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Development and Implementation of a Sustainable Monitoring and Evaluation Protocol for a Malnutrition Rehabilitation Program in a Resource-Limited Setting

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Development and Implementation of a Sustainable Monitoring and Evaluation Protocol for a Malnutrition Rehabilitation Program in a Resource-Limited Setting

by

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Dedication

To my beautiful wife Kathryn, for her infinite patience, understanding, and support

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Development and Implementation of a Sustainable Monitoring and Evaluation Protocol for a Malnutrition Rehabilitation Program in a Resource-Limited Setting

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Worldwide, nearly 7 million children die each year and malnutrition contributes to almost half of these cases. Malnourished children have lower life expectancy, perform worse in school, and are at increased risk for communicable diseases. The prevalence of undernutrition is highest in low-income countries. Risk factors include food insecurity, poverty and economic disparities, rapid population expansion, and high prevalence of communicable diseases. In Peru, UNICEF has estimated the prevalence of malnutrition in children less than 5 years old at 18% in urban areas, and up to 33% in rural regions of the country. El Comedor is a community-based kitchen established in the impoverished neighborhood of Ermañito Alto in Lima, Peru designed to combat these risk factors and improve the nutritional status of local children. This program provides direct nutritional support to at-risk children in a safe environment and nutritional education programs to their caregivers. Since its inception in 2009, El Comedor has lacked a sustainable monitoring and evaluation protocol. This report details an approach to the development and implementation of such a protocol in a resource-limited setting.

TABLE OF CONTENTS

List of Figures and Tables

List of Abbreviations

CDC	Centers for Disease Control and Prevention
EFNEP	Expanded Food and Nutrition Education Program
FANTA	Food and Nutritional Technical Assistance
GMP	Growth Monitoring and Promotion
GSBS	Graduate School of Biomedical Science
HHS	Household Hunger Scale
IRB	Institutional Review Board
IUGR	Intrauterine Growth Restriction
KAP	Knowledge, Attitudes, and Practices
MPH	Master of Public Health
MDG	Millennium Developmental Goals
M&E	Monitoring and Evaluation
NGO	Non-governmental Organization
RUF	Ready-to-Use Foods
TDC	Thesis and Dissertation Coordinator
USAID	United States Agency for International Development
UTMB	University of Texas Medical Branch
WHO	World Health Organization

Chapter 1 Introduction

SPECIFIC AIMS

This capstone describes the development and implementation of a monitoring and evaluation program that has the following aims.

- Aim 1: Determine the effectiveness of a community-based nutrition rehabilitation program on biometric outcomes and education retention.
- Aim 2: Describe the particular risk factors for malnutrition in the area served by El Comedor, Ermañito Alto, Lima, Peru including household income, education level, distance to food sources, and recent infections.

SIGNIFICANCE

Malnutrition (literally "bad nourishment") results from a misappropriation of calories in the diet. This can result from an inadequate, excess, or unbalanced intake of nutrients, or an inability to efficiently utilize consumed calories, (e.g. due to disease) termed secondary malnutrition.[1] Malnutrition encompasses a very broad spectrum of symptoms and consequences. Worldwide, the major manifestation is chronic undernutrition due to macronutrient (protein-energy) and/or micronutrient (iron, zinc, vitamin A, iodine, etc.) deficiency, especially in lower- and middle-income countries. The United Nations' Standing Committee on Nutrition (SCN) declared malnutrition to be the largest single contributor of disease globally.[2] The World Health Organization (WHO) has also labeled undernutrition the greatest single threat to the world's public health.[3]

For these reasons, childhood malnutrition has become prominent on the global stage as the direct aim of two of the eight United Nations Millennium Developmental Goals and indirectly targeted by each of the remaining six.[4] While increased public awareness of this public health problem is a vital first step, implementation of proven, sustainable intervention strategies are necessary to eradicate childhood malnutrition. Toward this end, practitioners in Lima, Peru, recently established a community-based malnutrition rehabilitation program ("El Comedor") in a very low-income neighborhood of Lima. The implementation of a low-cost monitoring and evaluation (M&E) protocol is essential to the assessment of the effectiveness and sustainability of the program. This noninvasive, cost-effective, sustainable M&E protocol could be replicated and tailored to other resource-poor communities where childhood malnutrition interventions are in greatest need.

Chapter 2 Background and Literature Review

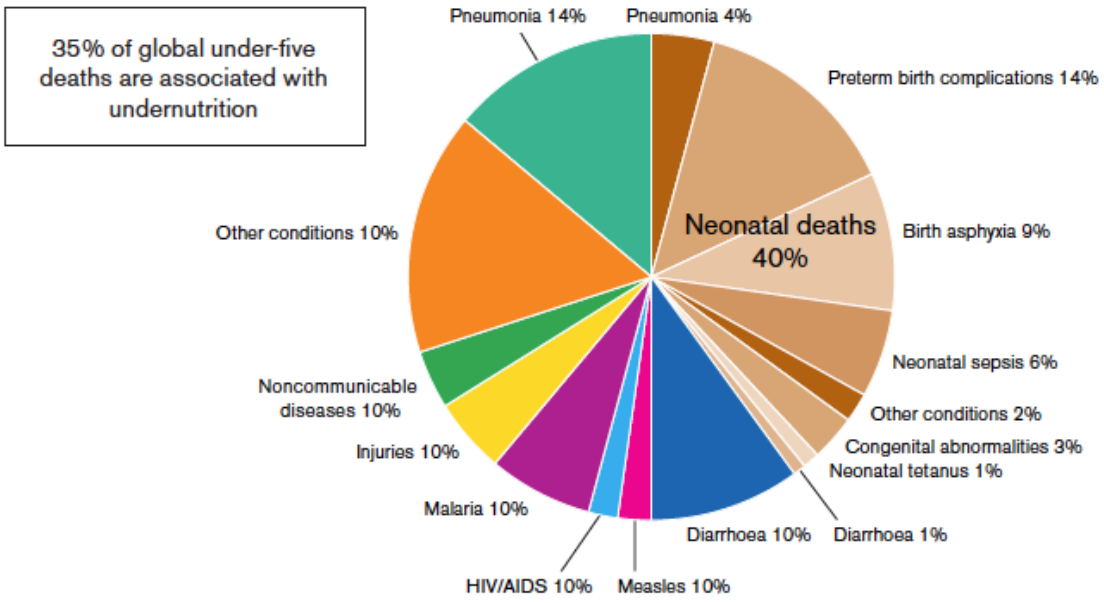
DISEASE BURDEN: GLOBAL

According to the Save the Children May 2012 report, one in twelve people globally are malnourished, and one quarter of the world's children suffer from chronic malnourishment.[5] The UN Special Rapporteur on the Right to Food reported 58% (36 million out of 62 million) of all deaths worldwide in 2006 were caused by "hunger or diseases due to deficiencies in micronutrients."[6] In 2011, underweight and stunting - the primary physical manifestations of chronic undernutrition - were documented in 101 million and 165 million children less than five years old worldwide, respectively.[7] The Department for International Development reports that one billion people worldwide go hungry each year and 195 million children are chronically malnourished, with greater than one in ten being acutely malnourished, which is a medical emergency.[8]

The consequences of undernutrition are often overlooked or misunderstood, yet have the potential to influence nearly every aspect of a child's development, and all too frequently prematurely end their lives.[7] The most clearly quantifiable effects of childhood malnutrition are child mortality rates. Malnutrition is implicated in nearly one half of all childhood deaths worldwide each year and undernutrition specifically is implicated in at least 35% of all deaths in children under five (Figure 1).[9] In a 2009 summit, U.N. Secretary-General Ban Ki-moon reported that hunger takes the lives of 6 million children each year, or 17,000 daily.[10] Children with inadequate nourishment are more susceptible to infections, increasing their risks for diarrheal diseases, pneumonia, HIV, and malaria.[9] Other contributors to these figures include poorly nourished mothers: intrauterine growth

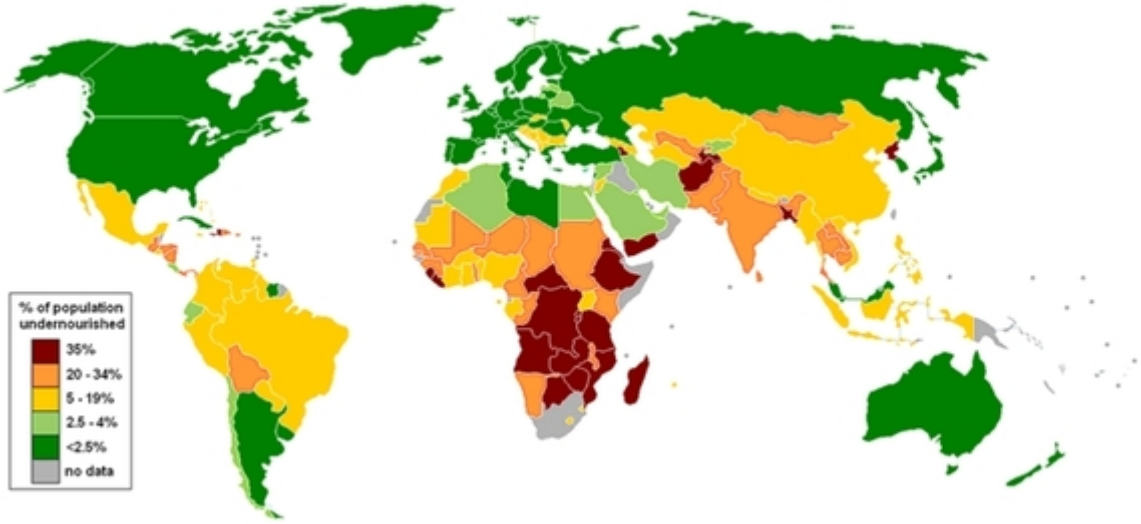
restriction (IUGR) account for 2.2 million child deaths/year and deficient breast feeding adds an additional 1.4 million deaths each year.[3]

Figure 1. Global distribution of causes of death in children less than 5 years old[7]



Adding complexity to the epidemiology is that macronutrient and micronutrient deficiencies are not distributed collectively across the globe (Figure 2). Low-income countries bear the burden of 98% of the world's undernourished population. Greater than 2 out of every 3 affected individuals inhabit only seven countries (Bangladesh, China, the Democratic Republic of the Congo, Ethiopia, India, Indonesia and Pakistan), with China and India alone hosting 40% of the world's undernourished.[11]

Figure 2. Global prevalence of undernutrition[12]



Macronutrient: According to the WHO, in 2000 greater than 70% of children suffering from protein-energy malnutrition lived in Asia, 26% in Africa, and 4% in Latin America and the Caribbean.[13] In addition to disproportionately affecting lower-income countries (on average, 16% of their population are undernourished), malnutrition also clusters to lower-income populations within these countries.[11]

Micronutrient: These deficiencies are not always as readily evident but are capable of equally devastating consequences. The WHO reports iron to be the most common deficiency, affecting roughly 2 billion people. This figure includes 600 million children and 469 million reproductive-aged women suffering from anemia, with more than 50% of cases due to iron deficiency.[14] The increased prevalence of anemia in children is attributed to the increased needs of their growing bodies coupled with deficient iron intake. In addition, 33.3% (about 190 million) children worldwide are vitamin A deficient with roughly 5.2 million having reached the point of night

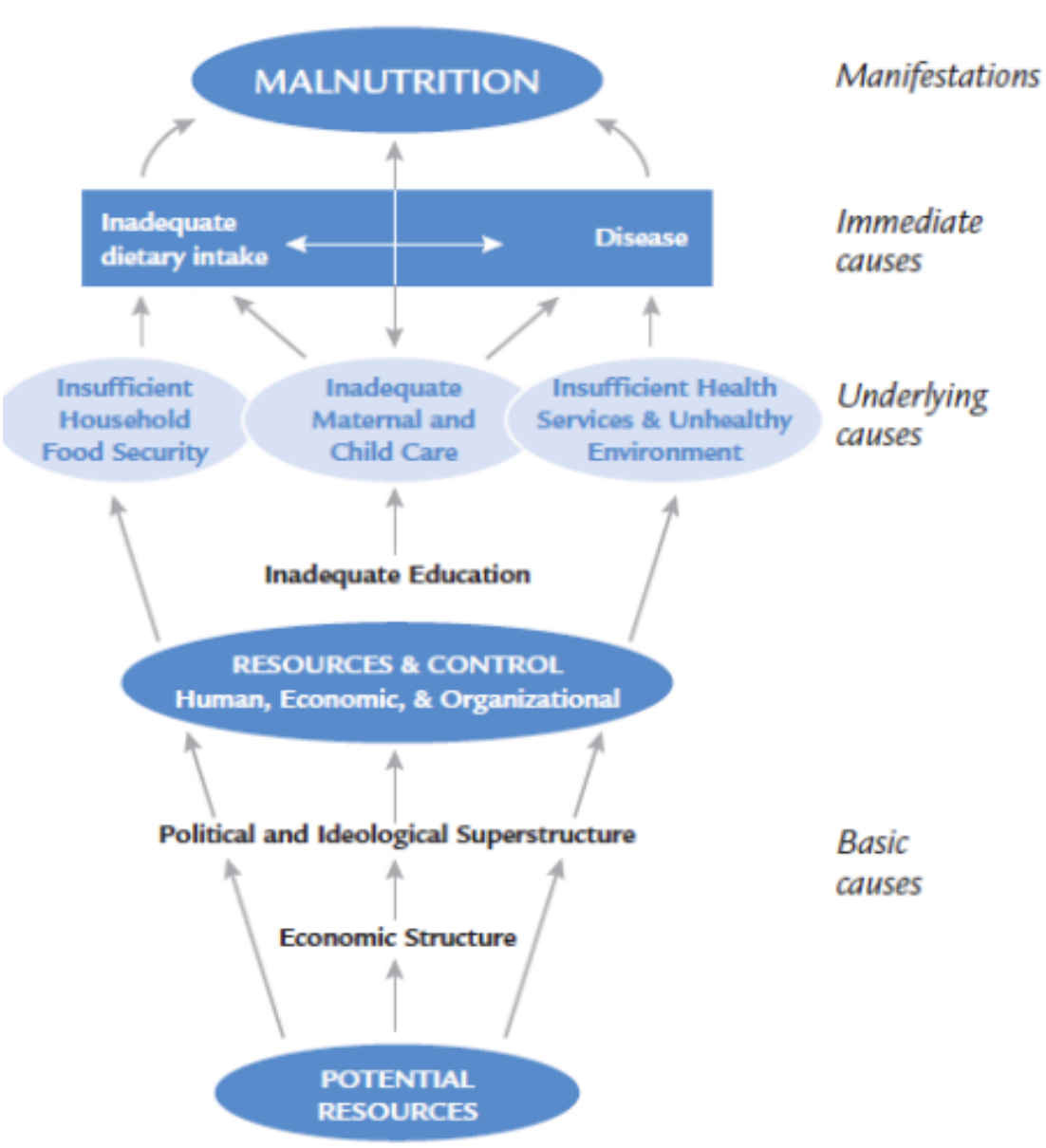
blindness.[14] Also, iodine deficiency has been identified as the "world's greatest single cause of mental retardation and brain damage."[9]

Micronutrient deficiencies contribute an additional 1 million deaths annually to the child mortality figures,[14] but have an even greater impact on child morbidity. Anemia may lead to a host of consequences, including, but not limited to: prematurity, low birth weight, perinatal mortality, impaired cognition, and impaired school and work performance. Vitamin A deficiency is the leading cause of preventable blindness in children and increases their susceptibility to the measles virus.[15] Iodine deficiency begins to take its toll in the womb. Deficient iodine levels during pregnancy have been demonstrated to cause stillbirth, spontaneous abortion, and cretinism, while iodine deficiency in children continues to be the most prevalent cause of mental impairment.[15] Many children are at increased risk of poor health even before birth. As referenced above, maternal malnutrition can lead to a host of pre- and perinatal complications in addition to IUGR, cretinism, and various birth defects. Malnutrition and its devastating effects in the first two years of life are largely irreversible.[3]

CAUSATION AND INTERVENTIONS

The factors leading to malnutrition are as varied as its consequences (Figure 3). Former Secretary of State for International Development Andrew Mitchell details the importance of health, culture, the status of women, income, and a lack of coordinated efforts in the propagation of chronic malnutrition. He also stresses that successful interventions must take into account all of these various elements.[16] The factors that Mr. Mitchell references ("poor health," "cultural issues," "status of women") are in themselves very broad, dynamic issues, further complicating targeted interventions.

Figure 3. Model of malnutrition causation[7]

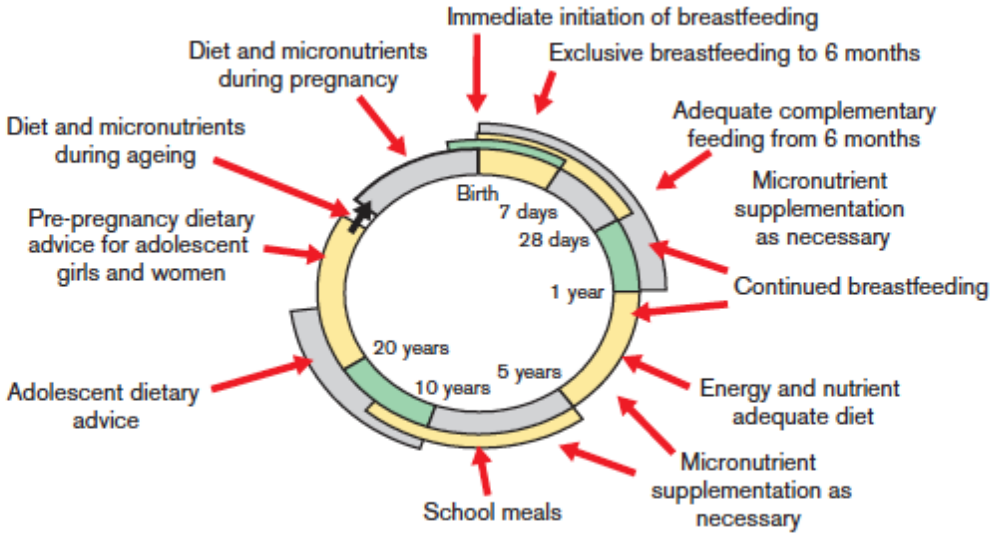


Malnutrition causation begins broadly with social, political, and economic structures limiting access to and knowledge of nutritious choices. Ultimately, these broad constructs lead to the more downstream, immediately apparent factors causing malnutrition: inadequate dietary intake and disease. Malnutrition interventions have been

implemented to target virtually every aspect along this chain of causation with varying levels of success.

The complexity of causation provides a variety of potential targets for intervention (Figure 4). The overwhelming numbers used to illustrate the scope and outcomes of undernutrition are countered by a multitude of studies demonstrating dramatic responses to cost-effective interventions. The health-measure results produced in response to such relatively low-cost programs are so substantial that the Lancet recently dubbed malnutrition "one of the big bills left on the sidewalk" in regards to combating child mortality.[3]

Figure 4. Potential targets for malnutrition interventions[7]



In the latter half of the twentieth century, scientific studies were conducted to identify risk factors for malnutrition and potential targets for intervention. Focusing on the immediate causes of malnutrition, in 1978 Kielmann, et al., published a landmark

paper on the subject of direct nutritional supplementation.[17] This group conducted a five-year prospective cohort study in 10 villages in Punjab, North India investigating the effects of providing supplemental foodstuffs on child health and development. Compared to a control population that received no intervention, the children provided with supplementary feeding demonstrated significant improvements in health, hemoglobin levels, growth (height and weight), survival, and development. Similarly, the researchers showed a decrease in perinatal mortality in children whose mothers received supplementary nutrition. The authors were also able to demonstrate the cost effectiveness of this approach toward improving childhood malnutrition and its sequelae.

Influencing breastfeeding habits allows for the earliest possible direct impact on a child's dietary intake. The WHO reports that improvement in exclusive breastfeeding techniques, appropriate complementary feeding practices, and continued breastfeeding through 2 years old could save the lives of 1.5 million children under 5 years of age each year. Additionally, these improvements have the potential to provide continued health and cognitive benefits into adolescence and adulthood.[7]

The positive economic impact of breastfeeding should also not be overlooked. Decreasing the number of childhood hospitalizations and infant deaths can have a dramatic impact on the local economy. A 2010 pediatric article projected $13 billion in annual savings and prevention of 911 infant deaths in the United States if 90% of mothers complied with the Healthy People 2020 recommendation of exclusive breastfeeding for the first 6 months.[18] Given the dramatic potential benefits and low costs, assessing and targeting breastfeeding knowledge and practices should be an essential component of any childhood malnutrition rehabilitation program.

Following the cessation of exclusive breastfeeding, caregivers must be able to access foods that provide appropriate nutrition for their children. Improper feeding habits due to lack of nutritional understanding present another risk factor for malnutrition. A 2005 study of infant feeding practices in rural Tanzania found that children consumed mainly a thin porridge prepared from maize flour as complementary food with carbohydrates contributing 70% of the calories. These children were noted to have a high prevalence of anemia (76%), malaria parasitemia (50%), and stunting (35%).[19] The infant's caregivers need to be aware of when to begin supplementary feeding and with which locally available and affordable foods.

However, education alone will frequently not be sufficient as the foods readily available to many households may not provide adequate nutrition or be obtainable in the appropriate quantities. To this end, many researchers have investigated the use of food supplements. Calorie and micronutrient supplementation have been demonstrated to improve mental development and behavior, in addition to mortality figures. In Pangalengan, Indonesia, the team of Pollitt, et al., administered varying amounts of calorie and iron supplements to children at risk for malnutrition. The authors noted that the cohort with the most calories (1171 kJ) and highest iron dosage (12 mg) walked sooner, scored higher on the Bayley Scale, and showed improvement in social-cognitive and emotional behaviors compared to the children on a lower dose supplementation regimen.[20]

A relatively novel approach has been the employment of fortified foods in defense against malnutrition. Food fortification to restore nutrients lost during the processing of certain foods has been in place for over 80 years in industrialized nations.[21] With

increased focus on the deleterious effects of micronutrient deficiencies, food fortification has expanded in lower-income countries. The widespread use of iodized salt has assuaged iodine deficiency globally.[15] Other campaigns have taken a more direct approach to micronutrient deficiency. Vitamin A supplementation efforts often utilize large, single-dose vitamin A capsules.[22] In a 2002 study, Bhandari, et al., demonstrated that Zinc supplementation in northern Indian children substantially reduced the incidence and duration of severe diarrhea, important determinants of diarrhea-related mortality. [23]

Macronutrient supplements (e.g., Plumpy'Nut™) have also been developed to combat malnutrition. However, these calorie-dense "ready-to-use therapeutic foods" are typically utilized exclusively in cases of severe acute malnutrition.[24] Perwestri, et al., investigated the clinical and cost effectiveness of programs utilizing locally produced ready-to-use food (RUF) biscuits to counter mild and moderately wasted children in Indonesia. The authors specifically examined the differences in daily and weekly distribution of the biscuits to the children. Implementation costs were found to be comparable at roughly $4/day/child for both groups. Daily and weekly schedules each demonstrated significant recovery (78.6% and 65.4% respectively) and weight gain (3.7 and 2.2 g/kg/day). While the daily distribution of RUF biscuits resulted in superior outcomes at a comparable economic cost, the researchers determined the "social cost" to the community to be twice as high for the daily program.[25]

Despite numerous studies lauding the successes of micro and macronutrient supplementation, the WHO food fortification guidelines acknowledge its many limitations. Potential barriers include inefficient supplementation in target populations due to limitations of access, insufficient dosage (inadequate intake or increased demand),

manufacturing cost, and safety considerations.[21] Any malnutrition rehabilitation program looking to implement a food fortification/nutrient supplementation strategy should address these concerns and be certain that their dosing guidelines, logistics, and facilities are appropriate to sustain such an intervention.

While the direct intervention approach of nutritional supplementation has repeatedly demonstrated dramatic responses in efficacy trials, other (often deemed more sustainable) 'upstream' options have also been implemented and investigated.[26] Many of these routes focus on altering the context of undernutrition via adjustments in the social aspects of a child's life, e.g. education, discrimination, income, housing, etc.[7] In this context, the WHO urges the use of non-health sector interventions in addition to the traditional clinic-centered approach (Table 1). In their report, the WHO stresses the importance of multisectoral methods to target the different causes of malnutrition, integrating education, health, sanitation, agriculture, etc. to construct the most comprehensive and sustainable interventions.[7]

Table 1. Health sector and non-health sector centered interventions[7]

Intervention	Link
Other nutrition-related health interventions affecting women and children	
Prevention of adolescent pregnancy	
Pregnancy spacing	
Intermittent preventive treatment of malaria in pregnancy	
Prevention and cessation of tobacco, alcohol and drug consumption in pregnancy	
Reduction of indoor air pollution	
Prevention and control of occupational risk in pregnancy	
Prevention and control of genitourinary infections in pregnancy	
Provision of insecticide-treated bednets (to prevent malaria and anaemia in pregnant women)	http://www.who.int/elena/titles/bednets_malaria_pregnancy/en/index.html
Properly-timed cord clamping	http://www.who.int/elena/titles/cord_clamping/en/index.html
Deworming of children and adolescents	http://www.who.int/elena/titles/deworming/en/index.html
Deworming of pregnant women	http://www.who.int/elena/titles/deworming/en/index.html
Handwashing with soap and other hygienic interventions	http://www.who.int/elena/titles/wsh_diarrhoea/en/index.html
Household water treatment and safe storage	
Community promotion of sanitation	
Non-health related interventions with an impact on nutrition	
1. Agriculture and food production	
Micronutrient fortification of staple foods	http://www.who.int/elena/titles/biofortification/en/index.html
Micronutrient fortification of complementary foods	
Salt iodization	http://www.who.int/elena/titles/salt_iodization/en/index.html
Water fluoridation	
Interventions to improve food security at household level	
Production of nutrient-rich foods and staple foods of the poor	
Home gardening and large-scale fruit and vegetable production	
Micronutrient-rich crop varieties (e.g. orange-flesh sweet potatoes)	
Diversified food production, and improved storage and processing of food	

Intervention	Link
Interventions to improve the nutritional quality of foods (reduction of the content of salt, fats and sugars, and elimination of trans-fatty acids	
Agricultural activities that generate employment	
Small-scale agriculture	
Nutrition counselling integrated into agricultural extension programmes	
Women's role in agriculture supported	
2. Social protection	
Conditional and unconditional cash transfers	
Food aid	
3. Trade	
Taxation, subsidies or direct pricing to influence prices and encourage healthy eating and lifelong physical activity	
Approaches, i.e. stepwise or comprehensive, to reduce the impact of marketing of foods high in saturated fats, trans-fatty acids, free sugars or salt to children	
Provision of food in public institutions	
Implementation of the International Code of Marketing of Breast-milk Substitutes	
Information to be provided on key nutritional aspects, as proposed in the Codex Guidelines on Nutritional Labelling	
4.Education	
Women's primary and secondary education	
Improvement of diet and physical activity in schools	
5. Labour	
Support to lactating working women (through adopting and enforcing ILO Maternity Protection Convention, 2000 (No. 183) and Recommendation (No. 191)	
6. Information	
Conducting social marketing campaigns	
Labelling of food products	
7. Water and sanitation	
Improvement of water supply	
Improvement of sanitation	

One such successful "non-health sector" intervention was implemented by Inyati, et al., who investigated the effectiveness of two different nutritional education methods.[27] The authors compared a weekly intense nutritional education program to a monthly non-intense program. The knowledge and practices of each cohort were evaluated via questionnaire pre- and post-intervention. The results showed no significant difference in knowledge levels pre-intervention. However those relegated to the intense weekly education scored significantly higher on their post-intervention assessment than their counterparts.[27] The improved knowledge retention following more aggressive education with limited interruptions demonstrates the importance of such an approach to educational initiatives when feasible.

Another important factor in childhood malnutrition is the accessibility of nutritious foods. Looking specifically at agricultural concerns in low-income countries, the UN Human Developmental report states "rising and volatile food prices, increasing pressure on natural resources, climate and environmental variability" combine to further stress an already heavily burdened sector.[28] Having limited resources available to allocate towards the purchase of nutritious foods is a significant challenge in low-income countries. Food prices continue to rise while remittances from family members abroad have declined, further complicating budgeting issues for extremely resource-poor families who are often forced to choose between food, shelter, or healthcare.[28] Successful nutrition rehabilitation programs must acknowledge these barriers to access and either directly intervene or tailor their efforts to remain culturally relevant.

The WHO also emphasizes the importance of community buy-in. Many aspects of these interventions require substantial behavioral changes (e.g. exclusive breastfeeding,

hygiene, etc.) and a nurturing environment with a supportive staff is essential to successful implementation and sustainability of these life modifications. They stress the need to focus on not only the content and efficacy of specific interventions, but also on the platform and routes of administration of various services. These interventions must remain locally relevant and culturally competent to sustain a successful impact.[7]

One such intervention that aimed to integrate multiple approaches was carried out in migrant communities of the Dominican Republic. Parikh, et al., investigated the role of food supplementation integrated with routine healthcare.[29] Children receiving healthcare at mobile clinics were screened for malnutrition and enrolled in the food supplementation program accordingly. While a control population was not feasible logistically or ethically, this observational study demonstrated significant improvement post-intervention. Both acute and chronic malnutrition rates decreased significantly (40% to 23% and 33% to 18% respectively) from 2005 to 2006.[29] These results demonstrate the importance of an integrated, multifactorial approach to malnutrition interventions.

DISEASE BURDEN: PERU

Malnutrition affects thousands of Peruvian children each year. Approximately 1 in 4 Peruvian children under five suffer from stunting secondary to chronic malnutrition, leading not only to diminished physical growth but also reduced school performance, socioeconomic status, and earnings.[30, 31] UNICEF has estimated the undernutrition prevalence in children less than five years old at 18% in urban areas, and up to 33% in rural areas of the country.[32] Risk factors include food insecurity, rapid population expansion, poverty and economic disparities, and high prevalence of communicable diseases.[31]

The Global Health Observatory Data Repository published by the World Health Organization reports the under-five mortality at 19/1000 live births in 2010, compared to 8/1000 in the United States in the same year.[33] This value is a conservative estimate compared to UNICEF's figures, which report Peru's under-five mortality rates as 22/1000 in urban areas and 39/1000 in rural settings.[32] Both groups recognize that Peru has made considerable progress over the past two decades, bringing the infant and child mortality rates down from 43/1000 and 59/1000 in 1996 to 21/1000 and 29/1000 in 2004-2006 respectively.[33] However the prevalence of childhood chronic malnutrition remained roughly 25% from 1998 to 2008. This figure includes dramatic regional differences, with some areas reporting nearly half (49%) of their children as undernourished.[33] Reflecting the global trend, malnutrition is more prevalent among the poorer populations within the country. According to a Pan American Health Organization's 2005 report, children in the poorest quintile in Peru are eight times more likely to die from nutritional deficiencies compared to the country's richest 20%.[34]

CAUSATION AND INTERVENTIONS: PERU

Poverty and food insecurity are the two broad, intimately associated, explanations for the increased prevalence of malnutrition in particular areas of Peru. Much of Peru's land is not suitable for food production, and, unsurprisingly, these areas have the highest prevalence of malnutrition. The highlands produce less food, leading to increased costs. The poorest members of a community, and children in particular bear the largest burden of these price fluctuations.[32] These populations also consistently demonstrate the poorest access to markets and education, complicated by transportation and infrastructure challenges. In 2005, the Peruvian Ministry of Health reported a dramatically inverse

relationship between maternal education and childhood malnutrition. They describe under five malnutrition rates of 54.5% for children of mothers with no education, decreasing to 16% of children whose mothers obtained a secondary education, and down to 3% in children of mothers with a tertiary education.[35]

Barriers to obtaining safe water, adequate nutrition, and hygiene present potential targets for intervention. With this in mind, the Peruvian Ministry of Health in 2011 outlined its goals for management strategies aimed to decrease undernutrition rates by 2021. These goals include reducing the rate of chronic malnutrition in children <5 years of age to 6% and anemia in the same age group to 12%, among other objectives.[31] The Ministry of Health plans to achieve these goals by invoking assistance from all levels of society, including professionals, government officials, non-profit organizations, and lay members of the Peruvian society to work together to improve indicators of malnutrition.

Vaso de Leche and Comedores Populares are two heavily government-funded programs in Peru working towards improving childhood nutrition.[30] Much like the Women, Infants, and Children (WIC) program in the US, Vaso de Leche provides food to low-income pregnant women and children less than six years old. However, abuse of this program has been reported, with up to 94% of beneficiaries in Lima exceeding the income threshold, and has widely been declared a failure in targeting malnutrition.[36] Comedores Populares is a program that establishes satellite "kitchens" throughout the country to provide meals at little to no cost for the poor, elderly, or infirmed. This program covers roughly half of its costs with local and national government funds.[30] Critiques of this program include their poorly targeted approach and concentration in urban areas despite the increased malnutrition prevalence in rural Peru. One study

showed less than 5% of Peru's extreme poor have access to Comedores Populares services.[36] In addition, The World Food Program, USAID, and the World Bank have all provided assistance in support of the country's nutritional deficiencies.

PROGRAM DESCRIPTION: EL COMEDOR

In response to the increased exposure of malnutrition and its consequences across the country, coupled with its government's support, many academic institutions pooled their resources in an attempt to respond to local needs. One such example comes from a research team from the Universidad Peruana Cayetano Heredia headed by Dr. Theresa Ochoa, an international leader in the field of childhood diarrheal disease and malnutrition. Designed to provide immediate relief while also targeting the root causes of malnutrition addressed above, El Comedor was established in 2009 in the neighborhood of Ermitaño Alto, an impoverished community on the outskirts of northern Lima. El Comedor operates out of a borrowed corner in the neighborhood's small ministry of health-run clinic where the children are brought 6 days a week by their caregiver. The program enrolls children between the ages of 6 and 36 months who are either currently malnourished or deemed to be at risk for malnutrition, defined as -1 height-for-age z-score. Each child is enrolled for 6 months, and the program supports 25 children at a time.

The most tangible service that El Comedor provides is direct nutritional assistance. Each child is provided with two balanced meals daily, six days a week, throughout their enrollment. The program's location in the health clinic provides the added benefit of a clean and safe environment where the children can eat one meal while the second is provided in a container to take to their homes. El Comedor's facilities

consist of a small kitchen for the cooking demonstration/meal preparation and a covered, enclosed, outdoor area equipped with tables and chairs where the children eat. In addition to this standard feeding program, El Comedor has provided their services as a pilot program for a number of government-lead nutrition initiatives. This includes an intervention aimed at evaluating the effectiveness of a purified fish protein supplement intended for use in publically funded school lunches.

Figure 5. Example from El Comedor's hygiene educational material[37]

Direct nutritional assistance alone is neither empowering nor sustainable. Thus, the educational component is emphasized throughout El Comedor's program. An onsite chef prepares the daily meals for the children while simultaneously instructing the children's caregivers on how to replicate this meal at home. They are also provided with

a copy of each day's recipe. Special attention is made to use only locally relevant, low-cost ingredients that are readily available to neighborhood families. In addition, an onsite nutritionist will be available daily to provide education regarding proper nutrition and to answer any of the caregivers' questions. Educational objectives include nutritional knowledge and behaviors (Figure 6), proper breastfeeding practices, recognition of common childhood diseases, and appropriate hygiene (Figure 5). The clinic facilities also provide the children an opportunity to practice their newly acquired hygiene knowledge under the supervision of trained health professionals. These daily, intensive educational efforts coincide with the increased efficiency of such an approach previously discussed.

Figure 6. Example from El Comedor's nutritional educational material[37]

During each child's enrollment in El Comedor, height and weight measurements are recorded weekly while hemoglobin levels and stool samples are examined on an as-needed basis. These data allow for the assessment of each child's health status, as well as the program's short-term success in improving malnutrition in the community. El Comedor's approach of providing a multifaceted intervention to alleviate childhood malnutrition in the setting of routine healthcare and health screenings corresponds with the majority of the successful, evidence-based strategies described above.

UTMB's collaboration with El Comedor began in the summer of 2010. That year, two students participated in the daily operation of El Comedor and focused on creating tools to increase awareness of and funding for the program. These efforts ultimately took the form of physical flyers, fundraisers, email announcements, and a website (www.elcomedor.org). Additional groups of students have returned each summer, and contributed to the mission in unique ways. One group quantified the short-term success of the program while another administered an extensive breastfeeding questionnaire throughout the community. UTMB continues to support the mission of El Comedor both on the ground and from afar by collaborating on innovative intervention strategies and providing human capital and monetary support.

Since El Comedor's inception in 2009, the program has ultimately been successful in carrying out its objectives despite briefly suspending operations earlier this year due to inadequate funding. El Comedor has relied on grant money and private donations to maintain their services. Their relatively low operational costs should allow for sustainable funding but donors require convincing data demonstrating the efficacy of the program. While protocols are currently in place to ensure the program's short-term

success, El Comedor lacks monitoring efforts that would demonstrate its continued effectiveness following the children's six-month enrollment. Establishing a low-cost, sustainable monitoring and evaluation program for El Comedor should help ensure the program's continuation and potentially increase its efficiency. With statistically sound methodology demonstrating significant improvement in anthropometric measures, knowledge retention, and behavioral changes, El Comedor would substantiate their impact and better position themselves to write successful funding proposals. In addition to monetary support, clearly defined results should improve the participation of the local population, which is critical to the success of any community-based intervention.

GENERAL PRINCIPALS OF MONITORING AND EVALUATION

Monitoring and evaluation (M&E) is best understood broken down into its individual components. Monitoring is defined as the systematic collection of project/intervention information with four main goals: to reflect on experiences in order to improve the program's functioning moving forward, to provide a source of accountability for resource utilization and program results, to inform decisions regarding the future course of the initiative, and to empower the participant population.[38] This practice is continually occurring throughout all aspects of an intervention, from planning stages to the conclusion.

The evaluation component is carried out via the information obtained during the monitoring efforts. Evaluation is defined as the assessment of a completed project or a specific phase of an ongoing project.[38] This step involves appraisal of the data collected to inform strategic decisions in regards to overall program improvement. Looking at

these definitions, the importance of an effective M&E protocol to the long-term success of any intervention should be readily apparent.

DEVELOPMENT OF M&E PROTOCOL

The M&E protocol developed in support of the study aims can be categorized into three interdependent arms: systematic anthropometric data collection (baseline and follow-up), administration of a novel caregiver schedule (sociodemographics, knowledge, attitudes, and beliefs), and the establishment of a user-friendly, comprehensive database for extensive and organized data collection.

In support of the first aim, anthropometric values from prior participants in El Comedor will be measured to quantify continued growth following completion of their enrollment. The use of growth monitoring and promotion (GMP) programs in conjunction with malnutrition interventions has become the subject of substantial scrutiny. Detractors point to the multiple factors contributing to measures of height and weight, unreliable/inconsistent measurements, complicated growth charts, and the unproven impact on morbidity and mortality.[39, 40, 41] The majority of concerns regard issues with the use of height and weight measurements as a screening tool for malnutrition rather than as a monitoring instrument.[41] Also, many of the studies demonstrated limited value of anthropometry when these measures are assessed in a vacuum. With the addition of supplementary inputs such as patient interviews and health history, anthropometric data has proven to be a valuable tool.[40] In a study of height and weight measurements in low-income countries, Gorstein, et al., determined weight for height z-scores and height for age z-scores to be sensitive indicators of short-term nutritional status and linear growth.[39]

The use of mid upper arm circumference (MUAC) to assess nutritional status has become commonplace worldwide due to its relative ease of measurement,[42] however, this practice has been similarly criticized as early as the 1970s.[43, 44] A 1976 study reported only a 57% agreement between MUAC and weight for height (considered the gold standard), resulting in misclassification of many undernourished children as normal.[44] Over time, improved technique, instruments, and standardization have improved the sensitivity and specificity of MUAC in assessing nutritional status. A 2012 study out of western Nigeria reported a specificity of 95.3% for identifying wasting via MUAC (with a 13.5 cm cutoff) when compared to weight for age.[42] Similarly, in a study of 1342 Zambian children age 0-60 months, McDowell, et al., found equivalent accuracy in MUAC and height/weight measurements in determining nutritional status, and recognize its use as an alternative to more cumbersome measurements in the field. However, these authors caution against the reliance on any one metric in isolation as a measure of a child's nutrition, stating, "Neither clinical judgment nor anthropometric measurements alone is likely to provide an adequate indication of the elusive quality 'nutritional status'."[43]

Accordingly, the M&E protocol established at El Comedor includes the measurement of children's height, weight, and MUAC. A child can be classified as wasted, stunted, and/or underweight with knowledge of only their height, weight, and age, proving these simple, non-invasive, cost effective, and objective values to be highly versatile and valuable. The addition of MUAC as a proven indicator of nutritional status improves the power of the analysis at negligible financial or labor cost. The setting of El Comedor addresses many of the criticisms associated with these measures. The

participants initial values will be measured by trained staff in a clinical setting, in conjunction with additional health analysis, while follow-up values will also be taken by trained staff and serve a monitoring role rather than function as a screening tool.

In support of study aim two, a novel schedule designed to assess various sociodemographic variables in addition to the knowledge, attitudes, and practices regarding malnutrition and nutrition behaviors of the children's caregivers was developed. The sociodemographic portion of the schedule aims to quantify various social risk factors for malnutrition and overall poor health. As previously mentioned, an effective malnutrition program must consider factors outside of what is traditionally deemed the realm of nutrition and health to achieve and sustain successful rehabilitation.[7] Identifying the community's greatest needs is vital for targeting potential social interventions. To this end, questions from a previous study conducted by Dr. Ochoa's team in this community were incorporated into the M&E questionnaire.[45] These validated questions target some of the most prevalent social determinants of poor childhood nutrition including: family size, parental education, housing conditions, possessions, income, and expenses. Analyzing these data in conjunction with the children's nutritional status will assist in the identification of the strongest sociodemographic risk factors for malnutrition specific to Ermitaño Alto and, in turn, aid in designing future targeted interventions. These data can also be used to develop a model for the identification of children at risk for malnutrition.

The remainder of the M&E schedule takes the form of a knowledge, attitudes, and practices (KAP) survey aimed at achieving a better understanding of the community's outlook on nutrition. Although numerous survey methods have been established to

quantify these abstract concepts, the KAP design has become the most widely utilized. A recent investigation of anthropological methods in malarial research credits the KAP survey's "easy design, quantifiable data, ease of interpretation and concise presentation of results, generalizability of small sample results to a wider population, cross-cultural comparability, speed of implementation, and the ease with which one can train numerators" for its rise in popularity.[46] Indeed, these are the reasons the KAP survey approach was the chosen format for the El Comedor M&E protocol. While no social science methodology is without its detractors, general consensus among the international health community regarding the superior validity of KAP surveys in the implementation of healthcare programs has been reached.[46]

Various methods of question formation and validation were employed in the development of the schedule in an attempt to precisely serve the target population. The schedule designed for El Comedor's M&E protocol was compiled from a number of sources to specifically assess general nutrition, breastfeeding, typical dietary intake, and the perceived utility of El Comedor among previous participants. The first block of questions attempts to assess general nutritional understanding, at the same time evaluating the effectiveness of El Comedor's caregiver education efforts during a child's enrollment.[37] Question style and formatting were modeled after well-validated nutrition assessments in the United States,[47] the UK,[48] and Latin America,[49] and content was tailored to locally relevant foods and current El Comedor education materials. This section primarily investigates knowledge of macro and micronutrients and the foods that supply them, specifically focusing on iron deficiency due to its high prevalence in the region. It also attempts to assess a caregiver's knowledge of prevention and recognition

of diarrhea and dehydration. A draft of these questions was originally created in English and translated to Spanish. After translation, the questions were provided to the local community health workers who will be administering the schedule. With their input, appropriate regional grammatical and vocabulary adjustments were made to ensure the questions more accurately gather the information being sought.

The second portion of the schedule focuses on breastfeeding knowledge and practices. Breastfeeding accounts for a significant proportion of the questions as its value in decreasing child morbidity and mortality is well established. Improved breastfeeding practices have been projected to potentially save the lives of 1.5 million children annually.[7] Potential benefits of breastfeeding to the child, mother, and community at large have been well documented; however, the best interventional approach to increase breastfeeding rates remains unclear. Potential barriers to exclusive breastfeeding remain and educational efforts alone will most likely not be adequate to increase rates.[50] To design appropriate interventions, assessing breastfeeding rates and attempting to identify pertinent potential barriers are essential. For this assessment, we adapted previously locally validated questions from another of Dr. Ochoa's ongoing projects investigating neonatal sepsis.

Two compound questions addressing household hunger follow the breastfeeding section of the schedule. USAID released a Food and Nutritional Technical Assistance (FANTA) report aiming to introduce a household hunger scale (HHS) as an indicator of hunger and food insecurity, with the goal of identifying a household as having little, moderate, or severe household hunger.[51] Adapted from this cross-culturally validated questionnaire, the M&E schedule questions attempt to quantify a household's food access

in the previous 4 weeks. In addition, the caregivers' reaction to a child who refuses to eat is also assessed as this response may have an important impact on an infant's nutritional status.

The next section addresses the caregivers' satisfaction of El Comedor's efforts, and its perceived utility. These subjective questions provide information on the long-term implementation and retention of the program's various undertakings. Caregivers will be able to report on the aspects that they perceive to be the most and least effective of the intervention. These questions also serve to assess any behavioral changes following the intervention and perceived barriers to providing a nutritious diet for their dependents.

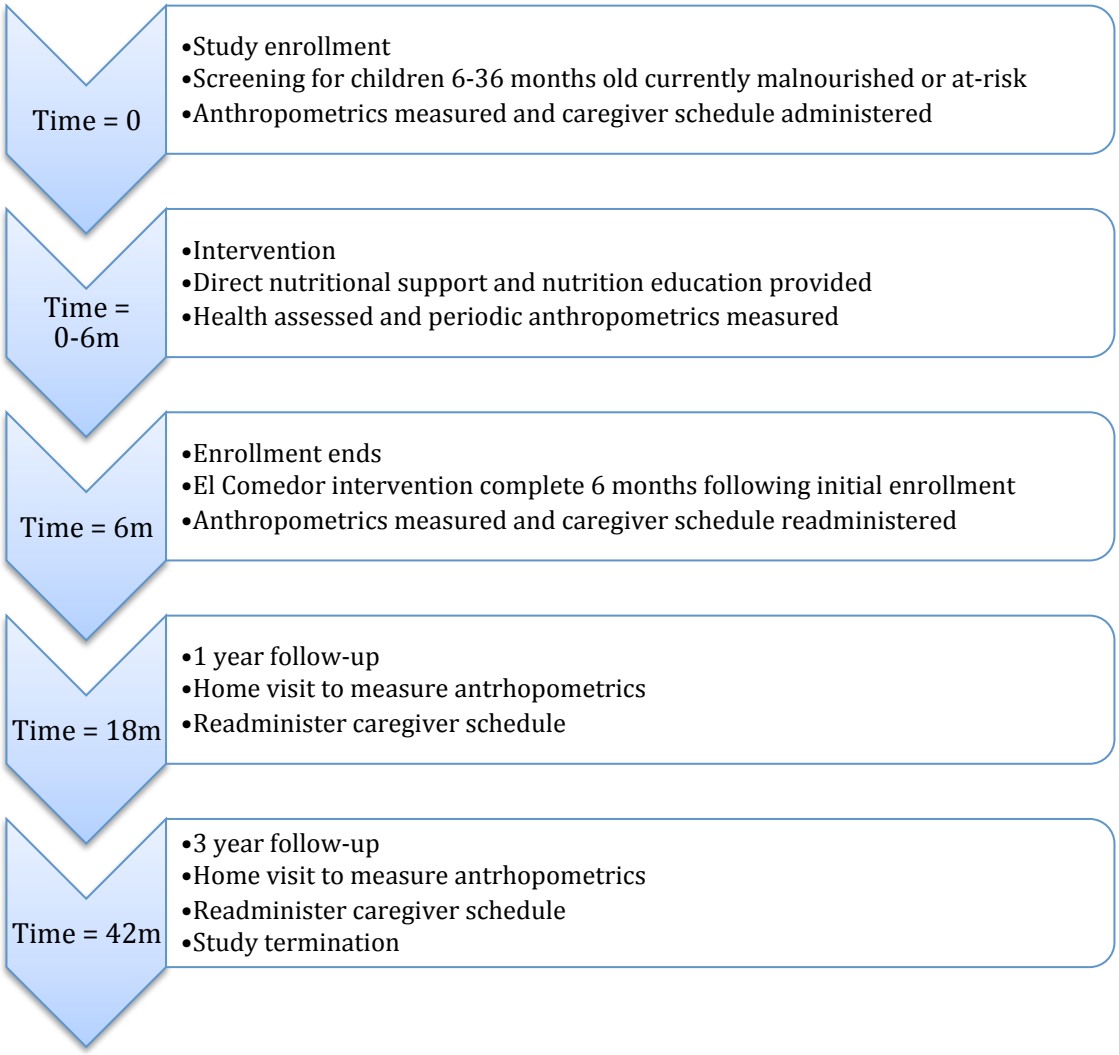
The nutrition portion of the schedule ends with a 24-hour food recall. The 24-hour food recall was designed and implemented in accordance with the Virginia Expanded Food and Nutrition Education Program (EFNEP).[52] This should aid in identifying a typical diet for both the caregivers and the children. Having a better understanding of the foods being purchased and consumed should serve to identify dietary insufficiencies as well as inform education efforts, survey questions, and appropriate ingredient utilization for cooking demonstrations. The current form of the M & E schedule can be found in Appendix A.

Chapter 3 Methods

IMPLEMENTATION

The pilot implementation of the schedule during follow-up home visits for 102 previously enrolled participants served as a cross-sectional survey to identify a number of cultural beliefs, nutritional understanding, the prevalence and duration of breastfeeding, the prevalence of hunger indices, and the typical diet in the study population. This initial administration also functioned to improve the quality of the questions utilized in the schedule. Those identified as confusing regarding language and syntax, misunderstanding, or multiple interpretations were recorded by the interviewer and later reviewed by program administrators. Analysis of the participants' responses will allow for further validation of the tool. Once validated, this schedule will function as a pre- and post-intervention assessment. First, when a child is enrolled in El Comedor their caregiver's knowledge, attitudes, and practices will be evaluated, and a second time upon completion of El Comedor's education protocol to evaluate the short-term success. Finally, a version of the schedule will be completed 2 additional times during long-term follow-up visits roughly 1 and 3 years following completion of the program to determine educational retention, behavioral change, and participant satisfaction with the program (Figure 7).

Figure 7. Timeline for El Comedor enrollment and follow-up



For the post pilot-phase roll-out of the M&E protocol, all of the children who have participated in the nutrition rehabilitation program comprised the study population, including as many past participants as possible in the analysis (102 children). Prior to implementation of the protocol, IRB approval was received from UTMB and Universidad Peruana Cayetano Heredia in Lima, Peru. Employing the help of two local community health workers and the El Comedor database, the homes of past participants and local food sources in Ermitaño Alto were mapped out. The community health workers and

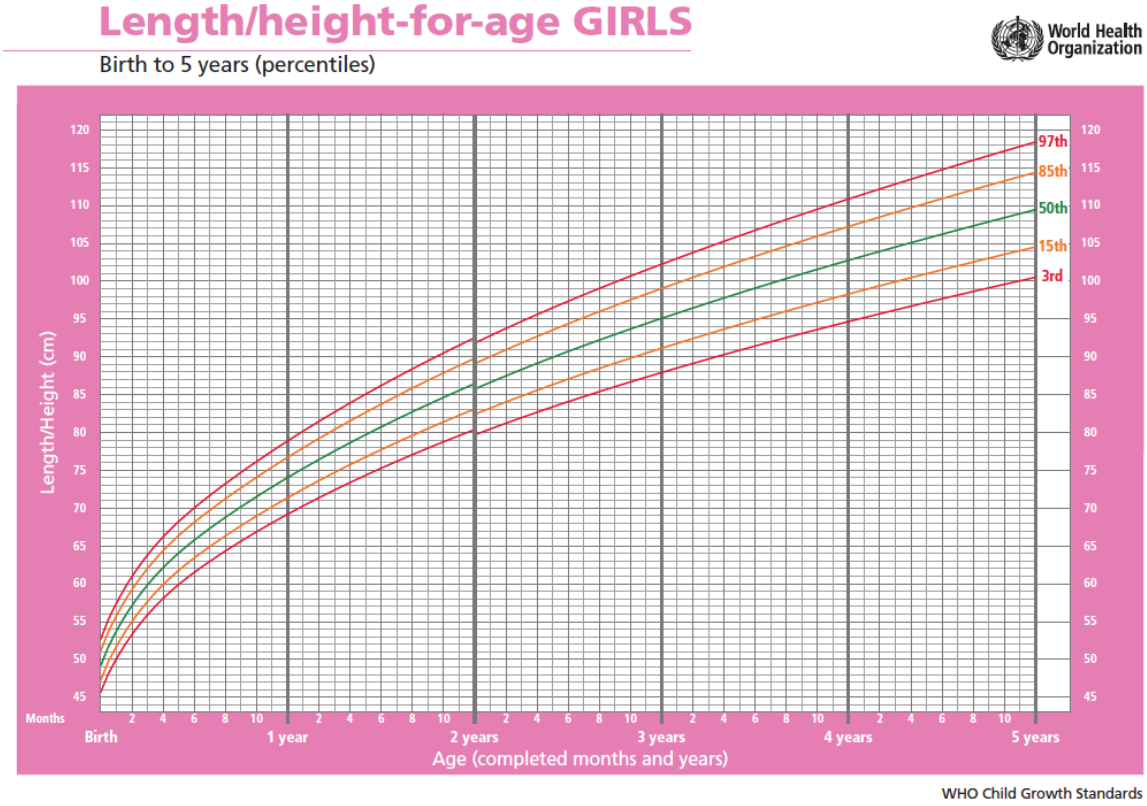
participating UTMB students were trained in obtaining consent, administering the KAP survey, and taking anthropometric measures before beginning fieldwork.

Upon arriving at the home of a child who had completed the program, informed consent was obtained from the caregiver in Spanish. Once consented, the Spanish language KAP schedule was administered to the child's caregiver. Concurrently, using a portable scale and cloth measuring tape, the child's height, weight, and mid-upper arm circumference were measured and recorded. Obtaining the caregiver's responses to the schedule and the child's anthropometric data concluded the assessment. Before the team left the home, the child/children's current nutritional status was explained to their caregiver using the WHO's international standard growth curves and any questions were answered.

The anthropometric values measured are assessed in conjunction with the children's baseline data recorded during their enrollment in El Comedor and compared to the WHO international growth standards (Figure 8). In addition to the measurement of MUAC, height and weight data facilitate the calculation of a variety of nutrition indicators, namely the prevalence of underweight, stunting, and wasting in the intervention group. Identifying a control population with which to compare El Comedor participants' growth values is complicated by logistic, financial, and ethical constraints. The ideal control group would be comprised of children in the same or similar community at risk for malnutrition or currently malnourished. Identifying these children and intentionally excluding them from any nutritional intervention would, of course, be highly unethical. Primarily for this reason, a control group was not included in the design of this evaluation.

With the lack of a control group as a limitation, the World Health Organization Child Growth Standards were selected as the control for analysis. (Figure 8) Released in 2006, these WHO standards represent the first globally representative growth charts.[53] Recognizing their limitations, the WHO international child growth standards provide an adequate barometer to assess the study population's growth metrics. This will allow for growth comparisons before and after participation in El Comedor, and while the program's at-risk population's growth rates are unlikely to have completely caught up with those of the relatively idealized standardized population, any progress can at least be quantified.

Figure 8. Example WHO Growth Chart: Girls 0-5 years old, Height/Age[54]



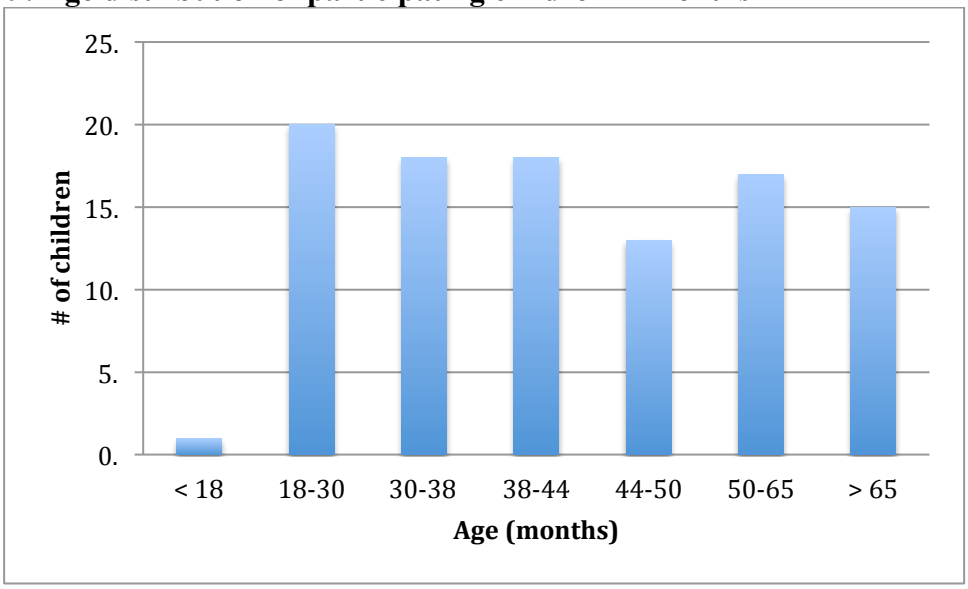
The final component of the M&E protocol is the establishment of efficient data collection tools. In order to maximize efficiency during home visits, paper field collection forms for this protocol have been designed to emphasize clarity without sacrificing comprehensiveness. Corresponding databases have also been established utilizing Excel, which is readily available on all local PCs. A study key with the participants' names and study numbers has been encrypted and stored on a single computer, separate from study data. Upon the team's return to the clinic following home visits, data collected with the paper forms were transcribed into these electronic databases identified only by their unique study ID. The majority of the KAP questionnaire responses have been transformed to numeric values to facilitate data entry and analyses. Also, a comprehensive Excel database was created for El Comedor's routine data collected throughout a child's enrollment. Previously the values recorded and their location were highly user dependent, making for very inefficient data collection and analysis. This comprehensive, standardized database should provide a clear indication of the values to be documented and a single location for the storage of all data pertaining to El Comedor enrollees.

Chapter 4 Preliminary Results

SOCIODEMOGRAPHICS

From May 27 to June 26 of 2013, the research teams performed 78 home visits and collected 78 caregiver surveys. Due to a number of households containing multiple past participants, data were collected on 102 children, 52 females and 50 males. The average age of the children was 49 months, ranging from 18 to 169 months. (Figure 9) The diarrheal prevalence was found to be 11% in the children visited, and a diarrheal incidence rate of 1.37 diarrheal episodes per person-year.

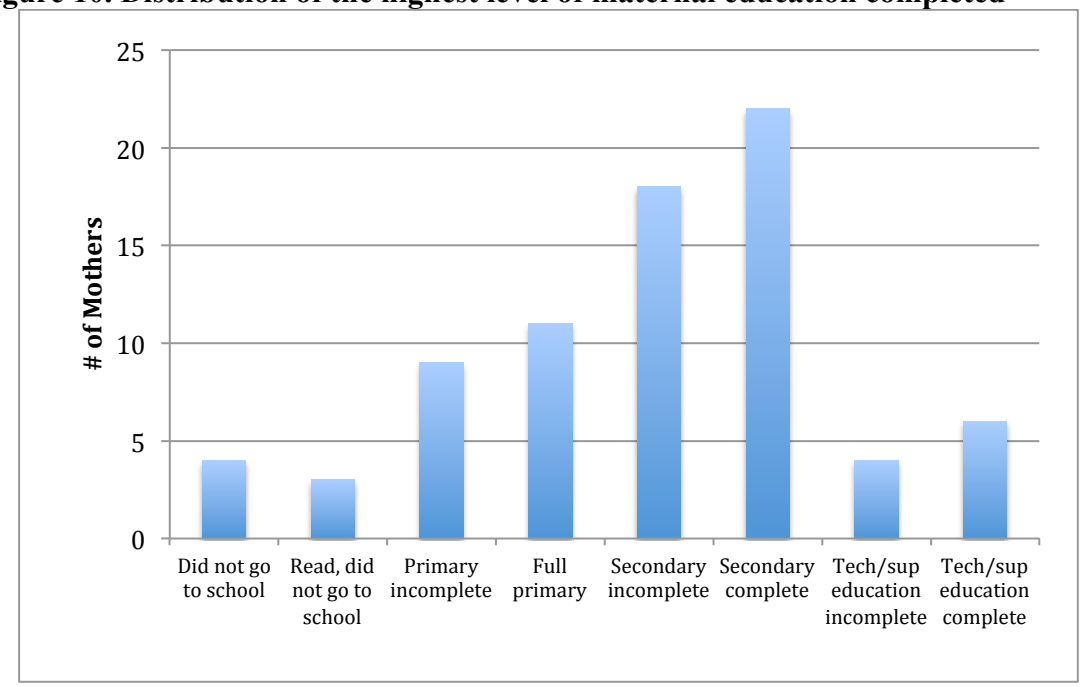
Figure 9. Age distribution of participating children in months



The knowledge, attitudes, and practices (KAP) schedule was administered to 78 caregivers, all mothers, with a mean age of 29 years old (range 16-48). Only 21% of the mothers are employed, and less than half (32/77) had completed secondary school

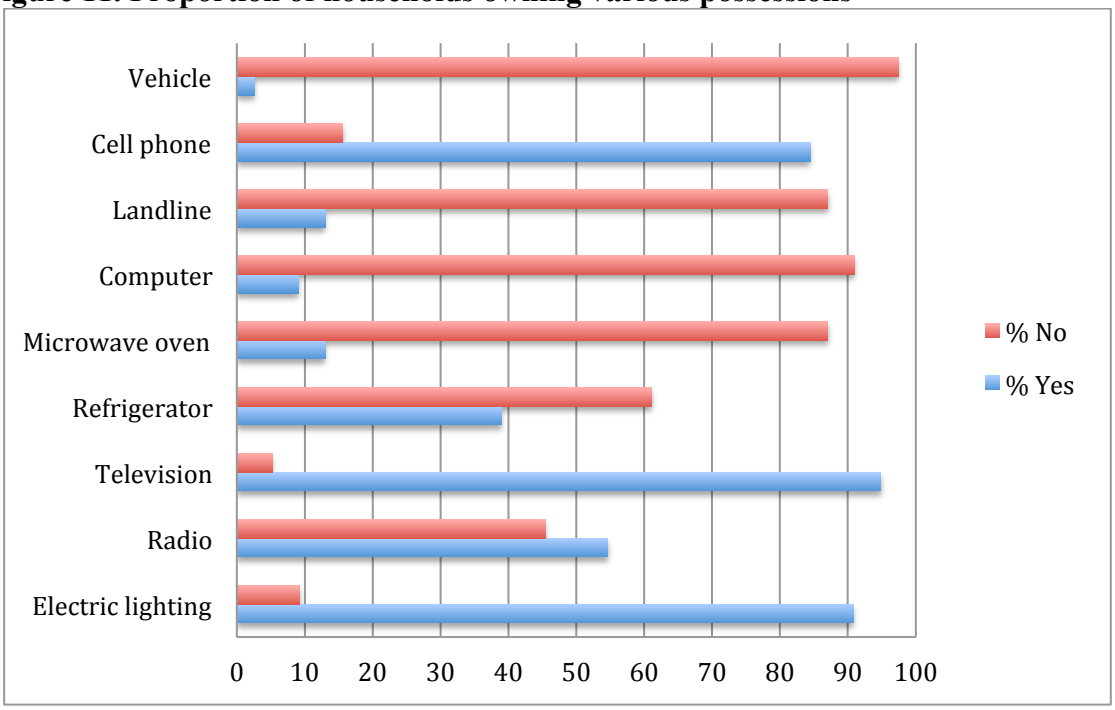
(Figure 10) despite the fact that 92% of Peruvian students typically progress from primary to secondary school.[55]

Figure 10. Distribution of the highest level of maternal education completed



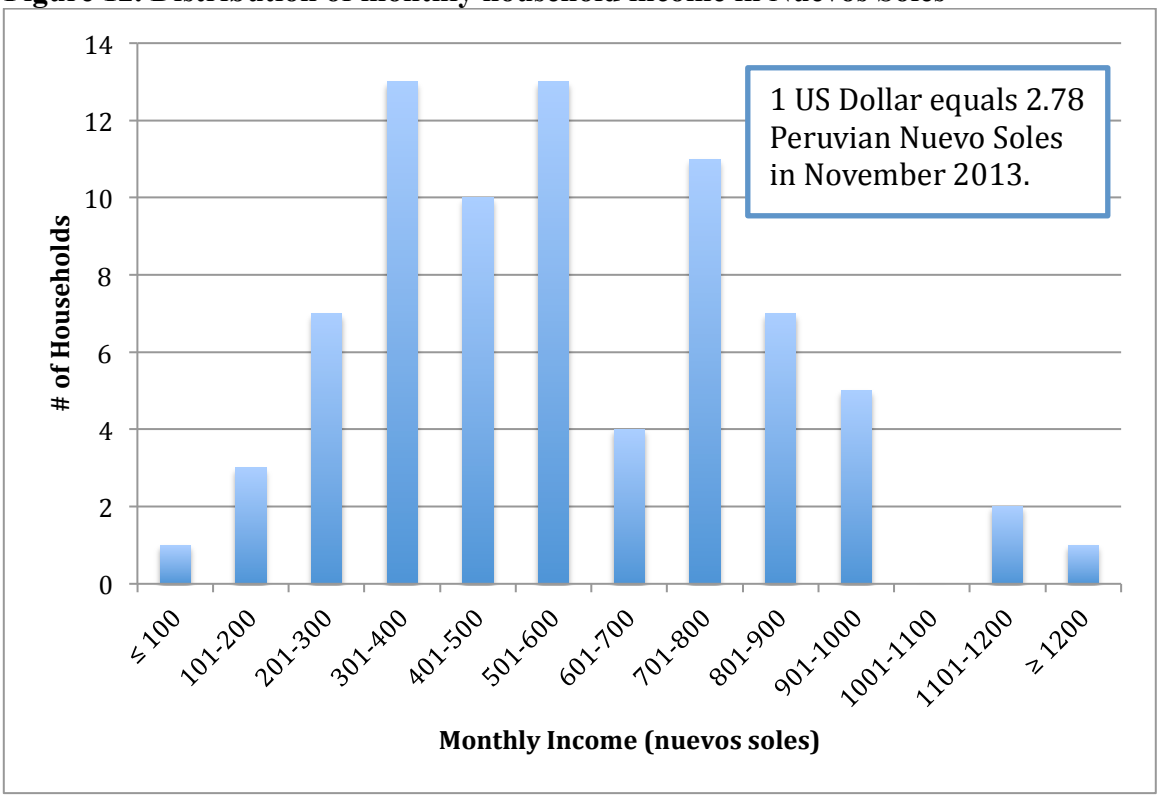
The average household surveyed contains 5 people (range of 2-15), including an average of 1.5 children less than 5 years old, despite caregivers reporting a mean of only 1.5 bedrooms (range 1-8) per home. Regarding household possessions, 73 mothers (95%) reported having a television, 65 (84%) own a cell phone, while only 10 (13%) have a landline and 7 (9%) possess a computer (Figure 11). 30 (39%) of mothers report having a refrigerator in the house and only 2 (2.6%) report owning a vehicle.

Figure 11. Proportion of households owning various possessions



The monthly household salary of those surveyed ranged from 100 Peruvian Soles ($36 US) to 2000 Peruvian Soles ($720 US) with an average of 617.2 Peruvian Soles ($222.26 US) (Figure 12). Daily household food expenditure ranged from 10 Peruvian Soles ($3.60 US) to 30 Peruvian Soles ($10.80 US) with an average of 18.23 Peruvian Soles ($6.56 US). Half of the households (39/78) reported that at some point over the past 4 weeks they have had no food of any kind to eat in the house, and over half (40/78) report going to sleep at night hungry at least once over the same time period.

Figure 12. Distribution of monthly household income in Nuevos Soles

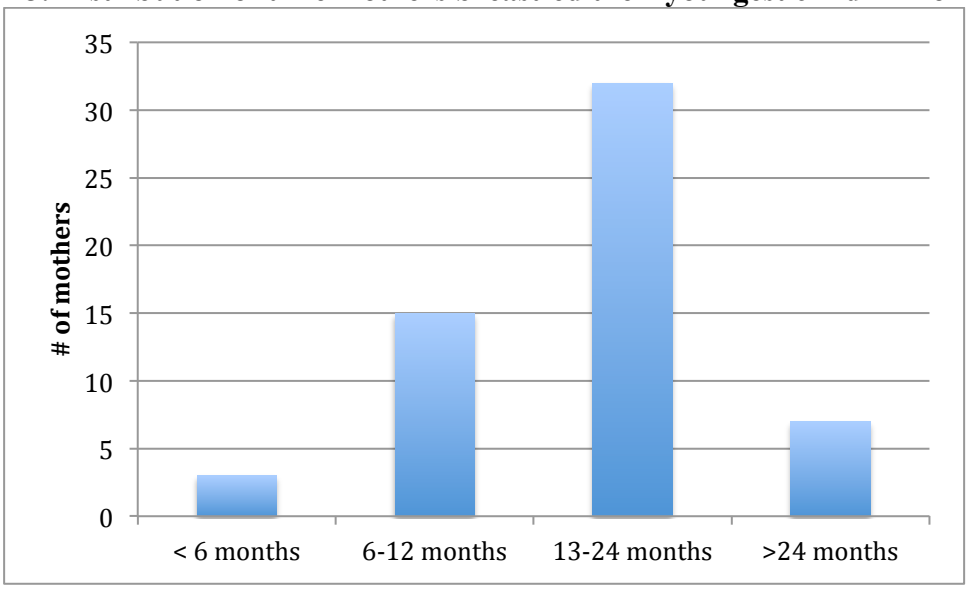


KNOWLEDGE, ATTITUDES, AND PRACTICES

With respect to nutritional knowledge and attitudes, only 44% (34/78) of caregivers responded that iodine was important for their child's development, and 92% (72/78) agreed that overweight individuals could not suffer from anemia. However 61% (48/78) of respondents correctly identified iron as a component of red blood cells, and 97% (76/78) agreed that anemia can cause decreased physical and mental performance. Additionally, 96% (74/77) of mothers identify breast milk as being better for their children than formula, 97% (76/78) report breastfeeding their youngest child, and the majority (32/57) breastfed for 13-24 months (Figure 13). The schedule also included a

24-hour food diary to better understand the typical diet of the community's parents and children.

Figure 13. Distribution of time mothers breastfed their youngest child in months



Another important aspect investigated by the schedule regards the community's perceived utility of El Comedor. 100% of caregivers either agreed (15/77) or strongly agreed (62/77) that El Comedor was beneficial for their family. 100% of the mothers also either agreed (17/78) or strongly agreed (61/78) that they felt more comfortable providing a balanced diet for their children after attending the program.

ANTHROPOMETRICS

Descriptive statistics on anthropometric measures are not reported here as the age range is to wide for height and weight comparisons to be meaningful. These values are currently being used to calculate z- and t-scores that will be compared to the children's

baseline values during their enrollment in El Comedor to assess any change in the prevalence of chronic malnutrition in this population. These values will also be compared with age-matched World Health Organization international growth curves as controls to quantify this population's growth status in relation to expected growth given relatively ideal nutritional practices and social setting.

The anthropometric data will be stratified according to the sociodemographic and knowledge data presented above, based on the caregiver schedule, to better identify at-risk subpopulations. Linear regression will be utilized to identity any correlations between nutritional status and the other variables assessed via the KAP schedule.

Chapter 5 Discussion

Over the past five years, El Comedor has efficiently provided malnutrition rehabilitation services in the resource limited setting of Ermitaño Alto, Lima, Peru. Based on successful malnutrition intervention strategies described in the background, the team has provided a combination of direct (food supplementation) and indirect (health assessments, nutrition and hygiene educational initiatives, etc.) nutritional assistance to achieve sustained results in the community. This M&E protocol addresses a deficiency in El Comedor's operation to clearly demonstrate its effectiveness, improve efficiency, and ensure long-term sustainability. Implementation of such a protocol should allow the program to more easily quantify their impact on the community, assess their strengths and weaknesses, while also more clearly demonstrating their value to the community and potential donors.

This quality improvement protocol will provide El Comedor with data to assist in monitoring its effectiveness, sustaining the operations of the program, and aid in the design and implementation of future interventions. For example, the results regarding nutritional understanding can be used to inform the maternal education curriculum utilized during enrollment in El Comedor. This initial implementation sought to identify gaps in the community's knowledge regarding proper eating habits and the sequelae of malnutrition, while its future implementation will be utilized as a pre- and post-intervention tool to assess the success of El Comedor's educational initiatives.

By cataloging socio-demographic risk factors, the project should allow El Comedor to tailor its services to best fit the needs of the community and improve the identification of children at-risk for chronic undernutrition. Noting household possessions

(Figure 11) helps to better understand the setting of chronic malnutrition and assess potential barriers to proper nutrition (transportation, storage, etc.), while also informing appropriate avenues for interventions, e.g. the use of cell phones instead of landlines or computers for public health campaigns. In addition, extrapolating the mean monthly income (Figure 12) and daily food expenditures out to their yearly values, we find that 90% of income is spent on food. Using different recall periods is an obvious source of bias in this calculation, regardless, it can be deduced that a majority of household income is spent on feeding the family. This sociodemographic information should also help to inform more upstream approaches that target the social structures at play regarding chronic malnutrition.

This protocol also provides feedback from participants on any behavioral changes they have enacted, their knowledge retention from El Comedor enrollment, and informs any necessary programmatic adjustments. These results also aim to clearly inform El Comedor's nutrition protocols and create applicable and scalable guidelines for similar resource-limited settings. Finally, the data collection and data entry instruments that were created can serve as a sustainable tool for program efficiency, in addition to monitoring and evaluation.

The implementation and preliminary data analysis has highlighted the faults in this protocol design, some were anticipated, others were not. The most glaring weakness of this study design is the lack of a control group. As mentioned previously, a control group selected from the community was not feasible logistically or ethically. The WHO international growth standards provide an adequate comparison, but not as strong as a group selected from the same community, with the same risk factors. To address this in

future installments, we may seek out other studies being implemented in similar communities. If these populations are of the same age range and risk status, this data can serve as El Comedor's control population without the ethical implications involved in identifying at-risk children without intervening.

An additional weakness is the relatively low number of children contributing data for this initial evaluation. The research group had some difficulty identifying and locating past participants of El Comedor. This was largely due to disorganized and incomplete data collection during the children's enrollment (understandably, the focus of El Comedor was to rehabilitate malnourished children, not to generate statistically sound data). This issue should be significantly improved with the use of the newly designed comprehensive Excel database. Other issues will likely surface during further data analysis due to the inconsistencies regarding El Comedor inclusion criteria. Occasionally ethics won out over good study design, as certain malnourished children were enrolled who were well out of 3-36 month old range. Additionally, during participation in the country-wide purified fish protein study,[37] El Comedor enrolled children not at-risk or currently malnourished. These children were also included in this evaluation, however the group is labeled and can be easily excluded during analysis.

A number of areas for improvement in future installments of this M&E protocol, including those mentioned above, have already been identified. Two adjustments involve improving data collection and entry. While the comprehensive Excel database should improve efficiency and consistency, it does not possess the most intuitive interface. The implementation of a user-friendly data entry interface (e.g. the Centers for Disease Control and Prevention's Epi Info) should make data entry easier and more efficient.

Another technological advancement that could improve the function of this protocol is use of electronic devises and software to record measurements and schedule responses during home visits. This would eliminate errors in transcribing handwriting and remove an entire step in data entry. On-site data entry provides a litany of other advantages, including GPS mapping of home visits, decreased clutter for CHWs, and electronic signatures for consent to name a few. Many software packages also allow for participant input via SMS services on the cellular phones. These are not decision to make frivolously. It is essential to work with the local staff to decide the most appropriate direction to take. The staff will be the ones utilizing these systems on a daily basis, so it is crucial that they be intricately involved in the selection process to ensure the software is intuitive and serves all of their needs. The implementation of these systems will also require substantial training. CHW training in general was lacking in this initial implementation. For future installments, more focus will be place on CHW training in anthropometric measurements and appropriate schedule delivery, regardless of the implementation of the above software adjustments.

With increased time and funding, there are a number of additions that can be made to enhance this protocol. One involves the assessment of additional variables. Assessment of growth indices was chosen due to its ease of measurement and cost-effectiveness, however this is far from the only metric useful to assess the impact of malnutrition and the success of interventions. Ideally this protocol will eventually include the collection of blood and stool samples to determine El Comedor's impact on anemia and parasite burden. Also, it would be very beneficial to investigate other health metrics, including the number of clinic visits, incidence of various illnesses (e.g. upper respiratory

infections), etc. It is also vital to evaluate the cognitive impact of malnutrition and any improvement in El Comedor participants. Ultimately, this cohort can be monitored as they become school aged and their performance (academically and socially) compared to their peers.

A sustained, successful M&E protocol is vital to the future direction of El Comedor. The data gathered is fundamental to optimize El Comedor's success and efficiency in anticipation of expanding similar programs into the highlands, where the undernutrition epidemic is at its worst. This information is also necessary to inform additional interventions currently being considered that target the social aspects at the root of malnutrition. This protocol should aid in identifying the greatest community needs and designing appropriate intervention strategies. This report has aimed to outline the continued global struggle with malnutrition and its dire sequelae, categorize successful interventions, provide a first-hand case-study of one such intervention in a resource-poor setting, and provide a blueprint for the development and implementation of a sustainable M&E protocol that may be tailored for use in similar programs in Latin America and worldwide.

Appendix A – KAP Schedule (Formato A)

Evaluación de los Resultados de un Programa de Rehabilitación Nutricional en Lima, Perú	Formato A – Encuesta para las Madres Numero de participante: _____

Instrucciones: este documento es la entrevista personal que deber ser administrada a las madres de los niños que anteriormente participaron en el programa de El Comedor. Deberá ser usado en el domicilio de las madres. Todas las instrucciones en letra mayúscula son para el entrevistador y no deberán ser leídas en voz alta al entrevistado. Por favor marcar con una x sobre respuesta apropiada.

P1: Número de identificación de participante: _____

P2: Nombre del entrevistarte: _____ **Iniciales:** ☐☐ (N AP)

P3: Fecha: ☐☐ ☐☐☐ ☐☐ (D M A)

Empezaremos a hablar sobre los nutrientes que hay en los alimentos

P4. Voy a leer una lista de alimentos. Después que nombre cada alimento, por favor dígame si alguno está incluido en una dieta balanceada.

		Si	No	No lo se
P4a	Harinas	1	2	8
P4b	Legumbres	1	2	8
P4c	Leche	1	2	8
P4d	Chocolate	1	2	8
P4e	Sodas/ Refrescos/Gaseosa	1	2	8
P4f	Carne y Huevos	1	2	8
P4g	Frutas	1	2	8
P4h	Vegetales	1	2	8
P4i	Grasa y Azucares	1	2	8

P5. Voy a leer una lista de alimentos. Después que lea cada alimento por favor señáleme si alguno está clasificado como alimento comida que contenga harinas.

		Si	No	No lo se
P5a	Queso	1	2	8
P5b	Fideos o Tallarines	1	2	8
P5c	Mantequilla	1	2	8
P5d	Nueces	1	2	8
P5e	Arroz	1	2	8
P5f	Avena	1	2	8

P6. Voy a leer una lista de alimentos. Después de leer cada uno, señáleme si es alto o bajo en proteínas.

		Alto	Bajo	No lo se
P6a	Pollo	1	2	8
P6b	Queso	1	2	8
P6c	Fruta	1	2	8
P6d	Frijoles	1	2	8
P6e	Mantequilla	1	2	8
P6f	Crema	1	2	8

P7. El yodo es importante para el desarrollo mental de mi hijo.

Si	1
No	2
No lo se	8

P8. ¿Cuál de estos alimentos contiene yodo?

		Si	No	No lo se
P8a	Sal	1	2	8
P8b	Pollo	1	2	8
P8c	Tomate	1	2	8

Ahora voy a hacerte algunas preguntas sobre la anemia.

Revisión date: 2013-05-09

Evaluación de los Resultados de un Programa de Rehabilitación Nutricional en Lima, Perú	Formato A – Encuesta para las Madres Numero de participante: _____

P9. ¿Que es la anemia?

Bajo niveles de yodo	1
Bajo niveles de hierro	2
Colesterol alto	3
Azúcar en sangre alto	4
No lo se	8

P10. La anemia causa un bajo rendimiento físico y mental

Si	1
No	2
No lo se	8

P11. El hierro es parte de las células rojas

Si	1
No	2
No lo se	8

P12. Por favor dígame cual de los siguientes problemas pueden causar anemia.

		Si	No	NS
P12a	Bajo consumo de comidas ricas en hierro	1	2	8
P12b	Infecciones con parásitos	1	2	8
P12c	Tos excesiva	1	2	8
P12d	Enfermedades Infecciosas (como diarrea)	1	2	8
P12e	Falta de sueno	1	2	8
P12f	Pérdida de sangre	1	2	8

P13. ¿Si usted tiene anemia como le afecta a su vida o la vida de su hijo?

		Si	No	NS
P13a	Peso bajo al nacer	1	2	8
P13b	Asma	1	2	8
P13c	Reduce la capacidad de trabajo	1	2	8
P13d	Reduce el desempeño escolar	1	2	8
P13e	Gastritis	1	2	8
P13f	Aumento el riesgo de infecciones	1	2	8

P14. Voy a leer una lista de alimentos. Después que nombre a cada uno, dígame si el alimento contiene un alto, medio, bajo o ningún contenido de hierro.

		Alto	Medio	Bajo	Ningún	NS
P14a	Hígado de res	1	2	3	4	8
P14b	Pollo	1	2	3	4	8
P14c	Garbanzos	1	2	3	4	8
P14d	Plátanos	1	2	3	4	8
P14e	Brócoli	1	2	3	4	8
P14f	Quinua	1	2	3	4	8
P14g	Papaya	1	2	3	4	8

Voy a leerle varias oraciones. Después de leerlas, dígame si usted piensa que la oración es correcta.

		Si	No	No lo se
P15	Betarraga, tomate , rabanito, espinaca, y gelatina puede curar la anemia	1	2	8
P16	El comer mucho limón puede causar anemia	1	2	8
P17	Extractos de alfalfa , hierbabuena, y betarraga pueden curar la anemia	1	2	8
P18	Personas con sobre peso u obesas no pueden sufrir de anemia	1	2	8

Ahora quiero hablar la lactancia

P19. ¿Cuántos anos tienes su hijo menor?

Anos	
Meses	

Revisión date: 2013-05-09

P20. ¿Usted dio de lactar a su último hijo?

Si	1
No → adelántese a pregunta P23	2
No lo se → adelántese a pregunta P23	8

P21. ¿Por cuánto tiempo amamanto a su hijo menor?

Menos de 6 meses	1
6-12 meses	2
13 – 24 meses	3
> 24 meses	4
No lo se	8

P22. ¿Por cuánto tiempo dio lactancia materna exclusiva (sin ningunas otra leche, o agua y otro alimento)?

Meses	

P23. ¿Qué es lo que piensa que es lo mejor para tu hijo?

Formula	1
Leche de Pecho	2
No lo se	8

P24. ¿El padre está de acuerdo con tu decisión de lactar?

Si	1
No	2
No lo se	8

P25. Leeré una lista de beneficios potenciales de la lactancia. Después de cada una, dígame si este es un beneficio verdadero.

		Si	No	No lo se
P25a	Te protege de infecciones como la diarrea y neumonía	1	2	8
P25b	Provee nutrición completa	1	2	8
P25c	Provee desarrollo apropiado	1	2	8
P25d	Ayuda a la madre a perder peso después del embarazo	1	2	8
P25e	Ayuda a proteger a la madre de enfermedades como cáncer de ceno o cáncer de ovarios.	1	2	8
P25f	Protege al bebe de las caries	1	2	8
P25g	Protege al bebe del desarrollo de alergias	1	2	8
P25h	Es bueno para su crecimiento	1	2	8

P26. Voy a leerle varias oraciones. Después que lea cada oración, dígame si usted piensa que si la oración es verdadero.

		Si	No	No lo se
P26a	Es necesario tomar leche para producir leche	1	2	8
P26b	Es necesario comer avena para producir leche	1	2	8
P26c	La leche de los primeros días es (calostro)	1	2	8
P26d	Si la madre tiene senos pequeños, ella no podrá producir suficiente leche.	1	2	8
P26e	La madre no puede dar de lactar si no está cubierta porque la leche puede enfriarse	1	2	8
P26f	Una madre no puede dar de lactar si ella tiene una infección	1	2	8
P26g	La madre no debe dar de lactar si él bebe tiene diarrea o vomito	1	2	8
P26h	La madre no debe de dar de lactar si ha consumido comida picante	1	2	8
P26i	La madre no debe dar de lactar si ha consumido frijoles	1	2	8

Ahora hablaremos sobre la deshidratación y la diarrea.

P27. Leeré una lista de síntomas. Por favor dígame cada uno es una señal de deshidratación en los niños.

		Si	No	NS
P27a	Boca y Lengua Seca	1	2	8
P27b	Decaimiento	1	2	8
P27c	Tiene sed	1	2	8
P27d	Tos	1	2	8
P27e	Llanto excesivo	1	2	8

P28.Leere una lista de comportamientos. Después de leer cada una, dígame si este comportamiento puede ayudar a prevenir la diarrea

		Si	No	NS
P28a	El amamantar exclusivamente durante los primeros 6 meses de vida, continuando hasta los 2 años de edad	1	2	8
P28b	Lavándose las manos con agua y jabón	1	2	8
P28c	Usando agua hervida o tratada para tomar	1	2	8
P28d	Limpiando y desinfectando los utensilios y biberones de leche	1	2	8
P28e	Desechando pañales con excremento en bolsas cerradas	1	2	8
P28f	Usando letrinas si no hay baño con drenaje disponible	1	2	8
P28g	Asegurándose que su hijo este apropiadamente vacunado	1	2	8

Ahora voy a hacerte unas preguntas sobre la disponibilidad de comida para usted y su familia.

P29. En las últimas cuatro semanas que tan seguido usted o su hijo

		Seguido	A veces	Raramente	Nunca
P29a	No haga tenido ningún tipo de comida para comer en su hogar	1	2	3	4
P29b	Se fue a dormir con hambre	1	2	3	4
P29c	Haber pasado un día y noche entera sin comer	1	2	3	4

P30. Si su hijo se rehúsa a comer, que tan seguido usted responde de las siguientes maneras

		Seguido	A veces	Raramente	Nunca
P30a	Alzar su voz y forzar al niño a que coma	1	2	3	4
P30b	Es paciente y trata de darle a su hijo diferentes comidas	1	2	3	4
P30c	Lequita la comida	1	2	3	4
P30d	Distraer al niño con juguetes o la televisión	1	2	3	4

Me gustaría ahora hacerle algunas preguntas sobre su experiencia en El Comedor. Por favor responda a las siguientes preguntas

		Muy de acuerdo	De acuerdo	Ni de acuerdo o desacuerdo	Desacuerdo	Muy en Desacuerdo
P31	Asistir al programa fue de mucha ayuda para mi	1	2	3	4	5
P32	Después de asistir al programa, me siento más cómoda en proveer una dieta balanceada para mis hijos	1	2	3	4	5

P33. ¿Qué tan beneficiosos fueron cada una de las siguientes componentes de El Comedor?

		De Mucha ayuda	Algo de Ayuda	Sin Opinión	No útil	Nada útil
P33a	Proporcionando Comida	1	2	3	4	5
P33b	Atención Medica	1	2	3	4	5
P33c	Demostración de Cocina	1	2	3	4	5
P33d	Educación Nutricional	1	2	3	4	5
P33e	Ambiente Seguro	1	2	3	4	5

P34. ¿Desde su participación en El Comedor, ha cambiado en donde compra usted su comida?

Si	1
No → adelántese a P35	2
No se → adelántese a P35	8

POR FAVOR ESCRIBA EXACTAMENTE LO QUE LAS MADRES DIGAN EN LAS LINEAS ABAJO

P34a. ¿Qué cambio usted?

_____|___ | ___ |

_____|___ | ___ |

P35. ¿Desde su participación en EL Comedor, usted ha cambiado el tipo de comida que le ofrece a su hijo?

Si	1

Revisión date: 2013-05-09

No → adelántese a P36	2
No se → adelántese a 36	8

P35a. ¿Qué cambio usted?

_____|___ | ___ |

_____|___ | ___ |

P36. ¿Desde su participación en El Comedor, usted ha cambiado la manera de mantener a su hijo saludable?

Si	1
No → adelántese a P37	2
No lo se → adelántese a P37	8

P36a. ¿Qué cambio usted?

_____|___ | ___ |

_____|___ | ___ |

P37. ¿Qué es lo que le dificulta ofrecer una dieta balanceada en su hogar?

_____|___ | ___ |

_____|___ | ___ |

Para terminar esta encuesta, nos gustaría preguntarle sobre su dieta y la de sus hijos el dia de ayer.

	Articulo de comida	Características
¿Que es lo que comió usted de desayuno ayer por la mañana?		
¿Que es lo que comio usted de almuerzo ayer?		
¿Que es lo que comio usted para la cena anoche?		
¿Comio algo pequeño entre comidas?		
Que es lo que comieron sus hijos para desayuno ayer por la manana?		
Que es lo que comieron sus hijos ayer para el almuerzo?		
Que es lo que comieron para la cena ayer por la noche?		
Sus hijos comieron algo pequeño entre comidas?		

¿Algo mas?

_____|___ | ___ |

_____

Revisión date: 2013-05-09

Evaluación de los Resultados de un Programa de Rehabilitación Nutricional en Lima, Perú	Formato A – Encuesta para las Madres Numero de participante: _____

MIEMBROS DE LA FAMILIA

9 ¿Cuántas personas en total, incluyendo usted, viven en su hogar? [ ] personas
10 ¿Cuántos niños menores de 5 años vivien en su hogar? [ ] niños <5a
11 ¿Cuántos niños entre 5 y 14 años viven en su hogar? [ ] niños 5-14a
12 Edad de la madre [ ] años cumplidos
13 La madre ¿trabaja? [0:no, 1:en su casa, 2: fuera de casa] [ ] 1:si:casa, 2:fuera, 0:no
14 ¿En qué trabaja la madre? _____

15 El padre ¿trabaja? [0:no, 1:eventual, 2: estable] [ ] 1:eventual, 2:estable, 0:no
16 ¿En qué trabaja el Padre? _____

17 ¿Quién cuida mayormente al niño? (0:madre, 1:abuela, 2:tia, 3:otro) [ ]
18 ¿Asiste el niño a una guardería infantil o cuna? [0:no, 1:si] [ ] 1:si, 0:no
(por lo menos 3 veces por semana)

EDUCACION DE LOS PADRES

19 ¿Cuál es el nivel de educación más alto alcanzado por el padre? [ ]
20 ¿Cuál es nivel de educacion más alto alcanzado por la madre? [ ]
21 ¿Cuál es nivel de educación más alto alcanzado por la persona que cuida al niño (si es que es otra persona diferente que la madre)? [ ]

0:no fue a la escuela
1:sabe leer, no fue a escuela
2:Primaria incompleta
3:Primario completa
4:Secundaria incompleta
5:Secundaria completa
6:Estudios técn./sup. Incomp.
7:Estudios técn./sup. Compl.
88:No Aplicable

CARACTERISTICAS DE LA VIVIENDA

22 ¿Cuántas habitaciones usan para dormir en su hogar? [ ] habitaciones
23 Material predominante en paredes exteriores [ ]
0:ladrillo/cemento, 1:adobe/tierra, 2:madera/triplay, 3:calamina/eternit, 4:estera, 5:otro
24 Material predominante en el techo [ ]
0:cemento/concreto, 1:madera/triplay, 2:calamina/eternit, 3:estera, 4:otro
25 Material predominante en los pisos [ ]
0:cemento, 1:acabado (parquet, locetas), 2:tierra/arena, 3:entrablado (madera), 4:otro
26 Principal fuente de abastecimiento de agua [ ]
0:red pública dentro de la vivienda, 1: red pública fuera de la vivienda
2:pozo artesanal o pilón, 3:camión/tanque/aguatero, 4:otro
27 ¿Dónde almacena el agua? [ ]
0:No almacena, 1:tanque con caño, 2:tanque sin caño, 3:cilindro, 4:otro
28 ¿Dónde hace sus necesidades higiénicas? [ ]
0:red pública dentro de la vivienda, 1:red pública fuera de la vivienda,
2:letrina o pozo ciego, 3:fuera de la casa (acequia, canal, campo), 4:otro
29 ¿Tiene alumbrado electrico? [0:no, 1:si] [ ] 1:si, 0:no

TENENCIA DE BIENES

30 Combustible usado para cocinar [ ]
0:electricidad, 1:gas, 2:kerosene, 3:carbón/leña, 4:otro, 5:no cocina
31 ¿Tiene radio que funciona? [ ] 1:si, 0:no
32 ¿Tiene televisor que funciona? [ ] 1:si, 0:no
33 ¿Tiene refrigerador que funciona? [ ] 1:si, 0:no
34 ¿Tiene cocina que funciona? [ ] 1:si, 0:no
35 ¿Tiene horno microondas que funciona? [ ] 1:si, 0:no
36 ¿Tiene computadora que funciona? [ ] 1:si, 0:no
37 ¿Tiene teléfono fijo? [ ] 1:si, 0:no
38 ¿Tiene teléfono celular? [ ] 1:si, 0:no
39 ¿Tiene motocicleta, motoneta, motocar que funciona? [ ] 1:si, 0:no
40 ¿Tiene vehículo (carro, camion) que funciona? [ ] 1:si, 0:no
41 ¿Cria aves de corral dentro de la casa? [ ] 1:si, 0:no

INGRESOS Y GASTOS

42 ¿Cuánto gasta por lo general en la comida cada dia? [ ] nuevos soles
(todos los alimentos dia, para toda la familia)
43 ¿Cuánto es aproximadamente el ingreso familiar mensual? [ ] nuevos soles

Revisión date: 2013-05-09

Appendix B – Field Collection Forms

Número de participante	Fecha de la visita (D/M/A)	Fecha de nacimiento (D/M/A)	Género (M/F)	Talla (cm)	Peso (kg)	MUAC (cm)	Episodios de diarrea los últimos 6m	Diarrea durante los últimos 7d
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS
								Si No NS

References

[1] *Malnutrition - Definition and More from the Free Merriam-Webster Dictionary*. (n.d.). Retrieved August 13, 2013, from http://www.merriam-webster.com/dictionary/malnutrition

[2] *Facts for life* (4). (2010). New York, NY: United Nations Children's Fund.

[3] *Malnutrition: The starvelings | The Economist*. (2008, January 24). Retrieved April 3, 2013, from http://www.economist.com/node/10566634

[4] *United Nations Millennium Development Goals*. (n.d.). Retrieved August 8, 2013, from http://www.un.org/millenniumgoals/

[5] *Nutrition in the first 1,000 days: State of the world's mothers 2012*. (2012). Westport, Conn: Save the Children.

[6] Ziegler, J. (2005). *L'Empire de la honte*. Paris, France: Fayard.

[7] *Essential Nutrition Actions: improving maternal, newborn, infant and young child health and nutrition*. (2013). Geneva, Switzerland: World Health Organization.

[8] Department for International Development - GOV.UK. (n.d.). Retrieved August 13, 2013, from https://www.gov.uk/government/organisations/department-for-international-development

[9] *What is malnutrition? | WFP | United Nations World Food Programme - Fighting Hunger Worldwide*. (n.d.). Retrieved June 4, 2013, from http://www.wfp.org/hunger/malnutrition

[10] U.N. chief: Hunger kills 17,000 kids daily - CNN.com. (n.d.). Retrieved August 18, 2013, from http://edition.cnn.com/2009/WORLD/europe/11/17/italy.food.summit/

[11] *Global hunger declining, but still unacceptably high*. (2010). Rome, Italy: Food and Agriculture Organization of the United Nations.

[12] 007 - Malnutrition - geobecks.net. (n.d.). Retrieved August 18, 2013, from http://www.geobecks.net/myp-humanities/year-11/resources/007---hunger

[13] *The world health report 2000: Health systems: improving performance*. (2000). Geneva, Switzerland: World Health Organization.

[14] WHO | Data, statistics and epidemiology. (n.d.). *WHO*. Retrieved August 18, 2013, from http://www.who.int/ maternal_child_adolescent /epidemiology/en/

[15] WHO | Micronutrient deficiencies. (n.d.). *WHO*. Retrieved August 18, 2013, from http://www.who.int/nutrition/topics/vad/en/

[16] *Scaling Up Nutrition: The UK's position paper on undernutrition*. (2011). London, UK: Department for International Development.

[17] Kielmann, A. A., Taylor, C. E., & Parker, R. L. (1978). The Narangwal Nutrition Study: a summary review. *The American journal of clinical nutrition*, *31*(11), 2040–2057.

[18] Bartick, M., & Reinhold, A. (2010). The burden of suboptimal breastfeeding in the United States: a pediatric cost analysis. *Pediatrics*, *125*(5), e1048–e1056.

[19] Mamiro, P. S., Kolsteren, P., Roberfroid, D., Tatala, S., Opsomer, A. S., & Van Camp, J. H. (2005). Feeding practices and factors contributing to wasting, stunting, and iron-deficiency anaemia among 3-23-month old children in Kilosa district, rural Tanzania. *Journal of Health, Population, and Nutrition, 23*(3), 222-30

[20] Pollitt, E., Saco-Pollitt, C., Jahari, A., Husaini, M. A., Huang, J., Pollitt, E., & Schürch, B. (2000). Effects of an energy and micronutrient supplement on mental development and behavior under natural conditions in undernourished children in Indonesia. *European Journal of Clinical Nutrition*, *54*(supp 2), S80–S90.

[21] Allen, L. H., De Benoist, B., Dary, O., & Hurrell, R. *Guidelines on food fortification with micronutrients*. (2006). Geneva, Switzerland: World Health Organization and Food and Agriculture Organization.

[22] Ahmed, F. (1999). Vitamin A deficiency in Bangladesh: a review and recommendations for improvement. *Public Health Nutr*, *2*(1), 1–14.

[23] Bhandari, N., Bahl, R., Taneja, S., Strand, T., Mølbak, K., Ulvik, R. J., Sommerfelt, H., Bhan, M. K. (2002). Substantial reduction in severe diarrheal morbidity by daily zinc supplementation in young north Indian children. *Pediatrics*, *109*(6), e86–e86.

[24] *Community-based management of severe acute malnutrition: 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). Geneva, Switzerland: UNICEF.

[25] Purwestri, R. C., Scherbaum, V., Inayati, D. A., Wirawan, N. N., Suryantan, J., Bloem, M. A., Pangaribuan, R. V., Hoffmann, V., Biesalski, H. K., Qaim, M., Bellows, A. C. (2012). Cost analysis of community-based daily and weekly programs for treatment of moderate and mild wasting among children on Nias Island, Indonesia. *Food & Nutrition Bulletin*, *33*(3), 207–216.

[26] Bhutta, Z. A., Ahmed, T., Black, R. E., Cousens, S., Dewey, K., Giugliani, E., Haider, B. A., Kirkwood, B., Morris, S. S., Sachdev, H. P. S. (2008). What works? Interventions for maternal and child undernutrition and survival. *The Lancet*, *371*(9610), 417–440.

[27] Inayati, D. A., Scherbaum, V., Purwestri, R. C., Wirawan, N. N., Suryantan, J., Hartono, S., Bloem, M. A., Pangaribuan, R. V., Biesalski, Hoffmann, V., Bellows, A. C. (2012). Combined intensive nutrition education and micronutrient powder supplementation improved nutritional status of mildly wasted children on Nias Island, Indonesia. *Asia Pacific Journal of Clinical Nutrition*, *21*(3), 361–373.

[28] *Human development report 2011: Sustainability and equity: a better future for all*. (2011). New York, NY: United Nations.

[29] Parikh, K., Marein-Efron, G., Huang, S., O'Hare, G., Finalle, R., & Shah, S. S. (2010). Nutritional status of children after a food-supplementation program integrated with routine health care through mobile clinics in migrant communities in the Dominican Republic. *The American journal of tropical medicine and hygiene*, *83*(3), 559.

[30] Aguiar, C., Rosenfeld, J., Stevens, B., Thanasombat, S., & Masud, H. (2007). An Analysis of Malnutrition Programming and Policies in Peru. *Paper prepared for the International Economic Development Program The Gerald R. Ford School of Public Policy and School of Public Health University of Michigan*

[31] *Documento técnico: lineamientos de gestión de la estrategia sanitaria de alimentación y nutrición saludable*. (2011). Lima, Peru: Ministerio de Salud.

[32] *Situation of children in Peru: executive summary.* (2008). Lima, Peru: United Nations Children's Fund and Instituto Nacional de Estadística e Informática.

[33] WHO | Peru: country profiles. (n.d.). *WHO*. Retrieved August 18, 2013, from http://www.who.int/gho/countries/per/country_profiles/en/index.html

[34] *Health in the Americas*. (2002). Washington, D.C: Pan American Health Organization.

[35] *Lactancia y nutrición de los niños. ENDES Continua 2004-2005: Presentación de Resultados Preliminares.* (2005). Lima, Peru: Ministerio de Salud.

[36] Rogers, B. L., Rajabiun, S., Levinson, J., & Tucker, K. (2002). Reducing chronic malnutrition in Peru: a proposed national strategy. *Tufts University FPAN Discussion Papers. Medford, MA*.

[37] Ochoa, T., Evaluación de la seguridad y eficacia de una proteína purificada de pescado (FPi) en la nutrición de niños menores de 36 meses- Promoviendo una Adecuada Nutrición y Alimentación de Nuestros Hijos y Hijas. *Universidad Peruana Cayetano Heredia Fundacion Cayetano Heredia.*

[38] *What is Monitoring & Evaluation (M&E)? : International Platform on Sport and Development*. (n.d.). Retrieved April 15, 2013, from http://www.sportanddev.org/en/toolkit/monitoring___evaluation/what_is_monitoring___evaluation__m_e__/

[39] Gorstein, J., Sullivan, K., Yip, R., De Onis, M., Trowbridge, F., Fajans, P., & Clugston, G. (1994). Issues in the assessment of nutritional status using anthropometry. *Bulletin of the World Health Organization*, *72*(2), 273.

[40] Gerein, N. M., & Ross, D. A. (1991). Is growth monitoring worthwhile? An evaluation of its use in three child health programmes in Zaire. *Social science & medicine*, *32*(6), 667–675.

[41] Roberfroid, D., Kolsteren, P., Hoeree, T., & Maire, B. (2005). Do growth monitoring and promotion programs answer the performance criteria of a screening program? A critical analysis based on a systematic review. *Tropical Medicine & International Health*, *10*(11), 1121–1133.

[42] Dairo, M. D., Fatokun, M. E., & Kuti, M. (2012). Reliability of the mid upper arm circumference for the assessment of wasting among children aged 12-59 months in Urban Ibadan, Nigeria. *International journal of biomedical science: IJBS*, *8*(2), 140.

[43] McDowell, I., & King, F. S. (1982). Interpretation of arm circumference as an indicator of nutritional status. *Archives of disease in childhood*, *57*(4), 292–296.

[44] Vijayaraghavan, K., & Sastry, J. G. (1976). The efficacy of arm circumference as a substitute for weight in assessment of protein-calorie malnutrition. *Annals of Human Biology*, *3*(3), 229–233.

[45] Ochoa, T. J., Chea-Woo, E., Baiocchi, N., Pecho, I., Campos, M., Prada, A., Valdiviazo, G., Lluque, A., Lai, D., Cleary, T. G. (2012). Randomized double-blind controlled trial of bovine lactoferrin for prevention of diarrhea in children. *The Journal of pediatrics, 162*(2):349-56

[46] Launiala, A. (2009). How much can a KAP survey tell us about people's knowledge, attitudes and practices? Some observations from medical anthropology research on malaria in pregnancy in Malawi. *Anthropology Matters*, *11*(1).

[47] Kruizenga, H. M., Seidell, J. C., De Vet, H. C. W., Wierdsma, N. J., & van Bokhorst–de van der Schueren, M. A. E. (2005). Development and validation of a hospital screening tool for malnutrition: the short nutritional assessment questionnaire (SNAQ). *Clinical Nutrition*, *24*(1), 75–82.

[48] Parmenter, K., & Wardle, J. (1999). Development of a general nutrition knowledge questionnaire for adults. *European Journal of Clinical Nutrition*, *53*(4), 298–308.

[49] Pérez-Escamilla, R., Melgar-Quiñonez, H., Nord, M., Álvarez, M., & Segall-Correa, A. M. (2007). Escala latinoamericana y caribeña de seguridad alimentaria (ELCSA). *Perspectivas de Nutrición Humana*.

[50] Edmond, K. M., Zandoh, C., Quigley, M. A., Amenga-Etego, S., Owusu-Agyei, S., & Kirkwood, B. R. (2006). Delayed Breastfeeding Initiation Increases Risk of Neonatal Mortality. *Pediatrics*, *117*(3), e380–e386. doi:10.1542/peds.2005-1496

[51] Coates, J., Webb, P., & Houser, R. *Food and Nutritional Technical Assistance - Measuring Food Insecurity: Going Beyond Indicators of Income and Anthropometry.* (2003). Washington, DC: USAID

[52] Burney, J., & Haughton, B. (2002). EFNEP: A nutrition education program that demonstrates cost-benefit. *Journal of the American Dietetic Association*, *102*(1), 39–45.

[53] Ziegler, E. E., & Nelson, S. E. (2012). The WHO growth standards: strengths and limitations. *Current opinion in clinical nutrition and metabolic care*, *15*(3), 298–302. doi:10.1097/MCO.0b013e3283511478

[54] WHO | The WHO Child Growth Standards. (n.d.). *WHO*. Retrieved August 19, 2013, from http://www.who.int/childgrowth/en/

[55] *UNESCO Institute for Statistics*. (n.d.). Retrieved October 25, 2013, from http://stats.uis.unesco.org/unesco/TableViewer/document.aspx?ReportId=121&IF_Language=en&BR_Country=6040

Vita

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