2	Did the CBD identify the correct page in the register for this patient? *(weeks 2-16)*		

SECTION 2: DANGER SIGNS

Instruction: Tick ONE response for each question.

Did CBD assess:		YES	NO
iCCM Danger Signs 2.1	Cough for 21 or more days *(Tick if child does **not** have cough)* ☐		
	Diarrhea for 14 or more days *(Tick if child does **not** have diarrhea)* ☐		
	Fever for 7 or more days *(Tick if child does **not** have fever)* ☐		
	Blood or worms in stool *(Tick if child does **not** have diarrhea)* ☐		

Did CBD assess:		YES	NO
General Danger Signs 2.2	Stiff neck *(Tick if child is alert/active)* ☐		
	Unconscious or abnormally sleepy *(Tick if child is alert/active)* ☐		
	Chest in-drawing *(Tick if child does **not** have cough)* ☐		
	Convulsions		
	Unable to breastfeed or drink		
	Vomits everything		

Did CBD:	YES	NO
Bilateral Pitting Oedema 2.3		
Apply pressure on the feet for 3 seconds		
Test both feet		

Did CBD:	YES	NO
MUAC 2.4		
Remove clothing covering arm		
Measure the approximate midpoint of child's arm		
Measure MUAC on relaxed arm		
Insert the tape through the slit instead of through the window		
Pull the tape so that it was not too tight or too loose		

Did CBD:		YES	NO
Referral 2.5	Refer if the child has a danger sign? *(Tick if there is **no** danger sign)* ☐		

If any NO > CORRECT CBD STOP VISIT if danger sign observed, otherwise continue

83

SECTION 3: APPETITE TEST

Instruction: Tick ONE response for each question.

		YES	NO
3.1	Was the appetite test conducted?		
3.2	Did CBD advise the caretaker to wash his/her hands?		
	Did CBD explain how to feed RUTF without force feeding?		
	Did CBD provide water for the child to drink?		
	Did CBD observe the child eating the RUTF?		
3.3	Did the CBD visually confirm if at least half of the Plumpynut was eaten?		
	Was the correct decision made based on appetite test result?		
If any NO > CORRECT CBD **STOP VISIT if appetite test failed, otherwise continue**			

SECTION 4: RUTF DOSAGE

Instruction: Tick ONE response for each question.

		YES	NO
4.1	Was the scale calibrated?		
	Was child wearing minimal or no clothing?		
	Was there nothing else in the basin?		
	Did CBD identify the correct daily dosage?		
4.2	Based on their reading of the daily dosage, did CBD pile the correct number on each square of the calculator?		
	Did CBD subtract one sachet for the appetite test?		
If any NO > CORRECT CBD **STOP VISIT if child weight in black section, otherwise continue**			

SECTION 5: REGISTER AND MEDICATION

Instruction: Tick ONE response for each question.

ONLY WEEK 1		YES	NO
5.1	Was the correct icon for sex of the child marked in the register?		
5.2	Was the correct icon for age marked in the register?		
5.3	Was the correct MUAC color marked in the register?		
5.4	Was the correct RUTF dosage marked in the register?		
5.5	Was the correct amoxicillin dosage given to the child?		
5.6	Was the correct amoxicillin marked in the register?		
	If any NO > CORRECT CBD		

ONLY WEEK 2		YES	NO
5.3	Was the correct MUAC color marked in the register?		
5.4	Was the correct RUTF dosage marked in the register?		
5.7	Did the CBD give the correct albendazole dosage to the child?		
5.8	Did the CBD mark the correct albendazole icon in the register?		
	If any NO > CORRECT CBD		

ONLY WEEK 3-16		YES	NO
5.3	Was the correct MUAC color marked in the register?		
5.4	Was the correct RUTF dosage marked in the register?		
	If any NO > CORRECT CBD		

SECTION 6: COUNSELING, PROGRESS MONITORING, DISCHARGE

Instruction: Tick ONE response for each question.

COUNSELING		YES	NO
6.1	Did CBD explain how to give RUTF to the child?		
	Did CBD tell the caretaker how many RUTF to give the child per day?		
	Did CBD tell the caretaker not to share RUTF with others?		
	Did CBD explain to the caretaker that RUTF is medicine for children?		
	Did CBD tell the caretaker when to return?		
6.2	Did CBD give the ID card to the caregiver?		

Instruction: Tick ONE response for each question.

Progress Monitoring & Discharge (WEEKS 2-16 ONLY)		YES	NO
6.3	Did CBD identify child's status correctly? *(continue treatment, recovered, non-respondent, refer)*		
6.4	Did CBD correctly refer stationary child (4 consecutive visits in the red zone, or 4 consecutive visits in the pink zone)? *Tick if not applicable* ☐		
6.5	Did CBD correctly refer child with MUAC below the admission color? *Tick if not applicable* ☐		
6.6	If the child was discharged, did CBD mark the correct icon? *Tick if not applicable* ☐		
If any NO > CORRECT CBD **Provide general feedback.** **End of form**			

ANNEX 4.

AVERAGE OF PERFORMANCE ITEMS PROPERLY COMPLETED ACROSS SUPERVISION VISITS, ACCOUNTING FOR CLUSTERING AT CBD LEVEL (N=40 CBDS, 141 CHECKLISTS)

Assessed for following danger signs:	% (95% CI)
Cough	87.9 (82.1-92.1)
Diarrhea	87.2 (80.7-91.8)
Fever	83.7 (76.7-88.9)
Blood in stool or worms	88.7 (83.1-92.5)
Stiff neck	90.8 (84.8-94.6)
Unconsciousness	90.1 (84.2-93.9)
Chest in-drawing	85.8 (79.8-90.3)
Convulsions	83.7 (77.7, 88.3)
Difficulty with breastfeeding / feeding	86.5 (79.9-91.2)
Vomiting	79.4 (71.4-85.6)
Oedema	78.0 (69.7-84.5)
Made correct treatment decision based on danger signs	100
Correctly took MUAC measurement	92.2 (85.3-96.0)
Correctly conducted appetite test	95.7 (89.6-98.3)
Scale was calibrated	96.5 (91.7-98.5)
Correct daily dosage determined	97.9 (93.6-99.3)
Weekly dosage calculator used correctly	98.6 (94.3-99.7)
Correct MUAC color bubbled in register	95.7 (89.4-98.3)
Correct RUTF amount bubbled in register	97.9 (93.4-99.3)
Counseling given for the following:	
How to give RUTF	92.9 (84.6-96.9)
How many sachets to give	88.7 (78.6-94.3)
Instructed not to share RUTF	85.1 (76.7-90.9)
Instructed that RUTF is not medicine	78.7 (70.3-85.2)
Told when to return for next visit	89.4 (80.5-94.5)
ID card given	94.3 (87.2-97.6)
Proper child treatment status determined	96.5 (91.6-98.5)