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Assessment of malnutrition in children under five years in Southern Province, Zambia

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BOSTON UNIVERSITY
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Thesis

**ASSESSMENT OF MALNUTRITION IN CHILDREN UNDER FIVE YEARS IN
SOUTHERN PROVINCE, ZAMBIA**

by

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**ASSESSMENT OF MALNUTRITION SCREENING IN CHILDREN UNDER
FIVE YEARS OF AGE IN SOUTHERN PROVINCE, ZAMBIA**

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ABSTRACT

Early deficits in childhood growth and development contribute to long-term problems that can persist into adulthood, including poor psychosocial wellbeing and reduced adult income. According to recent estimates, more than 200 million children worldwide fail to reach their full developmental potential. Underdevelopment is particularly widespread among children in Zambia; approximately 40% of Zambian children under five years of age are stunted due, in large part, to widespread malnutrition. It is a tremendous challenge for the public health care system in the country to address this burden. In this thesis, I investigate the capacity of rural health workers in Southern Province, Zambia to treat acute malnutrition among children under 5 years of age.

Data presented in this thesis were collected from several sources. Information regarding current guidelines, trainings for treatment of acute malnutrition and supply chain for supplemental nutritious and ready-to-use therapeutic foods were collected during key informant interviews performed with nutritionists (n=4) and rural health workers (n=5) in Lusaka and Southern Province, Zambia. Nutritionists working within the health care system at the national, provincial and district levels were interviewed, as were rural health workers selected from a sample of health centers. Information on child nutrition was collected using 24-hour food recall questionnaires that were administered to mothers from a sample of households (n=215) in Southern Province. Data were analyzed with qualitative

and quantitative methods. Outcomes of interest included the following: capability of rural health workers to address and treat acutely malnourished children; average daily consumption of carbohydrate, protein and fruit containing meals and snacks among infants; maternal perception of child growth and development as compared to other children of the same age; and mothers' satisfaction with nutrition information and services provided by their local health centers.

The first key finding of this study was that only 40% of rural health workers had been trained in the treatment of acute malnutrition within the last five years, while 100% of nutritionists had received training within the last two years. The second key finding was that infants six to 12 month old in the study sample were reported to have low protein and high carbohydrate consumption. On average, children consumed protein 0.75 times per day and carbohydrates 3.24 times per day. The third key finding was that mothers appeared to overestimate the development of their children. Despite the high rate of childhood stunting in the study sample (38%), 76% of mothers felt their child was the same height or taller than other children of the same age and sex, and close to 75% of mothers felt their child learned at the same speed as or quicker than other children of the same age and sex.

These findings suggest that there are currently inadequate resources and capabilities within the Zambian health care system to properly manage the high rate of child malnutrition and stunting in the country. In order to have a greater effect on the reduction of stunting in children, efforts to better disseminate resources from the national level to the rural health centers for the treatment of chronic and acute malnutrition should be considered. Necessary resources include better access to trainings for rural health workers,

anthropometric tools to measure levels of malnutrition and supplemental nutritious foods or ready-to-use therapeutic foods to treat children who are moderately or severely malnourished should be increased.

TABLE OF CONTENTS

TITLE.....	i
COPYRIGHT PAGE.....	ii
READER APPROVAL PAGE.....	iii
ABSTRACT.....	iv
TABLE OF CONTENTS.....	vii
LIST OF TABLES.....	ix
LIST OF FIGURES.....	x
LIST OF ABBREVIATIONS.....	xi
I. INTRODUCTION.....	1
II. METHODS.....	14
III. RESULTS.....	23
IV. DISCUSSION.....	38
APPENDICES	
APPENDIX 1.....	46
APPENDIX 2.....	48
APPENDIX 3.....	51
APPENDIX 4.....	52
APPENDIX 5.....	53

APPENDIX 6.....	57
APPENDIX 7.....	58
APPENDIX 8.....	61
APPENDIX 9.....	64
REFERENCES	68
CURRICULUM VITAE.....	72

LIST OF TABLES

Table	Title	Page
1	Number of times current breastfeeding infants were breastfed from sunrise to sunset (n=215)	32
2	Number of times current breastfeeding infants were breastfed from sunset to sunrise (n=215)	33
3	Number of children who consumed a protein, carbohydrate or fruit source at least once, from sunrise to sunset (n=213)	33
4	Number of children who consumed a specific food or drink, at least once, from sunrise to sunset (n=213)	34
5	Average number of instances a food group was fed to a child per day (n=213)	35
6	Mothers' view on their child's development and the nutrition services offered by their health center	37

LIST OF FIGURES

Figure	Title	Page
1	Prevalence of acute malnutrition in South Asia and Sub-Saharan Africa	2
2	Global prevalence of stunting	3
3	Most recent training for treatment of acute malnutrition among nutritionists and rural health workers in Southern Province, Zambia	23
4	Percentage of various clinics by type provided at selected health centers in Southern Province, Zambia (n=5)	25
5	Nutrition related advice provided to mothers among five health centers in rural Zambia	26
6	Percentage of services provided at an under-5 clinic within the last 30 days of selected health centers in Southern Province, Zambia (n=5)	27

LIST OF ABBREVIATIONS

AM	acute malnutrition
BMI	body mass index
CM	chronic malnutrition
CMAM	community-based management of acute malnutrition
DHS	demographic health survey
HAZ	height for age z-score
IECDZ	Improving Early Childhood Development Zambia
IMAM	integrated management of acute malnutrition
IRB	Institutional Review Board
IYCF	infant and young child feeding
KII	key informant interview
MAM	moderate acute malnutrition
MCD	most critical days
MDG	millennium development goal
MOH	Ministry of Health
MUAC	mid-upper arm circumference
NFNC	National Food and Nutrition Commission
P/GN	pounded/ groundnut
PMPCT	prevention of mother to child transmission
RUTF	ready to use therapeutic food
SAM	severe acute malnutrition

SNFsupplemental nutritious food
SUN..... Scaling Up Nutrition
WHO..... World Health Organization
WHZ weight for height z-score
UNICEF United Nations International Children’s Emergency Fund

I. INTRODUCTION

“There is a lot of competition for that title [Africa’s biggest health challenge]: the HIV epidemic, malaria, the fact that vaccines aren’t getting delivered to over 35% of the kids in sub-Saharan Africa. If I’d actually have to pick one, I’d pick malnutrition to go at the top of the list. Malnutrition is under-appreciated as an incredible health problem. A very high percentage of children don’t achieve full physical and mental development because of malnutrition. This affects their lives and their ability to learn and contribute to society”

-Bill Gates.

A. The Problem of Malnutrition

i. Global Burden

Acute malnutrition (AM) is one of the world’s most preventable conditions and yet, 52 million children (or one in 12) under 5 years of age are affected (UNICEF 2013). Figure 1 shows the global burden of AM by country. As a region, South Asia has the greatest burden of children affected by AM (one in 6), and India alone has more than 25 million malnourished children (UNICEF 2013). In Sub-Saharan Africa, it has been estimated that one in ten children under 5 years of age are affected (UNICEF 2013). Vulnerable groups such as children under 5 years of age, pregnant and lactating women, and those with acute infection or chronic illness are at the highest risk of AM; although, it can affect any group within a population.

Figure 1: Prevalence of acute malnutrition in South Asia and Sub-Saharan Africa

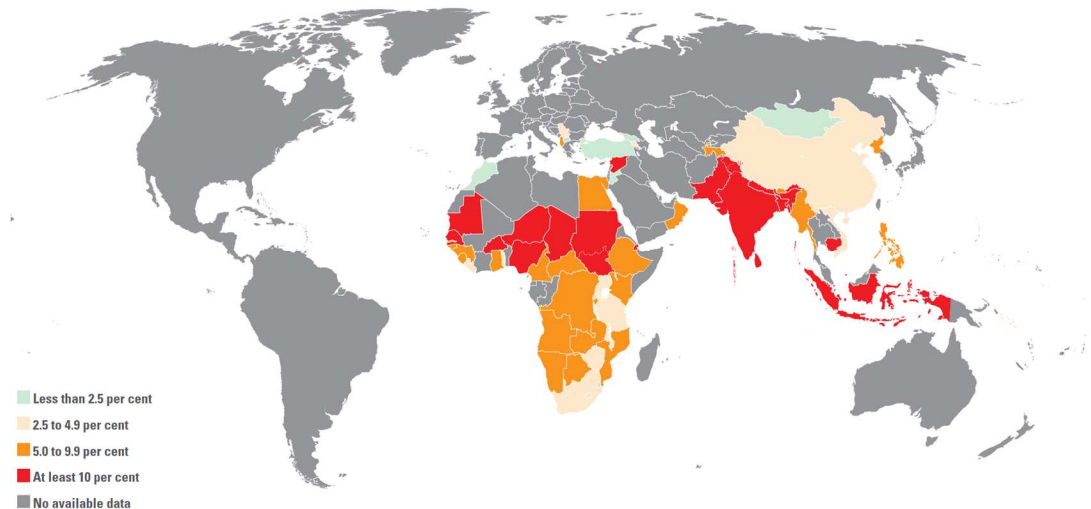


Figure 1: Countries with a very high prevalence of wasting (above 15%) are: South Sudan, India, Timor-Leste, Sudan, Bangladesh and Chad. Seven of the 10 highest burdened countries with wasting prevalence, also have a severe wasting percent above 5. (Figure taken from Improving Child Nutrition, The achievable imperative for global progression UNICEF 2013)

In addition to AM, developing children also face a risk of chronic malnutrition (CM), frequently identified as stunting. Stunting rates exceeded a quarter of the global population under 5 years of age in 2011; that's more than 165 million children affected (UNICEF 2013). Three quarters of these stunted children live in only 14 countries, primarily located in South Asia and Sub-Saharan Africa (UNICEF 2013). Timor-Leste, Burundi, Niger and Madagascar are at the top of that list, with stunting rates that reach over 50% of their under 5 population. (Figure 2) High prevalence of stunting is often found in low socioeconomic circumstances, and/ or in children with frequent exposure to illness and/or inadequate feeding methods (Lima 2010; Monteiro 2009).

Additionally, poor maternal education, increased maternal stress and depression (Gorman *et al* 1992; Stoltzfus *et al* 2001; Lozoff *et al* 2003) and insufficient stimulation

(Lozoff 2000) in the home, all factors associated with poverty, that add to the infant's increased risk of infection and stunting. Studies were conducted in both Guatemala and Jamaica showing that infants who were born at term, but with low birth weight, were developmentally delayed as compared to their full-term, normal birth weight counterparts. More specifically, infants with low birth weights in Guatemala were found to have had lower cognitive scores at two and three years of age (Gorman *et al* 1992; Villar *et al* 1984), while those in Jamaica had inferior problem solving capabilities at seven months of age (Gardner *et al* 2003) and lower developmental levels at 15 and 24 months (Walker *et al* 2004)

Figure 2: Global prevalence of stunting

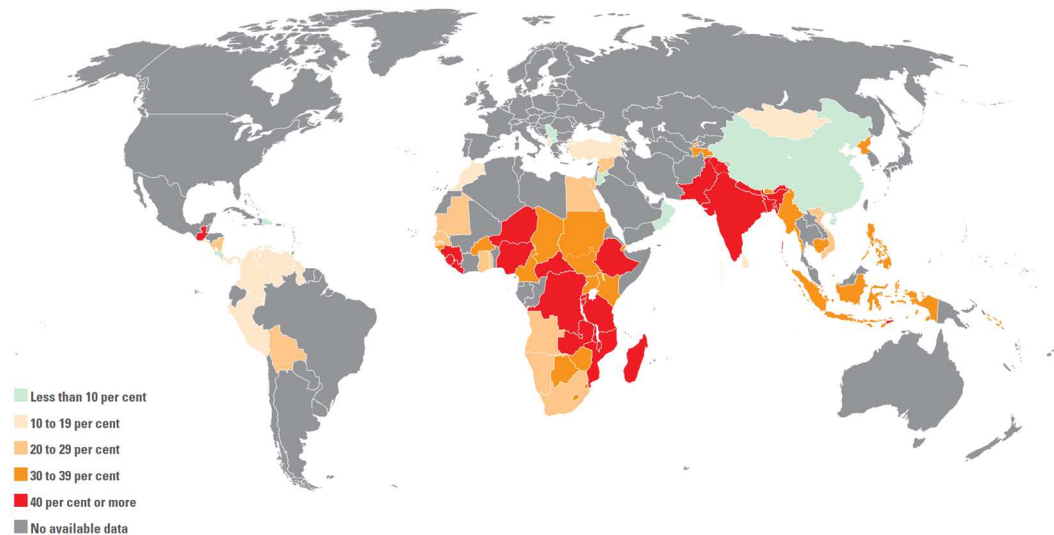


Figure 2: Three fourths of the world's stunted children under 5 years of age live in Sub-Saharan Africa and South Asia, with rates of 40% and 39%, respectively. (Figure taken from Improving Child Nutrition, The achievable imperative for global progression UNICEF 2013)

ii. Indicators

When assessing the nutritional status of a child, there are many growth indicators that can be used, but, for the purpose of this paper, two main anthropometric indicators will be focused on for assessing acute and chronic malnutrition. I use wasting, defined as weight-for-height z-score (WHZ) less than -2, as an indicator of AM. Wasting is, in most cases, the result of an abrupt significant weight loss endured by the infant, with or without nutritional edema, and leads to a primary outcome of infant mortality. Severe acute malnutrition (SAM), the worst form of AM, is defined as a child six to 59 months of age that either has a mid-upper-arm circumference (MUAC) less than 115mm, or a WHZ less than -3 standard deviations from the median of the WHO Child Growth Standards, independent of nutritional edema (WHO 2009). It is difficult to quantify the actual number of children under 5 years of age who die each year due to AM. Deaths are often recorded as infectious diseases such as malaria, tuberculosis and pneumonia, rather than a combination of AM and infectious disease due to the infant's compromised immune system.

I use stunting, defined as height-for-age z-score (HAZ) less than -2, as an indicator of CM. Stunting is a reflection of insufficient health and/or nutritional conditions that, ultimately, resulted in a sustained failure to reach the infant's growth potential. Unlike AM, CM does not suddenly develop, but rather occurs over a period of time and is defined as a child, zero to 59 months of age, who is greater than -2 standard deviations from the median of the WHO Child Growth Standards (e.g. HAZ <-2) (WHO 2009). CM is not life threatening, but is still a significant factor that exposes vulnerable infants to preventable

life long consequences. Under-nutrition, as a whole, (limited fetal growth, CM, SAM, vitamin A and zinc deficiencies and less than ideal breastfeeding practices) accounts for nearly 3.1 million deaths worldwide each year in children under 5 years of age, translating to about 45% of all deaths in this age range of children (Black *et al* 2013).

Z-scores are commonly used in prevalence data to capture summary statistics such as mean and standard deviation. Usually, <-2 and $>+2$ z-scores are used to represent the 2.3% of a specific population that falls below and above the “normal” (~95%) range, respectively (WHO Database on child growth and malnutrition 2015).

iii. Developmental Consequences of Childhood Malnutrition

Disease and inadequate dietary intake play a vital role in early childhood malnutrition, beginning at the time of conception, with the greatest possibility of a decline in length-for-weight occurring during the first 24 months of life (Dewey & Huffman 2009; Victora *et al* 2010). It is estimated that over 200 million children under 5 years of age worldwide are not reaching their full developmental potential (Engle *et al* 2007). A child who is poorly nourished enters into a ‘vicious cycle’ where s/he becomes more susceptible to infection and disease, which can then lead to higher levels of malnourishment. Short-term effects of infection can reduce infant appetite and intestinal absorption and increase catabolism, the reallocation of nutrients toward immune response and away from growth (Brown 2003), leading to poorer psychomotor and mental development (Abubakar *et al* 2010; McDonald *et al* 2013). The Lancet on *Child Development in Developing Countries I* (2007) reports an association between reduced years of schooling and both stunting and

poverty (Grantham-McGregor 2007). Additionally, stunted children have been shown to learn less per year than those who are not stunted. Looking at studies from 51 countries, Psacharopoulos and Patrinos found that for every year of schooling, wages increased by 9.7% (Psacharopoulos and Patrinos 2004). The average deficit in annual adult income for children who are stunted, living in poverty, or both, is estimated at 219 million (19.8%) with Sub-Saharan Africa showing the greatest number of disadvantaged children (Grantham-McGregor, Cheung YB, Cueto S, *et al* 2007). See Appendix 1 for more on long-term developmental consequences.

B. Responding to Childhood Malnutrition

i. Global Funding

For many decades, nutrition has been a field that was under-utilized, under-resourced and pushed to the backburner when it came to international funding priorities. In order to put this into perspective, international funding for nutrition interventions reaches just 1.4% of the estimated need that is necessary in order to address ‘basic nutrition’ across the globe (Hobbs and Bush *et al* 2014).

‘Basic nutrition’ covers aid for direct feeding programmes (maternal feeding, breastfeeding, and weaning foods, child feeding, school feeding); determination of micronutrient deficiencies; provision of vitamin A, iodine, iron, etc.; monitoring of nutritional status; nutrition and food hygiene education; household food security. (Aid For Nutrition 2013)

Globally, rates of acute malnutrition have only been reduced by 11% over the past two and a half decades, from 58 to 52 million; however, in Sub-Saharan Africa, numbers have increased from 10 to 13 million children (UNICEF-WHO 2012; Hobbs and Bush *et al* 2014, respectively). It is estimated that 90% of children with SAM are unable to access proper treatment for their condition (Hobbs and Bush *et al* 2014).

ii. Local Interventions

Although the quality of evidence is limited, the WHO recommends that an early identification system including the measurement of MUAC and checking for any degree of bilateral edema be put in place at the community level (i.e. community health workers, members, volunteers, etc.) in order to detect AM. If the MUAC is less than 115mm or edema has been identified, immediate referral to the nearest health center for evaluation and treatment or referral to a primary health care facility is recommended. WHO strongly emphasizes that inpatient or outpatient treatment for children, ages six to 59 months, be determined by the infant's clinical condition, and not solely based on anthropometric outcomes such as MUAC and weight-for-length/height. The follow-up on infants and children with SAM is critical and should be performed after discharge from treatment in order to prevent a relapse.

In Africa, several countries (Malawi, Ghana and Zambia) have begun the implementation of community management of acute malnutrition (CMAM) programs into their under-5 health packages, with the aim to increase coverage and enhance the treatment outcomes for both MAM and SAM children (Maleta and Amadi 2014); however, a major

challenge still exists for both Ghana and Zambia, as the potential growth of the CMAM program is limited due to the lack of local production of ready-to-use therapeutic foods (RUTFs) within country and its reliance on their importation. RUTFs are lipid-based nutritional supplements containing high amounts of vitamins and minerals used to treat children who are moderately or severely malnourished. CMAM was endorsed by WHO, The World Food Program, United Nations System Standing Committee on Nutrition and UNICEF in 2007 (WHO/WFP/UNSSCN/UNICEF 2007). See Appendix 2 for more information on WHO recommendations.

C. Malnutrition in Zambia

i. Summary of the Current Situation

A landlocked state, Zambia is bordered to the north by Tanzania and the Democratic Republic of the Congo; to the east by Malawi and Mozambique; to the south by Botswana and Zimbabwe; to the southwest by Namibia; and to the west by Angola. The 2010 Zambia Population and Housing Census reported 13.1 million people, and The 2010-2014 World Bank data estimating current numbers reaching 14.5 million (World Bank 2014). The millennium development goals (MDGs) progress report in 2013 stated a growth rate that reached 2.8 percent per annum from 2000 to 2010, making it one of the fastest growing countries in Sub-Saharan Africa (MDG 2013).

Despite the increasing population, social and economic development programs have not simultaneously expanded, hindering economic growth and reducing poverty levels. In 2010, 42.3% of the Zambian population lived in extreme poverty, with about a

four times higher prevalence in rural areas than in urban (MDG1 2010). Some of the many factors that may explain the greater prevalence of extreme poverty in rural areas include limited access to physical and social infrastructures such as, roads, electricity, safe water, sanitation, latrines and medical facilities. The Living Conditions Monitoring Survey in 2010 reported that only 22% of Zambian households had electricity (Central Statistical Office of Zambia).

One of the biggest challenges children under 5 years of age in Zambia faced between 2000 and 2007 was under-nutrition, with 45.8% of the children being moderately or severely stunted (DHS 2007). Amongst the highest prevalence in the world, a 45.8% stunting rate placed Zambia eighth worldwide (UNICEF: Improving Childhood Nutrition) and above the 42% stunting average in Africa (First 1000 Most Critical Days (MCD) Program). However, the recently released Zambian DHS 2013-2014 reported a 5% decrease in overall stunting (from 45.8% to 40%), with 23% moderately stunted and 17% severely stunted; males (42% stunted) had a 4% higher prevalence of stunting than females (38%). When broken down by age groups, children aged 18 to 23 months showed the highest stunting rates at 54%, and 25% of 18-23 month olds were severely stunted. This is consistent with data from Victoria *et al* that showed, regardless of the growth curve used, rapid growth faltering was observed until 24 months of age (Victoria *et al* 2010). Mother's nutritional status also has been shown to play a key role on the development of a child. Children born to mothers with a body mass index (BMI) $<18.5 \text{ kg/m}^2$ had a 50% likelihood of being stunted whereas those who were born to overweight mothers (BMI $>25 \text{ kg/m}^2$) only had a 32% likelihood. Now nearly universal in Zambia, 98% of children born in the

last two years have been breastfed at some point, with a median breastfeeding duration of 20.1 months over the last three years (2010-2013) and exclusive breastfeeding duration of 4.1 months (DHS 2013-2014). However, when it comes to appropriate feeding practices, only 11% of six to 23 month olds are fed according to the recommended infant and young child feeding (IYCF) practices (DHS 2013-2014).

ii. Health System in Zambia

Health sector organization and coordination are key elements in reducing rural malnutrition rates. The Zambian health care system is broken down into four areas of management: national, provincial, district and community levels. The national level, managed by the Ministry of Health (MOH) with headquarters in Lusaka, takes responsibility for the overall coordination and management aspects of the health sector, i.e. tertiary hospitals, guidelines and policies, while the Ministry of Community Development, Mother and Child Health is responsible for secondary level hospitals down to the community level; provincial and district levels are responsible for coordinating health service delivery in their respective provinces or districts; and the community level serves as the link between rural health centers and upper levels of the health system (National Health and Strategic Plan 2011-2015). The national level contains level 3 tertiary hospitals, the provincial level contains level 2 general hospitals, the district level contains a level 1 hospital and the community level contains health centers and health posts. Referrals, at any of the lower levels, follow this same hierarchy.

Southern Province, Zambia, which hosts the Improving Early Childhood Development in Zambia (IECDZ) study and data collected for this thesis, has 0- Level 3 hospitals, 2- Level 2 hospitals, 14- Level 1 hospitals, 34 urban health centers, 174 rural health centers and 30 health posts with 159 of these facilities or centers publically run, 11 and 4 health centers are mission-based and private, respectively (National Health and Strategic Plan 2011-2015/ Health Institutions in Zambia, MOH, 2010).

iii. Zambian Guidelines for Malnutrition

Although many countries have specific policies, it was very difficult to find actual Zambian MOH guidelines for treatment of AM. Contact with nutritionists or Clinical Care Specialists at the national and provincial levels was made via email or telephone calls. Though specific guidelines were not found, several “strategic plans” were found: IYCF (MOH 2006), National Food and Nutrition Commission/ First 1000 MCD Program and CMAM/ IMAM. IYCF practices demonstrate positive effects of integrating community-based approaches that target improved breastfeeding and complementary feeding practices. The NFNC Strategic Plan for Zambia 2011-2015 aims to strengthen and expand interventions via multi-sector, synchronistic effort that focus on the first 1000 most critical days of infant lives, with the hope to decrease stunting rates and increase health and productivity of families in Zambia, and Zambia as a nation. CMAM relies on “strong community mobilization, outpatient supplementary feeding for patients with MAM, outpatient therapeutic care for uncomplicated cases of SAM, and inpatient care for patients with SAM with medical complications.” (WHO Management of SAM: a manual for

physicians 1999) CMAM has not officially been integrated into a Zambian policy, though it is part of the NFNC Strategic Plan for Zambia 2011-2015, as well as the District Implementation Plans.

D. Thesis hypothesis and objectives

This study is based on the hypothesis that rural Zambian health centers lack sufficient resources to address and treat malnourished children, either MAM or SAM, including staff, supplemental nutritious foods (SNF), trainings and educational materials for mothers addressing appropriate diets for their infants and measuring infant heights throughout infant development. This paper addresses gaps residing in the health care system in Zambia.

With virtually no community-based agents currently screening for AM in Zambia, a big question of concern is the health center's capacity to manage and treat AM, an essential element for child health and survival. If health centers are either under-staffed or under-trained or simply do not have the resources to treat these children, the benefits of a referral program for sick children are very limited. The second area of concern is the degree to which community-based agents educate mothers about nutritious diets for their infants and the implications of acute and chronic malnutrition.

The primary objectives of this thesis are as follows: (1) determine the types and quality of nutrition services currently provided in the five health centers and referral feeding centers in Choma and Pemba Districts; (2) estimate average daily consumption of certain food groups for infants who are six to 12 months in age; (3) assess mothers'

perceptions of their child's growth and development as compared to other children of the same age children; (4) determine the relationship between five selected health center's quality of services (measured and perceived) and parents' use of services for malnourished.

II. METHODS

Improving Early Childhood Development in Zambia

Data obtained for this thesis was constructed from the larger IECDZ study. This pilot study, funded by “Grand Challenges Canada’s Saving Brains”, aims to integrate early community childhood development support with routine health and community level care via the creation of child development agents in Southern Province, Zambia. This community-based program simultaneously addresses under-nutrition, infection and insufficient cognitive stimulation within the first two years of infant’s lives. Primary outcomes included the following: (1) prevalence of stunting (HAZ <-2) and cognitive and motor development by age two, as measured by the Intergrowth-21st century test (Fernandes et al 2014). It was hypothesized that children followed by the child development agents would have higher cognitive and motor development scores and less stunting than other children. The child development agents monitor the nutritional status and also screen the child for common infections via bi-weekly home visits. If the child shows signs or symptoms of infection or AM, they are immediately referred to the nearest health center or health post for assessment and treatment. The child development agents also track vaccinations, vitamin A supplementation, growth monitoring and deworming to ensure that the children are receiving the full health benefits offered by their local health center. A home-based stimulation component for cognitive brain development of the infant is being implemented and the final task for the child development agents is to coordinate with selected local volunteer mothers. Volunteer mothers were chosen by their

communities as women who are bilingual and literate in both English and Tonga, hardworking, motivated and who have respectable reputations in their communities. During bi-weekly home visits, child development agents coordinate with selected local volunteer mothers to discuss early childhood development games, songs, nutrition, hygiene and other hands on stimulation activities, which are then presented to the rest of mothers in the form of mothers' groups.

A. Setting

Southern Province contains 11 districts with a total population of 1.59 million (average household size is 5.4 persons) and, ethnically, is the primarily location of the Tongas. Two of the districts, Choma and Pemba Districts, are the primary locations of data collection for this thesis. Within the Choma District lies the town Choma, which is estimated to contain around 40,000 people and, as of 2012, is the new capital of Southern Province. Choma lies along the one paved road that goes from the capital of Lusaka to Livingstone in southwest Zambia.

According to the 2013-2014 DHS, the stunting, wasting and underweight (low weight-for-age) rates in Southern Province were at 37.2%, 4.2% and 13.1%, respectively (DHS 2013-2014). Micronutrient deficiencies, such as vitamin A, zinc and calcium, are common in children under 5 years of age. Low iron intake can lead to anemia and decreased cognitive function. In Zambia, biannual mass campaigns are carried out to provide mass supplementation of vitamin A for children ages six to 59 months in order to help reduce the prevalence of vitamin A deficiency (First 1000 MCD Program). At the time of the

Zambian DHS, 75.5% of children in Southern Province had consumed foods high in vitamin A in the last 24-hours and only 54% had consumed food(s) high in iron (DHS 2013-2014).

B. Sampling

In total, 11 nutritionists or rural health workers were asked to participate in the key informant interviews (KIIs). Four nutritionists were selected; two were representatives from the national level and are heavily involved in the nutrition strategy and implementation processes; one was from the provincial level; and one was from the district level. Nutritionist KIIs were selected based on their current role within the Zambian health system. In circumstances when a nutritionist was not available, a representing nutritionist was asked to participate. At rural health centers, at least one key person (trained in the treatment of acute malnutrition or the supervising nurse) from each of the five selected health centers was also asked to participate.

Baseline data were used from both intervention and control arms from the IECDZ baseline assessment, and 24-hour dietary recalls were conducted only in the intervention arm households. A total of 521 mother-child pairs were enrolled in the study, with eligible infants being age six to 12 months old at the time of enrollment.

The five health centers in Choma and Pemba Districts used for this thesis data collection were the same as those selected for the IECDZ study. At the selected health centers, rural KIIs were conducted, including health center assessment of supplies, clinics offered and recent trainings. Several criteria were considered when IECDZ determined

health center eligibility for their study: distance from a referral center, number of health zones around the health center, number of children in the health center catchment area and the number of active community health workers in the health center catchment area. Health centers could also not be currently participating in another large ongoing study.

C. Data Collection

Nutritionist and rural health worker interview consents were given ethical clearance in October 2014 by the Boston University Institutional Review Board (IRB) and the Zambian ERES Converge IRB. The submission was reviewed as an expedited application for supplemental data collection under the IECDZ study. KIIs were performed in November and December 2014. In total, four nutritionists and five rural health workers were interviewed and used in the data analysis; two in Lusaka and seven in Southern Province. Contact for nutritionist KIIs was made by email or telephone. Each interviewee was asked to participate and provide verbal consent in a structured 30-minute in-person interview that was recorded and notes were taken. Interviews for all but one person occurred within the individual's working environment. Rural health worker contact was made in-person, at the time of a routine IECDZ visit, due to unreliable telephone service and availability. All interviews were anonymous and given only an interview number; the names of the individuals, employers and affiliated health centers were not recorded. Audio notes were then recorded on an Olympus VN-6200PC. Follow-up secondary questions were only asked at the end of the structured interview to reduce any influence of his/her answer to preceding questions. Nutritionists only received the nutritionist-specific KII,

while rural health workers were given an assessment of health center supplies and services provided questionnaires, in addition to the rural health worker-specific KIIs.

24-hour food recalls were constructed using the Indicators for Assessing Infant and Young Child Feeding Practices Part 2 (WHO 2010), the IYCF Practices: Collecting and Using Data: A Step-by-Step Guide (Care 2010), and the Zambian Demographic and Health Survey (2007). The 24-hour food recall was then piloted in a local market in November 2014 with four mothers who had infants six to 15 months of age. To obtain measurements of foods or liquids, a local plastic cup was purchased for mothers to use as a reference. Where wording was incorrect or unclear, modifications were then made to the recall. Child development agents received a full-day training, using the IYCF practices (2010), on how to ask non-leading questions such as “from the time your child woke up yesterday, tell me everything s/he has had to eat starting with the first food or drink” and “what was the next thing your child had to eat or drink?” Each child development agent was given one plastic cup, identical to the one pilot tested, to use during her interviews. During a routine home visit, the child development agents would ask mothers to participate in the 24-hour food recall survey about the foods their child consumed over the previous 24 hours. All mothers/caregivers who had consented to participate in the IECDZ intervention were asked to participate and consent for this food recall. Child development agents followed prompts on the recall sheets for asking questions and recording the data on time, place, food or drink, ingredients and amount. Responses to 24-hour food recalls were recorded and written on the form in English.

In addition to the KIIs and the 24-hour food recalls, six questions were incorporated into the IECDZ baseline assessment survey. These questions were added with the intention of obtaining mothers' perceptions of their child's growth and development as compared to other children of the same age. Furthermore, we wanted to determine the percentage of children who had ever had their height measured either at a health center or in the community and, as well as, the overall satisfaction of mothers towards nutrition services and information provided by their local health center.

D. Analysis

First, for the nutritionist and rural health worker portion of the study, the response frequencies for all KII questions were calculated separately for nutritionists and rural health workers. Some questions were constructed with a choice of categorical responses and others were open-ended. In the case of open-ended questions, responses were categorized based on the actual responses. For example, the participants were asked about their most recent training in the treatment of AM. Responses were grouped as follows: (1) zero to two years, (2) three to five years ago, (3) six to eight years ago, (4) nine or more years ago.

All KIIs were transcribed and transferred into NVivo software for Mac for consolidation, which allowed common themes to be identified.

Themes for nutritionist interviews were his/her awareness of current guidelines for treatment of acute malnutrition, when and how associated trainings are performed, and current supply chain operations for procurement and transportation of RUTFs in Zambia. Themes for rural health workers were awareness of current guidelines and treatment of

acute malnutrition, when his/her last training was for treatment of acute malnutrition, advice and services provided by health centers, and procedures on ordering RUTFs. Sections of the KIIs that were open-ended were categorized and calculated as frequencies per category.

The health center assessments of supplies were obtained after the health worker KIIs, where the respondent was asked about adequacy of certain supplies. Items stated as currently available and/or functional were physically verified. All supplies had to be available and functional at the time of audit. Devices available for assessing nutritional status of children were asked as close-ended questions, and then summed and calculated as frequencies of specific anthropometric tools available. Assessment for current stock of supplemental food and vitamins were asked as closed ended questions; however, if the health center did not have it currently in stock, the number of times the health center has been out of stock were asked as a free-response, and then categorized and calculated as frequencies.

The 24-hour recall data were broken down into two parts: I) mothers' responses to questions regarding breastfeeding behavior during the previous day and II) mother-reported number of times her child had a particular food or drink during the previous day. In total, 215 recalls were used for the breastfeeding data and 213 recalls were used for daily food consumption data. These data were entered into Access and then exported into Excel. Frequencies for part I were collated and then used to calculate the average number of breastfeeding times during daylight hours (sunrise to sunset) and during night hours (sunset to sunrise) across the interviewed group of mothers. Frequencies for part II were also

totaled and used to compute two new sets of data: 1) the average frequency intake of daily protein, carbohydrates and fruits during the previous day and 2) the percentage of children who received at least one sub-component (food or drink) from each food group and, more specifically, the percentage of children who received at least one source of each food/drink during the previous day.

Summing the intake frequencies of all sub-components for each food group and dividing these sums by the total number of children participating in the recall equated to the average daily intakes for each food group. The food groups were as follows:

1. Protein: Chicken, beef, beans, pounded/grounded nuts, eggs, *kapenta* and milk (not including breast milk)
2. Carbohydrates (all maize-containing foods): *Nshima*, porridge, *chibwantu*, *mukoyo* and sweet beer
3. Fruit: Bananas and mangos

Additionally, the percentage of children who received at least one sub-component from each food group was found by totaling the number of children who consumed at least one sub-component from each food group and dividing this total by the number of children participating in the recall. Each food group was broken down into various subcomponents and the percentage of children who consumed at least one source of each subcomponent was calculated in a similar manner.

The last key components of this study was to evaluate mothers' perceptions of their child's growth and development as compared to other children of the same age and sex. In total, 521 baseline forms were collected and included in the analysis. The categorical data

that was collected was exported into Excel, where for each question, the numbers for each response option were tallied and then calculated as a percentage.

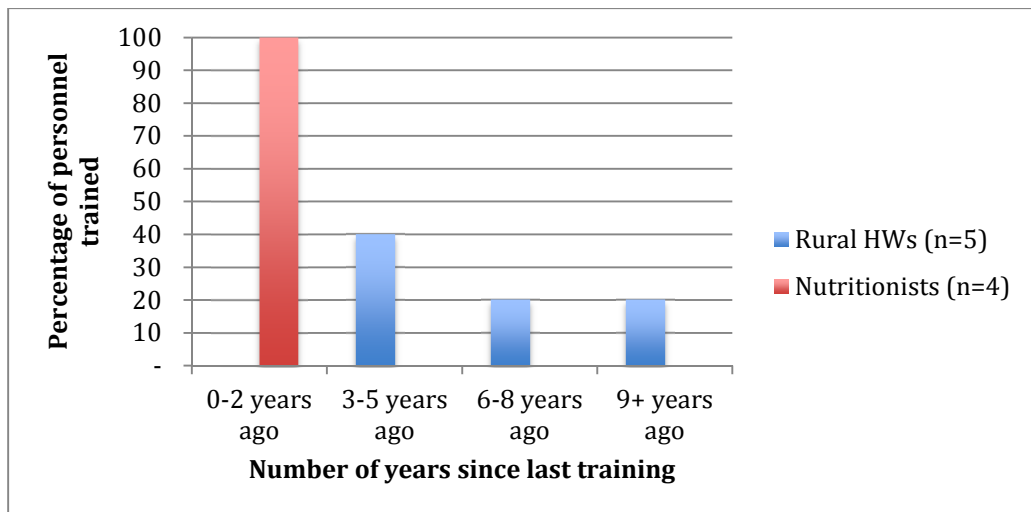
III. RESULTS

A. Key Informant Interviews: Training and Service Delivery

i. Staff training

Figure 3 presents results on the most recent training for AM that the interviewed nutritionists and rural health workers in Southern, Province, Zambia could recall. All four nutritionists interviewed had training in treatment of AM within the last two years; a majority of trainings occurred in 2012. None of the rural health workers had training in the last two years, 40% had training in the last three to five years, 20% in the last six to eight years and 40% have not had a training in over nine years. Although many rural health workers had not had a recent training in the treatment of AM, 80% were knowledgeable on current IYCF practices.

Figure 3: Most recent training for treatment of acute malnutrition among nutritionists and rural health workers in Southern Province, Zambia



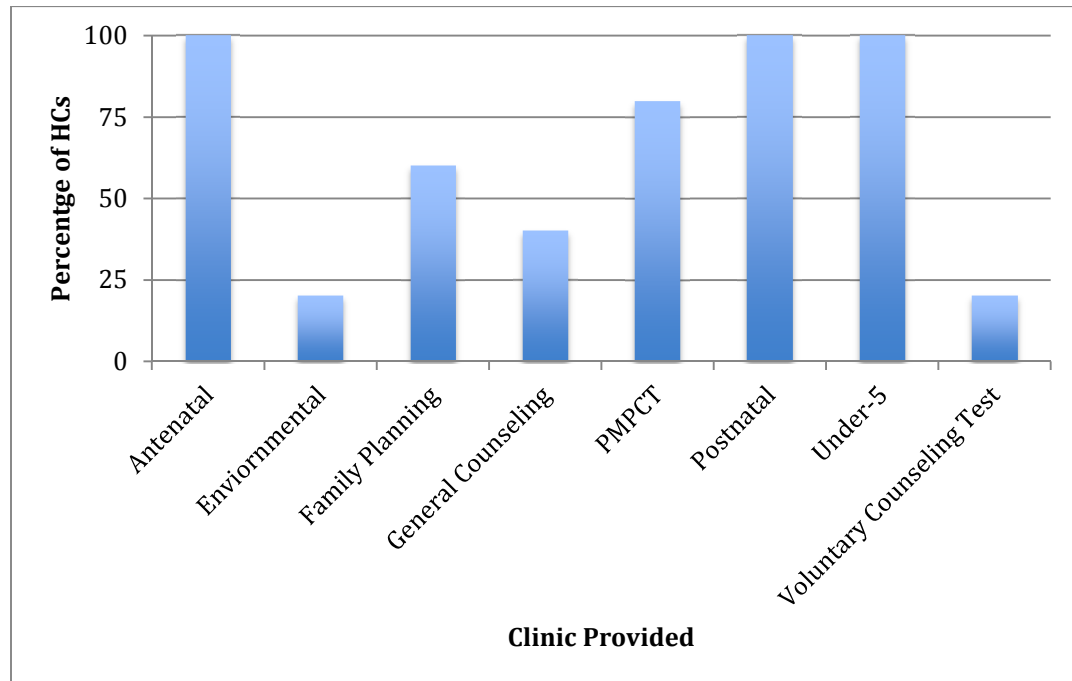
ii. Services provided

Figure 4 presents results on the percentage of specific specialty clinics provided at the selected health centers. All (100%) health centers provided an antenatal clinic, under-5 clinic and a postnatal clinic; 80% provided a prevention of mother to child transmission of HIV clinic (PMTCT); 60% provided family planning; 40% provided a general counseling clinic; and 20% offered an environmental* and voluntary (HIV) counseling and testing clinic.

Each health center visited their respected outreach communities two times per month for each outreach performed, weather permitting. Although 100% of health centers offered a postnatal clinic, only 40% provided this service during community outreach. The voluntary counseling clinic was only offered at the health center, and environmental clinic, only at community outreaches. Only one health center had any capability to measure height in children at either their health center or at community outreaches. In the last month, 60% of the health centers reported to have treated a child for AM (15 cases total), while only two cases of SAM were reported by health centers.

* Environmental clinics, provided by Environmental Health Technicians, consisted of a variety of topics: organizing community meetings about diseases (e.g., diarrhea, malaria, measles) with a heavy disease burden; preparing the community for Ebola; general health issues; community educational meetings for incoming research projects and teams; and meetings with traditional leadership.

Figure 4: Percentage of various clinics provided by type at selected health centers in Southern Province, Zambia (n=5)

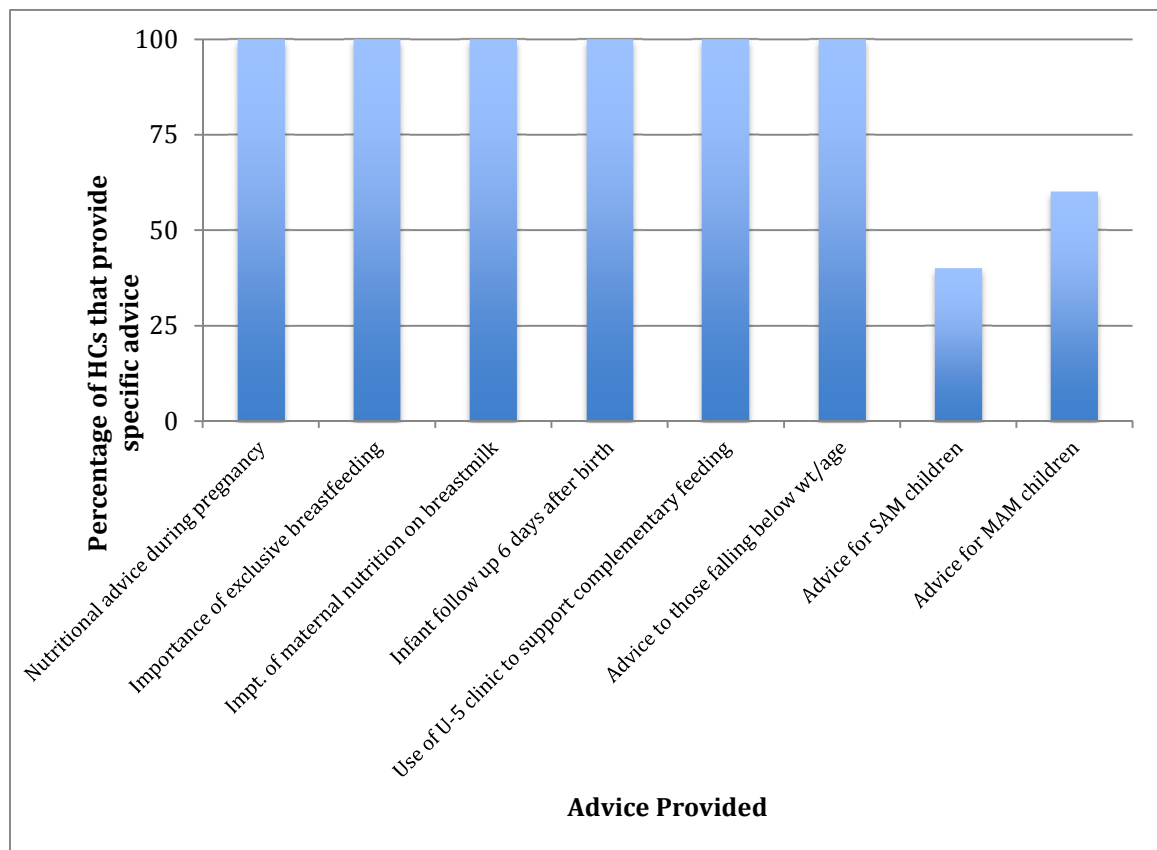


iii. Nutrition-Related Advice

Figure 5 presents results on nutrition-related advice that rural health workers were able to provide to mothers at both health center visits and community outreach clinics. The advice health workers provided to their service population was fairly consistent: 100% of the health centers reported providing nutritional advice (locally available nutritious foods) during pregnancy, the importance of exclusive breastfeeding through six months of age, the importance of maternal nutrition while breastfeeding, complementary feeding advice during under-5 clinics and advice to mothers of children with a low weight for age z-score (within -2 standard deviations). Only 60% provided advice to mothers whose child was

moderately malnourished and 40% provided advice to mothers whose child was severely malnourished (greater than -2).

Figure 5: Nutrition related advice provided to mothers among five health centers in rural Zambia (n=5)

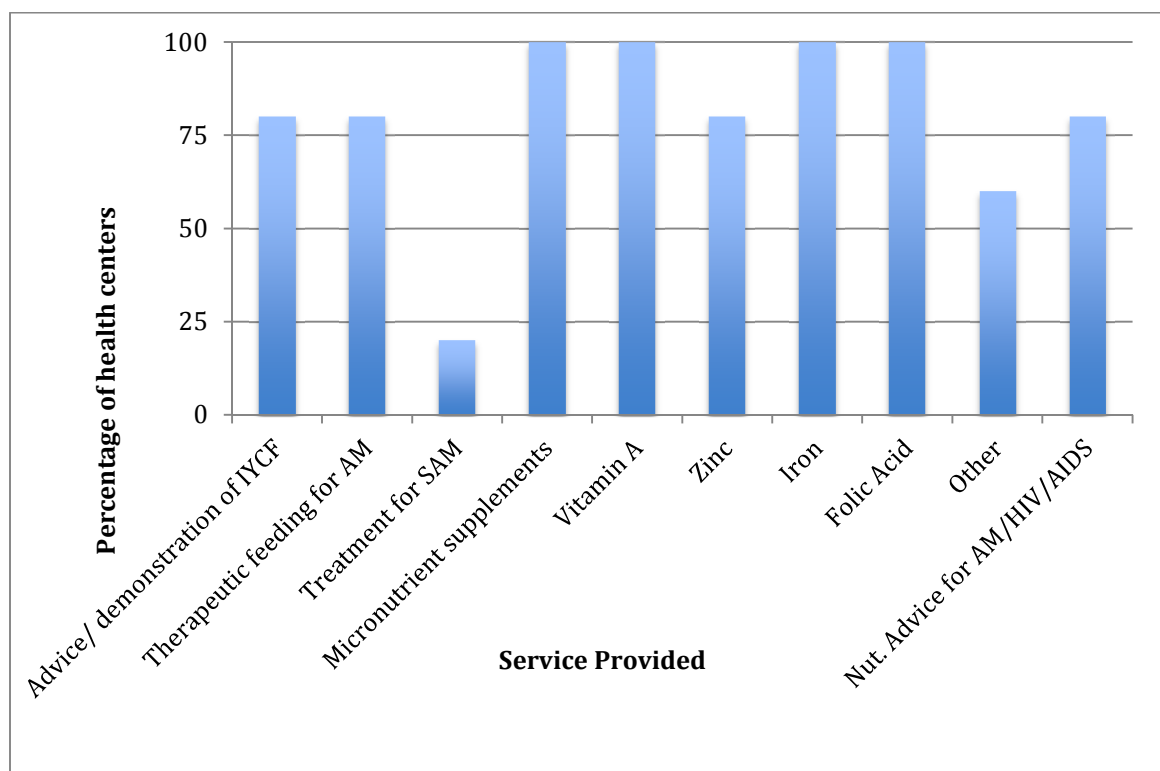


iv. Services at Under-5 Clinic

Figure 6 shows the percentage of health centers that provided a specific service during an under-5 clinic: 100% provided micronutrient supplementation, vitamin A, iron and folic acid; 80% provided advice or demonstrations of IYCF practices, therapeutic feeding for AM, and nutritional advice to mothers of an acutely malnourished child with

HIV/AIDS; only 20% provided treatment for SAM; other advice for treatment or prevention of AM given by health centers included deworming and high energy protein supplements.

Figure 6: Percentage of services provided at an under-5 clinic within the last 30 days of selected health centers in Zambia (n = 5)



During under-5 clinics, health workers usually give a talk on various topics to the women who attend clinic that day. All health centers provided routine talks on proper breastfeeding techniques, frequency of breastfeeding, when to stop breastfeeding, when to incorporate food into the child’s diet, the type of foods to incorporate, quantities of food per day, frequency with which to feed solid foods and nutritious foods (in addition to

breastfeeding) for infants at various ages. Only 20% of the health centers were able to currently provide some sort of cooking demonstration on how to properly prepare foods at their health center or during an outreach.

Resources among the five health centers interviewed were scarce. Health centers all reported to have at least one functioning scale (hanging or floor), though calibration had never been performed. None of the health centers had MUAC strips readily available at the time of the interview due to misplacements, rips, or loss while out in the field for outreach clinics. Screening for AM is not specifically done during clinics unless a child presents with symptoms that lead to a screening for AM, such as lighter brown colored hair, glossy eyes or discoloration of the nail beds. None of the health centers had RUTF or other SNFs in stock, nor did any facility have an inpatient department for in-house monitoring of severely or moderately malnourished children. Several health centers did have an outpatient system, though many health workers interviewed stated that follow-up and monitoring of children is very difficult due to the distances mothers or caregivers have to travel from their home to the health centers.

B. Key Informant Interviews: Qualitative Summary

The KIIs were summarized to identify important themes related to the adequacy of treatment for acute malnutrition. Outcomes identified from the KIIs were as follows: reasons why many rural health workers felt they could not participate in current trainings and why they lacked information on treatment of malnourished children, challenges faced by the district in monitoring rural health workers, and other hindrances for reducing AM

more drastically. There were several recurring responses as to why many rural health workers did not attend district or provincial trainings, including the distance and travel cost, in addition to the loss of work at the health center during that time away due to insufficient staff to provide back-up coverage. A response from a rural health worker during a KII is stated below in response to why s/he has not attended training in recent years:

...ah, but it's far, much too far [the distance to travel for a training] and very expensive.

- Rural health worker #2

Statements below relay the challenges of monitoring rural health workers from the district level due to the constant shifting of nurses from one health center to another, and a huge need for more specialized and trained personnel in treatment of AM:

So we've got a challenge of coordination....the biggest work force that we have are nurses, and the nurses are rarely in one place for more than one year...

...we have very few nutritionists in the country and most facilities don't have nutritionists and I will tell you, we've got ...over 260 health facilities [in the province] and only 18 nutritionists.

-Nutritionist #12

Rural health workers and nutritionists indicated that the lack of availability or consistency of SNF was a problem. All SNF are currently imported rather than produced in-country, leading to frequent supply shortages. Zambia currently relies on a “push” system for all SNFs. A push system is one that, regardless of the current need or overstock at the district level, will send shipments when the supplier has sufficient quantities to send; unlike a “pull” system which is based on actual demand or current stock levels at the districts.

[A] Push system makes planning for shipments difficult and unpredictable. During the rainy season, many health centers do not receive any shipments because of the impassible road conditions. Only seven functional trucks that have to deliver all drug and SNF to health centers in the Province...- sometimes the food comes in such huge quantities you don't know what to do with it; one minute it's dry completely for long spells and children don't have food.

- Nutritionist #12

It's quite a challenge. Children are malnourished, moderately, you tell them about what to feed the child, then they tell you that they don't have that and you can't provide [SNFs] for them. That one is a challenge.

- Rural health worker #4

The MOH relies on Medical Stores Limited, as the national medical store, to manage, store and distribute drugs throughout Zambia. Although SNFs were not previously being delivered through the same system, the MOH has now included all SNFs to be managed, stored and delivered through Medical Stores Limited in the same manner as current drug distributions. These recent changes began early in 2014, in which the SNFs are still finding their place in the system with the same priority as drugs:

...the Medical Stores [Limited] is always moving medical supplies into the provinces, but sometimes....they feel these (SNFs) are too bulky, they...give them last priority.

– Nutritionist #1

In summary, there are several factors that come into play as to why rural health workers do not participate in, and are not up to date on, current trainings for the treatment of AM. At the district level, consistent monitoring and mentoring of rural health workers remains a challenge as nurses are constantly being relocated to other health centers around the country. Lastly, SNFs are still finding their place in the Medical Stores Limited system of being monitored, stored and distributed with the same priority as other drugs throughout the country.

C. 24-hour Food Recalls

24-hour food recalls were only collected from the IECDZ intervention group due to the time period that recalls were collected. In total, 215 surveys were collected on infants six to 12 months old. Tables 1 and 2 display part I of the 24 hour recall regarding mothers' responses to questions about breast-feeding behaviors. Table 1 shows the frequency of breast-feeding during the daytime (sunrise to sunset) and Table 2 shows the frequency of breast-feeding at night (sunset to sunrise). Of children currently breast-feeding, very few children (2.8%) were only breastfed three times per day or less during daylight hours. A majority (84.2%) were breastfed four to nine times. Table 1 During night hours (sunset to sunrise), most mothers (78.6%) breastfed their children three to six times. Table 2

Table 1: Number of times current breastfeeding infants were breastfed from sunrise to sunset (n=215)

Number of Times	Number of Responses	Percent
3 or less	6	2.8%
4 to 6	113	52.6%
7 to 9	62	31.6%
10+	31	11.6%
Did not know	3	1.4%
Total	215	100%

Table 2: Number of times current breastfeeding infants were breastfed from sunset to sunrise (=215)

Number of Times	Number of Responses	Percent
2 or less	17	7.9%
3 to 6	169	78.6%
7+	25	11.6%
Did not know	4	1.9%
Total	215	100%

In addition to questions regarding breast-feeding behavior, mothers were also asked to recollect their child’s intake of foods and liquids, other than breast milk. Only 213 mothers, out of the 215 that participated in part I of the recall, participated in part II of the 24-hour food recall. Table 3 represents an overview of the number of children who consumed a protein, carbohydrate or fruit-based meal the previous day from sunrise to sunset. In total, 111 (52.1%) children consumed at least one protein source, 210 (98.6%) consumed at least one carbohydrate source and 19 (8.9%) consumed at least one fruit source the previous day (sunrise to sunset).

Table 3: Number of children who consumed a protein, carbohydrate or fruit source at least once, from sunrise to sunset (n=213)

Food Group	# of children who consumed one serving of: (n=213)	Percentage who receive one serving of:
Protein	111	52.1%
Carbohydrates	210	98.6%
Fruit	19	8.9%

Table 4 provides a detailed description of the foods and drinks within each food group category. Protein-based sources included *kapenta (dried fish)*, chicken, beef, beans, pounded/ ground nuts (P/GNs) milk and eggs. Of the proteins, 49 children (19.2%) consumed milk, 29 consumed P/GNs (13.6%) and 28 consumed beans (13.1%), and chicken and beef consumed by the least amount of children (1.9%). Carbohydrate-based sources included porridge, *nshima* (maize grain and water), *sweet beer* (maize-based drink with local plant roots), *chibwantu* (maize-based drink), and *mukoyo* (drinks made with bark of a baobab tree). 197 children (92.5%) consumed *nshima*, 169 children (79.3%) consumed porridge and 126 consumed *chibwantu* (59.2%). Fruit consumption consisted of bananas and mangos; 16 children (7.5%) consumed bananas and 4 consumed mangos (1.9%).

Table 4: Number of children who consumed a specific food or drink, at least once, from sunrise to sunset (n=213)

Food Group	Food or drink	# of children who consumed at least one serving of: (n=213)	Percentage who receive one serving of:
Protein	Kapenta	26	12.2%
	Chicken	4	1.9%
	Beef	4	1.9%
	Beans	28	13.1%
	P/GN	29	13.6%
	Milk	41	19.2%
	Eggs	8	3.8%
Carbs	Porridge	169	79.3%
	Nshima	197	92.5%
	Sweet Beer	5	2.3%
	Chibwantu	126	59.2%
	Mukoyo	5	2.3%
Fruit	Bananas	16	7.5%
	Mango	4	1.9%

Table 5 represents the average number of instances when a food group source was fed to a child per day. A protein source, on average was fed less than one time (0.75) per child per day, a carbohydrate source was fed on average 3.24 times per child per day and a fruit source was fed on average 0.09 per child per day.

Table 5: Average number of instances a food group was fed to a child per day (n= 213)

	Average # of instances when food group source was fed to child/day
Protein	0.75
Carbohydrates	3.24
Fruits	0.09

D. Parent Experiences with Childhood Malnutrition

Table 6 represents the results of questions added to the IECDZ baseline assessment survey to capture data regarding mothers' perceptions of their child's development and the nutritional services offered by their local health center. In total, 521 surveys were analyzed. The average age of the mother or caregiver at time of survey was 27.2 years, 117 (22.5%) were first time mothers. The average age of children enrolled into the IECDZ study was 8.6 months (boys on average were 8.7 months and females were on average 8.6 months); 247 (47.4%) were females, 267 (51.3%) were males, and 7 entries were left blank (1.3%).

When asked if mothers thought their children were the same as, taller, shorter or didn't know compared to other children of the same age and sex, 37.6% reported that they

were taller and 37.6% reported that they were the same height (n=518). In response to how mothers thought their children learned –same speed as, quicker, slower, didn't know- 52.4% reported that their child learned quicker than others (n=519). When asked if their child had ever had their height measured, 96.7% reported that their child's height had never been measured at a health center (n=516), and 92.3% reported it had never been measured in the community (n=517). A majority (89.4%) reported to have received nutritious food advice in addition to breast milk at a health center (n=502). Mothers (73.0%) were either mostly satisfied or very satisfied with the nutritional support provided to them at their local health center (n=519). Table 6

Table 6: Mothers' views on their child's development and the nutrition services offered by their local health center

Mother's response to question:	# of Responses	Percent
How do you perceive your child's height vs. others his/her age/sex?		
Same	195	37.6%
Taller height	195	37.6%
Shorter	86	16.6%
Don't know	42	8.1%
Total	518*	100%
How do you perceive your child's learning capabilities vs. others his/her age/sex?		
Same learning speed	116	22.4%
Quicker	272	52.4%
Slower	94	18.1%
Don't know	37	7.1%
Total	519*	100%
Has your child's height ever been measured at a health center?		
Never measured at health center	499	96.7%
Measured at health center	4	0.8%
Don't know	13	2.5%
Total	516*	100%
Has your child's height ever been measured during community outreaches?		
Never measured in community	477	92.3%
Measured in community	33	6.4%
Don't know	7	1.4%
Total	517*	100%
Have you received advice on what to feed your child in addition to breastmilk from the health center?		
Yes	449	89.4%
No	53	10.6%
Don't know	0	0.0%
Total	502*	100%
How satisfied are you with the nutritional support that you have received from the health center?		
Very dissatisfied	70	13.5%
Somewhat dissatisfied	10	1.9%
Neither	17	3.3%
Mostly Satisfied	82	15.8%
Very Satisfied	297	57.2%
Don't know	1	0.2%
Refused	42	8.1%
Total	519*	100%

* The total number of responses per question varied as not all mothers answered each question. The total number of surveys collected was 521; missing responses were not used in the calculations.

IV. DISCUSSION

A. Key Findings

In this paper, I identified three important gaps that hinder the reduction of malnutrition in children in Southern Province, Zambia: 1) health centers had limited capacity to address AM; 2) sources high in protein were only consumed, on average, less than one time (0.75) per child per day, and fruit consumption was very low; and 3) despite high rates of stunting, most mothers feel that their child is normal height, or taller than normal, and most are satisfied with the existing nutrition services.

Rural health centers in Zambia were generally lacking in training, staffing, and other material resources for treating and managing AM. Under half (40%) of the rural health workers interviewed had completed a refresher/ training course in the last three to five years for the treatment of acute malnutrition. In contrast, at the upper levels of the Zambian health care system, 100% of nutritionists had completed a related refresher/training course within the past two years.

Several factors were identified that may explain why rural health workers do not have sufficient numbers of training opportunities: travel distances from rural health centers to district or provincial locations, the cost of travel, absence from the health center, limited numbers of personnel to provide trainings, and a small proportion of literate rural health center staff who can read and understand materials brought back by supervising personnel. In addition, there are only 18 nutritionists in Southern Province, for about 260 health centers, making it extremely difficult to satisfy all health center needs with sufficient support. While some health centers are stable enough to operate while the supervising nurse

is away, other health centers barely get by on a day-to-day basis. Such centers may use support from environmental health technicians, and even security guards from the community or from the health center itself, to help with clinics. The movement of nurses and other health center staff from one health center to another makes trainings and district monitoring extremely difficult, as it is not uncommon for nurses to spend only a year or two at a health center and then be transferred to another. Not only does shifting nurses around become difficult for district support to monitor rural nurses, but it also is then a challenge for nurses to monitor moderately or severely malnourished children in the communities. As a result, some children are unfortunately lost to follow up.

When new guidelines are adopted into the healthcare system, but rural health workers are unable to attend the dissemination meeting, written guidelines are distributed to the supervising personnel of each health center in order to allow the standards to be translated to other staff members and volunteers at their health centers without interrupting normal daily services. In order to ensure standardized care throughout the country via proper dissemination of these new guidelines, a biannual performance assessment test is run at each health center. Performance assessment tests are generic tests containing any technical aspect of health care that the MOH may want to monitor. See Appendix 3 for more on performance assessment tests.

With Zambia having one of the highest burdens of stunting in the world, the MOH, along with other external organizations, have established programs to reduce the prevalence of stunting. However, there has not been an efficient system for transferring these guidelines into actual policies that can then be implemented in rural communities.

Although recent efforts have given more attention to nutrition and solidifying guidelines, once finalized, dissemination of new guidelines into rural health centers can take a year or more to be completely dispersed. See appendix 2 for more on current guideline to policy actions in Zambia.

The infrastructure for which SNF travels from suppliers to rural health centers is not consistent, and therefore, drastically affects the day-to-day survival of rurally malnourished children. At the time of the health center supply assessment, none of the five health centers had any SNF and stock had been out anywhere from two weeks to several months. Because the system is a push system, shipments come in at irregular intervals, making it hard for health centers to have a constant supply of SNFs. See Appendix 3 for more on supply chain. During many parts of the year, hard-to-reach health centers will not receive shipments for many months, as vehicles will not be able to travel the impassible roads during rainy season. Southern Province has just seven functional and operating trucks that are now responsible for delivering all drug and SNF to every health center in the Province. The unfortunate result is that SNFs are frequently left at the provincial or district levels due to the Medical Stores Limited higher priority to deliver drugs.

The second key finding of this thesis focuses on the 24-hour food recalls; 97.7% reported to be currently breast-feeding their infant, which is above the reported 92% stated in the recent 2013-2014 Zambian DHS (DHS 2013-2014). Of those 97.7% of mothers who breastfed, 84.2% reported breastfeeding four to nine times a day and 78.6% reported breastfeeding their infant three to six times at night, from sunset to sunrise. Just over 11% reported to have breastfed 10 or more times during the day and seven or more times during

the night. These unusually high numbers of feeding could be due to improper attachment to the breast, as well as the incomplete consumption of the breast milk in one setting, which then require additional feedings. High rates of breastfeeding practices obtained from this recall indicate effective dissemination of IYCF practices, and reach current targeted recommendations from the WHO (WHO 2015).

The average number of times a protein source was consumed was only 0.75 times per child per day and only 111 out of 213 (52.1%) children consumed a protein source; milk, *pounded/groundnuts* (peanuts), beans and *kapenta* were consumed by the most number of children. It is a bit alarming that as most rural areas have plentiful access to *groundnuts*, eggs and/or beans, the amounts consumed are extremely low for the developing infants. When mothers were asked why *groundnuts*, eggs or beans are not consumed more, they simply stated that they did not know how to prepare them. It is a key component for rural health centers to have the resources to adequately educate their communities not only regarding individual health, but nutrition and health for the developing infants.

When it came to consumption of a carbohydrate source, *nshima* was consumed on average, 3.24 times per child per day, and 210 out of 213 (98.6%) children consumed a carbohydrate source; the greatest number of children consumed *nshima*, *porridge* and *chibwantu*. The average consumption of a carbohydrate source was more than triple that of protein source for children. Although the maize can come with the shell intact, the primary Zambian maize consumed is finely ground without the shell. This highly processed maize has virtually no protein left and makes it that much more difficult for infants to consume

the needed amounts of protein by maize grains alone. Maize with the shell is often less expensive than the finely ground maize, though due to preference of texture, Zambians are willing to pay a little more for less protein.

Surprisingly, fruit was consumed very minimally, even though several local fruits were in season. Only bananas and mangos were reported on the recall, with bananas being consumed by 16 children and mangos by 4 children. The average number of instances a fruit source was consumed per child per day was 0.09 times. It is crucial that health workers be more vocal when it comes to promoting the consumption of fruits for the developing infant as vitamin and mineral deficiencies are not uncommon in Zambia, specifically vitamin A, iron, and zinc. Victora *et al* (2008) showed that under-nutrition, via height-for-weight measurements at 24 months, best-predicted -and linked- lower human capital. Vitamin A deficiency can lead to eye damage and a reduced immune system to fight disease and increase the severity of infections. A nutrition intervention in Guatemala showed that children who were exposed to nutrition supplementation -versus a lower nutrition supplementation- up to three years of age had higher economic wages as men, revealing the benefits of investing in early childhood nutrition (Hoddinott *et al* 2008). See Appendix 2 for current recommendations for breastfeeding or cooking demonstrations in Zambia.

The third key finding was that efforts to identify stunted children should be increased, as 40% of children under 5 years of age are still stunted in Zambia. Nearly all (96%) mothers reported that their child's height had never been measured at a health center, and 92% reported never having had their child's height measured in the community. When asked how people of the community perceive, if at all, stunting, rural health workers

consistently stated that ‘because the mother and father are short, it is okay for the child to be short, too.’ In Kenya, a study found that women perceive under-nutrition to be due to factors such as the ‘evil eye’ and witchcraft, or a child’s proneness to a specific body type (Abubaker *et al* 2013). Another intriguing response from health workers was that as long as the child looks healthy, it is okay that a child is not as tall as other children; that as long as they look healthy, other immediate life-threatening issues take priority. Primary resources for health worker staff consist of scales and under-5 cards that are used to track weight and growth. A concern for using these cards is that they do not measure height, and therefore, do not calculate height-for-age or notify health worker staff if a child is falling below height-for-age.

B. Limitations

A major limitation to this study work was the lack of access to the MOH policy guidelines for treatment of AM. Though several strategic guidelines for Zambia were found, implementation of each strategic guideline was not consistent between districts as some districts and rural health centers did not have all current strategic guidelines at the time of the KIIs. Another key limitation to the data collected was the number of KIIs performed for both nutritionists and rural health workers. Limitations regarding nutritionist interviews were the small number available, busy schedules and proximity between the district, provincial and national offices. The limitation of rural health worker interviews were that they could only be performed at IECDZ selected health centers, which greatly limited the areas and amounts of KIIs that could be performed. A third limitation of this

study is that the 24-hour food recall, which was created for this thesis study, is subject to random error as a result of different child development agents performing the in-person interviews and possible language and cultural barriers. Additionally, 24-hour recalls were only collected once, during the dry season, in which food was very insecure due to delayed rains for maize planting. To get a better assessment of the foods consumed throughout the year, several recalls should be assessed throughout the various seasons.

C. Policy Recommendations

Moving forward, a more transparent system that targets all four levels of the healthcare system equivalently should be implemented in order to maximize the reduction of acute malnutrition in children under 5 years of age. Second, efforts to incorporate shipments of SNFs and RUTFs to rural health centers on a regular basis (rather than secondary to drug deliveries) should be initiated. Third, more education should be provided during under-5 clinics related to the implications of stunting on long-term growth and developmental potential of children. Finally, as refined maize grain is the staple food of the Zambian households, other ways of incorporating more protein into the maize grain would allow for the increased consumption of daily protein not only for infants, but for the population as a whole.

D. Overall Conclusions

Results from this study reveal the need for improvement in several key areas to progress infant malnutrition rates, both acute and chronic malnutrition. Current guidelines

and strategic plans are not equally distributed and disseminated to all health centers in Zambia, and as a result, many rural health centers are not up-to-date on current policies, trainings and resources. Zambia has recently increased awareness and efforts to improve child nutrition by acknowledging the need to transition current nutrition guidelines and strategies into actual policies. Follow through with this [statement from the recent SUN seminar held in Lusaka] is going to be a key element in increasing and standardizing formal malnutrition care and practice across the country. In addition to formalizing policies and increasing dissemination techniques, protein consumption in infants six to 12 months was extremely low. Dietary diversity and adequate protein intakes are crucial to the developing infant and efforts should target increased awareness during under-5 clinics and community outreaches, including cooking demonstrations, classes and nutrition clinics.

APPENDIX 1

Long-term consequences of chronic malnutrition

Long-term effects for children who are stunted before the age of 24 months have a decreased adult height, academic achievement, adult income, offspring birth weight, and increased risk of chronic diseases in those children who later had excessive weight gain. Interestingly, study children had similar lengths at birth but then some quickly faltered up to 24 months of age with slight increases after 24 months, showing just how pronounced and detrimental early childhood stunting is (Victora *et al* 2010).

A recent publication in the American Journal of Clinical Nutrition set out to examine child growth from birth into adulthood to see if a “catch-up growth” in infants is possible after the first two to five years of life (Lundeen *et al* 2014). Lundeen *et al* compared HAZs and difference height for 5287 individuals from birth cohorts in five middle-income countries, and compared them to the WHO reference median at birth, 12 months, 24 months, mid-childhood, and adulthood. Initial results were consistent with previous studies as a majority of the height deficits still accrued by 24 months, 59% in the Philippines and 90% South Africa, reinforcing the importance of the first 1000 most critical days on long-term human capital (Lundeen *et al* 2014). Although there were increases in mean HAZ after 24 months, results may be due to the method in which z scores were calculated and not necessarily the reflection of a true ‘catch-up’ in height. This is consistent with other arguments by Leroy *et al* in that HAZ can simultaneously increase as “accumulation of height deficits further”, relative to the reference medians (Leroy *et al* 2013).

Although there is supporting evidence from nutrition interventions globally, (Buzra et al 2015, Taneja 2012, Aguayo 2013 and 2014) concerns still remain regarding sustainability and feasibility when community-based child nutrition programs end. In Bihar, one of the first CMAM programs in India, found that by lowering admission criteria for children –therefore including more children who are at a lower risk of death- they could attain a lower mortality rate while also increasing cure rates. In addition to the mentioned factors that can increase sustainability, increased supervision and monitoring, as well as internal technical support would need to be achieved as all three countries currently rely on external technical support. Additionally, sustainability concerns focus on the capability of the government -or a non-externally supported program- to efficiently implement the program, as well as to improve the condition of health facilities.

APPENDIX 2

WHO Recommendations

Although quality evidence is low, the WHO recommends that an early identification system be in place for measuring AM, beginning at the community level i.e. community health workers, members and volunteers etc., including measuring MUAC and checking for any degree of bilateral edema. At primary health care facilities and hospitals for children six to 59 months, WHO strongly recommends that health workers measure the MUAC and weight-for-length/height. Those who show a MUAC less than 115mm and/or have weight-for-length/height less than -3 Z-score of the WHO growth standards should be admitted immediately for treatment of SAM. While children who are severely malnourished have deficiencies of potassium and magnesium, which can take about two weeks to get back up to normal levels, children with edema additionally have a higher than normal retention of sodium (WHO Pocketbook 2013). Additionally, monitoring sodium consumption for a SAM child is extremely important and vital to the life of the child as excessive levels can be fatal.

WHO strongly recommends that inpatient or outpatient treatment for children six to 59 months be determined by the infant's clinical condition and not solely based on anthropometric outcomes such as MUAC and weight-for-length/height. Those who are admitted to the hospital for SAM can be admitted to outpatient care when "medical complications, including edema, are resolving and they have good appetite and are clinically well and alert". (WHO Pocketbook 2013) Follow-up of infants and children with

SAM is critical and should be performed after discharge from treatment to prevent a relapse.

Inpatient treatment for a severely malnourished child older than six months at a primary care facility or feeding center is a two phase process that begins with stabilization of the infant on a high carbohydrate, low protein, low fats and sodium milk-based F-75 drink. The amount is determined based on the child's nutritional status and usually lasts around two days. In the second nutritional recovery phase, a high protein and energy F-100 milk-based drink will be given to the infant as a transitional food, allowing the infant to rebuild lost muscle. F-100 can be used as both inpatient and outpatient treatment until a normal nutritional status has been reached, lasting on average three to four weeks (WHO-5 community based management of SAM). Unlike F-75 and F-100 which are reconstituted with 500 mL of drinking water, RUTFs do not require any reconstitution or direct supervision from a medical personnel and can be given under the mother or caregiver's supervision at the infant's home. Treatment with RUTF usually lasts around six to eight weeks. Additionally, because RUTFs are not water based, bacteria will not grow in them and they do not require refrigeration, allowing for use in more rural areas (WHO-5 community based management of SAM).

In Zambia, the NFNC Strategic Plan 2011-2015 (NFNC 2011), First 1000 MCD Program 2013-2015 (NFNC 2013), and the National Health and Strategic Plan 2011-2015 (MOH 2011) recommend and promote breastfeeding exclusively up to six months of age, with incorporation of complementary foods thereafter, and ceasing breast milk at two years of age.

Rural health centers in Zambia used to be sponsored by the government or outside organization to perform cooking demonstrations and nutrition classes for mothers, but as most rural health workers reported, the funding or resources have not been replenished in many years for those to still occur. One health center even reported that they use to have special cooking demonstrations for MAM and SAM children in addition to the regular cooking demonstrations.

Recently, at the Global Nutrition Report held in Lusaka on the 26th of February 2015, round table discussions recognized the necessity to translate guidelines into policy, guiding the private sector towards good nutrition practices and the opportunities for the NFNC to produce more professionally trained nutritionists to be more readily available at service delivery points (SUN).

APPENDIX 3

Supply Chain in Zambia

In the past, district representatives had to travel to the national level to collect their SNFs; however, current efforts have switched to operate off of a push system in which the Medical Stores Limited will receive a consolidated list from the MOH and can then allocate the commodities as they were requested. Orders for SNF are made by the health center to district medical offices where the district then compiles all numbers from rural health centers. Each district will then send in their totals to the province where the province totals all district requests and sends them to the national level where the MOH will tally up provincial orders and submit the request to suppliers. SNF that are received in Lusaka are then transported by Medical Stores Limited to provinces and districts, then distributed to the health center by Medical Stores Limited, and finally to the consumer. If all goes accordingly, once shipments are received in Lusaka, the process is said to take around a month at best. The current push system began in early 2014, and is still finding its place in the operation as Medical Stores Limited has a previous priority to deliver drugs, and often, results in SNF only being delivered when there is room in the truck.

APPENDIX 4

Performance Assessment Tests

As new guidelines become adopted into the healthcare system, individualized meetings may not occur in which the time and dedication needed to fully explain a new protocol or guideline, may be only briefly covered at the beginning of an already scheduled meeting. For example, upper level health monitoring groups will visit a health center and ask specific questions like, “do you have a weighing scale?” If yes, the monitor will observe how it is used by the health worker and correct techniques if they are not adequate. Efforts to teach health center staff correct usage of anthropometric tools and or guidelines at times other than performance assessment tests would optimize health center performance and infant monitoring. Currently, performance assessment tests are ideally conducted twice a year and supervision check-ins four times a year.

APPENDIX 5

Health Facility Services

Health Facility: _____ **Date:** _____

- 1) What is the service population?
- 2) Is there a pediatric ward at this facility? Y N
- 3) Is there a nutrition unit in the pediatric ward? Y N
- 4) Do you measure child height or length at the facility or at facility clinics?
Y N

If YES, how do you measure it?

- a. Measuring tape Y N
 - b. Length board Y N
 - c. Meter stick Y N
 - d. Height for age Y N
 - e. Other, specify: _____
- 5) Do you calculate height for age using the length/height measurements? Y
N
 - 6) Are the following services provided at this health facility for children under-5 years?
 - a. Advice or demonstration of infant & young child feeding? Y N
 - b. Therapeutic feeding for acute malnutrition? Y N
 - c. Micronutrient supplementation? Y N
 - i. If yes, which ones:
 1. Vitamin A Y N
 2. Zinc Y N
 3. Iron Y N
 4. Folic acid Y N
 5. Other: _____
 - d. Specialized nutritional advice for malnourished HIV/AIDS children?
Y N

- 7) How many of each cadre of health worker has been trained in treatment classification and management of moderate or severe acute malnutrition in the last year?

a. Doctor	N	Y	1	2	3	4
b. Medical licentiate	N	Y	1	2	3	4
c. Clinical officer	N	Y	1	2	3	4

- d. Registered nurse N Y 1 2 3 4
- e. Enrolled nurse N Y 1 2 3 4
- f. Registered midwife N Y 1 2 3 4
- g. Certified midwife N Y 1 2 3 4
- h. Other, please specify: _____

8) How many of each cadre of health worker has been trained in infant and young child feeding in the last year?

- a. Doctor N Y 1 2 3 4
- b. Medical licentiate N Y 1 2 3 4
- c. Clinical officer N Y 1 2 3 4
- d. Registered nurse N Y 1 2 3 4
- e. Enrolled nurse N Y 1 2 3 4
- f. Registered midwife N Y 1 2 3 4
- g. Certified midwife N Y 1 2 3 4
- h. Other, please specify: _____

9) Does this facility currently have nutrition clinics, cooking demonstrations, or other nutrition education programs.? Y N

10) If YES:

- a. Nutrition clinics at health facility Y N
- b. Nutrition clinics at community outreaches Y N
- c. Nutrition clinics at other locations, please specify:

- d. Cooking demonstrations at health facility Y N
- e. Cooking demonstrations at community outreaches Y N
- f. Cooking demonstrations at other locations, please specify:

- g. Others, please specify: _____

11) If NO, did the clinic ever have these types of programs in the past?
Y N

12) If yes but they are no longer in place, why did you stop having nutrition education programs?

- a. Funding ran out Y N
- b. Supplies ran out Y N
- c. No trained or knowledgeable staff to run them Y N
- d. Other, please specify: _____

13) Who sponsored or currently sponsors the nutrition clinics or cooking demonstrations?

- a. NFNC Y N

- b. UNICEF Y N
- c. WHO Y N
- d. WFP Y N
- e. PAM Y N
- f. MoH Y N
- g. Other: _____

14) What information is/was given at the nutrition clinics ?

- a. How to properly breastfeed Y N
- b. How often to breastfeed the child Y N
- c. At what age to stop breastfeeding Y N
- d. When to start incorporating foods into the child's diet Y N
- e. What type of foods to incorporate into the child's diet Y N
- f. Quantities of solid foods to feed the child per day Y N
- g. How often to feed infant, in addition to breastfeeding Y N
- h. Important nutritious foods for the child, i.e. ground nuts, eggs, milk, cooking oil, fruits, vegetables etc. Y N
- i. Cooking demonstrations Y N
- j. Others, please specify: _____

15) Are the nutrition policy guidelines available in the health center and readily visible?

- Y N

16) What guidelines or protocols do you follow for providing guidance to mothers in treating infant and young child feeding?

- a. None
- b. IMAM Y N
- c. MoH Y N
- d. Other, specify: _____

17) What guidelines or protocols do you follow for treating children with moderate or severe malnutrition?

- a. None
- b. IMAM Y N
- c. MoH Y N
- d. Other, specify: _____

18) Have you provided this service in the last month:

- a. Treatment of moderate malnutrition to a child under-5 (past mo.)
 - Y N
 - i. Number of times: _____
 - ii. Where were these children identified?
 - In-facility Y N

Under-5 clinic Y N
 Community outreach Y N
 Other (specify)_____

b. Treatment of severe malnutrition to a child under-5 Y N

- i. Number of times:_____
- ii. Where were these children identified?
 - In-facility Y N
 - Under-5 clinic Y N
 - Community outreach Y N
 - Other (specify)_____

c. Given vitamin A supplementation to a child under-5 Y N

- i. Number of times:_____
- ii. Where were these children identified?
 - In-facility Y N
 - Under-5 clinic Y N
 - Community Outreach Y N
 - Other (specify)_____

d. Given breast feeding counseling to a mother or caregiver Y N

- i. Number of times:_____
- ii. Where were these children identified?
 - In-facility Y N
 - Under-5 clinic Y N
 - Community outreach Y N
 - Other (specify)_____

e. Given complementary feeding advice to a mother or caregiver

- Y N
- i. Number of times:_____
 - ii. Where were these children identified?
 - In-facility Y N
 - Under-5 clinic Y N
 - Community outreach Y N
 - Other (specify)_____

APPENDIX 7

Health Worker Interview Guide

Respondent demographics:

- 1) Health worker ID#: _____
 - a. Gender: 1 Female 2 Male
 - b. What is your current title? _____
 - c. How old are you? _____ (years)
 - d. How long have you worked in health care? _____ (years including decimal)

Services:

- 1) What specific clinics do you provide, both in facility and at outreaches?
 - a. List clinic type 1 (circle one) 0= None 1= Facility 2= Outreach
 - b. List clinic type 2 (circle one) 0= None 1= Facility 2= Outreach
- 2) If treatment for a malnourished child is out of this facility's capability, do you refer to another hospital or feeding center? 1= Yes 2= No
 - a. If so, where?

 - b. For what types of services do you make such a referral?

 - c. Approximately what percent of malnourished children do you refer to another hospital or feeding center? _____%
- 3) Do you provide pregnant women with nutritional advice during pregnancy?
1= Yes 2= No
 - a. If so, what type of advice? _____
 - iii. Importance of exclusive breastfeeding after delivery?
1= Yes 2= No
 - iv. Importance of maternal nutrition on breast milk for infant?
1= Yes 2= No
 - v. Other advice? _____
- 4) Do you advise mothers to breastfeed after delivery? 1= Yes 2= No
 - a. Exclusively b. Non-Exclusively c. Advice varies d. Please elaborate _____
- 5) Do you schedule the first appointment for a woman and her baby following childbirth? 1= Yes 2= No
 - a. If so, _____ weeks / months (circle)

- 6) Are immunization visits used to support exclusive breastfeeding and appropriate complementary feeding? 1= Yes 2= No
- a. If so, can you provide a typical scenario?

- 7) When families seek care for a sick child:
- a. Is that visit used as an avenue to assess the child's nutritional status?
1= Y 2= N
 - b. To discuss feeding practices? 1= Y 2= N
 - c. To help families solve any difficulties they may have in feeding the child?
1= Y 2= N
- 8) Does this facility have a mother's shelter? 1= Y 2= N
- a. If so, can you describe any challenges women face while residing in the shelters? _____
 - b. Are they able to prepare their own food? 1= Y 2= N
 - c. Are there any barriers to doing so? 1= Y 2= N
 - i. Please explain _____
- 9) Do you use the mother's shelter as a resource for educating women on various topics? 1= Y 2= N
- 10) What services that are not currently provided would you like to see implemented by community members, facilities, government or other programs?

Procedures and Advice:

- 11) What procedure(s) do you follow for growth monitoring in children under-5?
- 12) Can you walk me through the process of screening for acute malnutrition and the screening measurements used (weight, height, MUAC, etc.)?
- 13) Who provided you with training in the management of malnutrition?
- a. What year was that conducted?
 - b. Have you had any refresher training?
 - c. Do you have any supportive supervision on screening or treatment of malnutrition?
- 14) Does your health facility provide inpatient or outpatient treatment for severe acute malnutrition (SAM) ?
- a. What criteria do you use to provide outpatient vs. inpatient treatment?
 - b. What advice do you give to mothers whose child is severely malnourished?

- c. Typically, where are severely malnourished children identified, health center, outreach, etc.
- 15) What advice do you give to mothers whose child is moderately malnourished?
- a. Typically, where are moderately malnourished children identified? 1= Facility 2= Outreach Other _____
 - b. Do you provide any supplements to these children?
1= Y 2= N
- 16) Do you feel that you have the resources to identify a stunted child?
1= Y 2= N
- a. If so, what are those resources?

- 17) Do you provide advice to mothers who child is falling below height for age?
1= Y 2= N
- a. if so, what advice?

Personal opinion:

- 18) What are the strengths of the nutrition services at this health center? What do you feel could be improved? Who do you feel responsible for improving that?
- 19) Do you feel that women in the health center catchment area are fully knowledgeable about local nutrient rich foods? 1= Y 2= N
- a. For those that are knowledgeable about local nutrient rich foods, do you feel that they know how to properly prepare them? 1=Y 2= N
 - b. Do you feel that they are utilizing all of their food resources adequately?
1= Y 2= N

APPENDIX 8

District, provincial & national key informant interview guide

Respondent Demographics

- 2) DPN ID#: _____
 - a. Gender: 1 Female 2 Male
 - b. What is your current title? _____
 - c. How old are you? _____ (years)
 - d. How long have you worked in health care? _____ (years including decimal)
 - e. How long have you been in this current role? _____ (years)

From your expertise, would you be able to tell me more about the classification and management of acute malnutrition, highlighting some of the main challenges from a district, provincial or national level?

Awareness of guidelines:

- 1) Are you aware of the current nutritional policy guidelines? 1= Y 2=N
 - a. If so, can you name the specific guidelines for Zambia? _____
- 2) Can you tell me a bit about those current nutrition policy guidelines:
 - a. Once finalized and formally approved by the MOH, how are guidelines disseminated to rural health centers? 1= Y 2= N
 - i. Determining factors for which district/ health facilities receive them?
 - b. Monitoring and implementation in rural areas- once formally approved, how long does it take for the guidelines to reach rural health facilities? 1= Y 2= N
 - i. (national/ provincial) how do you know the guidelines have been effectively implemented?
 - c. Are you aware of when the last training was performed for the current nutritional policy guidelines? 1= Y 2= N
If so for who?
 - i. By who?
 - ii. Where did they take place?
 - iii. How long was the training?
 - iv. Type of training? Classroom, feeding tests, practice sessions
- 3) Are you aware of other resources that district and community health facilities and centers use and implement as an alternative to the national nutrition policy guidelines? 1= Y 2= N

- a. If the rural health centers are not receiving the national nutritional guidelines, do you monitor how facilities treat children with malnutrition?
 1= Y 2= N
 If so, can you explain that process?

Supply Chain

4) Are you aware of how the current supply chain operates in Zambia? 1= Y 2= N

5) If so, can you tell me about the current supply chain for supplemental nutritious foods (SNF) for Zambia?

a. Where the SNF comes from 1= Y 2= N
 Explain:

b. How the demand is estimated 1= Y 2= N
 Explain:

c. Who pays for the RUTFs and SNFs 1= Y 2= N
 Explain:

d. Once the aid arrives into Lusaka, how it is stored and monitored from the national level down to the district and community 1= Y 2= N
 Explain:

i. What are the specific distribution locations in Zambia, besides Lusaka?

ii. How long does the distribution process take until the aid reaches the districts?
 In months:

e. What is the storage capacity for distribution locations outside of Lusaka 1= Y
 2= N

i. i.e., Choma: what is the capacity of storage? 1= Y 2= N

ii. How often are shipments received, monthly bi-weekly etc. 1= Y
 2= N
 In months:

iii. How do you request shipments, how does the request work? 1= Y
 2= N

—

1. How do or can community facilities request aid? 1= Y
2= N

iv. What is the consumption rate of the Choma district facilities and centers? 1= Y 2= N

In months:

1. What health facility or center receives the most aid? 1= Y
2= N

6) Is there a similar supply chain process for anthropometric tools? 1= Y 2= N
a. From who, to who, what tools, when, how, etc

Opinion

7) What are some of the main strengths or successes of the current guidelines?
a. Do you think the guidelines are adequate to address some of the specific challenges of rural areas? 1= Y 2= N
If so, why? If not, why?

b. Are you able to see if the nutritional status of children is changing with the current guidelines? 1= Y 2=N

8) What suggestions do you have for improving the system overall?
a. Improvements specifically for training, supply chain distribution and or implementation

APPENDIX 9

INTERACTIVE RECALL OF 'YESTERDAY'S' LIQUID AND FOOD CONSUMPTION FOR MOTHERS OF INFANTS, 6-15 MONTHS OLD INSTRUCTIONS

Study ID: _____ Age in Months: _____ Date: _____ child development agent #: _____

Please read out loud to the mother, "We would like to ask you a few questions about how you fed your infant yesterday . We will start by discussing breastfeeding. Please answer "yes or no" unless the question asks for months or times"

PART I.

1A. Are you currently breastfeeding [Name]? (Circle Yes or No) YES (Skip to #2) NO

1B.If **NO to 1A**, did you ever breastfeed [Name] in the past? (Circle Yes or No) YES NO (Skip to PART II)

1C.If **YES to 1B**, for how many months did you breastfeed [Name]? _____ (months)

Now skip to **PART II**.

2. How many times did you breastfeed yesterday during daylight hours? _____ times

3. Do you give your baby any other liquid or food during daylight hours besides breast milk? (Circle Yes or No) YES
NO (Skip to #5)

4. If **Yes to #3**, at what age did you introduce other liquid or food into (Name's) diet _____(months)

5. Do you breastfeed your child during the night? (Circle Yes or No) Yes No (If No, skip to #6)

6. How many times did you breastfeed last night from sunset to sunrise? _____times

7. Do you give your baby anything other liquid or food from sunset to sunrise, besides breast milk? (Circle Yes or No) YES
NO

PART II.

Please read to the mother, “Now we want to ask you about any liquid (including breast milk) or food that you gave to [Name] to eat or drink YESTERDAY ONLY, from sunrise to sunset.” Child development agents: Please list EVERYTHING that [Name] had to eat or drink yesterday during daylight hours.

Example: Ask the mother, “yesterday, from when the sun came up, what was the first thing [Name] had to eat or drink?” (fill out first row). “At what time and where was this feeding?” Proceed to ask the details about the food, how it was cooked and the amount using the purple cup. Then, what did [Name] have to eat or drink after the first feeding?” (fill in second row) and ask what time, place, details, amount, etc. Work your way through the day and continue asking what the next liquid or food was that the child had, until you get to sunset and stop. Please include breastfeeding times.

Example: If the child is only breastfeeding and does not yet eat ask, “yesterday, when did you breastfeed the child for the first time after the sun came up?” Then, “when was the next time that [Name] was breastfed?” “Did [Name] have anything else to drink besides breast milk yesterday? Cows milk, plain water, sugar or glucose water, gripe water, sugar-salt water, fruit juice, infant formula, tea/ infusions, honey etc.

65

Please fill in and complete the table on the next page

A. Confirm number of feeding times for the infant yesterday during daylight hours by repeating the table in Part II to the mother, to make sure she hasn't forgotten any feedings. For example, say "So far, you have told me that you breastfed your baby (4) times yesterday at this (x) time? First breastfed at __. then at __ at __ at __. then at __ And that you fed [Name] 3 times yesterday, The first meal at __ The next meal at __. And the last meal at __ Does that sound right? If yes, continue. If No, go back through the day with the mother to ensure the table is filled in correctly. If the mother said she breastfeeds the child 8 times during the daylight hours, make sure you have 8 breastfeeding times listed on the table.

The times do not have to be exact, they can be an estimation. For example, the mother could say I first breastfed around 0800 or 900. The [Child] then ate again around 1100 or 1200 hours and breastfed around 14 hours.

Part III

If the answer to question #4 is NO, please **DO NOT** fill out this table and the interview is over. If the answer to either question #4 Yes, please continue this part.

"Because every child has a different feeding cycle, we would now like to ask you about if your child had any liquid or food last night from sunset to sunrise."

Please fill in and complete this table for anything the child had- any liquid or food DURING THE NIGHT- from sunset to sunrise, including breast milk.

67

Time from sunset to sunrise	Place	Liquid or food (include breast milk, water, etc)	Details (e.g. ingredients) as needed (not for breastfeeding)	Cooked/ raw (describe preparation and other details)	Amount (exclude breast milk)

REFERENCES

- Abubakar A, Holding P, Van De Vijver FJ, Newton C & Van Baar A. Children at risk for developmental delay can be recognized by stunting, being underweight, ill health, little maternal schooling or high gravidity. *Journal of Child Psychology and Psychiatry, and Allied Disciplines* 2010; 51: 652–659
- Abubakar A, Holding P, Mwangome M, Maitland K. Maternal perceptions of factors contributing to severe under-nutrition among children in a rural African setting. *Rural and remote health*. 2011; 11(1):1423
- Aguayo VM, Agarwal V, Agnani M, Das Agrawal D, Bhambhal S, Rawat AK, Gaur A, Garg A, Badgaiyan N, Singh K. Integrated program achieves good survival but moderate recovery rates among children with severe acute malnutrition in India. *American Journal of Clinical Nutrition* 2013; 98:1335–42
- Aguayo VM, Jacob S, Badgaiyan N, Chandra P, Kumar A, Singh K. Providing care for children with severe acute malnutrition in India: new evidence from Jharkhand. *Public Health Nutrition* 2014; 17:206–11
- Aid For Nutrition: Are we on track to meet the needs? 2010 and 2011. Action Against Hunger. ACF International 2013
- Black RE, Victoria CG, Walker SP, Bhutta ZA, Christian P, de Onis M, Ezzati M, Grantham-McGregor S, Katz J, Martorell R, Uauy; Maternal and Child nutrition Study Group. Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet* 2013; 382-427-51
- Brown K.H. Diarrhea and malnutrition. *The Journal of Nutrition* 2003; 133, 328S–332S
- Burza S, Mahajan R, Marino E, Sunyoto T, Shandilya C, Tabrez M, Kumari, K, Mathew P, Jha A, Salse N, and Nath KM. Community-based management of severe acute malnutrition in India: new evidence from Bihar. *American Journal of Clinical Nutrition* 2015
- Central Statistical Office (CSO) [Zambia], Ministry of Health (MOH) [Zambia], and ICF International. Zambia Demographic and Health Survey 2007. Rockville, Maryland, USA: Central Statistical Office, Ministry of Health, and ICF International. 2007
- Central Statistical Office (CSO) [Zambia], Ministry of Health (MOH) [Zambia], and ICF International. Zambia Demographic and Health Survey 2013-14. Rockville, Maryland, USA: Central Statistical Office, Ministry of Health, and ICF International. 2014
- Central Statistical Office (CSO) [Zambia], Ministry of Health (MOH) [Zambia], and ICF International. Rockville, Maryland, USA: Central Statistical Office, Ministry of Health, and ICF International. 2014. Zamstats.gov.zm
- Dewey K.G. & Huffman S.L. Maternal, infant, and young child nutrition: combining efforts to maximize impacts on child growth and micronutrient status. *Food and Nutrition Bulletin* 2009; 30, S187–S189
- Engle PL, et al. Strategies to avoid the loss of developmental potential in more than 200 million children in the developing world. *Lancet* 2007; 369: 229-242

Fernandes M, Stein A, Newton CR, et al. The INTERGROWTH-21st project neurodevelopment package: a novel method for the multi-dimensional assessment of neurodevelopment in pre-school age children. *PLoS One* 2014

First 1000 Most Critical Days Program. Three Year Program 2011-2015. Republic of Zambia. Lusaka, Zambia 2012

Gardner JM, Walker SP, Powell CA, Grantham-McGregor S. A randomized controlled trial of a home-visiting intervention on cognition and behavior in term low birth weight infants. *Journal of Pediatrics* 2003; 143: 634–39

Gates, Bill. “How Can Africa Settle its Health Bill?” Mail & Guardian. Bhekisisa. August 2014

Gorman KS, Pollitt E. Relationship between weight and body proportionality at birth, growth during the first year of life, and cognitive development at 36, 48, and 60 months. *Infant Behavior Development* 1992; 15: 279–96

Grantham-McGregor S, Cheung YB, Cueto S, et al. Developmental potential in the first 5 years for children in developing countries. *Lancet* 2007; 369: 60-70

Health Institutions in Zambia. Ministry of Health. Lusaka, Zambia. 2010

Hobbs B and Bush A. Acute Malnutrition: an Everyday Emergency. *Generation Nutrition Campaign Report*. 2014

Hoddinott J, Maluccio J, Behrman J, Flores R, Martorel RL. Maternal and child undernutrition: consequences for adult and human capital. *Lancet* 2008; 271:340-357

Improving Child Nutrition: The achievable imperative for global progression. United Nations Children’s Fund. New York, New York. April 2013

Infant and Young Child Feeding Practices: Collecting and using data: A Step-by-Step Guide. Cooperative for Assistance and Relief Everywhere, Inc. (CARE). January 2010

The Lancet. Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet* 2013; 9890:427-451

Leroy JL, Ruel M, Habicht JP. Critical windows for nutritional interventions against stunting. *American Journal of Clinical Nutrition*; 2013;98:854–5

Lima AL, Silva AC, Konno SC et al. Causes of the accelerated decline in child undernutrition in Northeastern Brazil (1986–1996–2006). *Rev Saude Publication* 2010; 44: 17–27. 20

Lozoff, B, Jimenez E, Jagen J, et al. Poorer Behavioral and Developmental Outcome More Than 10 Years After Treatment for Iron Deficiency in Infancy. *Pediatrics* 2000; 105(4):1-11

Lozoff, B, DeAndraca I, Castillo M, Smith J, Walker T, Pino P. Behavioral and developmental effects of preventing iron deficiency anemia in healthy full-term infants. *Pediatrics* 2003; 112-846-854

Lundeen EA, Stein AD, Adair LS, Behrman J, Bhargava S, Dearden K, Gigante D, Norris S, Richter L, Fall C, Martorell R, Sachdev HS, Victora CG. Height-for-age z scores increase despite increasing height deficits among children in 5 developing countries. *American Journal of Clinical Nutrition* 2014; 100:821-5

- Maleta K, Amadi B. Community-based management of acute malnutrition (CMAM) in sub-Saharan Africa: case studies from Ghana, Malawi and Zambia. *Food Nutrition Bulletin* 2014; 35
- McDonald C.M., Manji K.P., Kupka R., Bellinger D.C., Spiegelman D., Kisenge R. et al. Stunting and wasting are associated with poorer psychomotor and mental development in HIV-exposed Tanzanian infants. *The Journal of Nutrition* 2013; 143: 204–214
- Millennium Development Goals Progress Report 2010. United Nations Development Programme. Lusaka, Zambia. 2010
- Millennium Development Goals Progress Report 2013. United Nations Development Programme. Lusaka, Zambia. 2013
- Ministry of Health, 2006. *Health Management System*. Lusaka, Zambia. Ministry of Health 2006
- Monteiro CA, Benicio MH, Konno SC et al. Causes for the decline in child under-nutrition in Brazil, 1996–2007. *Rev Saude Publication* 2009; 43: 35–43
- Mwangome, MK. et al. Mid- upper arm circumference at age of routine infant vaccination to identify infants at elevated risk of death: a retrospective cohort study in the Gambia. *Bulletin of World Health Organization* 2012; 90:887-894..
- National Health Strategic Plan for Zambia 2011-2015. National Food and Nutrition Commission of Zambia. Lusaka, Zambia. July 2011
- Psacharopoulos G and Patrinos HA. Returns to Investment in Education: A Further Update. *Education Economics* 2004; 12(2): 111-134
- Scaling Up Nutrition. Lusaka, Zambia. 2013. Scalingupnutrition.org/sun-countries/zambia
- Stoltzfus, R.J., Kvalsvig, J.D., Chwaya H.M., et al. Effects of Iron Supplementation and Anthelmintic Treatment on Motor and Language Development of Pre-school Children in Zanzibar: Double Blind, Placebo Controlled Study. *British Medical Journal* 2001; 323:1-8
- Taneja G, Dixit S, Khatri A, Yesikar V, Raghunath D, Chourasiya S. A study to evaluate the effect of nutritional intervention measures on admitted children in selected nutrition rehabilitation centers of indore and ujjain divisions of the state of Madhya Pradesh (India). *Indian Journal of Community Medicine* 2012; 37:107–15
- UNICEF-WHO-The World Bank, Joint Child Malnutrition Estimates: Levels and Trends in Child Malnutrition, UNICEF, WHO, World Bank 2012; statistical table
- UNICEF: The achievable imperative for global progress. UNICEF. New York, New York. 2013
- Victora, C.G., Adaire, L., Fallb, C., Hallala, P.C., Martorell, R., Richterf, L., and Sachdevc, H.S. Maternal and child undernutrition: consequences for adult health and human capital. *Lancet* 2008; 371:340-357
- Victora C.G., de Onis M., Hallal P.C., Blossner M. & Shrimpton R. Worldwide timing of growth faltering: revisiting implications for interventions. *Pediatrics* 2010; 125, e473–e480
- Villar J, Smeriglio V, Martorell R, Brown CH, Klein RE. Heterogeneous growth and mental development of intrauterine growth-retarded infants during the first 3 years of life. *Pediatrics* 1984; 74: 783–91

Walker SP, Chang SM, Powell CA, Grantham-McGregor SM. Psychosocial intervention improves the development of term low birth-weight infants. *Journal of Nutrition* 2004; 134: 1417–23

Walker SP, Wachs TD, Garner JM, Lozoff B, Wasserman GA, Pollitt E, Carter JA. Child development: risk factors for adverse outcomes in developing countries. *Lancet* 2007; 369:145-157

The World Bank 2010-2014. The World Bank Group. Lusaka, Zambia. 2015

World Health Organization: database on child growth and malnutrition. Geneva: WHO, 2015

World Health Organization: infant and young child feeding. Geneva: WHO, 2015

World Health Organization: pocketbook. Geneva: WHO, 2013

World Health Organization: 5 community based management of SAM. A Joint Statement by the World Health Organization, the World Food Programme, the United Nations System Standing Committee on Nutrition and the United Nations Children’s Fund. 2007

The World Health Organization: management of severe malnutrition: a manual for physicians and other senior health workers. Geneva: WHO, 1999

World Health Organization/World Food Programme/United Nations System Standing Committee on Nutrition/ United Nations Children’s Fund. Community-based management of severe acute malnutrition. Geneva: WHO, 2007

World Health Organization child growth standards and the identification of severe acute malnutrition in infants and children: A Joint Statement by the World Health Organization and the United Nations Children’s Fund World Health Organization and UNICEF 2009

WHO Health Statistics. World Health Organization. Geneva: WHO, 2010

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