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Evidence-Based Recommendations for the Assessment of Severe Acute Malnutrition in Children Aged 6-59 Months in the Central African Republic

Rachel R. Wong
Cedarville University, rwong@cedarville.edu

EVIDENCE-BASED RECOMMENDATIONS FOR THE ASSESSMENT OF SEVERE ACUTE MALNUTRITION IN CHILDREN AGED 6-59 MONTHS IN THE CENTRAL AFRICAN REPUBLIC

An evidence-based project submitted in partial fulfillment of the requirements for the degree of Master of Science in Nursing

By

RACHEL REBEKAH WONG

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Cedarville University

Abstract

Thirty-five percent of mortalities in children under the age of five can be attributed to malnutrition (World Health Organization (WHO), n.d.). Nearly 24 percent of children less than five from 2008-2012 in the Central African Republic were moderately or severely underweight and nearly eight percent suffered from severe or moderate wasting (The United Nations International Children's Emergency Fund, 2013). As a result of recent sectarian violence which began with a coup in March 2013, the Central African Republic is facing a nutrition crisis. As a result, an estimated 28,000 Central African children under the age of five are predicted to be affected by severe acute malnutrition (SAM) and 75,000 from moderately acute malnutrition in the year 2014 (The Assessment Capacities Project, 2014). The WHO (2007) defines SAM in children aged 6-59 months as a low weight-for-height/length below -3z scores/standard deviations (SD)of the median WHO growth standards (WHO, 2006), the presence of nutritional edema, or a mid-upper arm circumference (MUAC) less than 115mm. Uncomplicated cases of SAM may be treated on an outpatient basis through community feeding programs. The limited access to resources such as training materials, protocols, charting systems, accurate scales, height boards, growth charts, or measuring tapes in developing countries hinders the utilization of objective admission, assessment, and discharge criteria. The purpose of this project is to develop practical and evidence-based recommendations for assessing the nutritional status of children aged 6-59 months for a community based nutrition program in the Central African Republic in order to establish evidence-based standards for screening, admission, monitoring, referral, and discharge criteria.

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List of Abbreviations

CAR	Central African Republic
CHW	Community Health Worker
CMAM	Community based Management of Acute Malnutrition
DALY	Disability-Adjusted Life Year
IMCI	Integrated Management of Childhood Illness
MAM	Moderate Acute Malnutrition
MDG	Millennium Development Goal
MIRA	Multi-cluster/sector Initial Rapid Assessment
MUAC	Mid-Upper Arm Circumference
NCHS	National Center for Health Statistics
RUTF	Ready-to-Use Therapeutic Food
SAM	Severe Acute Malnutrition
SD	Standard Deviation
UNICEF	United Nations International Children's Emergency Fund
USAID	U.S. Agency for International Development
WFH/L	Weight-for-Height/Length
WHZ	Weight-Height Z Score
WHO	World Health Organization

Evidence-Based Recommendations for the Assessment of Severe Acute Malnutrition in Children Aged 6-59 months in the Central African Republic

Chapter 1: Introduction

According to the World Health Organization (WHO) (n.d.), thirty-five percent of mortalities in children under the age of five can be attributed directly or indirectly to malnutrition. Globally, an estimated 20 million children less than five years old suffer from severe acute malnutrition (SAM) resulting in an estimated 1 million child deaths per year. The majority of severely malnourished children reside in South Asia and sub-Saharan Africa (WHO, the World Food Programme (WFP) the United Nations System Standing Committee on Nutrition, & the United Nations International Children's Emergency Fund (UNICEF), 2007).

Severe Acute Malnutrition in Children aged 6-59 months

Severe acute malnutrition (SAM) is a form of severe undernutrition. International diagnostic criteria, research, and treatment interventions for SAM pertain to children between 6-59 months. The diagnostic criteria for SAM in children aged 6-59 months are 1) a weight-for-height less than -3 standard deviations of the WHO growth standards (WHO, 2006), 2) a mid-upper arm circumference (MUAC) <115 mm, or 3) bilateral edema (WHO & UNICEF, 2009). Undernutrition in children aged 0-8 years old can impair behavioral and cognitive development, learning ability, and reproductive health (World Bank, 2011). According to Prado and Dewey (2014), SAM is a major risk factor for impaired motor, cognitive, and socioemotional development. In addition, SAM places children at increased risk for infectious disease; and mortality (Black et al., 2008; Merson, Black, & Mills, 2012; Myatt, Khara, & Collins, 2006). In fact, according to

Black et al. (2008), a child under five years old with a weight-for-height less than -3 standard deviations (SD) of the WHO standards has a nine times higher overall risk of death in comparison with a child with a weight-for-height above -1 SD. Additionally, the child with SAM (weight-for-height <-3 SD) has an increased risk of dying from diarrhea (6 times), pneumonia(8 times), malaria(2 times), and measles(6 times) in comparison with a child with a weight-for-height greater than -1 SD. Therefore, correctly identifying and treating children aged 6-59 months with SAM may prevent cognitive, motor, and socioemotional disability; infection; or mortality (WHO, the WFP, the United Nations System Standing Committee on Nutrition, & Unicef, 2007; Prado & Dewey, 2014).

The Central African Republic

The sub-Saharan country-the Central African Republic (CAR) is home to an estimated 4,525,000 (WHO, 2012). The CAR gained independence from France in 1960 and has since been troubled with instability. It is known as one of the world's least developed countries and has undergone several coups since its establishment (BBC, 2014). The most recent coup in March 2013 has left the country in crisis. As of April 2014, the ongoing, widespread sectarian violence has resulted in thousands of fatalities, over 600,000 internally displaced persons, 450,000 refugees, and 2.5 million persons in need of basic support to ensure survival. (UN News Centre, 2014). The purpose of this project is to develop evidence-based recommendations for a community-based nutrition program in the Central African Republic. The recommendations of this project specifically establish evidence-based protocols for community nutrition workers in screening, admitting, referring, monitoring, and discharging children aged 6-59 months from a community-based nutrition program.

Nutritional Status

Prior to the conflict, the baseline nutritional status of the CAR was poor. In 2006, the country was globally ranked 21st for the number of underweight children under the age of five (Central Intelligence agency, n.d.), and was ranked 6th globally for an under-five mortality rate of 129 in 2012. In addition, 23.5% of children under the age of five from 2008-2012 in the CAR were moderately or severely underweight; 7.9% were severely underweight. Seven percent suffered from severe or moderate wasting and 40.7% were moderately or severely stunted in growth (UNICEF, 2013).

Shortly following the collapse of the government, widespread violence, and displacement of families; a multi-cluster/sector initial rapid assessment (MIRA) of the Central African Republic conducted in December 2013 concluded that the highest priority need for the CAR was food security. Researchers conducting the MIRA found that ninety percent of families were eating only one meal a day rather than eating two to three meals a day as most were doing prior to the national conflict. In addition, households reported that they are consuming less meat. 96% of key informants for Bangui reported a perceived increase in the number of children with signs of malnutrition, and 90% of informants in rural prefectures also reported a perceived increase (United Nations Office for the Coordination of Humanitarian Affairs & WFP, 2014).

In fact, according to a Food and Agriculture Organization (FAO) of the United Nations, Rome & WFP, Rome (2014) report issued April, 2014, the CAR is facing a nutrition crisis which is impacting an estimated 1.6 million persons. Gross Domestic Product decreased by 37% from 2012 to 2013 with the CAR agricultural sector

decreasing by 46%. The 2014 crop production is 58% lower than the average crop production prior to the conflict due to a reduction in planting supplies and insecurity during the planting season (WFP, 2014) (FAO of the United Nations & WFP, 2014). The situation is concerning for potential long term consequences in the nutritional state of children due to a lack of food variety and animal protein. A crop and food security assessment conducted in August-September, 2014 found that the amount of livestock has decreased by 77% and the fish supply has decreased by 40% in comparison to pre-conflict numbers. In addition, food access is limited by inflation of prices which increased from 3.5 to 12% in Bangui in 2014. Similarly, in 2014, the cost of maize, millet, and groundnuts was greatly increased (30-70%) although local cassava prices declined by 13% (FAO of the United Nations & WFP, 2014). As a result, since the beginning of 2014, over 10,000 CAR children below the age of five have been treated for severe malnutrition (UNICEF, 2014). An estimated 28,000 children under the age of five are predicted to be affected by severe acute malnutrition in 2014 and 75,000 from moderately acute malnutrition (The Assessment Capacities Project, 2014).

Community-Based Management of Severe Acute Malnutrition

One means of managing acute malnutrition is through community based management of acute malnutrition (CMAM). This care framework is described as having four facets, 1) community participation, outreach, and mobilization measures, 2) outpatient therapeutic care for the management of uncomplicated SAM, 3) inpatient care for the management of complicated SAM, and 4) supplementary feeding of moderately malnourished children to prevent SAM (Gatchell, Forsythe, & Thomas, 2006; U.S. Agency for International Development (USAID), 2008; Valid International, 2006).

Community outreach measures include active assessment, screenings, education, and follow up within the community. Outpatient care of children with SAM involves children aged 6-59 months who meet anthropometric criteria for SAM, but lack medical complications, have an appetite, have less than 3+ pitting edema, and are alert. Outpatient care includes a clinical assessment, anthropometric monitoring, the provision of ready to use therapeutic foods (RUTF), and basic medical treatment. Inpatient care is recommended for complicated cases of SAM and involves nutritional rehabilitation and medical care. Supplementary feeding includes the provision of additional food to children with moderate acute malnutrition (weight-for-height <–2 SD but >–3 SD; MUAC <125 mm but>115 mm) in order to prevent the development of SAM (WHO, 2013; USAID, 2008; Valid International, 2006). Outpatient feeding programs may utilize community health workers (CHWs) in order to assess and monitor the nutritional status of children within communities (WHO, WFP, the United Nations System Standing Committee on Nutrition, & UNICEF, 2007; WHO & UNICEF, 2012). According to UNICEF (2015), there are currently 36 inpatient and 224 outpatient facilities for management of SAM in the CAR with the target for 2015 being 48 inpatient and 280 outpatient facilities

Community Health Workers

As mentioned previously many outpatient nutrition programs utilize community health workers as a means of screening, monitoring, referring, educating, and following-up with children in their communities (Ethiopa-Federal Ministry of Health, 2007; Harris & Jack, 2011; Somassé, Bahwere, Laokri, Elmoussaoui, & Donnen, 2013; UNICEF, 2012; USAID, 2008; WHO 1981). A community health worker is defined as a local

member of the community who has been nominated by the community to undergo training in a health care subject such as pediatric nutritional assessment and monitoring. The CHW is supported, educated, and overseen by a professional health worker, but the CHW is not considered to be a licensed health care worker (Lopes, 2014; Smith et al, 2014; WHO & Global Workforce Alliance, 2010; WHO, 2007; WHO & UNICEF, 2012).

CAR Community-Based Outpatient Nutrition Program

One example of a community-based outpatient nutrition program for which these recommendations have been developed is an outpatient nutrition program located in Bangui, CAR. The program was founded in Yaloke, CAR over ten years ago by a missionary couple, Dr. Michael (PA) and Myra (RN) Taylor. They developed the program after observing symptoms of pediatric starvation. Myra Taylor (RN) trained a local couple, Dr. Paul and Denise Dibona in managing the program. The program is currently funded through Three Strands-a nonprofit organization cofounded by Dr. and Mrs. Taylor. The program is run out of the Dibona's home in Bangui and primarily treats children 3-5 years old. Upon admission, most children's diet consists almost exclusively of manioc. Mrs. Dibona, who has been trained as a nurse, provides nutritional education, spiritual care, locally prepared food, and supplements if available to each child and his or her mother twice a week. Dr. Taylor expressed interest in developing a simplified and evidence-based method for screening children for malnutrition for the nutrition program. Currently the home-based nutrition program does not have standardized protocols for training workers in acute malnutrition screening, referral, monitoring, or discharge criteria (Taylor, M., personal communication. April 21 and 23, 2013).

Need for Protocol and Training Material Development

Lacking an evidence-based resource for training nutrition workers for screening, assessing, referring, and monitoring children for acute malnutrition in an outpatient nutrition program is problematic for several reasons. First, in the case of this community nutrition program, the burden of nutritional assessment and community outreach falls solely on a nurse and a physician rather than utilizing community health workers. Second, in the absence of a protocol, nutrition program workers are at risk of incorrectly diagnosing the nutritional status of a child. Third, the absence of protocol places children at risk of receiving the improper treatment.

High Workload for Upper-level Providers

In the case of the aforementioned community nutrition program, the work of identifying malnourished children for treatment falls on a physician and a nurse. In the case of the Central African Republic, this can be problematic as the physician to population ratio in 2000-2009 was 1 to 10,000 persons (WHO, 2010). The WHO and UNICEF published a joint statement in 2012 describing the need for integrated community case management of childhood illness. The WHO and UNICEF in this statement propose utilizing community health workers for increasing health care coverage and providing quality care for children. Specifically, one of the roles of community health workers described in this statement is to identify children with SAM through the use of anthropometric measurements (mid-upper arm circumference).

Risk of Misdiagnosing Nutritional Status

Without a standardized protocol, nutrition program workers, are at risk of incorrectly diagnosing the nutritional status of a child. A 2009 joint statement by the WHO and UNICEF states that children should be admitted to a community feeding

program according to mid-upper arm circumference (MUAC) criterion, weight-for-height z score (WHZ/ WFH) criterion, or the presence of nutritional edema. These recommendations assume that community based workers have access to and have been trained to use appropriate anthropometric tools such as scales, measuring tapes, height boards, and growth standards. Table 1 depicts the classification of acute malnutrition according to international guidelines.

Table 1.

Acute Malnutrition Classification in Children aged 6-59 Months.

Children 6-59 months	MUAC (independent criteria)	Weight-for-height/length(WFH/L) (independent criteria)	Nutritional edema
Moderate Acute Malnutrition (MAM)	115-125 mm	≥-3 and <-2 standard deviations of WHO standard	None
Severe Acute Malnutrition (SAM)	<115 mm	< -3 standard deviations of WHO standard	Bilateral pitting edema

Note. Compilation of information from USAID, 2008; WHO, 2013; WHO, 2014; WHO & UNICEF, 2009.

The alternative to using anthropometric measurements to diagnose SAM may be to use a visible clinical assessment; however, research by Mogeni et al. (2011) in two inpatient settings in sub-Saharan Africa concluded that using visible assessment to detect severe wasting failed to correctly diagnose approximately fifty percent of children who met anthropometric criteria for SAM. In addition, the 2013 WHO guideline update advises against using visible severe wasting as admission criteria for SAM treatment; however, the WHO guideline update does support the recommendation that a trained clinician should perform a clinical examination on each child who is anthropometrically identified as having SAM (WHO, 2013).

Risk of Improper Treatment

Children who have their nutritional status improperly diagnosed and classified subsequently receive improper treatment. Table 2 depicts the recommended management of acute malnutrition according to international guidelines.

Table 2.

Management of Acute Malnutrition

Children 6-59 months	Criteria	Treatment	Referral	Follow-up
MAM without medical complications	MUAC 115-125mm OR WFH/L ≥-3 and <-2 SD of WHO standard	-Assess child for tuberculosis(TB) -Assess child's feeding -Provide education and counseling to caregiver	Outpatient supplementary feeding	- In 7 days if feeding problem -In 30 days if no feeding problem
SAM				
Uncomplicated SAM	MUAC< 115 mm OR WFH/L < -3 SD of WHO standard OR bilateral edema < 3+ AND -No medical complications -With appetite -No IMCI danger signs	-Oral antibiotics x 5 days -Ready to use therapeutic food (RUTF) -Counseling -Assess for TB -Refer to outpatient center for full clinical examination	Outpatient Nutrition Program	In 7 days
Complicated SAM	Severe bilateral pitting edema (3+) OR MUAC< 115 mm OR WFH/L < -3 SD of WHO standard AND -Medical complication - One or more IMCI danger signs -No appetite	-Immediately give first dose antibiotics -Immediately treat for low blood sugar -Keep child warm -Immediate referral to inpatient center for full clinical examination and treatment	Inpatient Nutrition Center	N/A

Note. Compilation of information from USAID, 2008; WHO, 2013; WHO, 2014; WHO & UNICEF, 2009.

Integrated Management of Childhood Illness (IMCI) danger signs are (1) the child is unable to drink or breastfeed, (2) the child vomits everything, (3) the child is currently convulsing or has had convulsions (multiple or one with a duration> 15 minutes), and (4) the child is lethargic or unconscious (WHO 2013; WHO, 2014). Medical complications in a child may include a lower respiratory tract infection, high fever, severe dehydration, severe anemia, hypoglycemia, or hypothermia. The recommended treatment, referral, and follow-up of a child with acute malnutrition depends on the initial anthropometric screening, malnutrition classification, and clinical examination. For this reason, programs which lack a protocol for standardized malnutrition screening and assessments are at risk for providing children with incorrect treatment plans.

Problem Significance for Advanced Public Health Nursing Practice

The lack of a standardized evidence-based protocol and training resource for a community-based nutrition program in Bangui, CAR is significant to advanced public health nursing practice. A board certified advanced public health nurse (APHN-BC) is a specific role in public health nursing requiring a registered nurse to have completed a graduate degree in nursing or public health, at least 2,000 hours of practical experience, and thirty hours of continuing education specific to advanced public health nursing prior to having a personal portfolio approved by a committee (American Nurses Credentialing Center, 2014). An APHN-BC is concerned with promoting the health of and preventing disease in a specific population. The practical role of an advanced public health nurse includes analytic and assessment skills, program planning, and community development as well as an emphasis on leadership, systems thinking, cultural competency, policy development, research, and financial planning and management (Quad Council

Competencies for Public Health Nurses, 2011). Therefore, addressing the current nutrition crisis affecting a large population of children in the CAR through the development of an evidence-based protocol for a community-based nutrition program in the CAR is within the scope of an APHN-BC. An APHN-BC could utilize her advanced skills of cultural competence, research, financial planning, leadership, and program planning in formulating a protocol and training resource for community health workers which would benefit the population of children aged 6-59 months with SAM who could be admitted to and treated by a community-based nutrition program in Bangui, CAR.

Purpose of This Project

The purpose of this project is to develop evidence-based recommendations for a community-based nutrition program in the Central African Republic. More specifically, the purpose of this project is to develop practical and evidence-based recommendations for assessing the nutritional status of children aged 6-59 months for a community based nutrition program in the Central African Republic in order to establish evidence-based standards for screening, admission, monitoring, referral, and discharge criteria. The purpose of this project align with the United Nations millennium development goals (MDGs). The United Nations MDGs seek to address the global tragedies currently affecting the international population. The first MDG is to "Eradicate extreme poverty and hunger" and the fourth MDG is to "Reduce child mortality" (United Nations, n.d.). This project will act in conjunction with MDG1 and MDG 4. By synthesizing evidence-based nutritional anthropometric standards for a community based nutrition program in the Central African Republic, local children suffering from acute malnutrition will be recognized and will receive adequate treatment. Additionally, establishing a protocol will

standardize care for this population and will ensure that nutritional resources reach the children who are in actuality severely malnourished. The recommendations and protocol developed through this project will be provided to Dr. and Mrs. Taylor for use by the Three Strands Bangui nutrition program.

Chapter 2: Concept Analysis

The major concepts in this project are mid-upper arm circumference (MUAC), community-based outpatient nutrition program, community health worker, and severe acute malnutrition (SAM). The concepts MUAC, community-based outpatient nutrition program, and community health worker will be briefly defined; and the concept SAM will be analyzed in further detail in the following sections.

MUAC

MUAC is conceptually defined as the circumference in millimeters of the mid-upper arm. Specific to this project, MUAC is an anthropometric measurement to assess the nutritional status of children between 6-59 months (Caleo et al., 2012; Somassé, Bahwere, Laokri, Elmoussaoui, & Donnen, 2013; The Sphere Project, 2011; UNICEF, 2012; USAID, 2008; WHO 2013; WHO, WFP, United Nations Systems Standing Committee on Nutrition, & UNICEF, 2007). MUAC is measured by placing a demarcated, flexible but non-elastic measuring tape around the relaxed mid-upper arm of a subject (Ayele et al., 2012; Joseph, Rebello, Kullu, & Raj, 2002; UNICEF, Lesson 3.1.3, n.d.; USAID, 2008; WHO, 2011). The most recently produced pediatric MUAC tapes by UNICEF (n.d.) have centimeter and millimeter markings as well as color-coded bars corresponding with the updated WHO criteria (red/SAM: 0-11.5 cm, yellow/MAM:

11.5-12.5cm, and green: >12.5cm). The specific technique for taking the MUAC of a child aged 6-59 months is presented in Table 3.

Table 3.

Steps for Using a MUAC Tape

For children aged 6-59 months

1. Remove clothing from child's left arm
2. Locate the midpoint of the left upper arm between the shoulder and elbow using non-elastic string
   -Place one end of the string at the tip of the child's shoulder, with the child's elbow at a right angle, bring the other side of the string taut to the tip of the child's elbow. Fold the string in half and mark the mid-point of the child's arm.
3. Have the child relax his arm and hang at his side
4. Wrap the MUAC tape around the mid-point of the child's relaxed left arm
5. Slide the end of the MUAC tape down through the first opening and up through the third so that the number scale and color block are visible in the middle window
6. Ensure proper tape tension
7. Identify the number and/or color in the window in between the two arrows
8. Record measurement immediately

Note. Information adapted from Essential Nutrition Actions Framework, 2011; USAID, 2008.

Community-based Outpatient Nutrition Program

A community-based outpatient nutrition program is conceptually defined as an outpatient nutrition program staffed by licensed and unlicensed health workers who asses the nutritional status of children, provide outpatient or home-based intervention for uncomplicated cases of SAM, provide supplementary feeding for MAM, provide nutritional education, refer complicated cases of SAM to an inpatient program, and monitor the progress of enrolled children (Ashworth, 2006; UNICEF, 2012; WHO & UNICEF, 2007). A community-based outpatient nutrition program covers three of the four facets of CMAM: 1) community outreach, 2) outpatient or at home care for children with uncomplicated SAM, and 3) services for the management of MAM. Community outreach measures include active assessment, screenings, education, and follow up within

the community. Outpatient care of children with SAM involves children aged 6-59 months who meet anthropometric criteria for SAM, but lack medical complications, have an appetite, have less than 3+ pitting edema, and are alert. Outpatient care includes a clinical assessment, anthropometric monitoring, the provision of ready to use therapeutic foods (RUTF), and basic medical treatment. Management of MAM includes nutrition and feeding education as well as supplementary feeding in order to prevent the development of SAM (UNICEF, 2012; USAID, 2008; Valid International, 2006; WHO, 2013). Outpatient feeding programs may utilize community health workers (CHWs) in order to assess and monitor the nutritional status of children within communities (WHO, WFP, the United Nations System Standing Committee on Nutrition, & UNICEF, 2007; WHO & UNICEF, 2012).

Community Health Worker

A community health worker is conceptually defined as a local member of the community who has been nominated by the community to undergo training in a health care subject such as pediatric nutritional assessment and monitoring. The community health worker is supported, educated, and overseen by a professional health worker, and is not considered to be a licensed health care worker (Lopes, 2014; Smith et al, 2014; WHO & Global Workforce Alliance, 2010; WHO, 2007; WHO & UNICEF, 2012). As mentioned previously many outpatient nutrition programs utilize community health workers as a means of screening, monitoring, referring, educating, and following-up with children in their communities (Ethiopa-Federal Ministry of Health, 2007; Harris & Jack, 2011; Somassé, Bahwere, Laokri, Elmoussaoui, & Donnen, 2013; UNICEF, 2012; USAID, 2008; WHO 1981).

Severe Acute Malnutrition (SAM)

The conceptual definition of SAM in children aged 6-59 months in this project is a life-threatening nutritional condition characterized by severe wasting or the presence of bilateral nutritional edema. The operational definition of SAM for this project (see Table 1) is a MUAC <115 mm, a weight-for-height/length <–3 Z-score/SD of the WHO growth standards, or the presence of bilateral nutritional pitting edema (Berkley et al., 2005; Briend, Maire, Fontaine, & Garenne, 2011; Caleo et al., 2012; Dale, Myatt, Prudhon, & Briend, 2013; Dasgupta, Sinha, Jain, & Prasad, 2013; Laillou et al., 2014; Mogeni et al., 2011; Mwangome, Fegan, Prentice, & Berkley, 2011; Rasmussen et al., 2012; USAID, 2008; WHO, 2013; WHO & UNICEF, 2009).

The diagnostic definition of SAM has changed in recent years. Using MUAC as an independent indicator as well as using the WHO growth standards are fairly recent updates. A 2007 WHO, WFP, USSCN, and UNICEF publication recommended using MUAC <110mm as a screening indicator for SAM and a WHO & UNICEF joint statement published in 2009 recommended using a MUAC <115 mm as an independent indicator of SAM. Until the publication of the WHO child growth standards in 2006, child growth was compared to National Center for Health Statistics (NCHS) child growth references. (Bern & Nathanail, 1995; Joseph, Rebello, Kullu, & Raj, 2002; Waterlow et al, 1977). The NCHS growth reference was developed in 1977 (Waterlow et al, 1977) and updated by the Centers for Disease Control and Prevention (CDC) in 2000 (CDC, 2009). In 2006, the WHO published growth standards for children aged 0-5 years based on a multicentre growth reference study utilizing data from children in six countries from 1997-2003 (Rehman, 2014; WHO, 2006). A 2010 study found that at least 110 countries

were already utilizing the 2006 WHO growth standards (Michaelsen, 2010). International organizations such as the Sphere Project (2011), USAID (2008), and Doctor's Without Borders (Goossens et al., 2012) utilize the updated WHO growth standards. Two studies analyzing nutrition program reports post-2006 were found to continue to utilize the NCHS references (Kerac et al., 2014; Somassé, Bahwere, Laokri, Elmoussaoui, & Donnen, 2013).

Characteristics of SAM

Clinical manifestations of SAM include marasmus (severe wasting), kwashiorkor (bilateral pitting edema), and marasmic kwashiorkor (severe wasting and bilateral pitting edema) (Goossens et al, 2012; UNICEF, n.d.; USAID, 2008; WHO & UNICEF, 2009). The WHO and UNICEF published a joint statement in 2009 which defines SAM in children aged 6-59 months as the presence of wasting or bilateral nutritional edema. The term wasting is medically synonymous with the term marasmus. Marasmus is characterized in children by the presence of loose, baggy skin, a "skin and bones" appearance, protruding bones, and a thin face. Children with marasmus are at high risk of developing hypoglycemia, heart failure, hypothermia, and infection. Kwashiorkor is a protein deficiency characterized by pitting edema, hair and skin changes, and apathy (Medline Plus, 2012; Merriam-Webster.com, n.d.). Marasmic- kwashiorkor is characterized by severe wasting of fat and muscle tissue in addition to the presence of edema (UNICEF, Lesson 2.3, n.d.).

Antecedents

Antecedents, or preceding factors to SAM include a lack of sufficient protein or caloric intake, food insecurity, lack of resources, poor utilization of resources, illness,

infection, poor feeding practices, and inadequate care (Black et al., 2008; WHO 2005; UNICEF, n.d.). Antecedents to SAM can be categorized into three levels of causation according to the model of maternal and child undernutrition by Black et al. (2008) (see Figure 2). These three levels include immediate, underlying, and basic causes of undernutrition. First, immediate causes of undernutrition may be insufficient dietary intake or the presence of disease. Second, underlying causes of child undernutrition may be food insecurity within a household, inadequate care such as breast-feeding practices, unhealthy household environment, or a lack of health care services such as an absence of public health services. Third, basic causes of child undernutrition may be a lack of available resources or poor utilization of resources due to various factors such as political, legal, or cultural factors (Black et al., 2008; UNICEF, Lesson 2.5, n.d.).

Consequences

Consequences of SAM may include impaired behavioral, motor, cognitive, and socioemotional development; impaired reproductive, metabolic, and cardiovascular health; an increased risk for infectious disease, morbidity, disability, and mortality; and impaired economic development of a population (Atinmo, Mirmiran, Oyewole, Belahsen, & Serra-Majem, 2009; Black et al., 2008; Merson, Black, & Mills, 2012; Myatt, Khara, & Collins, 2006; Prado & Dewey, 2014; World Bank, 2011). According to Black et al. (2008), a child under five years old with a weight-for-height less than -3 standard deviations (SD) of the WHO standards has a nine times higher overall risk of death in comparison with a child with a weight-for-height above -1 SD. Additionally, the child with SAM (weight-for-height <-3 SD) has an increased risk of dying from diarrhea (6 times), pneumonia(8 times), malaria(2 times), and measles(6 times) in comparison with a

child with a weight-for-height greater than -1 SD. According to Atinmo, Mirmiran, Oyewole, Belahsen, & Serra-Majem (2009), impaired intelligence and physical capacity resulting from early childhood (0-2 years old) malnutrition can impede economic development and propagate poverty. Consequences from maternal and child undernutrition can be short and long term (Black et al., 2008)

Disability-adjusted Life Year (DALY) as a Consequence

The disability-adjusted life year (DALY) is a composite indicator useful for the assessment of disease burden and health gap in a specified population. This measurement is calculated as the sum of years of life lost (YLL) and years of life lived with disability (YLD) (Merson, Black, & Mills, 2012). Because DALYs take into consideration years of life lost (YLL) as well as years lost to disability (YLD) of a particular disease, each DALY is equated to a lost year of healthy living (WHO, 2014). The global DALY rate per 100,000 for protein energy malnutrition in children under the age of five in 2010 was 3,936.7. The country with the highest rate was the Democratic Republic of Congo (30710.3) followed by Sierra Leone (28008.6), Niger (26600.7), Chad (24381.6), and the Central African Republic (23194.6). In comparison to the United States rate of 29.3285, these rates are extraordinary. The developing country DALY rate was 4429.59 as compared with the developed country rate of 70.6865. The Region with the highest DALY rate was Central sub-Saharan Africa (25531.7), followed by Western sub-Saharan Africa: (15025.9), Eastern sub-Saharan Africa (7759.85), and South Asia (3149.34) (Institute for Health Metrics and Evaluation, 2014).

Mortality as a Consequence

According to a 2007 WHO estimate, approximately 1 million child fatalities are due to severe acute malnutrition each year (WHO, 2007). According to Pelletier and Frongillo (1995), in an analysis of data from 53 countries, among children one to four years of age, malnutrition was implicated in 56% of all deaths. Additionally, according to a 2004 study, 52.5% of young child deaths can be attributed to undernutrition (Caulfield, de Onis, Blössner, & Black, 2004).

Model Case

This case is designed to present a situation in which severe acute malnutrition and the antecedents to and consequences of SAM are clearly illustrated. In addition, this case presents the role of community health workers in providing community-based management of uncomplicated SAM. Theodore and Angele reside in Bangui, Central African Republic with their eight children. The village in which they reside is notably impoverished. The land on which they reside is not particularly fertile and requires extensive work in order to yield produce. Theodore earns money for his family by repairing bicycles. The lack of financial resources in the community makes it difficult for them to earn any form of profit. Because of this lack of natural and financial resources, Theodore and Angele struggle to obtain a steady supply of food for their family. At times, their family will only eat one meal a day. Angele notices that her children are becoming increasingly thin and that her two year old child Susan seems lighter to carry. Susan's skin seems to be sagging in areas and her ribs are noticeably protruded. Her three year old son, Thomas, has thin limbs and swollen feet. Thomas does not receive any additional nutrients and continues to decline. His feet and abdomen become increasingly swollen, and he loses interest in playing with his siblings. Theodore and Angele are

concerned about the health of their child, but there are no health care providers in their village. Eventually, Thomas passes away. One year later, a nurse and physician couple along with several local community members collaborate to form a community-based nutrition program for the families in Bangui. A local community member from Theodore and Angele's village attends a training program to become a community health worker for the outpatient feeding program. The community health worker begins making home visits to her neighbor's houses to assess the nutritional status of children who are between 6 and 59 months of age. She visits Theodore and Angele's home, educates them on the nutrition program, and requests to assess the nutritional status of their two year old daughter Susan. The community health worker measures Susan's MUAC and finds it to be less than 115 mm. She recognize this criteria as indicating that Susan is suffering from severe acute malnutrition. She depresses Susan's feet and hands to assess for nutritional edema and finds none present. According to her training, she also notes that Susan is awake and alert, does have an appetite, and has no medical complications present. The community health worker discusses her findings with Theodore and Angele and recommends admitting Susan to be treated for uncomplicated severe acute malnutrition through the outpatient nutrition program. Susan's parents agree and bring Susan to the program center to receive a full clinical examination by the physician. Based on the findings, Susan is diagnosed with uncomplicated SAM and is admitted to the program. Angele receives a course of oral antibiotics, supplemental food, and micronutrients for Susan. During her subsequent weekly home visits, the community health worker notes that Susan's MUAC is steadily increasing. Angele carefully follows the instructions of the community health worker, and over the following month notices that her daughter's

skin is not as loose and that her bones are less prominent. After five weeks, Susan's MUAC is 126 mm, and she is discharged from the nutrition program.

Application to the Project

Severe acute malnutrition is characterized by wasting and nutritional edema. There are many layers of antecedents to SAM including insufficient dietary intake, presence of disease, food insecurity, inadequate care, unhealthy household environment, lack of health services, lack of available resources, and impaired utilization of resources due to the environmental context (UNICEF, Lesson 2.5, n.d.). Consequences of SAM may include impaired behavioral, motor, cognitive, and socioemotional development; impaired reproductive health; an increased risk for infectious disease and mortality; and impaired economic development of a population (Atinmo, Mirmiran, Oyewole, Belahsen, & Serra-Majem, 2009; Black et al., 2008; Merson, Black, & Mills, 2012; Myatt, Khara, & Collins, 2006; Prado & Dewey, 2014; World Bank, 2011).As illustrated in the model case, the purpose of this project is to utilize the defining characteristics of SAM, the operational means of measuring SAM (MUAC), local involvement, and current international guidelines to train community health workers to screen children aged 6-59 months for SAM and to monitor their progress throughout a community-based nutrition program. The recommendations in this project may be used specifically by the Dibona's nutrition program in Bangui, CAR to train CHWs in SAM management. This will allow the program to conduct community screenings and home visits to monitor the progress of children receiving treatment.

Chapter 3: Methods and Framework

Iowa Model

This evidence-based project will utilize two models. The first model is the IOWA model which has seven steps for introducing evidence into nursing practice (Doody & Doody, 2011). According to the Institute of Medicine (2001), one of the ten proposed rules for redesigning health care systems to improve the quality of health care is for health care providers to make decisions based on the best scientific evidence. According to Stevens (2013), evidence-based practice, a process of incorporating current high levels of research knowledge and patient values into nursing practice, has the potential to continue moving health care forward to higher levels of quality care and optimal health outcomes. The seven steps of the Iowa model, see Figure 1, are: "Selection of a topic, forming a team, evidence retrieval, grading the evidence, developing an evidence-based practice (EBP) standard, implement the EBP, and evaluation" (Doody & Doody, 2011).

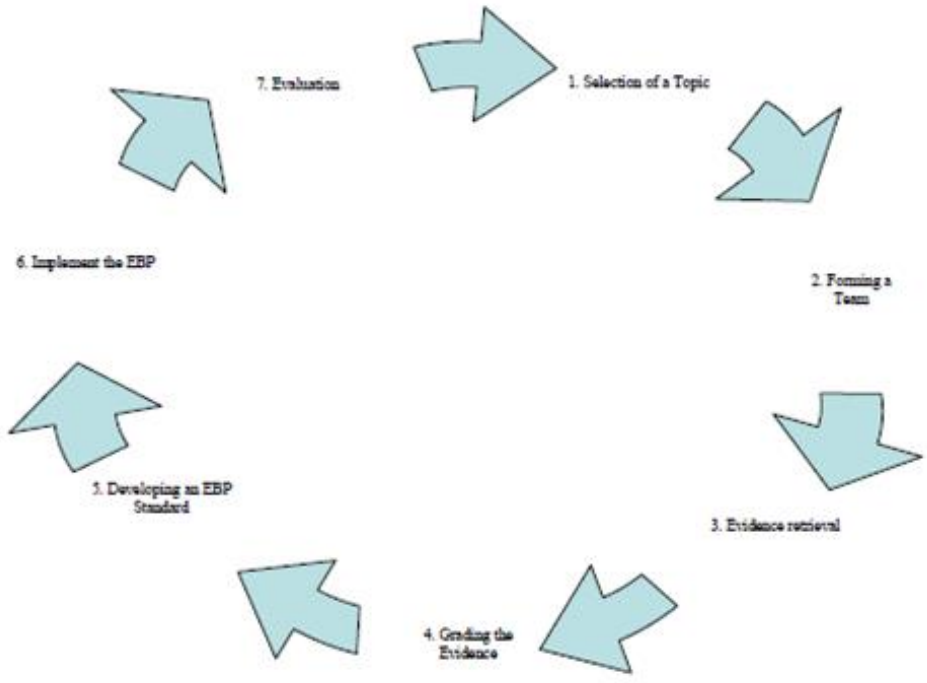
First, according to the Iowa model, a nurse will select a topic based on careful consideration of the scope of an identified problem, applicability of evidence to all areas of practice, contribution for care improvement, availability of evidence, multidisciplinary nature of the issue, and the commitment of persons involved. Second, a nurse will form a team who will develop, implement, and evaluate the evidence-based practice. The members of the team should be determined by the chosen topic and should include all interested stakeholders and persons who can knowledgeably discuss the feasibility of developing, implementing, and evaluating the changes.

Third, the team will research the topic through searching electronic databases and other sources of guidelines and standards such as national resources using key terms

proposed by the team. Fourth, the team will grade evidence according to a paradigm consistent with the proposed problem. Fifth, the team will analyze the graded data according to effectiveness, appropriateness, and feasibility and will develop an evidence-based standard. Sixth, the team will collaborate with local leaders and implement the evidence-based practice standard. Seventh, the team will evaluate the value and contribution of the change (Doody & Doody, 2011). The first five steps of the Iowa model are applicable to this project, and were used to guide the process of choosing the topic of community-based management of SAM, the selection of a committee, the gathering of evidence, the grading of evidence, and the development of evidence-based recommendations for an outpatient nutrition program.

Figure 1.

Figure 1. Seven steps of the IOWA model



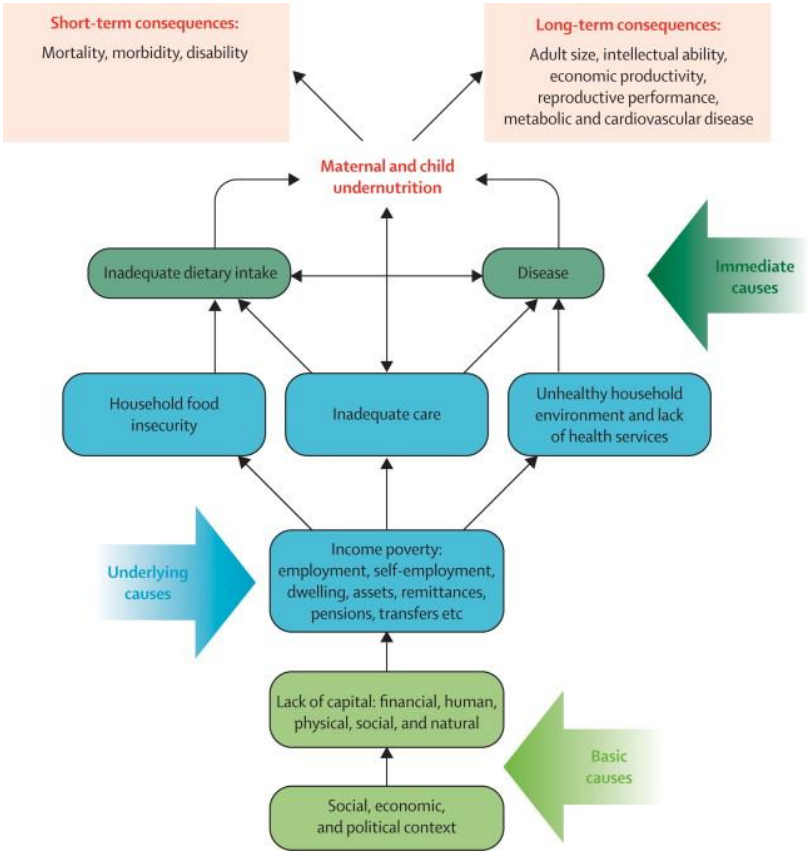
Note. Reprinted with permission from Introducing evidence into nursing practice: using the IOWA model. *British Journal Of Nursing, 20*(11), 661-664. By Doody, C. M., & Doody, O. (2011).

Framework for Maternal and Child Undernutrition

The second model which this project utilizes is a framework of the causes and consequences of maternal and child undernutrition developed by Black et al. (2008) (see Figure 2.). The model proposes three levels of causation as well as short and long term consequences of maternal and child undernutrition. The three levels are immediate causes, underlying causes, and basic causes. This model has also been adapted and utilized by the United Nations Children's Fund (Lesson 2.5, n.d.).

Figure 2.

Framework for Maternal and Child Undernutrition



Note. Reprinted with permission from, Maternal and child undernutrition: global and regional exposures and health consequences. *The Lancet*. DOI:10.1016/S0140-6736(07)61690-0. By Black et al. (2008).

Immediate causes. The two immediate causes for maternal and child malnutrition, according to this model are inadequate dietary intake, which can include a lack of consumption of necessary nutrients or poor absorption of nutrients, and disease which can contribute to an increase in nutritional requirements, loss of appetite, and poor absorption of nutrients. Maternal and child undernutrition can be caused by either of these two immediate factors (inadequate dietary intake and disease) or a combination of both (Black et al., 2008; UNICEF, lesson 2.5, n.d.)

Underlying causes. According to this model, underlying causes of maternal and child undernutrition may be due to issues in income, employment, assets, remittances, or pensions, among other things which then contribute to food insecurity, inadequate care, lack of health care, and unhealthy household environments. The United Nations Children's Fund (n.d.) specifically describes a lack of public health care as a specific example of inadequate health services. An example of food insecurity is demonstrated by the current nutrition crisis in the CAR in which food is not available for consumption. An example of inadequate caring practice is poor hygiene habits or a lack of breastfeeding of infants. An example of a lack of health services is demonstrated by the current lack of access to basic health services within the CAR (Black et al., 2008).

Basic causes. Lastly, included in the third and bottom level are the basic causes of maternal and child undernutrition. This includes a lack of resources such as capital, financial, physical, natural, social, or human due to the social, economic, or political context (Black et al., 2008). Utilization of available resources may also be affected by legal, or cultural factors (UNICEF, lesson 2.5). The nutrition crisis in the CAR is in part caused by a lack of resources (deficit of materials such as seeds and land for planting)

and the inability to utilize available resources as a result of ongoing violence and subsequent displacement of families.

Application to project. According to this model for undernutrition, deficits at the basic level contribute to underlying causes. Similarly, aberrancies at the underlying level contribute to immediate causes. In this way, the three levels of causation are not distinct from each other, but rather interact with and contribute to one another (Black et al., 2008; UNICEF, lesson 2.5, n.d.). Therefore, interventions addressing maternal or child undernutrition should identify and target multiple levels of causation. This model of targeting causes of undernutrition at multiple levels was utilized in formulating recommendations for this project. The recommendations for this project seek to address immediate causes, underlying causes, and basic causes of undernutrition by increasing the capacity of a community-based nutrition program. It will address the immediate cause of inadequate dietary intake by allowing children with SAM to be identified by and admitted to a community-based feeding program in which they and their caregivers will be educated on good nutrition options and feeding practices. It will address the underlying cause of lack of health services by providing a training resource for an existing nutrition program to train community health workers to accurately admit, refer, monitor, and discharge patients. It will address the basic cause of availability of resources by allowing children with SAM to be correctly identified and placed in a program in which they will receive food and nutritional supplements.

Chapter 4: Literature Review and Results

Evidence Retrieval

A review of literature for this project began Fall 2013. The researcher utilized the Cedarville University One Search database with a comprehensive search of all subscribed databases. This included CINAHL, Cochrane Database of Systematic Reviews, and Medline, among others. The PubMed database, the WHO, UNICEF, and governmental websites were also searched. Key search terms included, "MUAC", "Mid-upper arm circumference", "Anthropometric", "Severe Acute Malnutrition", Malnutrition", "Community Based Management", "Feeding Program", and "Community Health Worker."

Inclusion and Exclusion Criteria. Articles were utilized in the literature review if they met the following inclusion criteria: 1) Published within the past 20 years (1994-2014), 2) peer-reviewed and published in an academic journal, or 3) from a governmental source. Two exceptions to this criteria are 1) the inclusion of landmark studies which are foundational historic articles which were included in the literature review regardless of publication date and 2) the inclusion of program reports and data from non-governmental organizations (NGOs). Articles were excluded if they pertained to anthropometry other than WFH/L or MUAC such as the Quaker arm circumference (QUAC) stick. One article was excluded that studied the accuracy of acute malnutrition detection by using one's hand to measure arm circumference.

Data Management. Data was analyzed and graded according to the hierarchy described by Melnyk & Fineout-Overholt (2011), see Table 4.

Table 4.

Hierarchy for Grading Data

Level I	Evidence from a systematic review or meta-analysis of all relevant RCTs
Level II	Evidence obtained from well-designed RCTs
Level III	Evidence obtained from well-designed controlled trials without randomization
Level IV	Evidence from well-designed case-control and cohort studies
Level V	Evidence from systematic reviews of descriptive and qualitative studies
Level VI	Evidence from single descriptive or qualitative studies
Level VII	Evidence from the opinion of authorities and/or reports of expert committees

Note. Adapted from *Evidence-based practice in nursing and healthcare: A guide to best practice*, by Melnyk, B.M. & Fineout-Overholt, E., 2011, Philadelphia: Lippincott, Williams & Wilkins.

Timeline. This evidence-based project was completed and adequately prepared for presentation to other interested parties Fall 2014. The presentation was held at Cedarville University in Cedarville, OH with the committee members present on December 4, 2014. The results of this project were also given to Dr. and Mrs. Michael Taylor, founders of the Central African community-based nutrition program and cofounders of Three Strands-the nonprofit organization which currently funds the CAR nutrition program.

Project Committee. The committee for this evidence based project consists of Dr. Chu-Yu Huang (Ph.D., RN) and Dr. Sharon Christman (Ph.D., RN, FAHA). Dr. Huang is an expert in pediatric nursing and education. Dr. Christman is an expert in evidence-based practice nursing and education. She also has served for multiple years in Malawi through community health evangelism.

Results

A total of 48 articles, guidelines, training resources and program reports met inclusion criteria and were included in the literature review. Articles were reviewed, summarized, and graded according to the previously mentioned hierarchy by Melnyk & Fineout-Overholt (2011), see Table 4. Articles were placed into the following two data tables based on their respective content, outpatient management of acute malnutrition (Table 5) and/or anthropometry (Table 6).

Table 5.

Graded Review of Literature: Outpatient Management of Acute Malnutrition (24 articles)

Author/Year	LOE	Study Design	Methods	Results
Ashworth, A. (2006)	V	Literature Review	Review of 33 studies on community based nutrition rehabilitation for children with SAM (WHZ < -3 SD or edema). Effectiveness of a program defined as mortality <5% and average weight gain ≥ 5g/kg/day	Conclusion: 11 programs were effective according to criteria. All successful programs had external support. Domiciliary rehab was the most cost-effective form.
Defourny et al. (2009)	IV	Case Series	Community distribution of supplementary feeding to approximately 60,000 children (60-85 cm in height) in Niger, use of MUAC < 110 mm as criteria for monitoring SAM levels. Mother's given newly formulated RUF and instructed to feed children daily. MUAC re-measured monthly.	Rates of SAM (as diagnosed with MUAC <110mm) remained low throughout hunger gap time period. Reduction in inpatient (complicated SAM) admissions. Results of blanket distribution had similar effects as the individualized treatment of children for moderate wasting. Preventive distribution was 29% more costly than individualized moderate wasting program; however, RUTF was 77% and staff was 15% of cost as opposed to 35% (RUTF) and 38%(staff) for the individualized program. Conclusion: preventive blanket distribution of RUTF to mothers had similar effect as individualized treatment for the prevention of SAM (MUAC <110mm)
Dewey & Adu-Afarwuah (2008)	I	Systematic review	Systematic review of 42 studies including 29 efficacy trials and 13 effectiveness studies or program reports from 25 developing countries. Reviewed effectiveness of five interventions used in complementary feeding programs 1)Education, 2)Provision of complementary food only, 3) Provision of complementary food and education, 4) Complementary food with additional micronutrient fortification, 5) Complementary food with additional energy density	Conclusion: 1) Education with strong emphasis on nutrient rich animal food sources may improve growth of child more than general education messages. 2) If food insecurity, provision of food, rather than just education was more effective in improving outcome indicators. 3) Complementary feeding interventions improved behavioral development of children in recent studies. 4) Complementary feeding interventions can reduce morbidity

			using 1) growth, 2) morbidity, 3) child development, and 4) micronutritient status as outcome indicators.	and should include counseling on responsive feeding, hygiene, and continued breastfeeding.
Goossens et al (2012)	VI	Retrospective analysis	Retrospective analysis of 24,792 outcomes for a therapeutic feeding program (TFP) in Burkina Faso for children aged 6-59 months admitted with MUAC TFP included inpatient and outpatient care according to complicated or uncomplicated cases of SAM. Children with uncomplicated SAM as diagnosed by clinical exam, passed appetite test, edema not extending beyond dorsum of foot, and MUAC ≤118 mm were treated as outpatients with RUTF and weekly follow up.	Therapeutic Feeding Program outcomes: For all patients admitted to program (inpatient/outpatient) by MUAC: Recovery rate: 89.1% Default: 7.9% Failure to respond: 1.5% Mortality: 1% Average weight gain: 5.4 g/kg/day Average MUAC gain: .42mm/day Discharge criteria of 15% weight gain resulted in longer lengths of stay for less malnourished children. MUAC gain paralleled weight gain. Sex ratio of program close to 1 (F: 50.3/M: 49.7). Other TFP reported more female admissions using WHZ tables as admission criteria. 81.9% of patients treated as outpatients. Conclusion: MUAC ≤118 mm is useful alternative to WHZ in admitting children to TFP. Suggests potential for using MUAC as discharge criteria.
Harris & Jack (2011)	VI	Retrospective review	Retrospective review of a Cambodian home based nutrition program for treatment of 159 children < 5 years old admitted with MAM or SAM (WHZ < -2 or -3). Community program uses 2-3 full time nurses and up to ten community nutrition workers to provide nutritional education, home visits, and food support. SAM visited 2/month or daily if acutely unwell and unwilling to be admitted. MAM visited 1/month.	Average admission WHZ:-3.3 Case fatality rate: 5.6% Average weight gain: 4g/kg/day Average of 14 weeks of rehabilitation resulted in 55% of children having WHZ ≥ Conclusion: effective community-based outpatient program
Kerac, et al. (2014)	IV	Longitudinal cohort study Prospective	Researchers assessed long term patient outcomes of 899 (88% of 1187) of patients who were admitted to an inpatient SAM treatment center in Malawi between July 2006 and March 2007. The patients had been discharged > 1 year ago. SAM defined as weight-for-height< 70% median (NCHS growth references) and/or MUAC <110 mm and/or oedematous malnutrition Cure defined as two consecutive visits at above 80% weight-for-height, absence of oedema, clinically stable in MOYO's combined inpatient/outpatient program	42% admitted between 2006-2007 died during or after treatment at time of study. 25% of deaths occurred after program discharge (>90 days after admission). Mortality highest among HIV positive children (62%.) Conclusion/recommendations: Need for awareness of short and long term outcomes. Early identification and treatment of SAM are important in potentially improving short as well long term outcomes of children. Need for wholistic care of children due to other factors such as HIV.
Lenters, Wazny, Webb,	I	Meta-analysis, systematic	Meta-analysis, Systematic review, and	Conclusion:

Tahmeed, & Zulfiqar (2013)		review, and Delphi process	Delphi process of acute malnutrition management. 14 studies in meta-analysis.	SAM/MAM inpatient vs ambulatory care: two studies-no significant difference between outcomes. CMAM of SAM-RUTF vs. standard therapy: three articles. Children receiving RUTF were 51% more likely to recover. MAM management- children receiving ready to use supplementary food were more likely to recover than those receiving a blend of corn and soy. Delphi process: inpatient treatment of SAM according to WHO protocol estimated case fatality rate (CFR): 14% Recovery rate: 71%. Community based treatment of SAM Estimated CFR: 4% Recovery rate: 80%
Puett, Coats, Alderman, & Sadler (2013)	VI	Cross-sectional	Quantitative and qualitative evaluation of 55 CHWs management of SAM in Bangladesh. Evaluation using a quality of care checklist based on CMAM classification algorithms and treatment protocols. CHWs screened children using MUAC and provided care for uncomplicated SAM (MUAC <110 mm and/or edema). Uncomplicated SAM treated with weekly RUTF until recovery (MUAC >110 mm, >15% weight gain, and edema resolution >2 weeks).	Conclusion: CHWs who are well-trained and supervised provided effective outpatient care for uncomplicated SAM.
Schoonees, Lombard, Musekiwa, Nel, & Volmink (2013)	I	Systematic Review	Systematic review of home based treatment of SAM in children 6-60 months using RUTF	Either RUTF or local foods may be used to treat SAM at home. Further research needed.
Shewade et al (2013)	II	Randomized control trial	Outpatient therapeutic program (OTP) in India for children 6 mo-5 yrs with uncomplicated SAM. (WHZ < -3 or MUAC <115 mm). Exclusion criteria also included bipedal edema and visible severe wasting. 32 children, randomized into study and control group. Both treated with case management, anthropometric monitoring, feeding counseling, home visits once a week by doctor and twice a week by trained worker, and supplementary nutrition. The study group also received 2000kcal/kg/d of locally prepared RUTF.	Conclusion: 6/13 of study group attained primary outcome (115% of baseline weight) while only 1/13 of control group achieved this outcome. Statistically significant difference (10.28, 95% confidence interval). Addition of RUTF resulted in average additional weight gain of 13g/kg of baseline weight/week. Study conclusion: Indigenous RUTF was effective in managing uncomplicated SAM.
Sphere Project Handbook (2011)	VII	International authority	Created through the collaboration of over 700 persons from 228 relief organizations in 60 different countries.	Recommends community-based management of SAM as the preferred method of care and establishes the following standards for SAM treatment programs: 1) mortality rate <10%, 2) default rate <15%, 3) recovery rate >75%, 4) > 90% of target population is within < 1 day return walk of program site, and 5) program coverage is > 50% in rural areas, >70% in urban areas, and >90% in camp areas.

Somassé, Bahwere, Laokri, Elmoussaoui, & Donnen (2013)	VI	Program report review and interviews with key informants.	Review of program reports and interviews to evaluate CMAM program in Burkina Faso. CHWs volunteered. Six were chosen by village to form committee for nutrition. Volunteers received five day training course on screening and treating SAM and MAM. Went to homes and screened using MUAC and edema. SAM: MUAC <110mm or bilateral edema MAM: MUAC >110 mm and < 125 mm. Invited villagers to build nutrition center where education, treatment, and monitoring of cases was done. Volunteers also made home visits to monitor compliance. Volunteers received weekly supervision for first six months of program then fortnightly after this. The supervision was done by a team of three nurses and one local moderator who was over twenty villages. Discharge according to 85% weight for height index of median NCHS growth standard. Patients were treated by volunteers if uncomplicated cases. Transferred to health center if complications or did not meet discharge criteria within twelve weeks.	Conclusion: Coverage rate 90% in children <5 years old in 180 intervention villages. SAM: Recovery rate: 86.5%. Case fatality rate 4.2%. MAM: Recovery rate: 89.4% Case fatality rate: 2.8% All Cases: Default rate: 7%. Prevalence of SAM decreased from 5.4% to 1.8% from 2008-2009. Barriers to sustainability and scaling up included management by external personnel, lack of financial resources to scale up, lack of national advocacy, and nonsustainable activities such as free care. CMAM was effective, but handover and scale up was not satisfactory.
UNICEF, 2012 Nepal	VI	National CMAM Program Evaluation	Quantitative and qualitative evaluation of data. Four components of CMAM program evaluated: 1. Community outreach 2. Outpatient uncomplicated SAM care 3. Inpatient complicated SAM care 4. MAM management	Community outreach: Female community health volunteers (FCHVs) are effective in screening and referring children through use of MUAC. Challenges: limited resources, overburdening of FCHVs access and transport issues, inadequate incentives. Outpatient: Met Sphere standards. Recovery rate: 86%, mortality: .7%, default: 9%. LOS: 49 days. Weight gain: 4.8 g/kg/day. Relapse rate: 1.2%. Non-compliance due to distance from beneficiaries to outpatient facilities. Missing play areas and inadequate latrines/water supply in some sites. Inadequate time for staff to educate caretakers Inpatient: stabilization rate: 95.3%, mortality: .42%, default: 2.7%.. MAM: feeding counseling and home-based preparation of supplementary foods. Poor nutrition status monitoring and home visit follow-up. Need for more preventative measures.
UNICEF, 2012 Ethiopia	VI	National CMAM Program Evaluation	Quantitative and qualitative analysis of program data from 45 health facilities and 15 smaller administrative units of national CMAM program. Three components of program evaluated (MAM management not evaluated): 1. Community outreach/mobilization 2. Outpatient therapeutic program 3. Therapeutic feeding unit (inpatient care)	Performance: Nationwide program meets Sphere standards. Outpatient programs had recovery rate of 83%, mortality rate of .6%, and default rate of 5%. Successful community outreach by volunteer CHWs. Nationwide screening of 93.6% children < 5 years. 1 worker/50 households. Three identified situations for screenings-home visits, community health days, and at health program visits.

				Challenges: High operational costs and inadequate referrals of outpatient treatment programs Weak adherence to protocols, high turnover, inadequate training of staff in inpatient therapeutic feeding units Poor follow-up and counseling for MAM management programs
UNICEF, 2012 Kenya	VI	National IMAM Program Evaluation	Quantitative and qualitative evaluation of data from 21 sites. Four components of IMAM program evaluated: 5. Community outreach 6. Outpatient uncomplicated SAM care 7. Inpatient complicated SAM care 8. MAM management	Performance: Coverage: outpatient SAM treatment wide range of coverage but below 50%. Community outreach: limited by lack of staff, transport, difficulty reaching all children for screening. Outpatient care: Recovery rate: 80.7%, death rate 1.5%, default rate: 13%, average length of stay (LOS): 59 days, relapse rate: 3.2%. Defaults due to weak follow-up or caregiver employment. LOS affected by poor weight gain tracking and caregivers seeking continued RUTF for children. Inpatient Care: Stabilization rate: 84.6%, death rate: 8.7%, default rate: 1.4%, relapse rate: 6.1%. Relapse affected by lack of formal follow-up system MAM management: Cure rate: 80.5%, death rate: .4%, default rate: 14.5%, LOS: 81 days, relapse rate: 3.7%.
UNICEF, 2012 Chad	VI	National IMAM Program Evaluation	Descriptive analysis of four components of IMAM program: 1. Community outreach 2. Outpatient uncomplicated SAM care 3. Inpatient complicated SAM care 4. MAM management	Community: outreach activities present at 43.5% of health centers. Awareness and active screening are effective in identification and referral. Need for involvement of traditional healers. Lack of systematic follow-up due to lack of transport, remoteness, lack of incentives for workers. Good understanding of national protocols some lacking of knowledge in referral, admission, and discharge criteria. Outpatient: Meet Sphere standards. Recovery rate: 88%, mortality rate: 2.2%, default rate: 3.1% Inpatient: Default rate: 11.9% and mortality rate: 14%. MAM: Recovery rate: 81.7%, mortality rate: .6%, default rate: 9.9% Need for more regular supervision of programs
UNICEF, 2012 Pakistan	VI	National CMAM Program Evaluation	Quantitative and qualitative evaluation of data. Four components of CMAM program evaluated: 1. Community outreach 2. Outpatient uncomplicated SAM care 3. Inpatient complicated SAM care 4. MAM management 365 outpatient and 11 inpatient sites.	Community: Social mobilizers through nutrition support committees helped community outreach workers access households. Need for improvement of MUAC measuring skills of community workers, sustainability promotion of committees, strengthening of follow-up. Outpatient: Met Sphere standards. Cure rate: 91.5%, default rate: 7.5%. Some sites did not meet weight gain and LOS standards. Need for standardization of

				admission, discharge, and referral criteria. Inpatient: well managed, but poor coordination between inpatient and outpatient care. Need for program data recording improvement. MAM: Met Sphere standards. Cure rate: 95% and default rate: 4.2%. No districts met weight gain standard and some did not meet LOS standard.
UNICEF, 2013	VI	Global Synthesis Report	Evaluation of CMAM in Chad, Ethiopia, Kenya, Nepal, and Pakistan. Evaluation of case study data, secondary sources, databases, and observation.	Conclusion: CMAM is an appropriate and overall effective model for addressing acute malnutrition.
USAID (2008)	VII	CMAM training program	Eight training modules on CMAM. Approximately 26 hours or classroom time and 6 ½ days of field practice time. 2010 addendum with updated guidelines including MUAC <115mm.	Training guide and modules for CMAM programs. Community outreach, MAM management, outpatient uncomplicated SAM care, and inpatient complicated SAM care.
Valid International (2006)	VII	Community-based Therapeutic Care (CTC) handbook	Manual for caring for acute malnutrition in the community using RUTF, classification for care by medical complications, and screening and admission using MUAC	Four components of CTC model: Community mobilization, supplementary feeding programs for MAM, outpatient therapeutic programs, and inpatient stabilization centers.
WHO, WFP, UNSSCN, & UNICEF (2007)	VII	Joint statement by WHO, WFP, UNSSCN, and UNICEF	Joint statement regarding community-based management of acute malnutrition.	SAM can be identified in communities before complications develop. Uncomplicated SAM should be treated in the community with ready-to-use therapeutic foods. Weekly or biweekly follow-up by skilled health worker in clinic or community.
WHO & UNICEF, 2009	VII	Joint statement by WHO and UNICEF	Joint statement regarding the identification of SAM in infants and children as well as presentations of the WHO child growth standards.	Diagnostic criteria for SAM in children aged 6-60 months: Severe wasting, WFH <-3SD of WHO standards. Severe wasting, MUAC <115mm OR Bilateral oedema- clinical sign. Children with appetite and no medical complications should receive community-based treatment of RUTF and basic medical care. Discharged after 15-20% weight gain.
WHO (2013)	I	Guideline based on systematic review of evidence	Systematic review of evidence to create updated recommendations for: -Admission and discharge criteria for children 6-59 months old with SAM -Managing children with edematous SAM -Antibiotics in outpatient care of SAM -Vitamin A supplementation in SAM -Therapeutic feeding in SAM -Fluid management in SAM -HIV infection and SAM -Identifying and managing SAM in infants <6 months.	11 epidemiological studies reviewed: Recommendations: For children 6-59 months SAM is WFH≤-3 Z score, or MUAC <115 mm, or bilateral edema. Severe wasting not diagnostic criteria. Use WHO growth standards. **Screening:** trained CHWs should screen using MUAC and test for bilateral pitting edema. Immediately refer MUAC <115mm or any degree of bilateral edema for full assessment at SAM treatment center. Primary care/other health facilities should also screen and refer for MUAC or WFH criteria or bilateral edema. **Inpatient**: For complicated SAM, failed appetite test, IMCI danger signs, severe

				bilateral pitting edema. Potentially for disability, social issues, or difficulties with access to care **Outpatient**: For uncomplicated SAM. Provide with adequate RUTF. **Transfer:** transfer to outpatient based on clinical condition- medical complications and/or edema resolve, good appetite, clinically well. **Discharge:** WFH/L ≥-2 and no edema for at least 2 weeks or MUAC ≥125 mm and no edema for at least 2 weeks. Discharge anthropometry should coincide with admission anthropometry. If admitted for edema, use routine program anthropometry. **Follow-up**: discharged SAM children should be periodically followed up. Review of 8 reports on outpatient treatment of edematous SAM: Recommendations: **Outpatient**: +/++ bilateral pitting edema with appetite and no medical complications. I**npatien**t: +++ bilateral pitting edema with or without medical complications/appetite. +/++ bilateral pitting edema if medical complications or no appetite.
Yebyo, Kendall, Nigusse, & Lemma (2013)	IV	Retrospective cohort study	628 Children 6-59 months treated for SAM at an outpatient therapeutic feeding program (OTP) in Ethiopia. SAM: MUAC<110 mm And/or Wt/Ht ratio <70% or bilat pitting edema. Treated with supplements, deworming, antibiotics, measles vaccine, and weekly RUTF Pt's with marasmus discharged when reach target weight and/or wt/ht ratio >85%. Kwashiorkir discharged after resolution of edema regardless of body weight.	Conclusion: Program was partially effective. Overall recovery and weight gain rates were below sphere standards. The defaulter and mortality rates were within acceptable ranges. Recovery rate: 61.78% Default rate: 13.85% Mortality rate: 3.02% Weight gain: 5.23 gm/kg/day. Major problems with program was lack of referral of children with medical comorbidities and partial administration of routine medications. 44.3% of children had at least one medical problem of unknown severity. 61.7% of children managed for SAM recovered after OTP intervention. 34.05% children with medical problems recovered. 93.95% children without medical problems recovered.

Table 6.

Graded Review of Literature: Anthropometry (29 articles)

Author/Year	LOE	Study Design	Methods	Results
Ayele et al. (2012)	VI	Cross Sectional.	Researchers trained six local Ethiopian persons with no prior experience over two days in anthropometry. Researchers assessed the reproducibility of the anthropometrists measurements of height, weight, and MUAC of 606 randomly assigned children aged 0-5.	(95% Confidence interval) **Intra-anthropometrist Technical error of measurement (TEM)** Height (.35 cm/35%) Weight (.05 kg/.39%) MUAC (.18 cm/1.27%) **Reliability** Height: .998 Weight: .999 MUAC: .989 **Repeatability** Height: .81 cm Weight: .15 kg MUAC: .50 cm **Inter-anthropometrist TEM** Height (67cm/.75%) Weight (.09 kg/.79%) MUAC (.22 cm/1.53%) **Reliability** Height: .997 Weight: .999 MUAC: .954 **Repeatability** Height: 1.85cm Weight: .26 kg MUAC: .60cm **Conclusion:** local, minimally trained persons can reliably perform anthropometric measurements.
Berkley et al. (2005)	IV	Cohort study	Anthropometric data collected on admission and discharge/death for children aged 12-59 months admitted to Kenyan hospital	Sensitivity for inpatient death MUAC ≤115 mm: 46.2% WHZ ≤ -3 SD: 41.8% Specificity for inpatient death MUAC ≤115 mm: 91% WHZ ≤ -3 SD: 92.4% Conclusion: MUAC predicted inpatient death as well as WHZ. MUAC may be more appropriate due to findings, cost, and practicality in this population.
Bern & Nathanail (1995)	VI	Descriptive	3681 Rwandan refugee children measured Weight-for-height measured using NCHS guidelines and MUAC.	Poor overlap between NCHS weight-for-height criteria and MUAC criteria. MUAC <12 cm did not detect 74% of children with low weight-for-height. MUAC criteria selected more young children. Conclusion: MUAC < 12 cm not useful as screening method if W/H is used as gold standard.

Biswas, Bose, Mukhopadhyay, & Bhadra (2010)	VI	Cross-sectional	Study in India which used only MUAC z score to determine rate of undernutrition in children 3-5 years old.	Rates of severe undernutrition (MUAC < -3 SD z-score) Boys: 2.15% Girls: 1.20%
Briend, Maire, Fontaine, & Garenne (2012)	IV	Retrospective cohort study	12,638 measurements takeon on 5751 children < 5 years old in Senegal. Receiver operating characteristics curves (sensitivity versus specificity) calculated for WHZ < -3 SD and MUAC <115 mm, using death within 6 months of nutritional assessment as outcome	WHZ < -3 SD **AND** MUAC < 115 mm Specificity: 99% Sensitivity: 5.9% WHZ < -3 SD **OR** MUAC <115 mm Specificity: 96.9% Sensitivity: 13.2% MUAC had highest ROC curve Conclusion: MUAC < 115 mm identifies high risk severely malnourished children better than WHZ and is preferred criteria; no benefit to using both anthropometric criteria.
Caleo et al. (2012)	VI	Surveillance study	Community-based sentinel prospective surveillance system of acute malnutrition prevalence, mortality, and coverage of intervention. 18,081 persons in 24 randomly selected sentinel sites in southwestern CAR. One literate home visitor and three field supervisors received three days of training.	Over 32 weeks SAM prevalence (MUAC < 115 mm and/or bilateral edema in children aged 6-59 mo.): 3.0%. Edematous SAM: 46.3% Kwashiorkor prevalence: 1.3%. Coverage of SAM treatment: 29.1%. Predictive value of SAM classification by community home visitors: 60% Conclusion: No details of the anthropometric training provided for home visitors, but did not have high predictive value for SAM screening.
Connor & Manary (2011)	VI	Correlational	Bivariate correlation to see how weight and MUAC were related in 1,904 records from Malawi home-based feeding program for children aged 6-60 months admitted for MAM (WHZ -3<-2).	Significant correlation between change in weight and MUAC after first month of treatment (.431, p<.0001) and second month (.508, p<.0001). Conclusion: MUAC changes reflect weight changes in moderately malnourished children receiving RUTF in home-based therapy.
Dairo, Fatokun, & Kuti (2012)	VI	Descriptive cross-sectional	Anthropometry obtained from 319 Nigerian children 12-59 months from selected nursery schools Researchers calculated the Sensitivity, specificity, positive and negative predictive value of MUAC <13.5 cm in diagnosing undernutrition with weight for age, height for age, and weight for height as gold standard.	MUAC < 13.5cm and Weight- for-age (underweight) as gold standard Sensitivity: 27.5% Specificity: 96.8% Weight-for-height (wasting) as gold standard Sensitivity: 20% Specificity: 95.3% Height for age as gold (stunting) standard Sensitivity: 30.4% Specificity: 96.6% Conclusion: Optimal cut off for MUAC in diagnosing undernutrition: 15.5 cm.

				Sensitivity 80% and specificity 53% using weight for age (underweight) as gold standard.
Dale, Myatt, Prudhon, & Briend (2013)	VI	Descriptive	Researchers analyzed data from 753 cured children from north Sudan outpatient nutrition program. Program treated children 6-59 months with uncomplicated SAM (MUAC <115mm and/or mild edema) after being assessed by physician or medical assistant.	Used MUAC >125 mm as discharge criteria rather than 15% weight gain. This resulted in longer stays and higher percentage weight gain for the most severely malnourished children.
Dasgupta, Sinha, Jain, & Prasad (2013)	VI	Cross-sectional descriptive	Survey of 1,879 children (6 mo-3 years) in India	Poor overlap of WHZ <-3 and MUAC <115 mm. 8.9% had WHZ < -3 4.9% had MUAC < 115 MUAC < 115 mm with WHZ <-3 as gold standard: Sensitivity: 17.5% (low) Positive predictive value: 30.4% (low) Conclusion: WHZ and MUAC have poor overlap in this population. Questionable use in populations with chronic malnutrition and high levels of stunting
De Onis & Yip (1997)	VII	Expert committee	Used 2310 MUAC measurements to establish standards for the mean and SD by age and sex Premise: MUAC is simpler and less expensive than measuring height and weight. MUAC should be adjusted for age and gender. MUAC for age z score is more valuable predictor of nutritional status.	Creation of MUAC for age z-score reference charts for boys and girls aged 6-59 months. Conclusion: Recommends using MUAC for age reference data charts for determining nutritional status in boys and girls aged 6-59 months
Fernández, Delchevalerie, & van Herp (2010)	VI	Logistic regression models and ROC curve from cross-sectional data	Evaluation of change from former WHO and NCHS standards to updated WHO standards (MUAC < 115 mm rather than MUAC <110 mm) using results of 39 nutritional surveys conducted in 10 countries of 34,937 children aged 6-59 months old, between 65-110 cm without bipedal edema. Gold standard: SAM defined as WHZ <-3 SD.	With WHZ < -3 SD WHO standards as gold standard: Sensitivity of : MUAC<110 mm: 16% MUAC<115 mm: 25% Specificity MUAC < 110 mm: 99.7% MUAC <115 mm: 99.1% Change from MUAC <110 mm to MUAC < 115 mm reduces probability of diagnosing false-negative results by 12%. Conclusion: Change to MUAC < 115 mm in diagnosing SAM improves the diagnostic ability of criteria (increases sensitivity, little change in specificity, reduces chances of false negative diagnosis)
Goossens et al. (2012)	VI	Retrospective analysis	Retrospective analysis of 24,792 outcomes for a therapeutic feeding program (TFP) in Burkina Faso for children aged 6-59 months admitted with MUAC ≤ 118 mm or bilateral pitting edema	Therapeutic Feeding Program outcomes: Average weight gain: 5.4 g/kg/day Average MUAC gain: .42mm/day Discharge criteria of 15% weight gain resulted in longer lengths of stay for less malnourished children.

			TFP included inpatient and outpatient care according to complicated or uncomplicated cases of SAM. Children with uncomplicated SAM as diagnosed by clinical exam, passed appetite test, edema not extending beyond dorsum of foot, and MUAC ≤118 mm were treated as outpatients with RUTF and weekly follow up.	MUAC gain paralleled weight gain. Sex ratio of program close to 1 (F: 50.3/M: 49.7). Other TFP reported more male admissions using WHZ tables as admission criteria. 81.9% of patients treated as outpatients. Conclusion: MUAC ≤118 mm is useful alternative to WHZ in admitting children to TFP. Suggests potential for using MUAC as discharge criteria.
Joseph, Rebello, Kullu, & Raj (2002)	VI	Cross-sectional	Anthropometric measurements taken on 256 children in India aged 12-60 months old. < mean -2 SD NCHS standards used as diagnostic criteria	With W/H mean < -2 SD NCHS standards as gold standard. Sensitivity of MUAC < 125 mm: 24.6% Specificity of MUAC < 125 mm: 94.8% Conclusion: Use of NCHS reference data tables is ideal, use MUAC with caution, has low sensitivity.
Laillou et al. (2014)	VI	Descriptive	Analysis of survey data for 11,818 Cambodian children aged 0-59 months. Determination of overlap of MUAC and W/H z score criteria. Determination of prevalence, specificity, and sensitivity of MUAC <115 mm for SAM using weight for height (WHZ) < -3 SD WHO standards as gold standard.	Prevalence of SAM (MUAC <115 mm): .4%. Prevalence of SAM (WHZ < -3 SD): 1.45%. MUAC <115 mm missed 90% of children with a WHZ <-3 WHZ <-3 missed 80% of the children with a MUAC <115 mm. Sensitivity of MUAC < 115 mm: 6.1. Specificity of MUAC < 115 mm: 99.7 Optimal MUAC cut off for SAM using WHZ as gold standard is 133mm. Conclusion: Criteria identify different groups of children. Recommend using MUAC for community screening followed by measurement of both MUAC and WHZ which are to be used as independent criteria.
Mei & Grummer-Strawn (1997)	VII	Expert Committee	Development of MUAC-for-height and MUAC for age Z scores	Recommend using MUAC-for-height or MUAC for age Z scores as better predictors of weight-for-height than fixed cut-off.
Mogeni et al. (2011).	VI	Cross-sectional study	Study performed at two Kenyan hospitals. Children 6-59.9 months on admission had MUAC, height, and weight measured. 11,166 children admitted. 563 diagnosed with kwashiorkor. 1406 (12.5%) were severely wasted with MUAC <11.5cm. Studied diagnostic value of visible severe wasting in identifying SAM	Visible severe wasting against MUAC <11.5 cm: sensitivity (54%) and specificity (96%) CI of 95%. Visible severe wasting against WHZ <-3: sensitivity (44.7%) and specificity (96.5%). Correctly diagnosed children by visible assessment were consistently older, more severely wasted, more often had kwashiorkor and HIV, had longer duration of illness, and had higher risk of mortality. Conclusion: visible severe wasting had lower sensitivity than anthropometric measures and approximately half of children who met anthropometric diagnosis of SAM were incorrectly diagnosed by visible assessment. No evidence to require measuring both MUAC and WHZ.

				Recommend using MUAC as a standard assessment tool in all pediatric hospital admissions in this setting since it is quick, simple, inexpensive, and reliable
Mwangome, Fegan, Prentice, & Berkley (2011)	VI	Cross-sectional	Weight, height and MUAC were measured by two independent observers of 3mo-5yrs admitted to Kenyan hospital clinically diagnosed with dehydration and without kwashiorkor. Children were re-measured after receiving rehydration therapy 48 hours later. N=60 N=300 P<.05	Inter-observer reliability: MUAC: .99 Weight: .97 Height/length: .99 Repeated measure: 325 children. Linear regression model 1% change in weight associated with .4mm change in MUAC and .115z change in WFLZ MUAC less affected by hydrations status than WHZ; however both are affected. Recommend rehydrating child and reassessing nutritional status.
Mwangome, Fegan, Mbunya, Prentice, & Berkley (2012)	VI	Cross-sectional	Measurement of inter-observer variation and accuracy of measurements by expert anthropometrist, nurses, public health technicians, and 18 CHWs after two day training program. 147 infants <6 months old in Kenya measured.	MUAC by CHWs differed little from trainers. Mean difference in MUAC was .65mm with no significant difference in variation (p=.075). Conclusion: CHW can be trained to take absolute MUAC, Wt., and length measurements accurately and reliably among infants <6mo old. Length based z score indices are the least reliable. MUAC could be used by minimally trained nonprofessionals for community based screening.
Myatt, Khara, & Collins (2006)	V	Literature review	Review of methods for acute malnutrition detection for admission into community-based programs. Clinical assessment and anthropometric indicators analyzed according to simplicity, acceptability, cost, precision, accuracy, sensitivity, specificity, and predictive value.	According to framework of analysis: Subjective clinical assessment for visible severe wasting performed worse than any anthropometric method. Wt/Ht criteria perform worse than alternative anthropometric measurements. Conclusion: Best indicator is MUAC < 110 mm Or presence of bilateral edema for screening and identification of SAM in children aged 6-59 months. Recommend using MUAC for detection, referral, and admission criteria. Recommend continuing use of weight and clinical status as monitoring and discharge criteria.
Myatt, Duffield, Seal, & Pasteur (2009)	VI	Retrospective analysis	Retrospective analysis of nutritional anthropometry surveys in Ethiopia and Kenya. Children aged 24-59 months OR height≥85 cm AND height ≤110 cm. Somalian children. Agrarian n=1481 Pastoralist n=2741 Acute malnutrition defined as WHZ <-2 or MUAC <125 mm.	Conclusion: the use of WHZ (NCHS or WHO growth standards) overestimates the prevalence of acute malnutrition in populations with a higher SSR (sitting height/standing height) ratio as seen in long-legged pastoralist populations. MUAC not affected by SSR ratio.
Puett, Coats, Alderman, & Sadler (2013)	VI	Cross-sectional	Quantitative and qualitative evaluation of 55 CHWs management of SAM in Bangladesh. Evaluation using a quality of care checklist based on CMAM classification algorithms and treatment protocols. CHWs screened children using MUAC and provided care for uncomplicated	Conclusion: CHWs who are well-trained and supervised provided effective care for SAM.

			SAM (MUAC <110 mm and/or edema). Uncomplicated SAM treated with weekly RUTF until recovery (MUAC >110 mm, >15% weight gain, and edema resolution >2 weeks). CHWs were regularly supervised by two different groups. CHWs received refresher training monthly and a bimonthly intensive two day session. CHWs did receive a stipend.	
Shah, Shaikh, Memon, Siyal, & Nizamani (2014)	VI	Cross-sectional	Researchers measured the MUAC of 135 Pakistani children aged 6-59 months who were admitted to a pediatric hospital with W/H <- 2 or bilateral pitting edema.	Of 135 children admitted for bilateral pitting edema or W/H <-2. 69% had MUAC ≤125mm 27% had WHZ <-2 44% had bilateral pitting edema 44% had both bilateral pitting edema and W/H < -2 69% of admitted children also had MUAC ≤ 125 mm. Conclusion: MUAC appropriate tool for assessing for acute malnutrition.
Shekhar, S., & Shah, D. (2012)	VI	Cross-sectional	Hospital based Indian study of 340 children aged 6 months- 5yrs with weight for age <-2 SD of WHO standard. Anthropometric measurements taken on children. Calculation of sensitivity, specificity, and Youden index with WFL/H z<-3 of WHO standards as the gold standard.	With WFL/H Z <-3 WHO standard as gold standard. **MUAC< 110 mm** Sensitivity: 26.4% Specificity: 95.9% Youden index: .32. **MUAC <115 mm** Sensitivity: 43.2% Specificity: 90% Youden index: .32 **MUAC <120 mm** Sensitivity: 74.4% Specificity: 77.8%, Youden index: 0.52 Conclusion: MUAC <120 mm is best predictor of SAM with in this population.
USAID (2008)	VII	CMAM training program	Eight training modules on CMAM. Approximately 26 hours or classroom time and 6 ½ days of field practice time. 2010 addendum with updated guidelines including MUAC <115mm.	Training guide and modules for CMAM programs. MUAC <115 mm and WFH <-3SD of WHO standard as admission criteria. Discharge 15% weight gain. Community outreach, MAM management, outpatient uncomplicated SAM care, and inpatient complicated SAM care.
WHO & UNICEF, 2009	VII	Joint statement by WHO and UNICEF	Joint statement regarding the identification of SAM in infants and children as well as presentations of the WHO child growth standards.	Diagnostic criteria for SAM in children aged 6-60 months: Severe wasting, WFH <-3SD of WHO standards. Severe wasting, MUAC <115mm OR Bilateral oedema- clinical sign. Children with appetite and no medical complications should receive community-based treatment of RUTF and basic medical care. Discharged after 15-20% weight gain.
WHO (2013)	I	Guideline based on systematic review of evidence	Systematic review of evidence to create updated recommendations for: -Admission and discharge criteria for children 6-59 months old with SAM	11 epidemiological studies reviewed: Recommendations: For children 6-59 months SAM is WFH≤-3 Z score, or MUAC <115 mm, or bilateral edema. Severe wasting not

			-Managing children with edematous SAM -Antibiotics in outpatient care of SAM -Vitamin A supplementation in SAM -Therapeutic feeding in SAM -Fluid management in SAM -HIV infection and SAM -Identifying and managing SAM in infants <6 months.	diagnostic criteria. Use WHO growth standards. **Screening:** trained CHWs should screen using MUAC and test for bilateral pitting edema. Immediately refer MUAC <115mm or any degree of bilateral edema for full assessment at SAM treatment center. Primary care/other health facilities should also screen and refer for MUAC or WFH criteria or bilateral edema. **Inpatient**: For complicated SAM, failed appetite test, IMCI danger signs, severe bilateral pitting edema. Potentially for disability, social issues, or difficulties with access to care **Outpatient**: For uncomplicated SAM. Provide with adequate RUTF. **Transfer:** transfer to outpatient based on clinical condition- medical complications and/or edema resolve, good appetite, clinically well. **Discharge:** WFH/L ≥-2 and no edema for at least 2 weeks or MUAC ≥125 mm and no edema for at least 2 weeks. Discharge anthropometry should coincide with admission anthropometry. If admitted for edema, use routine program anthropometry. **Follow-up**: discharged SAM children should be periodically followed up. Review of 8 reports on outpatient treatment of edematous SAM: Recommendations: **Outpatient**: +/++ bilateral pitting edema with appetite and no medical complications. I**npatien**t: +++ bilateral pitting edema with or without medical complications/appetite. +/++ bilateral pitting edema if medical complications or no appetite.
WHO, 2014	VII	Training guide for CHWs	Caring for newborns and children in the community, adaptation for high HIV or TB settings. Community health worker manual.	Use MUAC for children 6 months to five years. Red indicates SAM. Yellow indicates risk of SAM. Instructions for usage. Check feet for edema which also indicates SAM. Press both thumbs on tops of both feet and hold for three seconds, lift thumbs and check for remaining dents on both feet. Danger signs needing referral: Ask caregiver: cough > 14 days, diarrhea > 14 days, bloody stool, fever for the last 7 days or more, convulsions, unable to drink or eat, vomits everything, or HIV or other illness Check child: chest indrawing, unusually sleepy or unconscious, red on MUAC, yellow on MUAC and HIV, or swelling of both feet.
WHO, 2014	VII	IMCI module 6	Distance learning module for integrated management of childhood illness for trained health workers. Module 6: malnutrition and anemia.	Check feet for edema which indicates SAM. WFH/L < -3 Z indicates SAM. MUAC (children 6-59 months) <115 mm (red) indicates SAM. Appetite test.

				Complicated SAM: medical complication, no appetite, or feeding problem. Action: urgent referral, first dose amoxicillin, glucose or sucrose, keep child warm. Uncomplicated SAM: no medical complications, passes appetite test. Action: urgent RUTF, deworming, oral antibiotics. Check HIV risk, vaccination for measles, test for malaria. Should return in one week for follow-up. MAM: assess feeding, counsel caregiver, consider HIV/TB screening. No feeding problem, follow-up in 30 days. Feeding problem? Follow up in five days.

Table 7

Summary of Levels of Evidence of Reviewed Literature

LOE	Outpatient management of acute malnutrition articles	Anthropometry articles
I	4	1
II	1	0
III	0	0
IV	3	2
V	1	1
VI	10	19
VII	5	6
Total:	24	29

Note. Articles graded according to levels of evidence adapted from *Evidence-based practice in nursing and healthcare: A guide to best practice*, by Melnyk, B.M. & Fineout-Overholt, E., 2011, Philadelphia: Lippincott, Williams & Wilkins.

Summary of Findings

Outpatient management of acute malnutrition. Eleven studies, five national CMAM program evaluations, three international guidelines, and three international aid resources regarding the outpatient management of acute malnutrition were reviewed. The majority of the studies were graded as a level VI, see Table 7 for a complete summary.

According to the reviewed data, uncomplicated SAM as well as MAM can be managed effectively in outpatient community-based programs. (Ashworth, 2006; Defourny et al., 2009; Dewey & Adu-Afarwuah, 2008; Goossens et al., 2012; Harris & Jack, 2011; Lenters, Wazny, Webb, Tahmeed, & Zulfiqar, 2013; Shewade et al., 2013; Somassé, Bahwere, Laokri, Elmoussaoui, & Donnen, 2013; UNICEF, 2012; UNICEF, 2013; USAID, 2008; Valid International, 2006; WHO, 2013; WHO, WFP, USSCN, & UNICEF, 2007). Effectiveness of SAM management is standardized by the Sphere guidelines. The Sphere Project (2011) handbook is a reference providing minimum standards for humanitarian work created through the collaboration of over 700 persons from 228 relief organizations in 60 different countries. The Sphere project recommends community-based management of SAM as the preferred method of care and establishes the following standards for SAM treatment programs: 1)mortality rate <10%, 2) default rate <15%, 3) recovery rate >75%, 4) > 90% of target population is within < 1 day return walk of program site, and 5) program coverage is > 50% in rural areas, >70% in urban areas, and >90% in camp areas. (Griekspoor & Collins, 2001; Sphere Project, 2011).

A common theme in the aforementioned effective programs is utilization of principles in the community-based management of acute malnutrition (CMAM) model, integrated management of acute malnutrition (IMAM), or community-based therapeutic care (CTC) approach. The CMAM model is considered synonymous with IMAM, and the CMAM model is a more recent evolution of the 2001 CTC approach (UNICEF, 2013; USAID, 2008; Valid International, 2006).

CMAM. CMAM is a care framework having four aspects, 1) community outreach, 2) outpatient therapeutic care for uncomplicated SAM, 3) inpatient care for the

management of complicated SAM, and 4) management of MAM (UNICEF, 2012; UNICEF, 2013; USAID, 2008). Community outreach measures include active assessment, screenings using MUAC measurements, education, and follow up within the community (USAID, 2008; WHO, WFP, USSCN, UNICEF, 2007). Outpatient care of children with SAM involves children aged 6-59 months who meet anthropometric criteria for SAM but lack medical complications, have an appetite, have less than 3+ pitting edema, and are alert(Goossens et al., 2012, Shewade et al., 2013; UNICEF, 2012; UNICEF, 2013; USAID, 2008; WHO, 2013, WHO& UNICEF, 2009; Yebyo, Kendall, Nigusse, & Lemma, 2013). Outpatient care includes a clinical assessment, anthropometric monitoring, the provision of ready to use therapeutic foods (RUTF), and basic medical treatment (Ashworth, 2006; Defourny et al., 2009; Goossens et al., 2012; Harris & Jack, 2011; Shewade et al., 2013; Schoonees, Lombard, Musekiwa, Nel, & Volmink, 2013; UNICEF, 2012; UNICEF, 2013; USAID, 2008, WHO & UNICEF, 2009; Yebyo, Kendall, Nigusse, & Lemma, 2013). Inpatient care for complicated cases of SAM involves nutritional rehabilitation and medical care (Goossens et al., 2012; UNICEF, 2012; UNICEF, 2013; USAID, 2008; WHO, 2013; WHO & UNICEF, 2009). Management of MAM may include supplementary or complimentary feeding if available and/or prevention programs providing nutrition monitoring and counseling (UNICEF, 2012; UNICEF, 2013; USAID, 2008; Valid International, 2006; WHO, 2013).

Nepal CMAM case study. One specific successful national CMAM example is the Nepal CMAM program. The program was started as a pilot program in 2008 in five districts of Nepal as a means of exploring community-based management of acute malnutrition. National rates of acute malnutrition (MAM plus SAM) were 13% in 2006

and 11% in 2011. The CMAM program is a collaboration between the Government of Nepal, Ministry of Health and Population, and UNICEF. The program also utilizes international and national non-governmental organizations (NGOs) for technical assistance. The national program guidelines and protocols were adapted from international sources to harmonize with current health services and current research. The CMAM program including all four facets (community outreach, outpatient care, inpatient care, and MAM management) was evaluated comprehensively in 2011 (UNICEF, 2012).

Community outreach. Community outreach in Nepal occurs predominantly through female community health volunteers (FCHVs). These women effectively screen and refer children using MUAC measurements and pedal edema assessments. MUAC screenings are done at vitamin A campaigns, vaccination campaigns, home visits, mother's group meetings, and other community events. Challenges for community outreach in this program include overburdening FCHVs, access and transport barriers, and insufficient incentives for FCHVs.

Outpatient Treatment. Identified SAM cases (MUAC <115 mm or bilateral pitting edema) are referred to one of seventy-five outpatient therapeutic programs. At these outpatient facilities children are clinically examined, receive an appetite test, and have their anthropometric measurements confirmed. If the child has no medical complications, has less than 3+ edema, passes the appetite test, and has a MUAC <115mm the child is admitted to the program. The caretakers are provided with counseling, education, RUTF, and follow-up instructions for a child return visit in two weeks. Health workers or FCHVs may follow-up with patients through home visits if the patient misses follow-up appointments or is not responding well to treatment. The Nepalese outpatient therapeutic

programs have an 86% recovery rate, .7% mortality rate, and 9% default rate. The average length of stay is 49 days and the average weight gain of 4.8 g/kg/day. The patient relapse rate is 1.2%. Children are discharged from the outpatient program upon reaching a 15% weight gain. Challenges for Nepalese outpatient centers include water and latrine access, absence of play areas for child stimulation, distance of facility from beneficiaries, and staff member time constraints limiting nutritional education of caretakers.

Inpatient Treatment. Identified cases of complicated SAM, SAM with no appetite, and MAM with medical complications are referred to inpatient stabilization centers for treatment. Upon resolution of medical complications and return of appetite, inpatient SAM children are transferred to outpatient therapeutic programs. Clinically-well inpatient MAM children are transferred to counseling services for follow-up by FCHVs. The inpatient stabilization rate is 95.3%, mortality rate is .42%, and default rate is 2.7%. Challenges for Nepalese inpatient facilities include inadequate beds and poor follow-up with outpatient care.

MAM management. Identified cases of uncomplicated MAM (MUAC <125 mm) receive counseling and monitoring by FCHV's until resolution. If the child fails to have a MUAC >125mm in two months, the child is referred to an outpatient program. FCHV's also encourage caretakers to take their MAM children to outreach centers for further monitoring and counseling services. The MAM program does not provide caretakers with supplementary food, but focuses on counseling caretakers in optimal feeding practices and home-based supplementary food preparation. Challenges to the Nepalese MAM management include poor follow-up measures and nutritional monitoring (UNICEF, 2012).

Effectiveness of outpatient care. Evaluations of five national community-based management of acute malnutrition (CMAM) programs (Nepal, Ethiopia, Kenya, Chad, and Pakistan) showed that the outpatient center outcomes for each of these national programs met Sphere standards. Specific to the CAR, a March 2015 UNICEF humanitarian report stated that for the current CMAM interventions, comprised of 36 inpatient and 224 outpatient facilities, the overall performance indicators (recovery rate of 84.4%, mortality rate of 3.2%, and a default rate of 12.3%) meet the global standards (UNICEF, 2015). In a Delphi process involving consultation of 15 experts in the management of acute malnutrition, community based outpatient treatment of SAM was estimated to have a case fatality rate of 4% and recovery rate of 80% (Lenters, Wazny, Webb, Tahmeed, & Zulfiqar, 2013). Similarly, Harris and Jack (2011) concluded that a Cambodian community based nutrition program utilizing nurses and community workers to provide nutrition education, food support, and home visits was an effective means of managing pediatric acute malnutrition. The case fatality rate of the Cambodian program was 5.6% and the average weight gain of patients was 4g/kg/day.

Inadequate care. Two studies suggested inadequate or partially effective management of SAM by community-based outpatient programs. Regarding inadequate management, Ashworth (2006) reviewed 33 studies on community-based nutrition rehabilitation for children with SAM (WFH/L < -3 SD or the presence of edema) and determined only 11 (33%) of those programs to be effective. Effectiveness of programs was defined as a mortality rate < 5% and average weight gain ≥ 5g/kg/day (as opposed to the more recent Sphere standard, mortality rate <10%). Of the effective programs, two were residential nutrition centers, two were clinic-based, and seven were home-based.

61% of the most recent programs (those within the past ten years of the literature review) were found to be effective. Possible reasons for ineffectiveness of programs include insufficient energy-density and frequency of meals; nosocomial infections; electrolyte/micronutrient deficiencies; weight-for-age admission and discharge criteria; poverty; counseling ineffective due to vagueness, impracticality, or conflicting with cultural beliefs; lack of involvement or support by influential family members; sharing of supplementary foods; substitution of normal intake rather than supplementation with addition of supplementary foods. Characteristics of successful programs include basic knowledge of SAM treatment, motivated and well-trained staff, high-energy/high-protein intake for patients (>5 meals/day, affordable food mixtures, or provision of RUTF), education for mothers regarding child feeding, broadened focus addressing social, economic, and health issues. All successful programs had external support from NGOs, universities, aid organizations, etc.

Partially effective care. One of the reviewed articles provided details of a partially effective outpatient program. Yebyo, Kendall, Nigusse, & Leman (2013) performed a retrospective cohort study on 628 children aged 6-59 months old with uncomplicated SAM managed at an outpatient program in Ethiopia from 2008-2012. Admission criteria for this program was MUAC<110 mm and/or a weight/height ratio <70% or bilateral pitting edema. All children with medical complications were transferred to inpatient care. Children in the outpatient program were treated with supplements, deworming, antibiotics, measles vaccine, and weekly RUTF. Patients were discharged upon reaching target weight and/or weight/height ratio >85%. Edematous patients were discharged upon resolution of edema regardless of body weight. The program recovery rate was 61.7%,

default rate 13.8%, mortality rate 3%, and average weight gain was 5.23 g/kg/day. The weight gain and recovery rate fell below the Sphere standard (>75% recovery rate); however all other rates were in acceptable ranges. The major identified problems with the program were the lack of referral of children with medical comorbidities and partial administration of routine medications. Within the program, 44.3% of children were found to have at least one medical problem. As a result of outpatient management, only 34% of these children with medical problems recovered, while 94% of children without medical problems recovered in the course of outpatient care.

Anthropometry. Twenty-four studies, one international guidelines, five national CMAM program evaluations, and three training resources were reviewed for use of anthropometry in detecting acute malnutrition. The majority of the reviewed articles were ranked as level VI, see Table 7 for a complete summary. In all the reviewed literature; a form of MUAC and/or weight and height criteria were utilized as a means of assessing acute malnutrition (Ayele et al., 2012; Berkley et al., 2005; Bern & Nathanail, 1995; Biswas, Bose, Mukhopadhyay, & Bhadra, 2010; Briend, Maire, Fontaine, & Garenne, 2012; Caleo et al., 2012; Connor & Manary, 2011; Dairo, Fatokun, & Kuti, 2012; Dale, Myatt, Prudhon, & Briend, 2013; Dasgupta, Sinha, Jain, & Prasad, 2013; De Onis & Yip, 1997; Fernández, Delchevalerie, & van Herp, 2010; Goossens, Bekele, Yun, Harczi, Ouannes, & Shepherd, 2012; Joseph, Rebello, Kullu, & Raj, 2002; Laillou et al., 2014; Mei & Grummer-Strawn, 1997; Mogeni et al., 2011; Mwangome, Fegan, Prentice, & Berkley, 2011; Mwangome, Fegan, Mbunya, Prentice, & Berkley, 2012; Myatt, Khara, & Collins, 2006; Myatt, Duffield, Seal, & Pasteur, 2009; Puett, Coats, Alderman, & Sadler, 2013; Shah, Shaikh, Memon, Siyal, & Nizamani, 2014; Shekhar & Shah, 2012; UNICEF,

2012; USAID, 2008; WHO, 2013; WHO 2014; WHO & UNICEF, 2009). Two studies, and one international guideline address the utilization of visible wasting as opposed to anthropometry to detect acute malnutrition (Myatt, Khara, & Collins, 2006; Mogeni et al., 2011; WHO, 2013)

MUAC and WFH/L. Specific to community-based management of acute malnutrition, MUAC is the described as the preferred anthropometric tool for active case detection and monitoring of SAM and MAM in the community (UNICEF, 2012; USAID, 2008; WHO, 2013; WHO, 2014; WHO, WFP, USSCN, & UNICEF, 2007). In the reviewed articles, guidelines, and resources, MUAC cut-off standards for SAM detection ranged from MUAC<110mm to MUAC<120mm and up to MUAC< 125mm for MAM detection; however, the most recently updated international WHO guideline (2013) recommends the use of MUAC <115mm as diagnostic criteria for SAM and MUAC 115mm-125mm for MAM diagnosis, see Table 1.1.

Table 1.1

Acute Malnutrition Classification in Children aged 6-59 Months.

Children 6-59 months	MUAC (independent criteria)	Weight-for-height/length(WFH/L) (independent criteria)	Nutritional edema
Moderate Acute Malnutrition (MAM)	115-125 mm	≥-3 and <-2 standard deviations of WHO standard	None
Severe Acute Malnutrition (SAM)	<115 mm	< -3 standard deviations of WHO standard	Bilateral pitting edema

Note. Compilation of information from USAID, 2008; WHO, 2013; WHO, 2014; WHO & UNICEF, 2009.

Seven of the reviewed articles, four out of five of the national CMAM program evaluations, and two training resources used MUAC <115 mm or ≤115 mm as a fixed cut-off point for SAM diagnosis (Berkley et al., 2005; Briend, Maire, Fontaine, &

Garenne, 2012; Dale, Myatt, Prudhon, & Briend, 2013; Dasgupta, Sinha, Jain, & Prasad, 2013; Fernández, Delchevalerie, & van Herp, 2010; Laillou et al., 2014; Mogeni et al., 2011; UNICEF, 2012; USAID, 2008; WHO, 2014). MUAC is regarded as a practical, cost-effective (Berkley et al., 2005), quick, simple, reliable, and acceptable anthropometric tool (Ayele et al., 2012; Myatt, Khara, & Collins, 2006). A fixed MUAC standard requires no growth charts or calculations as opposed to WFH/L SAM criteria. Regarding reliability, Ayele et al. (2012), found that after two days of training in anthropometry, six Ethiopians with no prior experience demonstrated high rates of reliability and repeatability of MUAC, weight, and height measurements. Regarding accuracy, three of five studies measuring sensitivity and specificity of MUAC < 115mm (with WFH/L < -3 SD as the gold standard) found that MUAC <115mm is an accurate means of detecting SAM with a high sensitivity and specificity (Briend, Maire, Fontaine, & Garenne, 2012; Fernández, Delchevalerie, & van Herp, 2010; Shekhar, & Shah, 2012). In predicting inpatient deaths, Berkley et al., found that MUAC≤115 mm had a higher sensitivity than WFH/L < -3SD and a comparable specificity. MUAC was found to be less affected by the hydration status of a child in comparison with WFH criteria (Mwangome, Fegan, Prentice, & Berkley, 2011). In addition, in an evaluation of nutritional assessment data for Somalian agrarian (1481) and pastoralist (2741) children Myatt, Duffield, Seal, & Pasteur (2009) found that weight-for-height measurements overestimated the rates of MAM in this population due to the long-leg-length typically seen in pastoralist children while MUAC was not significantly affected by this alteration in body structure in determining nutritional status. Goossens et al. (2012) suggest that MUAC may help eliminate a gender bias which may occur with the utilization of WFH/L

criteria. According to Isanka, Villamor, Shepherd, and Grais (2009), out of 25,754 children admitted to a program in Niger, there was a disproportionate number of males (66.4%) as compared to females (33.6%) admitted to the program based on WHO criteria of a WFH/L < -3 SD. In an analysis of patient data from a therapeutic feeding program in Burkina Faso which utilizes MUAC ≤118 mm as admission criterion, Gossens et al. (2012) found that out of 24,792 children aged 6-59 months, 49.7% were female and 50.3% were male. Three of the twenty-four reviewed studies did not use a fixed cut-off for MUAC, but used MUAC for age z scores to determine rates of malnutrition. Two of the three studies were published more than fifteen years ago, and none of the studies were specific to SAM management in outpatient nutrition programs (Biswas, Bose, Mukhopadhyay, & Bhadra, 2010; De Onis & Yip, 1997; Mei & Grummer-Strawn, 1997).

One 1995 study as well as two more recent studies found poor overlap between the groups identified by MUAC and WFH/L criteria. Bern & Nathanail (1995) determined that a MUAC <12 cm did not detect 74% of children with low weight-for-height using NCHS growth references. In an analysis of 1,879 children (6 months-3 years) in India, Dasgupta, Sinha, Jain, & Prasad (2013) found MUAC to have a low sensitivity and positive predictive value when WFH < -3 SD was used as the gold standard. In an analysis of data for 11,818 Cambodian children aged 0-59 months, Laillou et al. (2014) determined that MUAC <115mm missed 90% of children with a WFH < -3 SD, and WFH < -3 SD missed 80% of children having a MUAC < 115mm. As a result, the researchers recommended using MUAC for community screenings followed by reassessment using both anthropometric tools.

Visible assessment. Two articles and one international guideline address using visible wasting as a detection method for SAM. In a review of literature, Myatt, Khara, & Collins (2006) concluded that a subjective clinical assessment for visible wasting performed worse than any anthropometric method. In addition, Mogeni et al. (2011) found that visible severe wasting had a lower sensitivity than anthropometric measurements (MUAC < 115 mm and/or WHZ < -3) and that approximately half of children who met anthropometric measurements for SAM were incorrectly diagnosed by visible assessment. The 2013 WHO guideline states that visible severe wasting is not considered to be diagnostic criteria for SAM.

Anthropometry and outpatient nutrition programs. All five of the evaluated national CMAM programs and nine reviewed outpatient nutrition programs screen, refer, and monitor children for acute malnutrition using MUAC criteria and/or the presence of bilateral edema. Four of the nine programs utilize MUAC and/or WFH criteria. Four of the national programs excluding the Ethiopian CMAM program and two of the nine outpatient nutrition programs utilize the most recently updated MUAC <115 mm and/or bilateral edema as the cut-off standard for admission criteria (Dale, Myatt, & Briend, 2013; Shewade et al., 2013; UNICEF, 2012, WHO, 2013). Five of the reviewed programs as well as the Ethiopian program used MUAC <110 mm and/or edema as the standard for admission (Defourny et al., 2009; Kerac et al., 2014; Puett, Coats, Alderman, & Sadler, 2013; Somassé, Bahwere, Laokri, Elmoussaoui, & Donnen, 2013; UNICEF, 2012; Yebyo, Kendall, Nigusse, & Lemma, 2013). One program utilized MUAC ≤ 118 mm and/or bilateral edema (Goossens et al., 2012) and one program exclusively utilized WHZ standards for admission (Harris & Jack, 2011).

Regarding discharge criteria, one program utilized MUAC >125 mm as criteria (Dale, Myatt, Prudhon, & Briend, 2013), three programs utilized 15% weight gain, (Goossens et al., 2014; Alderman, & Sadler, 2013; Shewade et al., 2013; UNICEF, 2012), one program utilized MUAC <110 mm and 15% weight gain (Puett, Coats, Alderman, & Sadler, 2013), and two programs recorded weight for height > 80% and >85% as discharge criteria (Kerac et al., 2014; Yebyo, Kendall, Nigusse, & Lemma, 2013). All programs also required resolution of edema before discharge. Goossens et al. (2012) found that using 15% weight gain as discharge criteria for a therapeutic feeding program in Burkina Faso resulted in longer lengths of stay for less malnourished children since these children gain weight quickly. The WHO 2013 guideline update recommends discharging SAM patients from outpatient care using anthropometry coinciding with admission criteria, WFH/L ≥-2 or MUAC ≥125 mm and no edema for at least 2 weeks. Dale, Myatt, Prudhon, & Briend (2013) analyzed data from 753 cured children aged 6-59 months with uncomplicated SAM from a Sudanese outpatient nutrition program. These researchers found that by using a MUAC > 125mm as discharge criteria rather than 15% weight gain, the most severely malnourished children had the longest lengths of stay.

Community Health Workers. Of the reviewed literature, seven articles, five CMAM program evaluations, two international guidelines, and two training resources reference community health workers/volunteers as having a part in community-based management of acute malnutrition. Community-based nutrition programs utilize community health workers to screen and monitor the nutritional status of children within communities; to refer children to the correct nutrition program; to provide nutritional education, behavior change communication, and feeding counseling to caretakers; and to

provide follow-up home visits (Ashworth, 2006; Ayele et al., 2012; Caleo et al., 2012; Harris & Jack, 2011; Mwangome, Fegan, Mbunya, Prentice, & Berkley, 2012; Puett, Coats, Alderman, & Sadler, 2013; Somassé, Bahwere, Laokri, Elmoussaoui, & Donnen, 2013; UNICEF, 2012; USAID, 2008; WHO, 2013; WHO, 2014; WHO, WFP, UNSSCN & UNICEF, 2007). Utilizing CHWs has been associated with increased access and coverage of basic health care to communities, improved health outcomes- specifically in children, and community mobilization through an increase in local compliance, acceptance, and self-reliance (Puett, Coates, Alderman, & Sadler, 2013; WHO, 2007; WHO & UNICEF, 2007). (WHO, 2007). CHWs have been found to be accurate and reliable in screening for SAM and MAM using MUAC tapes and edema assessments (Ayele et al., 2012; Mwangome, Fegan, Prentice, and Berkley, 2012; Puett, Coates, Alderman, &Sadler, 2013; UNICEF, 2012). In a study calculating the inter-anthropometrist error of measurement and intra-anthropometrist reliability and repeatability of measurements taken by workers with two days of anthropometry training and no prior experience, Ayele et al. (2012) found that minimally-trained Ethiopian CHWs were capable of accurately performing anthropometric measurements including height, weight and MUAC in the community. Mwangome, Fegan, Mbunya, Prentice, and Berkley (2012) found similar results in minimally-trained Kenyan CHWs who accurately measured MUAC in infants <6 months old. These researchers found no significant variation between the two-day-trained health workers and their trainers ($p=.075$). In a cross-sectional study in which fifty-five CHWs were assessed by their supervisors using a quality of care checklist, Puett, Coates, Alderman and Sadler (2013), found that 89.1% of CHWs achieved scores >90%. One study by Caleo et al. (2012) found that SAM

MUAC classification by workers who had received three days of training had a low predictive value (60%) potentially due to inadequate training. The recommended typology for a nutrition specific CHW and an example of CHW involvement in community management of acute malnutrition is presented in Table 8.

Table 8

Typology for Nutrition Community Health Worker

Author/Year	Program	Role	Requirements	Training	Follow-up training	Supervision	General/Performance Incentives:
WHO & Global Health Workforce Alliance (2010)	Nutrition specific CHW typology	Breastfeeding promotion, hygiene and sanitation improvement, dietary intake for pregnant and lactating mothers, micronutrient supplementation, monitoring for SAM, treatment for diarrhea, infectious/parasitic disease, SAM, and vitamin A deficiency.	Primary-level education, 18-40 years old, permanent resident of local community. Community involved in identification of potential CHW. CHW completes literacy/ numeracy test and interview. Selected by local community and health center	Initial: 1-2 weeks. On the job: 2 weeks Exam given after initial training. Title awarded post initial training and exam completion. Certificate awarded post on-job-training completion.	None recorded	1 supervisor to 20-25 CHWs. Annual internal and 5 year external evaluation	Identification of child with severe malnutrition and monitoring the growth of a child for one year
Puett, Coates, Alderman, & Sadler (2013).	Community case management (CCM) of SAM in Bangladesh	Screening, monitoring, and treating uncomplicated SAM. 150-225 households per CHW. Screening of children < 3 years during home visits and monthly meetings. If MUAC < 110 mm and/or edema and no complications receive monitoring and weekly RUTF. Discharge: MUAC > 110 mm, > 15%	Selection of CHW based on exam score assessing basic literacy/numeracy and score in expanded program on immunization area.	Prior to SAM management these CHWs had > 3 years of experience in the maternal and child health nutrition (MCHN) program. Received two day training on CCM of SAM and subsequent refresher courses.	Refresher trainings 1/month with intensive bimonthly two day intensive session with technical training and forum for questions and feedback. 25% of refresher	25-40 CHWs per supervisor. 1-2 supervisor visits per month.	CHWs paid $11.80 per month. Evaluation: High quality of care of uncomplicated SAM according to CMAM algorithms. CHWs Assessed MUAC accurately and educated correct messages.

		weight gain, resolution of edema for >2 weeks.			training specific to SAM.		Caretakers valued education provided by CHWs and interpersonal skills of CHWs. Expressed trust in and gratitude for workers.

Note. Adapted from World Health Organization & Global Health Alliance, 2010; Puett, Coates, Alderman, & Sadler, 2013.

Evidence-based Recommendations for the Bangui Three Strands Nutrition Program

The following are evidence-based recommendations for the Bangui Three Strands nutrition program. The recommendations are classified as Grade A (strong) or Grade B (weak) according to criteria developed by the Joanna Briggs institute (2014). Grade A recommendations are considered to be strong. Grade A recommendations result in more favorable than unfavorable effects; are supported by evidence of adequate quality; benefit or have no effect on utilization of resources; and consider the values, preferences, and experience of the patient. Grade B recommendations are considered to be weak. Grade B recommendations may result in more favorable than unfavorable effects; are supported by evidence of lesser quality; benefit, minimally effect, or have no effect on the utilization of resources; and may or may not consider the values, preferences, or experience of the patient. The grade was determined by the researcher according to the aforementioned descriptions as well as feasibility, appropriateness, meaningfulness, and effectiveness of the recommended practice (Joanna Briggs Institute, 2014).

Recommendation I: Refocus program. The Bangui Three Strands outpatient nutrition program should refocus their program to address all four of the following for children aged 6-59 months: 1) community outreach measures including nutrition education and screenings, 2) outpatient care or referral to outpatient programs for

uncomplicated SAM, 3) outpatient management or referral to outpatient programs for MAM, and 4) referral of all complicated SAM cases for inpatient care.

This recommendation is classified as Grade A (strong) as the recommendation is based on high quality evidence from 21 articles (3 level I, 2 level II, 10 level VI, and 5 level VII) including the WHO 2013 international guideline for management of SAM. The recommendation to refocus the program to address these four aspects is feasible since knowledgeable and qualified health professionals run the program and are open to changes, Three Strands is able to provide financial funding for the program, and since the program has already been providing education and supplementary food for children 3-5 years of age. The recommendation is appropriate to the program context as it proposes a community-based model for managing acute malnutrition which is relevant to a home-based nutrition program. The recommendation is associated with positive and effective outcomes for managing acute malnutrition.

Recommendation II: Anthropometry. The nutrition program should use MUAC tapes and pedal edema assessments to assess the nutritional status of children aged 6-59 months and to refer children to the correct program according to results.

This recommendation is a Grade A (strong) recommendation as the quality of available evidence is high (29 articles; 1 level I, 2 level IV, 1 level V, 18 level VI, and 4 level VII). The recommendation is feasible and appropriate since MUAC and edema assessments are a simple, cost-effective, reliable, accurate, and practical means of assessing nutritional status requiring minimal training. The recommendation is meaningful as MUAC and edema assessments are a means of providing reliable classifications of nutritional status which can then be used to refer patients for treatment.

Similar programs which utilize MUAC and/or edema for community nutrition screenings have had positive outcomes in managing acute malnutrition.

Recommendation III: Screening. Trained nutrition workers should perform active community nutrition screenings. If a child aged 6-59 months has a MUAC <115mm and/or bilateral edema and no immediate danger signs (see Table 9), refer the child for a full clinical examination and appetite test at an outpatient nutrition program. If a child has a MUAC 115-125mm, no edema, and no immediate danger signs; refer the child for outpatient MAM management. Refer all children with danger signs immediately to an inpatient facility.

This is a Grade A recommendation. The quality of evidence for this recommendation is high (14 articles; 2 level I, 7 level VI, 5 level VII). Implementing this recommendation is feasible for the Bangui program, but does require training of additional nutrition workers, purchasing of supplies, and access to an inpatient facility for referrals. Nutritional screenings with MUAC and edema assessment are appropriate due to the simple, mobile, and practical nature of the anthropometry. The recommendation is meaningful as the screenings identify malnourished children for treatment; however the effectiveness of the recommendation hinges on the availability of treatment, both inpatient and outpatient, for the children who will be identified by the screenings. It is unknown to this author whether there is a nearby inpatient center for referral or whether community screenings will dramatically increase the patient load and overwhelm the Bangui nutrition program resources.

Table 9

IMCI Danger Signs

1. The child is unable to drink or breastfeed
2. The child vomits everything
3. The child is currently convulsing or has had convulsions (multiple or one with a duration> 15 minutes)
4. The child is lethargic or unconscious

Note. Information adapted from WHO; 2013; WHO, 2014.

Recommendation IV: Admission criteria for outpatient care. Admit children aged 6-59 months with uncomplicated SAM (MUAC < 115mm) and/or mild bilateral edema (< 3+) who are found to be clinically well with no medical complications and with an appetite for outpatient management of SAM. Admit children aged 6-59 months with MAM (MUAC 115-125mm) and no IMCI danger signs (see Table 9) to program for outpatient management of MAM.

This is a Grade A (strong) recommendation. The quality of evidence for this recommendation is high (8 articles; 1 level I, 1 level IV, 4 level VI, 2 level VII). This recommendation requires training and purchasing of supplies, but is feasible. A physician and a nurse are available to perform the clinical exam and appetite test for each child. Funding for supplies and supplementary food is available from Three Strands. This recommendation for outpatient management of acute malnutrition is appropriate for a home-based nutrition program. Treating uncomplicated cases of acute malnutrition in the community is an effective form of managing acute malnutrition with positive patient outcomes.

Recommendation V: Outpatient SAM follow-up criteria. Children aged 6-59 months who are admitted to an outpatient SAM nutrition program should receive weekly

follow-up care including resupply of supplementary food and monitoring the child's response to treatment.

This is a Grade A recommendation. The quality of evidence available for this recommendation is high (10 articles; 1 level I, 1 level II, 6 level VI, 2 level VII). The feasibility of implementing this recommendation for the Bangui nutrition program depends on how many children they admit to their program and how many staff they employ. The recommendation is appropriate to the Bangui program since the program is a home-based nutrition program. Weekly follow-up involving the provision of supplementary food and monitoring of a child's treatment response is meaningful in promoting positive patient outcomes.

Recommendation VI: Referral criteria for inpatient care. Refer children aged 6-59 months with SAM (MUAC <115mm) or mild (< 3+) bilateral edema who have one or more danger signs, medical complications, or no appetite for inpatient care. Refer all children aged 6-59 months with 3+ bilateral edema for inpatient care.

This is a Grade A recommendation. The quality of evidence available for this recommendation is high (15 articles; 1 level I, 1 level II, 1 level IV, 8 level VI, 4 level VII). The feasibility of referring children for inpatient care is unknown to this author. This recommendation is appropriate for this program since the home-based nutrition program is not equipped to provide inpatient services. The recommendation for inpatient referral of complicated and/or severely edematous cases is associated with positive patient outcomes and effective community nutrition programs.

Recommendation VII: Discharge criteria. Patients may be discharged from the outpatient care for SAM upon reaching a MUAC ≥125mm and having no edema for >2 consecutive weeks.

This is a Grade A recommendation. The quality of the evidence is high (4 articles; 1 level I and 3 level VI), but is limited in availability. In one level VI study, Goosseens et al. (2012) pointed to the need for an alternative to using percent weight gain as discharge criteria since this leads to the most malnourished children being discharged first due to rapid weight gain. Connor & Manary (2011) found that there was a significant correlation between weight gain and MUAC after the first month of home-based treatment for children with MAM. In a level VI study, Dale, Myatt, Prudhon, and Briend (2013) found that using MUAC >125mm as discharge criteria in an outpatient nutrition program effectively kept the most malnourished children for longer lengths of treatment. The most recently updated international guideline recommends using MUAC (≥125 mm) or WFH/L (≥-2 SD) criteria (coinciding with whichever anthropometric indicator is used for admission) rather than using 15% weight gain as discharge criteria. This recommendation is feasible since MUAC is a simple, practical, and cost-effective means of monitoring acute malnutrition. It is appropriate since the program will also admit patients based on MUAC criteria. In addition, the recommendation is meaningful as it will standardize length of care and will effectively allow the most malnourished children to have the longest duration of care as opposed to using 15% weight gain as discharge criteria.

Recommendation VIII: Monitoring and evaluation of outcomes. The outpatient nutrition program should develop a means of recording and archiving patient data in order to monitor and evaluate care as well as patient outcomes. Staff should

monitor mortality rate, default rate, recovery rate, program coverage, and program accessibility statistics. Workers such as CHWs should receive ongoing training and regular supervision to ensure quality of care. The SAM outpatient program should be held to the Sphere standards (see Table 10) for community-based management of acute malnutrition.

This is a Grade A recommendation. The quality of evidence for regularly monitoring, training, and supervising CHWs is level I and VI. In addition, all of the reviewed programs and articles regarding outpatient programs (17 articles; 1 level I, 1 level II, 2 level IV, 1 level V, 9 level VI, 2 level VII) included data monitoring and evaluation. Recording, monitoring, and evaluating patient data is feasible in the context of an outpatient nutrition program. This recommendation requires literacy of workers, access to paper charting materials, and knowledge of basic statistical calculations. These are assumed to be present within the program or available to the program. The recommendation is meaningful in that monitoring and evaluation of patient data as well as of CHWs can lead to program improvement initiatives.

Table 10

Sphere Standards for Community-based SAM management

1. Mortality rate <10%
2. Default rate <15%
3. Recovery rate >75%
4. > 90% of target population is within < 1 day return walk of program site
5. Program coverage is > 50% in rural areas, >70% in urban areas, and >90% in camp areas

Note. Information adapted from Sphere Project, 2011.

Recommendation IX: Nutrition CHWs. The outpatient nutrition program should expand their community outreach services by training and utilizing nutrition

community health workers in acute malnutrition, nutrition education, feeding counseling, acute malnutrition screening, and referral processes.

This is a Grade B (weak) recommendation due to high quality of evidence (17 articles; 2 level I, 1 level V, 10 level VI, 4 level VII), but poor feasibility of implementation at the Bangui nutrition program. The recommendation requires a substantial amount of planning, collaboration with the community, acquisition of resources for training, creation of a supervisory network, potentially additional funding for staff stipends, and ongoing refresher training and monitoring. This not entirely implausible for the Bangui nutrition program, as Dr. and Mrs. Dibona are qualified health professionals who have the medical and cultural knowledge to train workers. The recommendation is appropriate for the situation since the program will need additional staff to carry out tasks. The recommendation is meaningful since utilizing local workers may promote community mobilization, provide employment for locals, increase active case identification of acute malnutrition, and prevent malnutrition through education and counseling. International guidelines as well as several national community-based nutrition programs recommend the use of community health workers as an effective means of community screening and outreach measures.

Chapter 5: Discussion

Implementation of Recommendations

Below are propositions for implementing the aforementioned nine evidence-based recommendations in the Bangui Three Strands outpatient nutrition program. Propositions for implementation were formulated based on the reviewed literature and communication with Dr. Taylor from Three Strands.

Implementation of recommendation I. In order to refocus the Bangui Three Strands nutrition program (recommendation I), The Taylors and Dibona's should first complete a program and community assessment. The program assessment should include availability of staff, resources, budget, partnerships with other health facilities/government, and current program focus (MAM care, SAM care, or community outreach). If it has not been previously completed, the Dibona's may perform a community assessment to determine the prevalence of SAM and MAM, local views on malnutrition, and local interest in the program. Based on the program and community assessment, the Three Strands staff should then determine if they have the capacity to manage MAM and/or uncomplicated cases of SAM and if there are nearby programs available for referrals. The program goals should address: 1) community outreach, 2) outpatient MAM management, 3) outpatient uncomplicated SAM management, and 4) inpatient complicated SAM management. All four of these services should not be provided by the Bangui nutrition program, but all four should be addressed by the program through referrals, networking, or partnerships. The Dibona's should meet with local authorities, health officials, staff, and community leaders to discuss the program goals and objectives.

Implementation of recommendation II. In order to implement the second recommendation for utilizing MUAC as anthropometry and pedal edema assessments, Three Strands can purchase MUAC tapes through UNICEF supply division in units of fifty for $4.49 (UNICEF, n.d.). Included with the tapes are printed directions and illustrations for correct usage in English and in French. Following the purchase of the tapes, Three Strands staff should conduct a training session to teach and practice correct

usage of MUAC tapes and edema assessment. Pedal edema and MUAC assessments can be performed by minimally trained workers such as CHWs. Pedal edema assessments require an individual to gently, but firmly press both of her thumbs onto the top surface of a child's feet for three seconds, followed by withdrawal of her thumbs. If dents remain on the surface of both feet after thumb removal, the child has a positive test.

Implementation of recommendation III. In order to implement the third recommendation regarding nutrition screenings, the Dibonas need to determine who will perform the screenings, where, and how often. As mentioned previously minimally trained local persons (CHWs) can be trained to accurately screen children. The persons performing the screenings should receive training in correct age range (6-59 months), MUAC tape usage, edema assessment, nutrition status classification, referral process, and danger sign recognition. Screenings can be held at the program site, schools, home visits, scheduled nutrition events, vaccination campaigns, or other community events. The frequency of the screenings should be determined by the Dibonas and community leaders keeping in mind program capacity and community acceptance. The Dibonas should also set up a protocol for the workers to document and report the screening results and referrals. The workers should have an established way to directly communicate with a supervisor such as a cell phone or a nearby contact person for questions and concerns. At screenings, workers will screen children aged 6-59 months of age using MUAC and pedal edema assessments. Workers will assess a child for danger signs and will refer children based on the recommended acute malnutrition criteria to an inpatient or outpatient program. The Worker will record screening result, child age, name, gender, and contact information of caretaker for all referrals. The workers performing the screenings will

notify the outpatient program of all referrals and will pass along recorded patient data. An example of an algorithm for CHWS to utilize during community screenings is located in Appendix A, an example of a form for recording results of community screenings is located in Appendix B, and an example of a referral form is located in Appendix C.

Implementation of recommendation IV. Implementation of the fourth recommendation for admission criteria assumes that the program will provide MAM and uncomplicated SAM management. Prior to admitting patients using the recommended criteria, the program needs to have treatment protocols in place as well as adequate supplies for providing care (RUTF, medications, and supplements). The Dibonas may wish to establish days and hours for program operation during which a skilled worker will be available to admit children to the program. Children aged 6-59 months may come to the outpatient program for SAM management as a result of being identified at screening events, transferred from an inpatient facility, or through identification by a caretaker. A child brought to the program should receive a clinical exam for medical complications, an appetite test, and MUAC and edema assessment. A child who meets the criteria presented in recommendation IV will be admitted to the uncomplicated SAM outpatient program. The caretaker should receive a supply of RUTF as well as nutrition and feeding education.

Implementation of recommendation V. Implementing the fifth recommendation involves instructing the caretaker to bring the child back to the program center for weekly follow-up monitoring and resupplying of supplementary food. The child should be assessed weekly by a skilled health care provider such as a nurse or physician. The Dibonas can establish a specific day(s) of the week during which children can be brought

to the program for follow-up visits. If a child misses a return visit, the program staff should contact the caretaker through a home visit or phone call.

Implementation of recommendation VI. In order to implement the sixth recommendation, the Dibonas need to make connections with a nearby inpatient facility which has the capacity to care for complicated cases of SAM to discuss the referral process and the inpatient admission standards. The inpatient facility should be within a reasonable travel distance of the program's target community. Program staff should give clear directions and rationale for the referral to caregivers. The inpatient facility should be contacted directly with information on when and why a patient is being referred to their care and patient documentation should be exchanged between programs. The program should have a way to confirm that referrals reach inpatient facilities either through communication with the inpatient staff or through communication with the referred child's caregiver.

Implementation of recommendation VII. Regarding implementation of the seventh recommendation, children can be discharge from the outpatient SAM program once the child has reached the recommended criteria. Program staff should provide thorough education to the caretaker on rationale for discharge and instructions for child care, feeding, and indications for bringing child back to program. The 2013 WHO guideline recommends ongoing periodic follow-up with discharged patients, but does not specify frequency or duration of post-discharge checks. The Dibonas may determine this based on availability of staff, child outcomes, and proximity of child to program location.

Implementation of recommendation VIII. In order to implement the eighth recommendation, the Dibonas should first obtain paper charting material. This can be as

basic as notebook paper or printed charts that are available through USAID (2008) or WHO (2014). CHWs performing screenings should be equipped with forms to record results of their screenings and data collected from referrals. Examples of screening and referral forms are located in Appendix B and C, respectively. Outpatient program staff should keep a record of patient admissions, transfers, recovered discharges, deaths, defaults, and referrals to inpatient care. Individual enrolled patient records should be kept at the program site in a secured area. These forms should include data such as MUAC measurements, edema assessment, appetite, presence or absence of danger signs, clinical exam results, medical history, and immunization records and should be updated each time the patient visits the site. A qualified staff member should analyze screening as well as outpatient program data on a weekly and monthly basis including program spending. The Dibonas should establish monthly staff meetings involving refresher training classes, question and answer sessions, and a discussion of program data analysis. The Dibonas should also communicate with the local or national ministry of health to determine if there are requirements for reporting program data. The Dibonas may find it beneficial to establish an interval for reporting screening, outpatient program, and budgeting data to Three Strands personnel.

Implementation of recommendation IX. Lastly, implementation of the ninth recommendation, to train community health workers should first begin with an assessment of current staff, program staffing needs, and budget. The Dibonas should determine a form of reimbursement for workers through financial salaries or other incentives, create a supervisory structure and chain of command, create a clear scope of care and role description, and come up with a training plan for hired workers. Following

this, the Dibonas may collaborate with community leaders to find local nominees for workers. Potential workers should be tested for literacy and numeracy and interviewed for motivation. The Dibonas should train the CHWs in protocols, acute malnutrition, MUAC and edema assessment, screening, classification, danger signs, referral processes, optimal feeding practices, and malnutrition prevention. CHW training plans such as those offered by the WHO (2014) may be utilized. Supervision of CHWs should occur on a regular basis.

Evaluation of Recommendations

The nine evidence-based recommendations can be evaluated in three ways. First, the recommendations can be qualitatively evaluated by interviewing program staff and program recipients. Three Strands personnel may interview the program staff to gain feedback on the practical implementation of the recommendations. Three Strands personnel may interview program recipients to evaluate community acceptance, perceived value, satisfaction, and cultural relevance of the program recommendations. Second, since the recommendations apply to the Bangui Three Strands nutrition program, the recommendations can be evaluated by evaluating the effectiveness of this program. Program effectiveness can be evaluated using the Sphere standards for community management of acute malnutrition (see Table 10). This includes an evaluation of the mortality rate, default rate, recovery rate, coverage, and accessibility of the program. Third, since successful implementation of the recommendations should lead to correct identification and management of acute malnutrition, the recommendations can be evaluated by tracking the rates of MAM and SAM in the program target community.

Limitations of Recommendations

The following are limitations to the nine previously presented evidence-based recommendations. First, these recommendations are limited to screening, classification, admission, referral, and discharge criteria for acute malnutrition. The recommendations do not address the treatment protocols for MAM or SAM. Second, the recommendations are limited by the inaccessibility of a CAR national protocol regarding the management of acute malnutrition. The author of this project conducted a thorough internet search and emailed a contact person found on the national WHO web page, but was unsuccessful in gaining information regarding whether the CAR has protocols for the management of acute malnutrition. Third, these recommendations were limited by imperfect communication with Dr. and Mrs. Dibona. All information regarding the nutrition program came from Dr and Mrs. Taylor who currently reside in the United States and communicate remotely with the Dibonas. The author of this project did contact Dr. Dibona via email, but he redirected questions back to Dr. Taylor due to limited proficiency in English. Fourth, the implementation of the recommendations are limited by the availability of resources such as charting materials, RUTF, anthropometric supplies, and staff. The current ease of accessing these for the Bangui nutrition program is unknown to the author. Fifth, the recommendations may be limited by proximity of an inpatient facility at which to refer children with complicated SAM. The presence or absence of a nearby facility for referrals is unknown to this author. Sixth, the recommendations do not contain guidelines for follow-up or discharge for the management of MAM, but are focused on SAM detection and management. Finally, the recommendation to utilize MUAC as the sole criteria for admission, monitoring, referral,

and discharge criteria is limited by two recent studies suggesting that MUAC and WFH/L criteria may identify two separate groups of malnourished children. If subsequent research confirms these findings, these recommendations will need to be updated to include WFH/L in addition to MUAC as admission, monitoring, referral, and discharge criteria.

Conclusion

In conclusion, the purpose of this project is to present objective and practical evidence-based recommendations for assessing and monitoring the nutritional status of children aged 6-59 months for an outpatient nutrition program in Bangui, Central African Republic. As a result of recent sectarian violence which began with a coup in March 2013, the Central African Republic is currently facing a nutrition crisis. An estimated 28,000 Central African children under the age of five were predicted to be affected by severe acute malnutrition (SAM) and 75,000 from moderate acute malnutrition in the year 2014 (The Assessment Capacities Project, 2014). The literature reviewed for the recommendations included a total of 48 studies, program reports, training resources, and guidelines pertaining to SAM assessment and community-based management of acute malnutrition. Based on the reviewed and graded literature, the author formulated nine recommendations for the Three Strands outpatient nutrition program in Bangui CAR. These include a recommendation to refocus the program to address community outreach, MAM management, outpatient care for uncomplicated SAM, and inpatient care for SAM; a recommendation to utilize MUAC tapes and pedal edema assessments as tools for assessing children aged 6-59 months in the community for acute malnutrition; to admit children to the outpatient program for uncomplicated SAM management if they have a

MUAC <115mm or pedal edema; to refer children with a MUAC 115-125 mm for outpatient MAM management; to follow up weekly with children admitted for outpatient management of SAM; to refer children for inpatient care if they have complicated SAM; to discharge children from the outpatient program who are clinically well with a MUAC >125mm and no edema for at least two consecutive weeks; to train CHWs to screen children in the community for acute malnutrition and to educate caretakers in child feeding practices; and to establish a means of monitoring and evaluating program outcomes.

Appendix A

Sample Algorithm for Nutrition Screening

Step 1. Confirm age of child.

Child between 6 and 59 months? (circle one): YES or NO

Step 2. Measure MUAC.

MUAC color (circle one): Green Yellow Red

MUAC (record number):_____ mm

Step 3. Check for pedal edema. Press both thumbs firmly on top of both feet and hold for three seconds, then release. Is indent still present on BOTH feet?

Pedal edema? (circle one): YES or NO

Step 4. If child has MUAC <125mm OR edema, check child and inquire of caretaker for presence of danger signs

Danger signs? YES or NO (Circle one or more):

1. Unable to drink or breastfeed
2. Vomits everything
3. Convulsing or has had convulsions recently
4. Lethargic(unusually sleepy) or unconscious

Step 5. If one or more danger signs are present, refer child to closest health care facility for immediate care. Fill out referral form completely.

Step 6. If MUAC<115mm OR pedal edema and NO danger signs, refer child to outpatient program for full clinical examination and SAM management. Fill out referral form completely.

Step 7. If MUAC 115-125mm with no edema and no danger signs refer child for outpatient MAM management program. Educate mother on child feeding practices.

Appendix B

Sample Chart for Screening Children aged 6-59 months

Worker's Name: Rachel Wong Phone # 111-222-3333

Date of screening: March 30, 2015 Location of screening: Bangui

Child's name	Child's gender	Caretaker contact information	MUAC	MUAC <115 SAM	MUAC 115-125 MAM	Edema	Danger signs	Referral
1. Delphin Hibele	M	Angele Hibile 123-321-1234	128	No	No	no	none	none
2. Cyriel Magome	M	Elizabeth Magome 321-123-4321	112	Yes	No	no	none	outpatient
3. Manuella Aldo	F	Larissa Aldo 543-345-3456	112	Yes	No	yes	yes	inpatient
4. Theodore Mogena	M	Clarrise Mogena 345-543-6543	121	No	Yes	no	none	MAM
5.								
6.								
7.								
8.								

Totals:	
Number with SAM	2
Number with MAM	1
Inpatient referrals (a)	1
Outpatient referrals (b)	1
MAM referrals (c)	1
Total number of referrals (a+b+c)	3
Total children screened	4

Appendix C

Sample Referral Form

Worker's Name: Rachel Wong Phone # 111-222-3333

Date of screening: March 30, 2015 Location of screening: Bangui

Referral to: Outpatient Three Strands Nutrition Program for SAM

Child's Name	Cyriel Magome	
Child's age and gender	3 years and male	
Caretaker contact information	Elizabeth Magome. 321-123-4321	
MUAC	112mm	
Edema	No	
Danger signs	Unable to drink or breastfeed	no
	Vomits everything	no
	Convulsing or has had convulsions recently	no
	Unusually sleepy or unconscious	no

Notes: Child's mother is concerned about transportation.

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