Quality Improvement of a Community-Based Childhood Nutrition Program in Rural Guatemala

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Scholarly Report Title: Quality Improvement of a Community-based Childhood Nutrition Program in Rural Guatemala

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Abstract

TITLE: Quality Improvement of a Community-based Childhood Nutrition Program in Rural Guatemala

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Purpose: Various organizations have made efforts to reduce chronic malnutrition in children under 5 years old in Guatemala but have had limited success. Quality improvement endeavors have the potential to maximize a program's impact in resource-limited settings. We describe our experience implementing quality improvement (QI) of our childhood nutrition program in rural Guatemala. Our principal aim was to reduce the prevalence of chronic malnutrition in children under 5 years old by 15% each year in the communities served.

Methods: Direct observation of nutrition programming and meetings with key staff were used to inform our QI efforts. We established, tracked, and presented to staff monthly quality metrics, including the percent of children receiving growth monitoring, micronutrient supplementation, and deworming medication. We measured average height-for-age Z (HAZ) score, a proxy of chronic malnutrition, as well as the percentage of children with stunting in each community. We used run chart analysis to assess for improvement.

Results: Our QI efforts addressed four key drivers for mitigating stunting in Guatemalan children under 5 years old: (1) food security, (2) environmental health, (3) provision of health services, and (4) empowerment and education of caregivers. Incorporating elements of standards-based management and recognition as well as implementation science, our QI interventions included re-training staff, continued nutrition education, hiring a full-time licensed nutritionist, revision of educational instruments, checklists and algorithms to guide data interpretation and reinforce nutrition protocols, and constructive individualized feedback. The percentage of children who had growth monitoring per the protocol markedly improved. Administration of micronutrient supplementation and deworming medication was poorly documented. There was minimal improvement in average HAZ score and the stunting prevalence in children under 5 years old from February 2016 to February 2017.

Conclusions: The process outcome of growth monitoring coverage improved, but we still need to streamline our documentation system. Minimal improvement in average HAZ scores and stunting prevalence could be secondary to confounding factors, such as the overrepresentation of

children enrolled in the recuperative program in our calculations, expansion of our program to include more severely stunted children, climate change, and crop failure. More sophisticated control chart analysis is warranted to further explore if our quality improvement interventions impacted the severity and prevalence of stunting.

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Glossary of abbreviations

EBCD: experience-based co-design

EMRS: electronic medical record system

HAZ score: height-for-age Z score

IS: implementation science

MNP: micronutrient powder

NGO: non-governmental organization

PDSA: Plan-Do-Study-Act

QI: quality improvement

RUSF: ready-to-use supplementary food

SBM-R: standards-based management and recognition

WAZ: weight-for-age Z score

WHZ: weight-for-height Z score

WK: Wuqu' Kawoq | Maya Health Alliance

Section 1: Introduction

Chronic malnutrition impacts 46.5 percent of children younger than five years of age in Guatemala [1], which has the highest prevalence of chronic malnutrition of any country in the Americas and the fourth highest in the world [2]. Guatemala ranks among countries with the highest degree of inequality worldwide [3], and indigenous Guatemalan children disproportionately face chronic malnutrition with a prevalence of almost 60 percent[1] [1]. Chronic malnutrition also disproportionately impacts children of mothers without education (67.0%) and children from the lowest income quintile (65.9%) [1]. Despite multiple efforts by the government and non-governmental organizations to reduce the prevalence of childhood chronic malnutrition in Guatemala, it has only decreased 1.5% since 2009 [4]. Since 2007, Wuqu' Kawoq | Maya Health Alliance (WK), a nonprofit organization, has worked to prevent and treat acute and chronic malnutrition in children from rural, indigenous communities in Guatemala. WK's efforts to combat malnutrition have been modified to include more intensive nutrition education and food supplementation based on quantitative as well as ethnographic research in communities served, and the organization has expanded to serve more communities. At the end of 2015, WK initiated a formal quality improvement project.

Quality improvement (QI) in global health work is an emerging and important field with the potential to maximize the impact of scarce resources, provide better outcomes, and promote increased funding for healthcare in developing countries [5]. QI is now considered a competency in the education of health professionals [6]. The standards-based management and recognition (SBM-R) methodology of quality improvement, designed to address barriers in resource-limited settings, starts with evidence-based standardization of care and establishing targets for compliance, usually of 80% or better, with the standards of care. Once standards are implemented, gaps are then identified and addressed [7]. SBM-R emphasizes creating a culture of quality improvement rather than isolated interventions and incorporates evidence-based methods such as checklists, auditing, and feedback to detect areas needing additional improvement and support [7]. Implementation science (IS) can complement quality improvement by providing a methodology for understanding and addressing challenges encountered when

[1] 58.0% when mother's ethnicity self-identified, 61.2% when ethnicity by "traditional concept"

attempting to carry out QI interventions [8, 9]. Implementation outcome variables include acceptability, adoption, appropriateness, feasibility, fidelity, cost, coverage, and sustainability [9]. Fidelity refers to the extent to which an intervention is executed as planned and includes the quality of delivery, adherence, dose, and participant responsiveness [10]. Implementation strategies are tools used to promote adoption of interventions and can include audits, checklists, and staff education [9]. We used elements of SBM-R and IS to establish standards as well as implement, assess, and make iterative modifications to a QI initiative aiming to strengthen the quality and impact of our nutrition program. Our primary aim was to reduce chronic malnutrition in children younger than 5 years of age in the communities served. Specifically, we set the goal to improve the average height for age Z score of children under 5 years old by 15% each year and reduce the prevalence of children with chronic malnutrition by 15% each year.

Section 2: Student role

I actively worked on this quality improvement project on the ground in Guatemala from October 2015 to May 2016. After observing nutrition technicians in the field and obtaining input from Wuqu' Kawoq's Chief Medical Officer and the project mentor (Dr. Peter Rohloff), the Executive Director (Anne Kraemer Díaz), and the Medical Director (Dr. Waleska Lopez), I compiled a comprehensive nutrition manual. I co-organized and co-lead the training to standardize and improve nutrition programming and protocols in January 2016 as well as monthly meetings with nutrition staff to review data, provide additional training, and improve programming. I contributed to the determination of quality metrics as well as the design and implementation of improvement efforts. I frequently solicited and gathered feedback from staff to improve nutrition instruments. I prepared data for February and March 2016. April 2016 data was prepared jointly with the Nutrition Director, licensed nutritionist Andrea Guzman, who I helped onboard in March. Since May 2016, the Nutrition Director has prepared data, lead the monthly meetings, and spearheaded all quality improvement efforts. I prepared the run charts and analysis in this report.

Section 3: Methods

Context

The non-profit organization, Wuqu' Kawoq | Maya Health Alliance, has provided free healthcare services in rural indigenous areas of Guatemala since 2007. WK's mixed-methods research has informed its programmatic efforts. While most communities served by WK primarily rely on agricultural production for income generation, food insecurity is paradoxically common [11]. As nontraditional agricultural exports have replaced subsistence crops, access to nutritionally diverse foods has declined [11]. Further, income varies with the season resulting in food insecurity and the need to borrow money during the "off-season" [12]. Meanwhile, processed, junk food is readily available in small local stores [11, 12]. Although wasting (acute child malnutrition) is relatively uncommon and stunting (chronic malnutrition) is very common in Guatemala, focus group discussions and key informant interviews suggest that caregivers, community leaders, and NGO staff had awareness about acute malnutrition but poor awareness and understanding of chronic malnutrition [12], which is so prevalent in some communities that it has become normalized [13]. Dietary recalls conducted with 102 caregivers of children 6-36 months of age in two rural indigenous Maya communities showed inadequate dietary diversity and meal frequency. Few children from 6 to 23 months of age (3% in one community and 22% in the other community) meet the requirements for a minimum acceptable diet, defined as a composite of minimum dietary diversity and minimum meal frequency. In one community, a follow-up study of a random sample of 68 surveyed households showed that 100% of households experienced food insecurity, with 51% reporting severe food insecurity, and seven-day dietary recall of children 6 to 36 months of age suggested poor dietary diversity with deficiencies in vitamin-A rich foods, eggs, flesh foods, and dairy [11]. In Guatemala, when an infant begins complementary feeding, the caregiver often starts by giving the infant a gruel, which is usually prepared too diluted and mixed with a lot of sugar, and thus will fill the child's stomach but has little nutritive value [12]. Structured surveys, focus group discussions, and key informant interviews suggest that while mothers are primarily responsible for child feeding, fathers and paternal grandmothers influence food-purchasing decisions, and secondary caregivers including grandmothers and aunts influence child-feeding practices [12].

WK's nutrition program involves prevention and treatment of malnutrition in children under 5 years old. "Nutrition technicians," receive nutrition training, and are assigned to a community. Some nutrition technicians have completed training as nurse assistants and others have vocational training in education and/or prior experience working with non-profit organizations. WK partners with other non-governmental organizations as well as government health centers and health posts in the communities served in order to augment existing services. In a few communities, health promoters encourage caregivers to participate in growth monitoring and help measure children. Universal preventative efforts for children under 5 years of age focus on growth monitoring, nutrition education in groups, micronutrient supplementation, deworming medication, and free primary care services. The interactive nutrition education curriculum emphasizes empowerment of caregivers and has been constructed and revised based on findings from WK's mixed methods research to foster awareness of chronic malnutrition, dietary diversity, and adequate complementary feeding. During nutrition classes, caregivers learn and participate in healthy meal preparation. The proper consistency and density of food is demonstrated and reinforced. Recognizing the role that diarrhea plays in chronic malnutrition [14], WK has also provided water filters for some families, based on funding availability. Treatment efforts focus on children:

- under 5 years old with acute malnutrition, defined as a weight-for-length or weight-for-height Z score below -2 based on the 2008 WHO growth standards [15]
- under 25 months old with chronic malnutrition, defined as a length-for-age or height-for-age Z score below -2 based on the 2008 WHO growth standards [15]
- under 5 years old with weight loss for 3 or more months
- under 12 months with a mother unable to produce breast milk

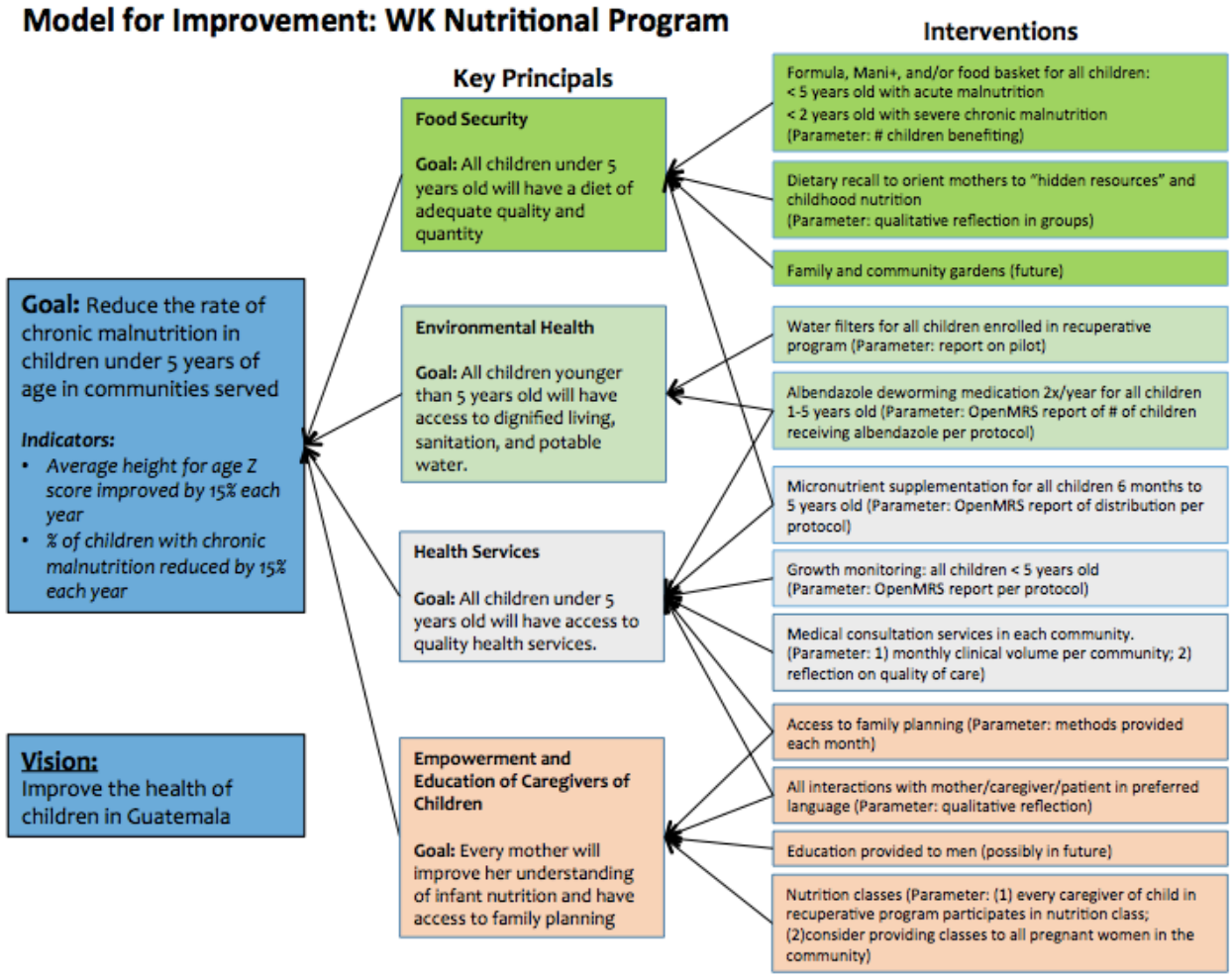
Children enrolled in the treatment program receive an individualized plan that includes supplementation, clinical visits with a physician, group nutrition classes, and individualized education based on 24-hour dietary recalls. Nutrition technicians also make home visits as needed to reinforce nutrition education for children in the recuperative program. In analyses pooled from 7 studies, provision of food supplements (with or without education) to food insecure populations was associated with a weighted mean increase in height-for-age Z score of 0.41 compared with controls [16]. Given communities served by WK experience food insecurity [11], children with chronic malnutrition receive a food basket every two weeks for a period of six

months. This food basket includes 20 eggs, 2 pounds of dried beans, and 2 bags of fortified corn and soy-based protein powder for first three months and then 20 eggs and 2 pounds of beans for the last three months. Children with acute malnutrition receive the same food basket every two weeks for six months in addition to ready-to-use supplementary food (RUSF). If RUSF is unavailable due to stock-out, then the caregiver is provided ingredients and instructions to make therapeutic formula (F-75 if the child has moderate acute malnutrition and F-100 if the child has severe acute malnutrition) [17]. The group nutrition classes consist of 4 classes, which cover nutrition during pregnancy; breastfeeding; complementary feeding with an emphasis on dietary diversity, meal frequency, and food consistency; and acute versus chronic malnutrition. The nutrition education emphasizes diverting money spent on junk food or instant soups to buy more nutritious foods. Over the past 2 years, WK has been rapidly expanding its services to additional communities. At the time of initiating the quality improvement efforts, Wuqu' Kawoq (WK) had active nutrition programs in Guatemala in 8 locations, primarily rural areas populated by indigenous people. With expansion, WK wanted to ensure high quality services are maintained and thus initiated a formal quality improvement project.

Intervention

Before initiating quality improvement efforts, nutrition programming at each site was observed and the existing protocol, training documents, and educational materials were reviewed. Input was also sought from a staff physician, who at the time was the research coordinator of a nutrition intervention study and had created observation checklists for auditing purposes. These checklists (found in the appendix) were used to identify areas in need of improvement. Nutrition technicians were also asked for their input to improve the program, especially regarding the appropriateness of educational instruments and materials and the feasibility of making changes. Meetings were held with the Chief Executive Officer, Medical Director, and Executive Director to discuss ways to strengthen the program and incorporate their input. This information informed the creation of a revised, comprehensive nutrition manual, which included pictures as well as key messages. We drafted a model for improvement with the following key drivers seen as integral to reducing the prevalence of chronic malnutrition in children under 5 years old: (1) food security, (2) environmental health, (3) provision of health services, and (4) empowerment and education of caregivers.

Figure 1. *Model for Improvement Key Driver Diagram (modified and translated to English**;** original version elaborated in Spanish by Peter Rohloff, MD, PhD and Andrea Guzman, LN)*



Measures

Using elements of SBM-R, we established standardized evidence-based quality metrics with targets for compliance [7]. The quality metrics below were used for monthly monitoring and evaluation of the nutrition program in aggregate and in each individual community to assess the nutrition program's fidelity, an implementation outcome variable [9].

- Percentage of children under 5 years old with growth monitoring per protocol (goal 90%)
- Percentage of children 6-60 months old receiving Chispitas (micronutrients) (goal 90%)
- Percentage of children 12-60 months old receiving de-worming medication (goal 90%)

We tracked monthly information on the following outcome measures:

- Average height-for-age Z scores (a measure of stunting, which is a proxy of chronic malnutrition) for each community
- Number and percentage of children with chronic malnutrition

"Community" 8 was excluded from outcome measure analysis since this site is solely composed of malnourished children referred to our recuperative program by collaborating organizations and the government health system. Site 8 includes children with complex medical care needs from several small villages, and the average HAZ score and prevalence of stunting can vary from month to month based on how many children are newly enrolled. The three communities added to our program in October 2016 were also excluded from aggregate outcome measure analysis.

Data was extracted from OpenMRS, our electronic medical record system (EMRS). To foster a culture of quality improvement, we presented aggregate, organization-wide data at monthly meetings with the nutrition team followed by individual meetings with each nutrition technician to confidentially review the data in their community from the previous month, provide constructive feedback, as well as discuss and make plans to address challenges or obstacles to carrying out nutrition programming in their respective communities. At monthly meetings, we emphasized using the data to learn, reassess, and improve rather than to rebuke.

Method of Analysis

We used run chart analysis to assess for improvement. Run charts, also known as time series charts, are considered a "universal tool" for improvement projects [18]. They provide visual and temporal representation of process performance and help to determine if improvement occurred with the introduction of efforts [18, 19]. Run charts enable more accurate conclusions about the impact of improvement projects than summary statistics, which rely on the most recent data point [19]. If a run chart has at least 10 points, it can be used to differentiate random variation from non-random variation (also known as "signals of change") through the application of run chart rules and use of the median as the centerline [19, 20]. Non-random variation can provide evidence of process improvement or degradation [18]. The Perla rules, as delineated below, were applied to determine if a signal of change was non-random.

1. The *shift rule* refers to a minimum of six consecutive points all above or all below the median. Values on the median do not count and are skipped [19].

2. The *trend rule* refers to a minimum of five consecutive points all increasing or all decreasing. If the value of consecutive points is the same, the value is only counted once [19].
3. The *run rule* is met if there are too few or too many runs. A run is defined as a series of consecutive points on one side of the median. We used Table 1 of Perla, Provost, & Murray's 2010 article to assess if there were too few or too many runs [19].
4. The *astronomical point rule* is subjective and met if there is a data point that is obviously different from all other data points [19].

The first three rules are probability-based, with an α error $p<0.05$ [19]. Analyzing run charts with probability-based rules requires the median to be calculated from at least 10 data points [18]. Run charts were generated using the Microsoft Excel Run Chart Template version 2.0 developed by Institute for Healthcare Improvement faculty member Richard Scoville, PhD and available for download at http://www.ihi.org/resources/Pages/Tools/RunChart.aspx [21].

Section 4: Results

Using elements of the standards-based management and recognition (SBM-R) methodology of quality improvement, our first step was compiling a comprehensive nutrition manual and providing training to standardize the protocol across sites. Aiming to create a culture of quality improvement, we also formally initiated monthly nutrition team meetings to review aggregate organization-wide data, discuss difficult cases, obtain staff suggestions for ways to improve, and provide continuing nutrition education. We frequently gathered feedback from staff to improve nutrition instruments since the nutrition technicians are experts in working in the community and see how mothers respond to program efforts. Continuing nutrition education is provided on areas of noted confusion and topics requested by the nutrition technicians. In the first few months of initiating QI efforts, we met with nutrition staff individually and confidentially, after the monthly team meeting, to review data from their assigned community and to discuss how to support and improve the work in their given community. A licensed nutritionist was hired as Nutrition Director in March 2016 to provide oversight and expertise to staff and closely monitor children in the recuperative program. Each nutrition technician now receives immediate constructive feedback during site visits as well as increased support for managing children in the recuperative program.

Areas for improvement and interventions by key principals

❖ ***Key principal: Food security***

Enrollment of children in recuperative program and interpretation of growth monitoring data

While observing nutrition technicians in the field and reviewing monthly data, we noticed a delay in identifying and enrolling children in the recuperative program. Through observation and talking with nutrition technicians, we concluded that in some communities, the lag was due to delayed calculation of Z scores and in other communities, secondary to incomplete understanding of Z scores. Reasons for delayed calculation included trying to speed up workflow during growth monitoring. While all nutrition technicians have a PC laptop with a Spanish version of the World Health Organization Anthropometry Calculator [22], which allows for calculation without Internet access of weight-for-age Z scores (WAZ), height-for-age Z scores (HAZ), and weight-for-height Z scores (WHZ), nutrition technicians have reported that this calculator is time consuming, cumbersome, and not completely user-friendly. Some nutrition technicians were waiting until the end of the month to calculate and enter Z scores rather than calculating and reviewing Z scores as the children were measured on growth monitoring days. In community 2, which has a particularly large population of children under 5 years old (N=271 in December 2016), our organization partners with the government health center to avoid duplicating growth monitoring, and community health promoters working for the government health center provide our organization with a list of names and growth measurements. There was a time lag to receive the list, and then making all the calculations is time consuming. We addressed this issue by meeting with the government workers and requesting that the community health workers coordinate with our nutrition technician, so she can be present on growth monitoring days to calculate Z scores promptly. Also, a volunteer created a Microsoft Excel file with embedded macros, which enables automatic calculation of WAZ, HAZ, and WHZ with the input of the child's date of birth, gender, date of measurement, weight, and height. With additional iterations, conditional formatting was added to the document to provide color-coding of Z scores based on severity and thus facilitate data interpretation. At the retraining and standardization meeting in January 2016 and subsequent monthly meetings, we reinforced that the nutrition technicians are expected to calculate and interpret the Z scores as they measure each child.

Difficulty with interpretation of growth monitoring data posed a significant barrier to providing timely high quality services to the communities. Monthly review of the data revealed that some acute malnutrition cases were not reported immediately. Some nutrition technicians were confused about the difference between acute malnutrition (wasting, Z score weight-for-height < -2.0) and chronic malnutrition (stunting, Z score height-for-age < -2.0). The nutritional intervention, urgency, and frequency of follow-up differs for these two types of malnutrition, so it is important for nutrition technicians to distinguish between the two types. After observing and talking with nutrition technicians in the field, we concluded that the confusion was due to confusing terminology surrounding Z scores, limited familiarity with the concept of standard deviations and related statistical concepts, normalization of stunting in Guatemala, and deficiencies in our paper and electronic growth charts. Specifically, our paper and electronic growth charts included the weight-for-age and height-for-age growth charts but not the weight-for-height growth chart, used for detecting acute malnutrition.

Incorporating feedback from nutrition technicians, we implemented several interventions to improve interpretation of Z scores. The difference between acute and chronic malnutrition was careful reviewed during the training in January and has been reinforced at monthly meetings and while in the field with staff. We also modified our documentation to facilitate Z score interpretation. Each nutrition technician received a laminated checklist (see appendix) with steps for interpreting measurements, Z scores, and growth charts as well as instructions for what do if there is a concerning measurement, Z score, or trend on the growth chart. A one-page "cheat" sheet of the difference between acute and chronic malnutrition with pictures, Z scores, and color-coded corresponding graphs was created and given to nutrition technicians (see appendix). The paper growth charts were modified to include 1) color-coding of the type and severity of malnutrition with a key, 2) columns on the back of the growth chart to record Z scores to make it easier to see if a child is improving or worsening from measurement to measurement, and 3) a key, modeled off Peru's growth charts, to facilitate interpretation of the growth curve trajectory [23]. We also made changes to the electronic documentation form, which now includes a free text field with instructions to document the Z scores. Wuqu' Kawoq recently hired a programmer who will improve the electronic growth charts in OpenMRS in the future. The Director of Nutrition now reviews all cases of acute malnutrition with staff on a weekly basis, and the protocol for acute malnutrition cases has been reinforced at monthly meetings and individually.

Lactation insufficiency and failure

By observing nutrition technicians in the field and reviewing the charts of children receiving milk-based formula, our nutritionist (the Director of Nutrition) noted that "lactation failure" was being incorrectly diagnosed in some mothers who were producing milk but struggling with breastfeeding technique, and some infants were unnecessarily started on formula. Also, in some cases, the amount of formula was not properly adjusted based on the child's weight. In response, nutrition technicians received additional training on the proper breastfeeding technique, the low prevalence of lactation failure, and differentiation between lactation insufficiency or failure and inadequate breastfeeding technique. Additional pictures on proper breastfeeding technique were added to the nutrition education booklet. Further, we established a more formal protocol for assessing lactation failure and providing formula. All cases of lactation failure or insufficiency are now reviewed with the nutritionist at least every 2 weeks to make adjustments in formula.

❖ ***Key principal: Environmental health***

Deworming medication (albendazole)

We attempted to integrate documentation of deworming medication distribution into our electronic medical record system (EMRS) by adding checkboxes to the electronic growth monitoring form, with the intent to easily extract this data when running monthly reports. Previously, the distribution of deworming medication to each child was documented on individual prescription papers, the carbon copies of which were turned into our procurement and logistics specialist who manages medication inventory. The Guatemalan Ministry of Health's standard of care is to provide deworming medication to children from 24 to 60 months of age twice a year. In reality, the distribution by government health centers and post varies depending on the availability of deworming medications and the frequency with which children visit a government health facility. We do not give children albendazole if they have received it from a government health facility in the past 6 months, unless they have symptoms of helminthic infection. Each nutrition technician receives a list of the children at their respective site, who did not have documentation of receiving albendazole in the last 6 months in our EMRS. According to our EMRS reports, the percentage of children between 12 and 60 months old receiving deworming medication within the last six months as delineated in the protocol was well below

the goal of 90%, ranging from 18% to 39% each month. However, there was poor agreement between paper and electronic documentation, which suggested lack of electronic documentation rather than lack of distribution.

- ***Key principal: Health services***

Growing monitoring: Measurement technique

Measurement technique, evaluated using an observation list (see appendix), was one area in need of improvement. The major pitfalls observed in the field included forgetting to zero the balance between weight measurements of each child, leaving too much clothing on the child during measurements (resulting in inaccurate measurements), and improper positioning of the child during measurements of height or length. These issues were addressed and resolved by reviewing proper technique at the re-training in January 2016 and by providing immediate feedback to nutrition technicians and to health promoters from the communities who help with anthropometric measurements. In community 2, WK collaborates with health promoters from the government health center, who weigh and measure children under five years old and were recording weight and height measurements to the nearest ½ kilogram and ½ centimeter, respectively, rather than the nearest 0.1kilogram or 0.1 centimeter. This difference results in inaccurate anthropometric Z scores. This problem was resolved after providing refresher training to collaborating health promoters.

Micronutrient supplementation

Electronic documentation of a micronutrient powder (MNP) supplementation called Chispitas was also poor. The government health system aims to provide children from 6 months to 5 years old with a 60-day supply of MNP twice a year. WK's goal is for these children to have MNP every day and thus WK provides MNP when the child has finished their supply from the governmental health system. It is challenging to track because different children are receiving MNP from the government health facilities at different times. We added a checkbox for Chispitas in the electronic growth monitoring form, which nutrition technicians were asked to mark if the child had received MNP from either WK or the government. However, the amount of Chispitas distributed at a given time varied from a 30-day supply to a 60-day supply depending

on the availability of MNP in our inventory, thus complicating documentation. According to monthly reports generated from OpenMRS, the percentage of children between 6 and 60 months old receiving MNP as delineated in the protocol ranged from 7.4-35.4% each month in 2016. Based on observation and talking with nutrition technicians, we concluded that these low percentages were secondary to 1) poor documentation in our EMRS given discrepancy between the electronic documentation and the increased amount of MNP ordered and used each month and 2) inadequate communication between nutrition technicians and our procurement and logistic specialist about the amount of MNP needed for each community each month. In an effort to improve documentation, we recently added a textbox in our EMRS to list the combined amount of Chispitas received from Wuqu' Kawoq and the government health care system.

Diarrhea management

Staff expressed interest in learning about diarrhea and dehydration management. A diarrhea and dehydration protocol, training based on the World Health Organization's diarrhea module for integrated management of childhood illness [24], and standardized kits were made and distributed. The standardized kit includes oral rehydration solution, zinc, a thermometer, and pictorial handouts explaining how to make homemade oral rehydration solution.

- ***Key Principal: Empowerment and Education of Caregivers of Children***

Dietary recall

We formalized the dietary recall based on feedback from nutrition technicians on what questions do and do not work and added additional questions to address key elements of complementary feeding. We modeled how to use the dietary recall to guide feedback given to caregivers. We also observed nutrition technicians administering the dietary recall and giving caregivers advice, and we provided technicians with immediate feedback. While observing, we noticed that advice given to caregivers was sometimes disorganized or not directly related to the dietary recall results. To address this issue, a table (see appendix) was constructed to facilitate providing mothers with organized and relevant, individualized feedback based on dietary recall responses. After administering a dietary recall, nutrition technicians now start by congratulating caregivers to re-enforce positive feeding practices followed by advice for improving a child's diet based on

their responses. Per their feedback, nutrition technicians also received standardized nutrition kits to use when administering the dietary recall and when providing nutrition education to caregivers about appropriate meal size for a child of a given age. Initially the standardized nutrition kit included a 250cc cup that was marked, but the nutrition technicians reported that the cup caused confusion with caregivers, who thought the cup referred to liquid consumption and had a difficult time relating the quantity of food given to their child to a cup. As a result, the cup was replaced with a small bowl typical of the dish size and type given to children by their caregivers. Currently, the standardized nutrition kit includes teaspoons, tablespoons, and a small bowl. The nutrition education booklet provided to caregivers who participate in our group nutrition classes was revised to reduce the quantity of text and increase the quantity and quality of pictures since some caregivers are illiterate or have limited literacy. A laminated 8.5 x 11 inch, 49-page educational flipbook was created with input from nutrition technicians and provided to all nutrition technicians to facilitate educating and empowering caregivers.

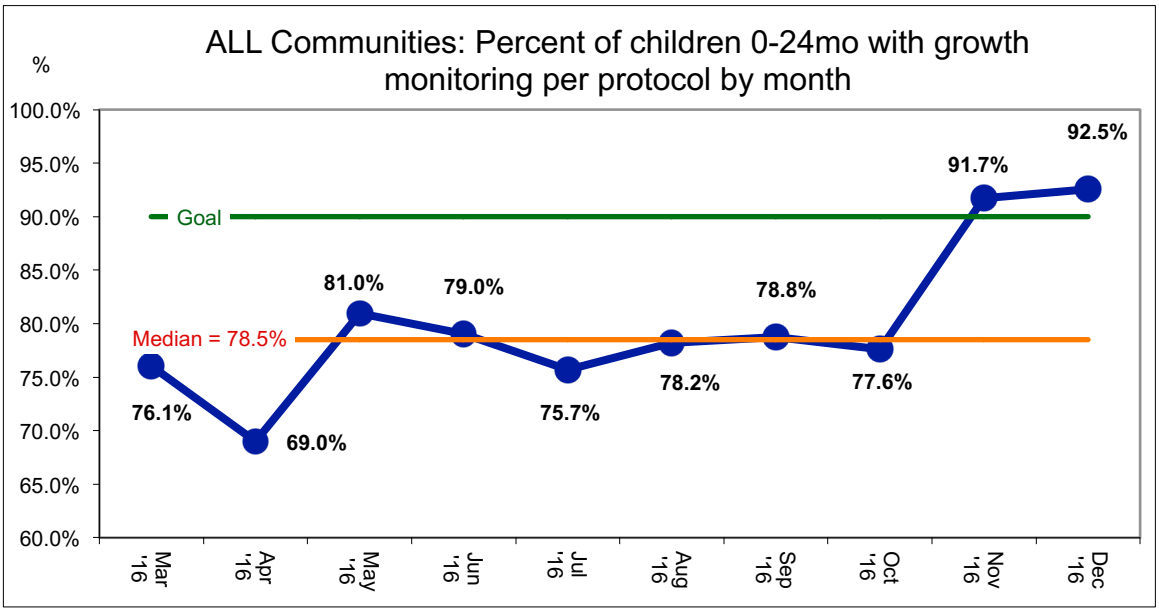
Figure 2. Timeline of our quality improvement efforts

Jan-16	▪ Nutrition protocol standardization and re-training ▪ Nutrition manual distribution ▪ Metrics and goals defined	
Feb-16	▪ Protocol modification based on staff feedback ▪ Dietary recall revision and tool for giving relevant advice ▪ Nutrition kit distribution	▪ Monthly data review ▪ Iterative modifications to the documentation system ▪ Continuous feedback from staff ▪ Immediate constructive feedback for staff in the field (monthly)
Mar-16	▪ Nutritionist hired and on-boarded	
Apr-16	▪ Lactation failure training and protocol revision ▪ ManíPlus rollout for stunted children 6-24 months	
May-16	▪ PlumpyNut protocol for acute malnutrition ▪ Growth monitoring checklist and interpretation tool ▪ Color-coded/labeled and revised growth charts ▪ Revised and laminated flip chart ▪ Diarrhea protocol and kit	

Process Measures

Between March 2016 and December 2016, the number of children under 60 months of age participating in the nutrition program increased by 36% from 761 to 1037 children, and the number under 24 months of age increased by 66%, from 259 to 429 children. Part of this increase was due to extending services in October 2016 to three additional communities with a combined total of 157 children under 5 years old, 48 of whom are under 24 months old. By November 2016, we achieved our goal of 90% compliance with growth monitoring coverage per the protocol for children in the universal nutrition program. From March to December 2016, the percentage of children under 2 years old, receiving growth monitoring per protocol, improved from 76.1% to 92.5%. The run chart (figure 3) below shows the process in time order from March 2016 to December 2016. We did not have a baseline for this chart since the frequency of growth measurements was variable depending on the community in prior years, standardized in January 2016 across communities, and then modified at the end of February based on feedback from nutrition technicians and discussions with WK's leadership. Thus, the median line of 78.5% is the median percent of children less than 24 months old with growth monitoring per the protocol (i.e. growth monitoring once a month) from March to December 2016. This run chart does not satisfy any of the Perla rules; thus, the pattern is considered random.

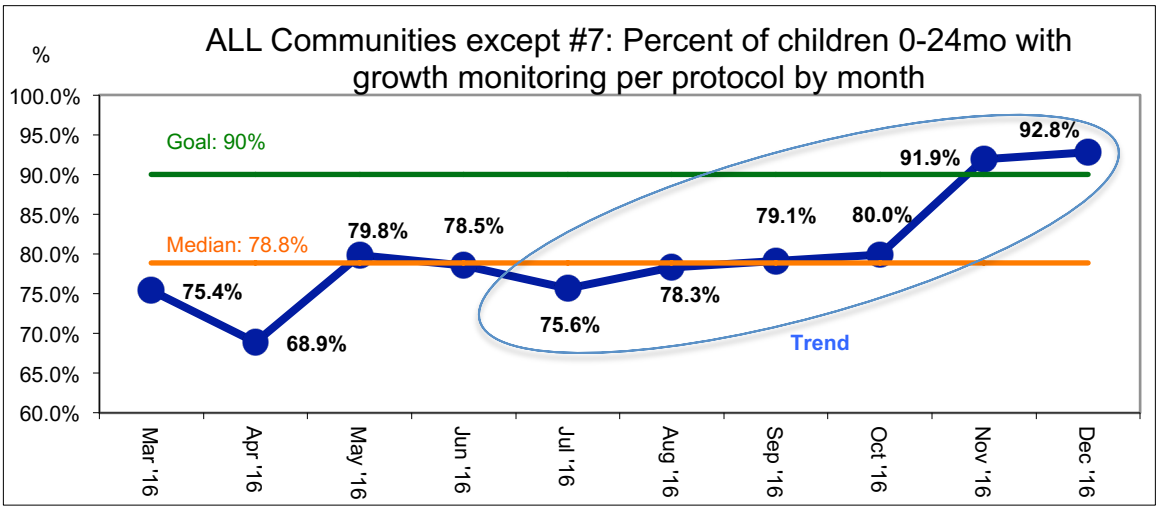
Figure 3. Run chart of percentage of children 0-24 months in all communities with growing monitoring per protocol by month



Run charts displaying percentages or rates should be interpreted with caution. The denominator for each data point should be about +/- 25% of the average denominator [18]. In figures 3, the denominator (number of children 0-24 months of age) for October and November (442 children and 429 children, respectively) exceeded +25% of the average denominator (343.9).

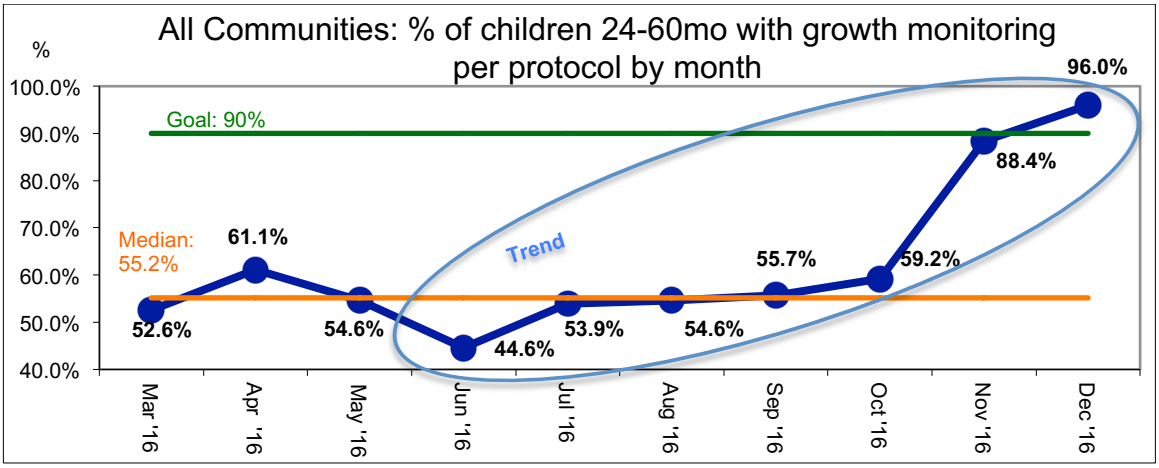
In community 7, no children under 24 months of age were measured in October. The run chart with all communities except community 7 is shown in figure 4. This run chart shows an upward trend (five consecutive increasing data points) from August to December 2016, which by the Perla trend rule indicates non-random variation and therefore evidence of process improvement. The denominators in October, November, and December exceeded +25% of the average denominator (412 children 0-24 months of age) in the setting of adding three additional communities to our nutrition program.

Figure 4. Run chart of percentage of children 0-24 months in all communities, except community 7, with growing monitoring per protocol by month



From March 2016 to December 2016, the percentage of children 24 to 60 months of age receiving growth monitoring per protocol improved from 52.6% to 96.0%, with a median of 55.2%. The run chart (figure 5) shows an upward trend (Perla rule 2) from July to December 2016, indicating non-random variation and thus evidence of process improvement. The denominator for each data point is within the range of +/- 25% of the average denominator.

Figure 5. Run chart of percentage of children 24-60 months old in all communities with growing monitoring per protocol by month

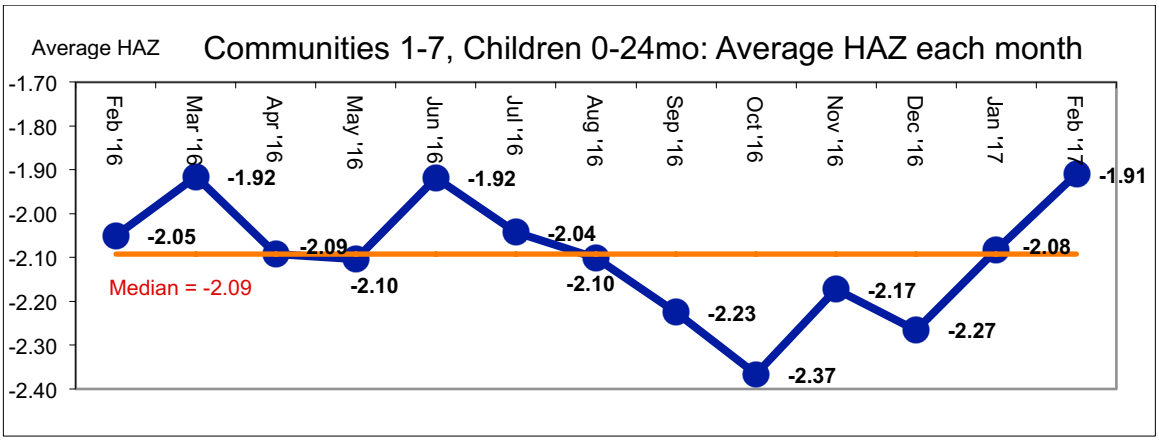


Outcome measures

Average height-for-age Z score for children under 2 years old

The aggregate data from communities 1 through 7 shows a 6.8% improvement in the average height-for-age Z (HAZ) score in children between 0 and 24 months old from February 2016 (average HAZ score -2.05) to February 2017 (average HAZ score -1.91). However, the run chart below (figure 6) suggests random variation in average HAZ score.

Figure 6. Run chart average HAZ each month in children 0-24months old in communities 1-7

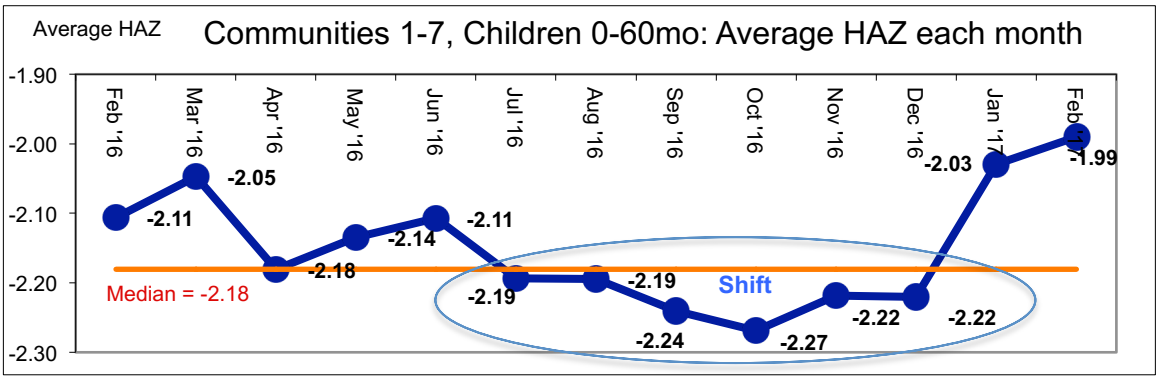


All disaggregated run charts for individual communities also showed random variation in the average HAZ scores for children under 2 years old.

Average height-for-age Z score for children under 5 years old

The average HAZ score for children 0-60 months old improved by 5.7% between February 2016 (HAZ -2.11) and February 2017 (HAZ -1.99). However, the run chart of average HAZ scores for children 0-60 months old (figure 7a) shows non-random variation with a shift of six consecutive points below the median from July to December 2016, indicating worsening HAZ scores.

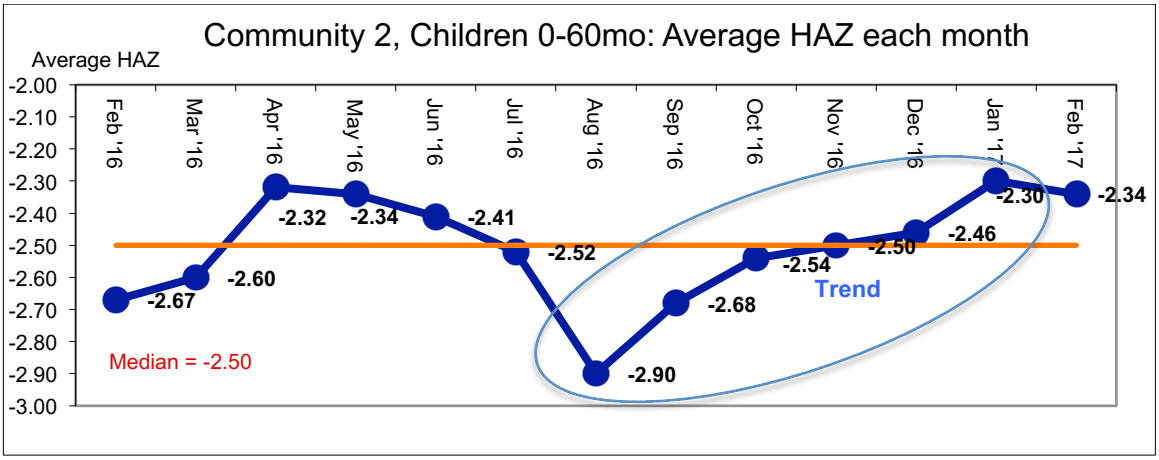
Figure 7a. Run chart of HAZ each month in children 0-60 months old in communities 1-7



Number of children under 5 years old measured each month: Range: 201-367, Average: 72.8, Average +/- 25%: 218.3-363.8

In community 2, there was non-random improvement in the average HAZ score of children under 5 years old from September 2016 to January 2016 as indicated by the trend on the run chart (figure 7b). Individual data for other communities showed random variation.

Figure 7b. Run chart of HAZ each month in children 0-60 months old in community 2

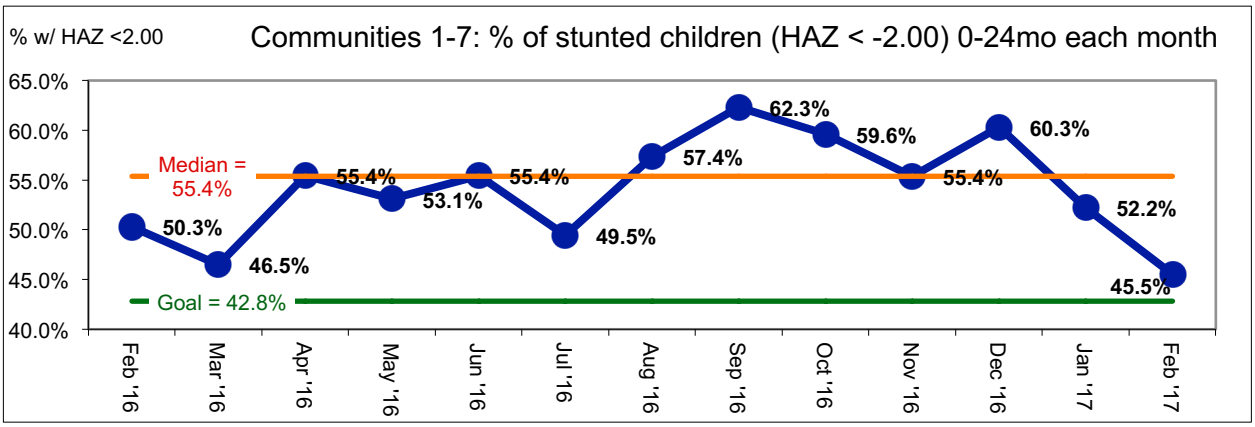


Number of children under 5 years old measured each month: Range: 53-109, Average: 78.2, Average +/- 25%: 58.7-97.8

Percentage of stunted children (HAZ < -2.00) under 2 years old

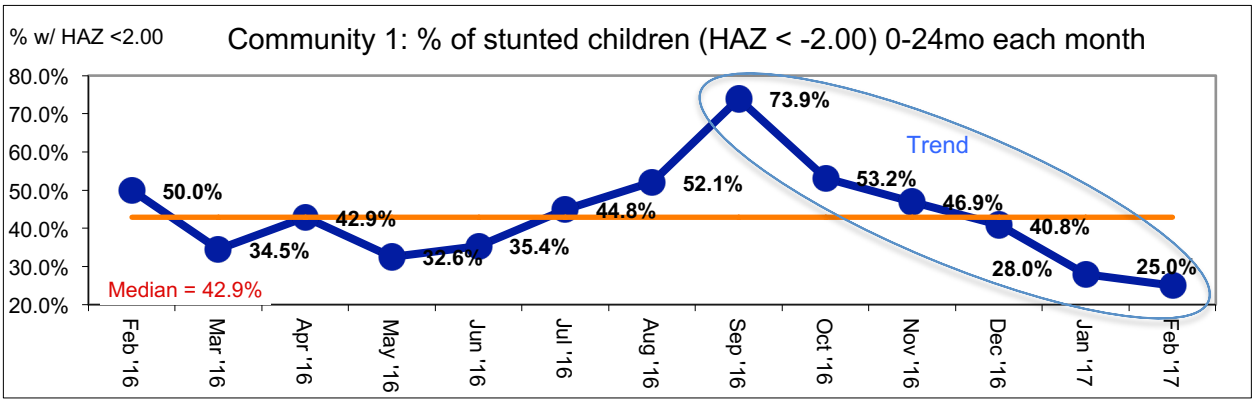
From February 2016 to February 2017, the percentage of stunted children under 2 years old in communities 1-7 decreased by 4.8% from 50.3% to 45.5%. However, the aggregate run chart (figure 8) suggests variations in prevalence of stunting are random rather than due to process improvement. The number of children measured each month was within +/-25% of the average.

Figure 8. Run chart of prevalence of stunted children (HAZ < -2.00) in communities 1-7, aged 0-24 months by month



In community 1, the prevalence of stunted children under 2 years old decreased from 50% in February 2016 to 25.0% in February 2017. The run chart (figure 8b) shows non-random improvement indicated by the downward trend from September 2016 to February 2017. Run charts of the prevalence of stunting in children under 2 years old in other individual communities showed random variation.

Figure 8b. Run chart of prevalence of stunted children (HAZ < -2.00) aged 0-24 months by month in community 1

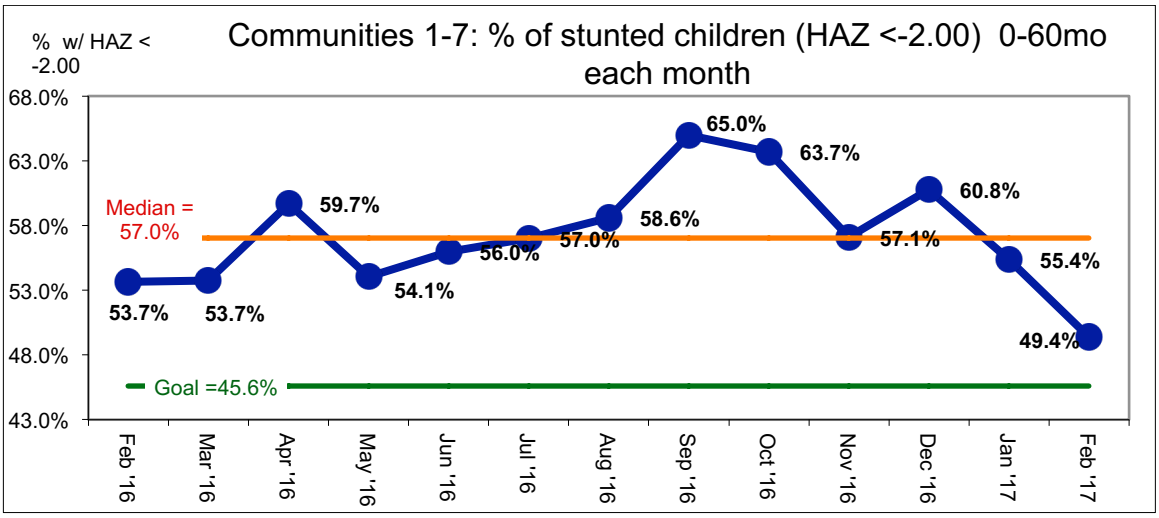


Number of children under 24 months of age measured: Range: 21-55, Average: 41, Average +/- 25%: 30.7-51.3

Percentage of stunted children (HAZ < -2.00) under 5 years old

From February 2016 to February 2017, the prevalence of stunted children under 5 years old in communities 1-7 decreased from 53.7% to 49.4%. The run chart rules do not apply to the corresponding run chart (figure 9); thus, the variations can be considered random rather than secondary to process improvement or degradation. The number of children under 5 years old measured in April 2016 was less than 75% of the average number of children under 5 years old measured each month from February 2016 to February 2017. The run charts for individual communities also showed random variation in the prevalence of stunting of children under 5 years old.

Figure 9. Run chart of prevalence of stunted children (HAZ < -2.00) under 5 years old in communities 1-7 by month



Section 5: Discussion, Limitations, Conclusions, and Suggestions for Future Work

Discussion

Quality improvement work in global health is important for continually reassessing interventions and for maximizing impact. Guided by our model for improvement and feedback from staff, we worked on quality improvement efforts related to food security, environmental health, health services, and empowerment and education of caregivers of children. We were able to make changes to improve services and education provided.

Our process measure of growth monitoring coverage for children younger than 5 years old markedly improved and by the end of 2016 was above our goal of 90% coverage. The run

charts provide evidence of upward trends, indicating process improvement. Reviewing the monthly growth monitoring coverage as a team and then in individual meetings each month likely fostered improvement since staff could visualize the impact of their efforts. Also, our programmer generated lists of the children who needed growth monitoring for a given month to help nutrition technicians with their workflow, and this effort likely contributed to the improvement in growth monitoring coverage. It is also important to note that if a child was measured during a given period, but the data was not yet in our electronic medical record system at the time of generating the report, then the child was not counted as measured. It is also worth highlighting the difference in the aggregate run chart of the percent of children under 2 years olds measured in all communities (figure 3) compared to the same run chart with all communities except community 7 (figure 4). The run chart in figure 4 shows an upward trend, indicating non-random variation and thus provides evidence of process improvement. This difference highlights the fact that combining data from multiple communities in a run chart can prevent a signal from being visualized [18]. Thus, it is also useful to look at the run charts for individual communities since one or a few struggling communities can make the difference between the presence versus the absence of a shift and/or trend. Also, looking at run charts for individual communities enables versatile visual identification of which communities are struggling and thus provides an opportunity for further discussion about obstacles and potential solutions.

As a result of poor electronic documentation, we were unable to assess if our other process measures, specifically the distribution of deworming medication and micronutrient powder (MNP) supplementation, improved. We postulate that part of the poor documentation is secondary to competing interests for time. We have made efforts to make sure the workload is reasonable for staff. It would be useful to recollect staff input for streamlining their work. While the electronic nutrition program documentation form in OpenMRS has checkboxes for documenting distribution of albendazole and MNP, some nutrition technicians do data entry on another day because OpenMRS requires Internet access to use. While most nutrition technicians have a portable Internet modem, the connection is poor in some communities and varies based on the weather.

Improvements in services and process measures do not necessarily translate to decreased stunting, our outcome measure. When only looking at data for the first and last month included

in the run charts, the average HAZ scores appear to have improved for children under 2 years of age and under 5 years of age. However, the aggregate run chart in children under 2 years old suggests that our quality improvement efforts did not impact their average HAZ score, and the aggregate run chart for children under 5 years old shows non-random worsening of HAZ scores from July to December 2016. It is important to note that in figure 7a, the aggregate run chart for children under 5 years of age, some data points included in the shift below the median (-2.19 in July and August 2016 and -2.22 in November and December 2016) are very close to the value of the median (-2.18). Per Perla run chart rules, values on the median do not count, and a difference in Z score of 0.01 or 0.04 is probably not clinically significant. Around the time when average HAZ scores start to decline in both run charts, there was an increase in enrollment of children into the nutrition program in community 2, which is historically an agricultural community, with high levels of food insecurity, where improvement has been challenging to effect [11]. Between September 2016 and December 2016, in that community, the number of children under 24 months old who were measured nearly doubled and the number of children under 24 months old in the recuperative program for chronic malnutrition tripled. Children in the recuperative program are more likely to have growth monitoring than other children since they are seen at least twice a month by a nutrition technician, and thus our HAZ scores may over-represent stunted children. For other children in community 2, we rely on the collaboration of community health promoters to help with measurements since there are so many children under five years old in that community. In December 2016, the community had about 271 children under 5 years old, which was 26% of the children in our nutrition program at that time. Community 2 usually has the worst or second-to-worst average HAZ scores of all the communities. Paradoxically, the only run chart for children under 5 years olds in an individual community that shows non-random improvement in average HAZ scores is community 2 from September 2016 to January 2017. A closer look at the run chart (figure 7b) shows that this non-random improvement occurs after a drastic decline in the average HAZ in community 2 to a nadir average HAZ of -2.90 in August 2016. It is possible that part of the improvement in average HAZ scores in community 2 was related to the significant increase in children enrolled in the recuperative program, which could mean earlier detection and more prompt intervention of chronic malnutrition at a less severe stage when it is easier to halt and/or reverse. It would be informative to construct a run chart looking at the HAZ scores of a cohort of chronically malnourished children enrolled in our

recuperative program before, during, and after the quality improvement interventions.

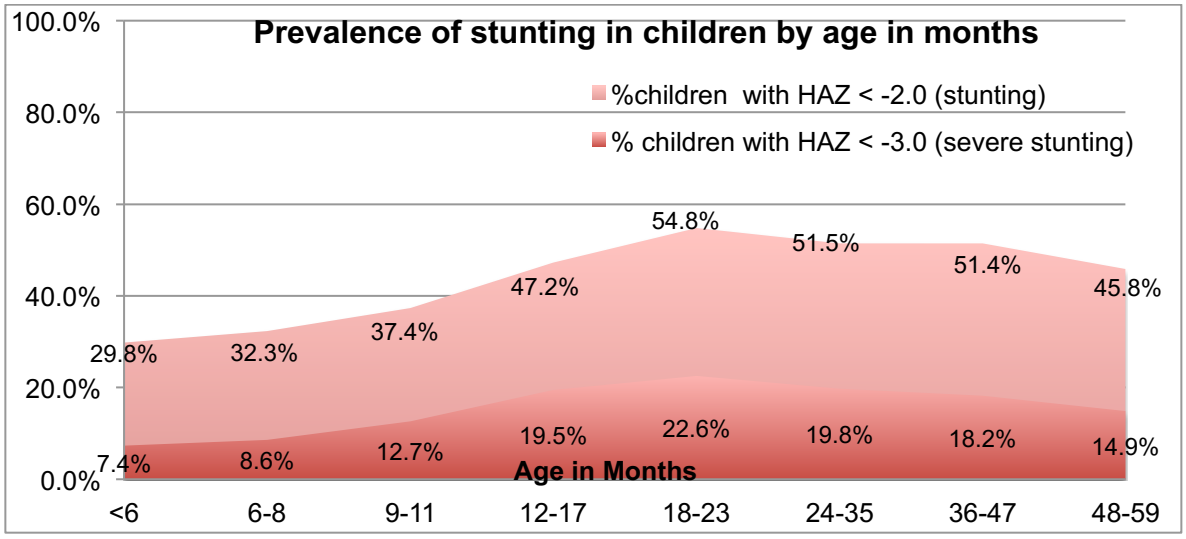
Guatemala ranks among the 10 countries "most susceptible to climate change," and agricultural production has been particularly hard hit during the past years in which prolonged periods of drought have resulted in decreased crop yield as well as complete crop failure for some [3]. Further, Guatemala has a period of "seasonal hunger" that usually extends from June to September [25], which may have impacted our results. For example, the aggregate run chart (figure 6) shows worsening HAZ scores from July to October 2016. Also, in one of the communities, where most men work on a rubber plantation, many men were being laid off as a result of the state of the rubber economy globally. Once we have additional data, it would be helpful to assess for seasonal variation in stunting incidence and prevalence.

The prevalence of stunted children, measured as percentage of children under 5 years old with a height-for-age Z score less than -2.00, decreased from February 2016 to February 2017, but almost all aggregate and disaggregated run charts show random variation in stunting prevalence. The only run chart showing a non-random decline in the prevalence of stunting is the run chart of the prevalence of stunting in children under 2 years old in community 1 (figure 8b). It would be helpful to explore potential reasons why the prevalence of stunting in children under 2 years old declined in community 1 and if there are certain things the nutrition technicians are doing well there that can be emulated in other communities. A closer look at the run chart (figure 8b) shows that the prevalence of stunting in community 1 increased during the period of "seasonal hunger" from June to September 2016, reaching 73.9% in September 2016 and then decreased each month thereafter.

When interpreting these run charts, it is important to note that the prevalence of stunting varies with age in months as seen in figure 10, which shows 2014-2015 data from the National Maternal and Infant Health Survey in Guatemala [1]. Among Guatemalan children under 5 years old, the prevalence of stunting was greatest in children between the age of 18 and 23 months old [1]. The prevalence of stunting in children between 12 and 17 months old (47.2%) was nearly 10% higher than the prevalence children between 9 and 11 months old (37.5%) [1]. This means that if more children between 12 and 17 months old are measured in a given month than children at an age with less stunting, the HAZ scores will look better. It also means that if a certain community suddenly has many newborns, the HAZ score may look better for a certain period of time. In future analysis, it would be helpful to construct a cohort of children who are followed

over time, with the last data point carried forward as necessary for each child without growth measurements in certain months.

Figure 10. Prevalence of Stunting by Age in Months in Guatemala Children under 5 years old. Data source: Ministerio de Salud Pública y Asistencia Social, MSPAS. Encuesta Nacional de Salud Materno Infantil, Guatemala, 2014-2015 [1]



Actively incorporating feedback from the nutrition technicians rather than simply doing Plan-Do-Study-Act (PDSA) cycles with the organizational leadership was a strength of our project. Flexibility and soliciting feedback from staff working in the communities about what is realistic are strengths of quality improvement projects [26]. Another strength to our project was creating a culture of quality improvement and sharing the monthly data with the nutrition technicians, so they can visualize if process and outcome measures are improving and feel empowered to effect change in their assigned community. We hope that our materials and reporting on our quality improvement efforts will prove useful to other organizations doing childhood nutrition work in developing countries but also recognize the importance of adapting approaches and tools based on local context. To date, our nutrition materials have been shared with a Peace Corps volunteer in Guatemala, a physician working in another area of Guatemala, and a nurse from Boston interested in starting a nutrition program in a poor, rural area in Honduras where she regularly volunteers. Meaningful components of our work include a formalized process of using the dietary recall as a tool to provide individualized positive reinforcement and advice as well as efforts to facilitate identification of stunting and interpretation of Z scores and growth charts.

Limitations

Our project had several limitations. While it is considered good technique to use an initial median generated from the baseline and extended it into the future, we were unable to create a baseline for the aggregate data of all sites due to missing baseline data from some communities. Additionally, though Perla rules have high sensitivity (99%), they have relatively poor specificity (53%) [27]. While run charts enable early detection of improvement or degradation, they do not show whether a process is stable [19]. Once we have additional data points, it would be helpful to use Shewhart control charts to assess for process stability and address the issue of denominators outside the range of +/- 25% the average denominator in charts with percentages [18]. Also, while we looked at process measures and outcome measures, we did not assess for balancing measures, which evaluate whether new problems arise as a result of improvements in some aspects of a program [28].

Another limitation is that children under 2 years old are measured every month whereas children between 24 months and 60 months old are measured every 3 months. As a result, in the charts for children under 5 years old, the degree of improvement or deterioration HAZ scores and stunting for children younger than 2 years old is more heavily weighted during certain months than for children between 2 and 5 years old. Finally, our data analysis was limited by poor documentation of distribution of micronutrient supplements and deworming medication.

Conclusions

While we saw improvement in our process outcome of growth monitoring coverage and increased our outreach efforts, we still need to streamline our documentation system. Despite improvement in a process outcome, there was minimal improvement in average HAZ scores and stunting prevalence. No or little improvement in communities is likely related to confounding factors, such as the overrepresentation of children enrolled in the recuperative program in our calculations, expansion of our program to include more severely stunted children, climate change, and crop failure. Additional analysis, looking at cohorts of children before and after the initiation of quality improvement efforts is warranted to fully explore if our quality improvement effort have impacted the severity and prevalence of stunting in communities where we work.

Suggestions for future work

It is important to consider the key principals in our model for improvement driver diagram – (1) food security, (2) environmental health, (3) health services, and (4) empowerment and education of caregivers of children – when speculating about potential reasons for lack of improvement in stunting and when planning future work to foster improvement. In terms of food security, the run charts suggest worse stunting during the seasonal period of hunger in Guatemala. While the food basket provides some alimentary support to children with chronic malnutrition younger than 2 years old and children with acute malnutrition younger than 5 years old, it does not eliminate food insecurity, and nutrition technicians have reported that the food is often shared with other family members. This reality highlights the importance of additional endeavors to address food insecurity. Our organization plans to initiate community garden projects, contingent on funding. Regarding environmental health, since March 2017, the families of all children newly enrolled in the recuperative program receive a water filter. We anticipate that this will help decrease the frequency of diarrheal illness in children and reduce the incidence and prevalence of stunting.

Regarding health services, in the future, we hope to improve our electronic medical record system (EMRS) and documentation. Possible ways to improve the documentation of deworming medication and micronutrient powder (MNP) distribution could include 1) asking staff about barriers to documentation and for their suggestions to mitigate obstacles, 2) providing a reward or recognition for adequate documentation, and 3) developing a way to use OpenMRS offline and then sync data once Internet connection is available. Our programmer is working to develop on offline version of OpenMRS. Another option would be to determine distribution using paper documentation rather than the EMRS. Improving communication with the procurement and logistics specialist about the quantity of deworming medication and MNP needed would also help since part of the issue was the supply chain. Part of strengthening our health services includes providing staff with additional nutrition training.

In terms of empowering and educating caregivers of children, there is also need to involve men in addressing malnutrition in Guatemala given research shows childhood stunting is associated with male employment status, mental health, and perspective on child-rearing [29]. Providing nutrition staff with formal training on motivational interviewing would also be helpful in improving education of caregivers. Additionally, it would be useful to integrate feedback from

parents and other caregivers. A quality improvement intervention in a South African hospital employed experience-based co-design (EBCD) to improve the nutrition and health of children [30]. In EBCD, staff and patients jointly create and implement quality improvement [30]. Involvement of caregivers in future quality improvement efforts would likely improve the engagement of caregivers in the nutrition program and could be piloted in the future.

Section 6: Acknowledgements

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APPENDICES

Consejos y Mensajes Claves Basados en Respuestas de Recuento Dietético

Pregunta y Tema	Recomendación por edad de niño o niña				Recomendación cumplida?	
	0-6 meses	**6-8 meses**	**9-11 meses**	**12-24 meses**	**Sí**	**No**
#2: Leche Materna	Exclusivamente, ~20 minutos cada pecho, ~8-12 veces cada día	**pecho primero,** comida después		**comida primero,** pecho después		
#3: Líquidos	Evitar agüitas y otros líquidos	**comida primero,** líquido después ***Incaparina no es una comida.***				
#4: Espesura de comida	Leche materna exclusivamente	papillas espesas, alimentos bien aplastado	alimentos finamente picados o aplastados o que el bebé pueda agarrar con la mano	alimentos de la familia; si es necesario picados o aplastados		
#4: Diversidad de dieta	Leche materna exclusivamente	Mínima de **4** categorías diferentes				
#6: Frecuencia de comida**	Leche materna exclusivamente	**Meta:** 3 veces **Mínima:** 2 veces	**Meta:** 4 veces (3 comidas, 1 refacción) **Mínima:** 3 veces	**Meta:** 5 veces (3 comidas, 2 refacciones) **Mínima:** 3 veces		
#7: Cantidad de cada comida	Leche materna exclusivamente	Empezar 2-3 cucharadas (6-9 cucharaditas), incrementar gradualmente a 8 cucharadas (24 cucharaditas = ½ **taza**)	**8 cucharadas = 24 cucharaditas = ½ taza** de 250 ml	12-16 cucharadas = 36-48 cucharaditas = ¾ **a 1 taza** de 250ml		
#8: Chispitas	No	Un sobre de Chispitas cada día				

**Para niños 6-24 meses no recibiendo leche materna, la frecuencia mínima de comidas es 4 veces al día.

Diversidad de dieta

Categoría	**Grupo**	**Sí = 1 No = 0**
Categoría 1: cereales y otros carbohidratos	Grupo 4A	
Categoría 2: frijoles y nueces	Grupo 4F	
Categoría 3: lácteos	Leche y/o 4G	
Categoría 4: carnes	Grupo 4D	
Categoría 5: huevos	Grupo 4E	
Categoría 6: frutas y verduras con vitamina A	Grupo 4B	
Categoría 7: otra fruta/verdura	Grupo 4C	
	Total:	

Advice & Key Messages Based on Dietary Recall Responses

Question and Theme	Recommendation based on age of child				Recommendation Followed	
	0-6 months	6-8 months	9-11 months	12-24 months	Yes	No
#2: Breast milk	Exclusively, ~20 minutes per breast, ~8-12 times per day	**Breast milk first,** then food		**Food first,** then breast milk		
#3: Drinks/Liquids	Avoid teas and other liquids	**Meal/food first,** liquid after ***Gruel is not a meal/food.***				
#4: Food consistency	Breast milk exclusively	Thick purees, well-mashed foods	Finely chopped or crushed food that the baby can grab with his/her hand	Family food; if necessary chopped or crushed		
#4: Dietary Diversity		Minimum of 4 different categories				
#6: Meal Frequency **		**Goal:** 3 times/day **Minimum:** 2 times/day	**Goal:** 4 times/day (3 meals, 1 snack) **Minimum:** 3 times/day	**Goal:** 5 times/day (3 meals, 2 snacks) **Minimum:** 3 times/day		
#7: Quantity with each meal		**Start** with 2-3 tablespoons (6-9 teaspoons), gradually **increase to 8 tablespoons (24 teaspoons = ½ cup)**	**8 tablespoons = 24 teaspoons = ½ of a 250cc cup**	12-16 tablespoons = 36-48 teaspoons = **¾ to 1 of a 250cc cup**		
#8: Chispitas	No	One packet of micronutrient powder every day				

**For children 6-24 month old who are not receiving breast milk, the minimum meal frequency is 4 times a day

Dietary Diversity

Category	Group	Yes = 1 No = 0
Category 1: cereals and other carbohydrates	Group 4A	
Category 2: beans and nuts	Group 4F	
Category 3: dairy products	Milk &/or 4G	
Category 4: meat	Group 4D	
Category 5: eggs	Group 4E	
Category 6: fruits and vegetables with vitamin A	Group 4B	
Category 7: other fruits/vegetables	Group 4C	
	Total:	

Pasos **cada vez** que obtenga medidas de crecimiento (peso y talla)

1. Obtener y apuntar medidas (hasta 0.1 kilo o 0.1 cm más cerca)

2. Graficar medidas en carnet o repasar gráfica en OpenMRS de una vez.

3. Calcular y apuntar puntuación Z (Z peso p. edad, Z talla/longitud p. edad, Z peso p. talla/longitud) **de una vez.**

4. Interpretar medidas de una vez.

A. ¿Cómo está la **talla** del niño desde la última visita?
☐ Ha aumentado
☐ Se mantiene igual

B. ¿Cómo está el **peso** el niño desde la última visita?
☐ Ha aumentado
☐ Se mantiene igual → **Si no ha subido por más de 3 meses** → llamar a nutricionista y programar para cita con médico
☐ Ha disminuido → **Si pérdida de peso continúa por 3 meses o más –O- ha perdido más de 0.3 kilos** → llamar a nutricionista y al médico de su comunidad y programmar para cita con médico

5. Interpretar puntuación Z

A. Revisar Z talla/longitud por edad:
☐ Z entre -2 y -3 (retraso de crecimiento moderada) → Si tiene menos de 24 meses de edad y nunca ha recibido víveres, Watsiar.
☐ Z por debajo de -3 (retraso de crecimiento severo) → Si tiene menos de 24 meses de edad y nunca ha recibido víveres, Watsiar.
☐ Mejorando ↑
☐ Empeorando ↓
☐ Igual
** **¡Ojo!** Cualquier niño/a menor de 60 meses con Z talla/longitud por edad por debajo de -4.0, debe tener cita con un médico.

B. Revisar Z peso por talla/longitud:
☐ **Z entre -2 y -3 (desnutrición AGUDA MODERADA) → llamar a nutricionista AHORITA y si niño identificado con desnutrición aguda moderada por primera vez, llama al médico de su comunidad también**
☐ **Z por debajo de -3 (desnutrición AGUDA SEVERA) → llamar a nutricionista y al médico de su comunidad AHORITA, programar para cita, y notificar al Centro de Salud mismo día**
☐ Mejorando ↑
☐ Empeorando ↓ → **Si tiene Z peso p talla entre -1.8 y -2.0, llamar a nutricionista**
☐ Igual

C. Revisar Z peso por edad:
☐ Mejorando ↑
☐ Empeorando ↓
☐ Igual
☐ Z entre -2 y -3 (bajo peso moderado)
☐ Z por debajo de -3 (bajo peso severo)

6. Interpretar gráfica

A. ¿Cuál es la tendencia de crecimiento del niño en gráfica de talla/longitud por edad?

☐ Cruzando líneas **hacia arriba**

☐ Sigue la curva

☐ Estancado (es decir **empeorando**)

B. ¿Cuál es la tendencia de crecimiento del niño en gráfica de peso por talla/longitud?

☐ Cruzando líneas **hacia arriba**

☐ Sigue la curva

☐ Estancado (es decir **empeorando**)

C. ¿Cuál es la tendencia de crecimiento del niño en gráfica de peso por edad?

☐ Cruzando líneas

☐ Sigue la curva

☐ Estancado (signo de peligro)

☐ Bajando (empeorando = peligro)

7. Explicar crecimiento a la madre.

- Medidas
  - Peso - mejor, igual, o peor?
  - Talla - mejor o igual?
- Gráficas – mejorando, igual, empeorando?
- Tipo(s) de desnutrición que tiene y si está mejorando, sigue igual, o empeorando

8. Necesita una cita con el médico?

☐ Sí, urgente → llamar al médico de su comunidad (si no contesta, llamar a Directora Médica) para consejos y mandar al Centro de Salud ahorita

☐ Sí, pero no urgente → programar para cita

☐ No

Steps with *every* growth measurement (weight and height)

1. Obtain and record the measurement (to the nearest 0.1 kilogram or 0.1 centimeter).

2. Graph the measurement on the paper chart or review the graph in OpenMRS immediately.

3. Calculate and record the Z scores immediately (weight-for-age Z score, height/length-for-age Z score, weight-for-height/length Z score).

4. Interpret the measurement immediately.

A. How is the child's height since the last visit?
☐ It has increased.
☐ It has remained the same.

B. How is the child's weight since the last visit?
☐ It has increased
☐ It is the same. → **If the child's weight has not increased for more than 3 months,** call the nutritionist and schedule a doctor's appointment!
☐ It has decreased → **If the weight loss has continued for 3 or more months –OR- the child has lost more than 0.3 kilograms,** call the nutritionist and the medical doctor assigned to your community and schedule a doctor's appointment!

5. Interpret the Z scores.

A. Review the height/length-for-age Z score:
☐ Z between -2 y -3 (moderate stunting) → If the child is less than 24 months old and has never received food supplementation, enroll in recuperative program.
☐ Z less than -3 (severe stunting) → If the child is less than 24 months old and has never received food supplementation, enroll in recuperative program.
☐ Improving ↑
☐ Worsening ↓
☐ Unchanged
** **Attention!** Any child less than 5 years old (60 months), with a height/length-for-age Z score less than -4.0, needs a doctor's appointment.

B. Review the weight-for-height/length Z score:
☐ Z between -2 and -3 (MODERATE ACUTE malnutrition) → call the nutritionist NOW and if this is the first time the child has been identified as having moderate acute malnutrition, also call the doctor assigned to your community.
☐ Z less than -3 (SEVERE ACUTE malnutrition) → call the nutritionist and the doctor assigned to your community NOW, schedule a doctor's appointment, and notify the government Health Center the same day.
☐ Improving ↑
☐ Worsening ↓ → **If the weight-for-height/length Z score is between -1.8 and -2.0, call the nutritionist.**
☐ Unchanged

C. Review the weight-for-age Z (WAZ) score:

☐ Improving ↑
☐ Worsening ↓
☐ Unchanged
☐ WAZ between -2 and -3 (moderately underweight)
☐ WAZ less than -3 (severely underweight)

6. Interpret the graphs.

A. What is the growth trend on the height/length-for-age graph?
☐ Crossing lines upward
☐ Continues in the same curve/slope
☐ At a standstill (that is to say **worsening**)

B. What is the growth trend on the weight-for –height/length graph?
☐ Crossing lines upward
☐ Continues in the same curve/slope
☐ At a standstill (that is to say **worsening**)

C. What is the growth trend on the weight-for-age graph?
☐ Crossing lines upward
☐ Continues in the same curve/slope
☐ At a standstill (sign of danger)
☐ Downward (worsening = danger)

7. Explain the growth to the caregiver.

- Measurements
  - Weight – better, same, or worse?
  - Height – better or same?
- Graphs – better, same, worse?
- Type(s) of malnutrition that the child has and if improving, same, or worsening.

8. Does the child need a doctor's appointment?

☐ Yes, urgently → Call the doctor assigned to your community (if the doctor does not answer, call the Medical Director) for advice, and send the child to the nearest health center now!
☐ Yes, but it's not urgent. → Schedule an appointment
☐ No

Observación de la Técnica Antropométrica

Medida **1** Bien **0** Mal		**PESO**			**LONGITUD**		
		1	**2**	**3**	**1**	**2**	**3**
1	Posición del equipo						
2	Ajuste a cero						
3	Ropa						
4	Actitud del niño						
5	Posición del niño						
6	Tiempo de lectura						
7	Angulo de lectura						
8	Valor de medidor apuntado hasta 0.1 cm o 0.1 kilo más cercano						
9	Valor acertado						
VALOR	Valor medidor	.	.	.	.	.	.
	Valor Observador	.	.	.	.	.	.
	Diferencia	.	.	.	.	.	.

10	Anotación correcta de puntos en las graficas **1** Si **2** No	
11	Explicación del resultado de peso y talla	
12	Dibujo de la curva de crecimiento	
13	Explicación de la tendencia	

Observaciones:

Observation of Anthropometric Technique

Measure **1**Good **0** Bad		Weight			Length/Height		
		1	**2**	**3**	**1**	**2**	**3**
1	Positioning of equipment						
2	Balance zeroed						
3	Appropriate amount of clothing						
4	Child's behavior						
5	Positioning of child						
6	Reading time						
7	Reading angle						
8	Value recorded to nearest 0.1cm or 0.1 kg						
9	Accurate Value						
VALUE	Value measured	.	.	.	.	.	.
	Value observed	.	.	.	.	.	.
	Difference	.	.	.	.	.	.

10	Correct plotting of the data points on the graph **1** Yes **2** No	
11	Weight and height explained to care provider	
12	Drawing of growth curve	
13	Explanation of growth trend (improving, worsening, same)	

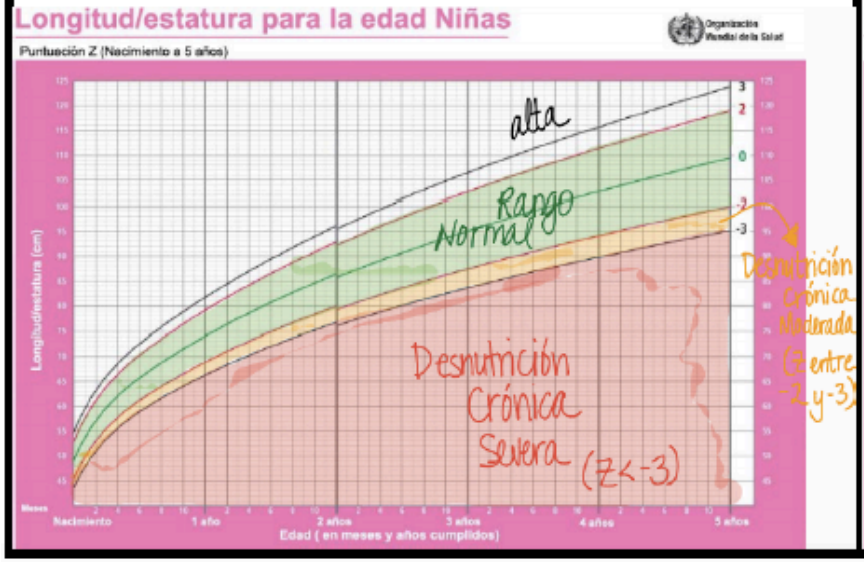
Observations:

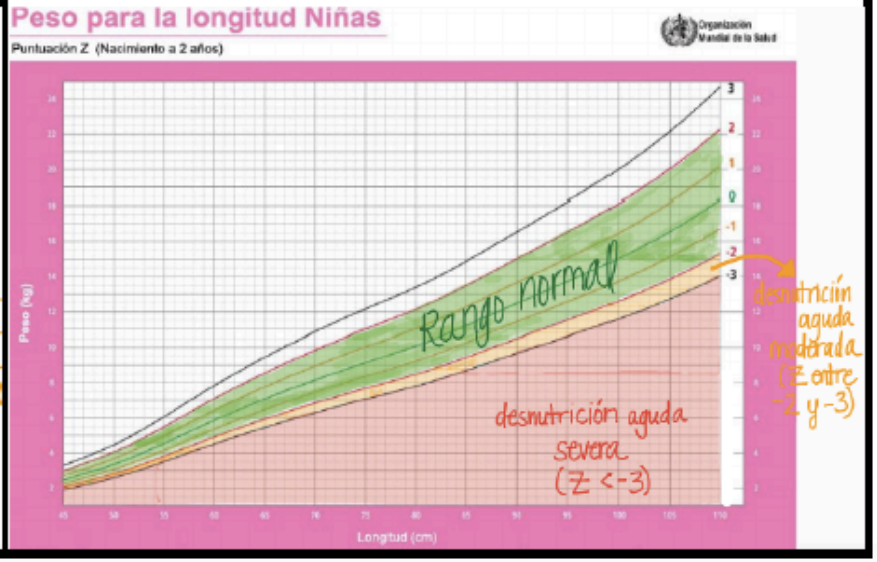
Desnutrición **CRÓNICA** (retraso de crecimiento): Z LONGITUD/ESTATURA PARA EDAD < -2	Desnutrición **AGUDA** (emaciación; delgado): Z PESO PARA LONGITUD/ESTATURA < -2

Niños guatemaltecos en Guatemala **Niños guatemaltecos en los Estados Unidos**

Fuente de Imagen arriba: http://abcnews.go.com/Health/malnutrition-severe-stunting-guatemalan-children/story?id=12381731; Imagen abajo modificada de OMS

Fuente de imagen izquierda: http://www.caputo-children-fund.org/guatemalaprofile.htm Patrick Farrell, Miami Herald). Fuente de imagen derecha: http://www.economist.com/node/14313735 Reuters "No, no es Africa, esto es Guatemala." Imagen abajo modificada de OMS





CHRONIC malnutrition (stunting):
HEIGHT/LENGTH for AGE Z score < -2

ACUTE malnutrition (wasting; skinny):
WEIGHT for HEIGHT/LENGTH Z score < -2

Guatemalan children . . .

in Guatemala **in the United States**

Image above: from: http://abcnews.go.com/Health/malnutrition-severe-stunting-guatemalan-children/story?id=12381731; Image below modified from WHO

Left image from: http://www.caputo-children-fund.org/guatemalaprofile.htm Patrick Farrell, Miami Herald). Right image from: http://www.economist.com/node/14313735 Reuters "No, no es Africa, esto es Guatemala." Image below modified from WHO