



## CASES IN GLOBAL HEALTH DELIVERY

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# Treating Malnutrition in Haiti with Ready-to-Use Therapeutic Foods

In June of 2008, Dr. Joseline Marhonne Pierre, the director of the Coordination Unit for the National Food and Nutrition Program of Haiti's Ministry of Health and Population (MSPP), met with representatives from a consortium of three non-governmental organizations (NGOs). The consortium had completed a six month field trial during which it treated children with severe acute malnutrition (SAM) according to a community-based care model with ready-to-use therapeutic foods (RUTF). They were meeting to draft new national protocols for the treatment of severe acute malnutrition using results from the evaluation of the field trial. Contrary to international recommendations, Marhonne believed that not only should severely acutely malnourished children be given RUTF, but so should moderately acutely malnourished children. This would mean procuring and delivering RUTF for over 100,000 children. The NGOs maintained that RUTFs were not designed for this use and that Marhonne's plan was not feasible given the rates of moderate and severe acute malnutrition in the country. How could the NGO consortium and Marhonne reach an agreement on how to proceed?

## Overview of Haiti

The Republic of Haiti was located on the western third of the Island of Quisqueya, called Hispaniola by the first Spanish settlers who arrived there in 1492. The Spanish ceded the western portion of the island to the French in 1697. With the labor of hundreds of thousands of slaves—estimated at 500,000 at the peak of slavery in the late eighteenth century—the French turned Haiti into the “Jewel of the Antilles,” a leading exporter of coffee, indigo, rum, and sugar.

In 1791 slaves launched a 13-year rebellion against their French masters, which ended in 1804 when Haiti became the second independent nation in the Western Hemisphere. In 1825, under threat of

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*Erica Phillips and Joseph Rhatigan prepared this case with assistance from Donna Barry for the purposes of classroom discussion rather than to illustrate either effective or ineffective health care delivery practice.*

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bombardment, Haiti was forced to pay 90 million francs in reparations to France (the equivalent of roughly USD 21 billion today) in exchange for France's recognition of Haiti as a sovereign nation.<sup>1</sup> Then President Jean Pierre Boyer (1818-1843) presumed that trade and diplomatic ties with France would open substantially with this arrangement, but they did not. The damages incurred through this agreement, as well as the failure of Boyer's other efforts at reform led to his overthrow in 1843. Haiti continued to pay "reparations" until 1883.

Frequent political uprisings continued, and instability increased.<sup>2</sup> To recover Haiti's debts, the US and many European nations engaged in a "customs receivership" arrangement, wherein they would trade with Haiti and collect the nation's customs receipts. A 1915 rebellion and presidential assassination spurred the US government to occupy the country.<sup>2</sup> Until 1934, the US government assumed complete control of Haiti's finances as well as all public health and public works programs. Infrastructure and fiscal management improved in the country, however, the order that prevailed was imposed largely by white, racist foreigners whose control incited resentment, especially among the country's mulatto elite.<sup>2</sup>

In 1957 the president, "Papa Doc" Duvalier, declared himself "president for life" and ruled Haiti for 14 years until his death in 1971. The *Tontons Macoutes*, Duvalier's paramilitary police force, killed an estimated 30,000 Haitians during his reign. His son took over after his death, but amidst corruption and violence similar to that of his father's, he was forced to flee the country in 1986. After a series of provisional governments, Jean Bertrand Aristide was elected president with 67% of the vote, largely on a popular reform platform. He was overthrown in 1991 but was reinstated in 1994. The first handover of power between two democratically elected leaders ever in Haiti took place in 1996, when Jean Bertrand Aristide handed power to René Préal, who would serve his second term of presidency from 2006-2011. Since 2004, a 9,000-person United Nations stabilization mission had been present in Haiti. Between 1804 and 2008, leadership changed hands 68 times, with tenures ranging from 3 days to 35 years.

## Demographics

Haiti was the poorest country in the Americas, and 27% of the population was considered "ultra poor," living on less than USD 0.50 per day.<sup>3,4</sup> Extreme poverty was almost three times higher in rural areas than urban areas.<sup>5</sup> Sixty three percent of Haitians had access to clean drinking water, and 42% had access to electricity.<sup>3</sup>

**Basic Socioeconomic and Demographic Indicators<sup>i</sup>**

INDICATOR		YEAR
UN Human Development Index ranking	149 out of 182	2007
Population (thousands)	9446	2006
Urban population (%)	44.1	2005
Drinking water coverage (%)	63	2008
Poverty rate (% living under USD 1.25 per day)	47	2008
Gini index	60	2001
GDP per capita in PPP (constant 2005 international dollar)	1,088	2008
GDP per capita (constant 2000 USD)	410	2008
Literacy (total, female, male)	61.0, 62.8, 59.1	2008

<sup>i</sup> This data was comprised from the following sources: United Nations (UN), United Nations Children's Fund (UNICEF), World Bank, and United Nations Educational, Scientific and Cultural Organization (UNESCO).

## Health in Haiti

### Health System and Epidemiologic Indicators<sup>ii</sup>

INDICATOR		YEAR
Average life expectancy at birth (total, female, male)	62, 64, 60	2008
Maternal mortality ratio (per 100,000 live births)	670	2005
Under five mortality rate (per 1,000 live births)	72	2008
Infant mortality rate (per 1,000 live births)	54	2008
Vaccination rates (% of DTP3 coverage)	53	2008
Undernourished (%)	58	2005
INDICATOR		YEAR
Adult (15-49 years) HIV prevalence (per 100,000)	3377	2006
HIV antiretroviral therapy coverage (%)	41	2007
Tuberculosis prevalence (per 100,000)	290	2008
DOTS coverage (%)	70	2007
Malaria cases (per 1,000)	17	2006
Government expenditure on health as a % of total government expenditure	9.5	2008
Government expenditure on health per capita (international dollar, USD)	36, 14	2005
Total health expenditure per capita (international dollar, USD)	73, 29	2005
Physician density (per 10,000)	3	1998
Nursing and midwifery density (per 10,000)	1	1998
Number of hospital beds (per 10,000)	13	2007

### Children's Health

In 2000, 21% of newborns had a low birth weight (<2500 grams).<sup>6</sup> Exclusive breastfeeding rates for children under 4-5 months was 24%, and continued breastfeeding for children 12-17 months and 18 -23 months was 74.6% and 39.4% respectively. Forty-one percent of children up to 12 months were considered fully vaccinated according to the World Health Organization (WHO) guidelines.<sup>iii 7</sup> Acute diarrheal disease was the number-one health problem in children. The leading causes of death in 1999 for children were intestinal infectious diseases (12.1%), infections of the perinatal period (10.2%), malnutrition (9.1%), and acute respiratory infections (6.9%).<sup>8 6</sup>

### Household and Individual Food Insecurity

In June of 2008, approximately 3 million Haitians were considered food insecure, with 9 out of 10 departments (provinces) reporting pockets of severe food insecurity.<sup>6</sup> In 2000 Haiti had the third-highest

<sup>ii</sup> This data was comprised from the following sources: WHO, UNICEF, UN.

<sup>iii</sup> BCG, measles, 3DTP and 3 doses of Polio

caloric deficit<sup>iv</sup> in the world (– 460 calories per capita per day),<sup>9</sup> and in 2003 average calorie consumption per capita per day was 2108 kcal.<sup>10</sup> Thirty-three percent of income was spent on food in urban areas and up to 55.6% in rural areas.<sup>11</sup> Seventy-seven percent of households who considered themselves food insecure were in rural areas.<sup>11</sup>

Two international targets to reduce food insecurity had had little impact on the number of people who suffered from hunger in Haiti. The World Food Summit goal was to halve the number of undernourished people in food insecure countries from 1992 to 2015.<sup>12</sup> Between 1990 and 1992, 4.5 million people in Haiti were considered undernourished; between 1995 and 1997, 4.8 million were undernourished; and between 2003 and 2005, 5.3 million were undernourished. The second target, the United Nations Millennium Development Goal 1, aimed to reduce by half the proportion of undernourished people in the world between 1990 and 2015 as well as the prevalence of underweight children<sup>vi</sup>. Due to population growth, the proportion of hungry people in Haiti had fallen from 63% in 1990-1992 to 58% in 2003-2005.<sup>12</sup>

The 2008 international food price crisis drove prices of major agricultural commodities out of reach for many middle- and low-income Haitians. In a major Port-au-Prince market, the prices of imported rice and local corn were approximately 53% and 55% higher respectively in April 2008 than in April 2007.<sup>13</sup> These elevated prices sparked civil unrest and riots in four cities in April 2008, prompting the Senate to pass a vote of no confidence for the country's Prime Minister. The position was left vacant through June 2008 and delayed the start up, monitoring, and coordination of programs aimed at those affected by the food crisis. The riots forced President Préval to establish temporary subsidies on imported rice, gas, and fertilizer. Hungry citizens used the phrase "*Grangou Klowoks*" or "*Clorox Hunger*" to describe the burning pain in their stomachs after an extended period of time without eating.

## Childhood Malnutrition

### *Classifications of Malnutrition*

"Childhood malnutrition" is defined as a state in which physical function of a child from birth to five years old is impaired due to either over- or under-nutrition, the latter of which is the result of poor or insufficient nourishment, poor absorption, or poor biological use of nutrients consumed. Malnutrition<sup>vii</sup> is assessed most often using anthropometry, the study of body measurement. The three most common anthropometric measurements are weight-for-height (WFH), weight-for-age (WFA), and height-for-age (HFA<sup>viii</sup>) (see **Exhibit 1** for more on common anthropometric measurements). Height-for-age is the best indicator of long-term and chronic undernutrition, whereas weight-for-height is the best indicator of short-term or acute undernourishment. Weight-for-age is the easiest and most commonly collected statistic but cannot discriminate between short- and long-term forms of malnutrition. Anthropometry is used to track individual children's growth by comparing this measurement to an international reference population. For any of these three indicators, children with values between two and three standard deviations less than the mean are considered moderately malnourished, and a child with a value below 3 standard deviations from

<sup>iv</sup> Caloric deficit is the difference between the average calories consumed and the estimated pooled caloric needs of children and adult men and women per day based on the lowest acceptable weight-for-height.

<sup>v</sup> These numbers are based on the estimation of the distribution of the dietary energy supply within a country's population. This measure is used to estimate the number and proportion of undernourished annually.

<sup>vi</sup> As defined by the proportion of the population below minimum level of dietary energy consumption, <ftp://ftp.fao.org/docrep/fao/011/i0291e/i0291e05.pdf>

<sup>vii</sup> In this paper malnutrition will be used synonymously with undernutrition.

<sup>viii</sup> For younger children who can not stand, length is used instead of height.

the mean is considered severely malnourished. Low weight-for-height is commonly called wasting; low weight-for-age is often called underweight; and low height-for-age is referred to as stunting.

### ***Malnutrition in Emergencies***

In emergency settings wasting is the most relevant indicator of malnutrition because it indicates short term or acute deficiencies in food intake or disease. In recent years, humanitarian organizations have redefined their nutrition classifications in emergencies to include other indicators as well as wasting, such as middle upper arm circumferences (MUAC) measurements and the presence of nutritional edema, or kwashiorkor. These three indicators form a new classification of acute malnutrition called global acute malnutrition (GAM), which is divided by severity into moderate acute malnutrition (MAM) and severe acute malnutrition (SAM; see **Exhibit 2** for classifications of global acute malnutrition).

In nutritional crisis situations, practitioners can use a WHO decision tool to determine when and how to intervene. This tool is based on three indicators: the prevalence of children with a weight-for-height less than two standard deviations as well as a mix of aggravating factors which include: general food rations (below 2100 kcal/person/day), crude death rates, or an epidemic of measles or whooping cough (see **Exhibit 3** for decision chart for implementation of selective feeding programs).<sup>14</sup>

### ***Prevalence of Malnutrition***

The WHO estimated that 20 million children under five years of age suffered from SAM and that between 36 and 60 million children suffered from MAM in 2008.<sup>15,16</sup> In sub-Saharan Africa 5.6 million children were severely wasted<sup>ix</sup> (3.9 %), and in South Asia, 13.3 million children (3.7%)<sup>x</sup>.<sup>15</sup>

Being underweight increases the likelihood that a child will become sick and die from a disease. Morbidity caused by undernutrition depends on the nature of the illness. It was estimated in 2004 that 5-16% of pneumonia, diarrhea, and malaria morbidity was attributable to being moderately to severely underweight.<sup>17</sup> The risk of mortality in malnutrition is directly related to severity. Moderate wasting is associated with a mortality rate of 30-148 per 1,000 children per year, and severe wasting is associated with a mortality rate of 73-187 per 1,000 children per year<sup>xi</sup>.<sup>15</sup> Eliminating malnutrition would prevent 53% of deaths in young children.<sup>18</sup>

### ***Causes of GAM***

Malnutrition is widely accepted to have immediate, underlying, and basic causes. The UNICEF framework for malnutrition identifies inadequate dietary intake and disease as the immediate causes and poor food security, inadequate care of children, poor access to health services, and poor environments as the underlying causes (see **Exhibit 4** for complete malnutrition framework). The relative importance of these four determinants varies by context. In most non-emergency settings, the prevalence of severe wasting usually begins after six months, peaks between one to two years old, and declines after two years. After six months of age, when new foods are introduced to the diet, it can be difficult for children to consume enough nutrient dense foods to achieve a high rate of growth. In environments where sanitation is poor, infectious disease and undernutrition act in synergy, reducing immunological capacity to defend against disease and

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<sup>ix</sup> Wasting is more frequently reported than “acute malnutrition” and can be a proxy for GAM. However, wasting statistics exclude children with edema, whereas GAM includes both

<sup>x</sup> Measurements based on new 2006 WHO Child Growth Standards

<sup>xi</sup> These numbers do not include children with edema, and therefore underestimate the number of children with SAM.

diseases depleting and depriving the body of essential nutrients, such as protein, potassium, magnesium, and zinc (see **Exhibit 5** for diagram of malnutrition-disease cycle).

Depending on underlying health issues, a child with SAM generally takes about five to seven weeks to recover, to achieve a WFH above two standard deviations. There is little evidence regarding how long it takes for children with MAM to recover because they are not generally tracked by health systems and because treatment protocols and availability vary. Depending on the type of SAM treatment, relapse rates can vary between zero and 18%.<sup>19</sup> Studies that included six-month follow-up visits of children after treatment showed relapse rates of 0-23%.<sup>19</sup>

### ***Impacts of Malnutrition***

The short and long term impacts of childhood malnutrition on societies and economies are vast. Children with SAM have mortality rates 5-20 times higher than well nourished children, and SAM directly and indirectly causes roughly 1 million deaths each year.<sup>20</sup> Children who suffer from acute malnutrition can experience long-term developmental consequences. Many studies have found IQ scores were 8-18 points lower in children who experienced acute malnutrition.<sup>17</sup> In the longer term, poorly nourished children tend to start school later, are more likely to drop out of school, and perform less well on achievement tests as adults.<sup>21</sup> Adults who were malnourished as children are less physically and intellectually productive, have at least 10% lower life-time earning potential, and are more vulnerable to chronic illness and disability.<sup>22</sup> A 2006 World Bank report stated that a 1% loss in adult height as a result of childhood stunting was associated with a 1.4% loss in productivity and that reversing this trend could improve GDP rates in countries like India and China by as much as 2-3%.<sup>23</sup>

Investment in global nutrition-related activities between 2000 and 2005 was estimated at USD 250-300 million per year. This included basic nutrition interventions and development and emergency food aid.<sup>24</sup> Foreign aid for HIV/AIDS interventions between 2000 and 2002 was USD 2.2 billion per year.<sup>25</sup>

## **Treating Severe Acute Malnutrition**

### ***Historic Treatment Options***

In 1999 and 2000 the WHO published two manuals standardizing the treatment of severe malnutrition. Until these manuals were published, four separate guidelines (two by the WHO from 1978 and 1981 and two by NGOs in 1978 and 1987) for treating severe malnutrition existed, each containing different information.<sup>26</sup> The need for more standardized care stemmed from the fact that between the 1950s and the 1990s, case fatality rates in hospitals for children with severe wasting remained constant at 20-30% and were as high as 50-60% for malnourished children with edema.<sup>27</sup> Hospitals that adhered to clinical management protocols based on the most recent evidence were able to reduce case fatality rates to under 5%.<sup>27</sup> A 1996 review of treatment of severe malnutrition in hospitals concluded that case fatality was attributed to faulty practice due to inadequate knowledge and training, as well as lack of essential supplies, understaffing, and unhygienic and overcrowded wards.<sup>27</sup> Inappropriate dietary management—including giving high protein, high energy foods too early in recovery, failure to give broad spectrum antibiotics upon admission, and use of a high sodium rehydration fluid—were the most common faulty practices.<sup>27</sup>

The 1999 and 2000 the WHO guidelines for the treatment of severe malnutrition contained 10 steps in two treatment phases: a one to two-week stabilization phase and a four-week rehabilitation phase (see **Exhibit 6** for schedule of treatment for child with severe malnutrition). The rehabilitation phase could be started in an inpatient center and completed at home.<sup>28</sup> The stabilization phase included identifying and

treating the most life threatening problems of malnourished children including hypoglycemia, hypothermia, dehydration, septic shock, cardiac failure, underlying infections, and vitamin deficiencies. The rehabilitation phase focused on intensive feeding and weight gain.

During the stabilization phase, F-75—the commercial name of a low energy, low protein, milk-based therapeutic formula—was fed until clinical conditions improved and a child’s appetite returned. F-100—another therapeutic milk, which contained more energy and almost three times as much protein—was given in the rehabilitation phase. Children needed to be fed 80-100cal/kg/day of these milks. F-75 should have been administered every three or four hours and F-100 every four hours day and night during the rehabilitation phase. Therapeutic milks had to be made with clean water and boiled. Because they were a growth medium for pathogenic bacteria and could not be stored after preparation, it was recommended that health professionals prepare them in hygienic settings multiple times a day. Average weight gain for children should have been 10-15 g/kg/day during these treatment phases.<sup>28</sup> Costs of inpatient treatment ranged from USD 156<sup>xii</sup> <sup>29</sup> to USD 400.

### ***Alternatives***

Although hospital treatment remained the norm through the 1990s, it was expensive, and there were low rates of compliance. In Bangladesh, for example, only 14% of parents of severely malnourished children who were referred to a hospital followed this recommendation. Parents cited competing demands at home, perceptions about disease severity, fear of hospitals, costs of transport, and perceptions about the cost and quality of hospital care as main deterrents.<sup>19</sup>

Challenges with hospital treatment prompted some practitioners to investigate other delivery systems for the rehabilitation phase of treatment, including daycare nutrition centers, residential nutrition centers, primary health clinics, and home rehabilitation. Each of these delivery systems had examples of successful programs based on mortality rates under 5% and weight gains greater or equal to 5g/kg/day. In locations where high energy and high protein food mixtures could be administered at home and there was sufficient monitoring by the health system, home rehabilitation was preferred.

### ***The RUTF Revolution***

In the mid 1990s aid organizations working in emergencies to improve their nutrition programs approached Dr. André Briend, a French physician with a PhD in nutrition. Briend’s previous work included anthropological assessment of malnutrition, the role of extended breastfeeding in high burden malnutrition regions, and the relationship between diarrhea and nutritional status in Africa and Asia. Upon performing an assessment for these aid agencies, he realized that the easily-contaminated, milk-based diets were not adapted for treating large numbers of children. He explained:

About 10 years ago, WHO made a recommendation for treating children with severe acute malnutrition using a diet that was prepared with milk powder, oil, sugar, vitamins and minerals. This diet was working very well but had a problem in that it had to be prepared with clean water, which means it was possible only to use it in hospitals. A few years ago - it was in 1997, I think - I had the idea of changing slightly the recipe. Actually, I had the idea by looking at a jar of chocolate spread when I noticed that the balance between proteins, energy and lipids were more or less the same in this chocolate spread as in the diet recommended by WHO. So, then it came to change a little bit the recipe by replacing part of the dry skim milk with peanut butter and getting something that the child could eat directly without the addition of water.<sup>30</sup>

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<sup>xii</sup> Includes staff services, lab tests, medicine, food, overhead, and mother/sibling food.

Briend worked with Nutriset, a private French company that produced nutritional products for humanitarian needs, to create “Plumpy’nut” (see **Exhibit 7** for a model of the Plumpy’nut sachet), the trademarked name of peanut butter-based RUTFs. Five years prior, Nutriset had also been the first to develop commercially available F-75 and F-100. Three NGOs—Valid International, Concern Worldwide, and Action Against Hunger—quickly adopted RUTFs for use in emergency settings where traditional inpatient care was not possible due to safety, logistical problems, or government policies. Results from these home-based treatment programs exceeded Sphere Project<sup>xiii</sup> minimum standards for recovery, case-fatality, and coverage rates (see **Exhibit 8** for Sphere Project key indicators for correction of malnutrition). Funding for these programs came from NGOs, occasional donations by the World Food Program, and operational support from the United States Agency for International Development through the Office of US Foreign Disaster Assistance (OFDA) and the Academy for Educational Development (AED).

## RUTF Properties

RUTFs were spreads or dry solid foods that were soft or crushable and could be eaten without preparation or adding water. The most widely used RUTF was a lipid-based, nutrient- and energy-dense paste<sup>xiv</sup>, which contained 30% whole milk powder, 28% sugar, 25% roasted peanuts, 15% oil, and 2% vitamins and mineral powder by weight. The micronutrient composition of RUTF was based on F-100, however, the energy density was five times higher (see **Exhibit 9** for nutrient composition of therapeutic foods and RUTF). Peanut butter-based RUTFs had a shelf life of two years in airtight foil packaging or six months in plastic containers. As a paste, it had limited contact with oxygen and humidity from the atmosphere because of the reduced surface to volume ratio for larger particles compared to the small particles of milk powder. RUTFs contained 2% moisture, making them resistant to bacterial contamination. When *E. coli* was introduced into F-100 at 40 degrees Celsius, it grew exponentially, but it did not grow in RUTF.<sup>31</sup>

Depending on program admission and exit criteria, children were treated on average for six to eight weeks with RUTF and consumed 10-15kg during that time. RUTFs could cost between USD 3 and USD 4.50 per kilogram, or approximately USD 30 to USD 67.50 per child per treatment. Locally produced RUTFs could reduce transportation costs and be less expensive than imported versions. In 2004, the cost of locally produced RUTF in Malawi was USD 2 per kilogram compared to USD 5 per kilogram for imported RUTF (USD 3 per kilogram plus and USD 2 per kilogram for duty and shipping).<sup>32</sup> The cost of different delivery models ranged from USD 29 to USD 170 per child (see **Exhibit 10** for malnutrition treatment program costs).<sup>33</sup>

## Policy Development

Between 1999 and 2005, over 10 efficacy trials of RUTF were performed (see **Exhibit 11** for RUTF efficacy and effectiveness trials). Most studies showed that when RUTF was given at 175 kcal/kg/day during the rehabilitation phase, average weight gain for non-HIV-infected children was above 5g/kg/day and mortality rates were under 5%.<sup>34</sup> Home-based care with RUTF proved to have higher rates of recovery and lower relapse rates because children had more rapid weight gain and fewer symptoms of infection (less cough, diarrhea, and fever) during the recovery period than children on standard therapy.<sup>32,34</sup> Few studies

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<sup>xiii</sup> The Sphere Project publishes voluntary practices and standards to improve the quality of assistance to people affected by disaster and improve the accountability of states and humanitarian agencies to their constituents, donors, and the affected populations.

<sup>xiv</sup> Although there are other kinds of RUTFs, in this paper, RUTF is used synonymously with peanut butter based RUTFs trademarked as Plumpy’nut.



reviewed long-term effects of treatment; however, two long-term studies found 3% and 9% of children treated with RUTF relapsed.<sup>35</sup>

Even with proven efficacy of RUTFs for treating SAM, donors remained unsure if it could be distributed effectively on a large scale. Between 2000 and 2006, 25,000 malnourished children had been treated with RUTF using a community-based management of acute malnutrition (CMAM) delivery model created by Valid International and Concern Worldwide.<sup>36</sup> The turning point came in 2005, when in response to the food crisis in Niger, Doctors Without Borders (MSF) distributed RUTF to over 60,000 severely malnourished children; 93% recovered, 3% died, and 4% were lost to follow up.

Kevin Phelan, deputy United States manager of MSF's Access Campaign reflected on the Niger experience:

After the emergency there, a lot of people in MSF were very uncomfortable, even though a lot of us were proud at the huge response....The facility-based treatment of malnutrition died that year... in the world .... Facility-based is over. It is now complicated cases you hospitalize and uncomplicated cases of severe malnutrition you treat at home. At least for us.... Finally, we have a tool in RUTF to be able to deliver [the equivalent of] F-100 safely, efficiently, and give the mothers primary responsibility for caring for their kids, which they do anyway. So it is easier logistically for us and easier on the families and the mothers because they have four or five other children, and they have to work in the field.

Speaking about the success of MSF's large-scale implementation of RUTFs, Stephen Jarrett, principal advisor of UNICEF's supply division said:

[It] really brought [RUTFs] to an international level. The MSF Niger experience [led to] discussions at a high level in UNICEF, and we began to focus much more on RUTF. We knew that this could be done in well-controlled circumstances, but MSF was at a certain scale to reach 60,000 children... in one go. And we are an organization that is concerned with scale. Pilots are okay, but if you can't get it to scale, then it's really not a long term solution to us. So that convinced us.

UNICEF joined the World Food Program (WFP), the UN standing Committee on Nutrition, and the WHO to produce a Joint Statement of Community Based Management of Severe Acute Malnutrition aimed at policy makers. The statement, published in May 2007, was the first document reflecting the WHO policy of RUTFs. It was a critical breakthrough that gave a political opening to UN institutions, donors, and NGOs to move forward with RUTFs and allowed them to work with governments. Not only did the statement endorse community-based treatment of SAM, but it also recognized a different classification system for malnutrition, so that children without medical complications such as anorexia, high fever, or severe anemia (about 80% of children with SAM) could be treated at home. In 2005 no countries had policies supporting the use of RUTF for the treatment of SAM, but by 2008, 25 countries in Africa did.

Even so, in 2008 only 3% of children with SAM worldwide had access to RUTF. Barriers included the cost, international production capacity, and lack of delivery systems. Between 2004 and 2008, global production of RUTF increased 16 times, but the price dropped only 10% due to the cost structure of the product.<sup>37</sup> Ingredients for making RUTF were expensive, comprising 60% of the total production cost. Milk comprised 50% of ingredient costs.

To treat all of the 19 million children worldwide with SAM, there was a need for approximately 238,000 tons of product, which would cost USD 713 million<sup>xv</sup> plus an additional USD 285 million for delivery. Production capacity in 2007 was estimated to be less than 19,000 tons. There were orders placed for only

<sup>xv</sup> Author's estimates based on average of 12.5kg per child at USD 3/kg.

8,500 tons. Even though UNICEF had set a goal of increasing production capacity of RUTF to 50,000 metric tons by 2011, this would have only covered approximately 3,330,000 children with SAM. Despite the success of RUTF in the field, *The Lancet* series on Maternal and Child Undernutrition published in January 2008 did not endorse community-based treatment of SAM. In defending its decision, the series' authors said that because there were no randomized trials investigating the use of RUTFs on mortality, the observational studies involving RUTF, which reported high recovery and coverage rates, could not be directly compared to facility-based treatment. Additionally, in the clinical trials many of the children were stabilized in the hospital and then released, whereas in practice children without complications were treated solely in the community. They concluded that community-based treatment of SAM "ought to be formally assessed in representative populations" but that ready-to-use type foods appear to be feasible in community settings.<sup>38</sup>

### ***RUTF for Moderate Acute Malnutrition***

MSF's experience in Niger in 2005 convinced the group to broaden its admissions criteria to include children with MAM in 2006. As Phelan describes:

[In 2005] we were turning a lot of people away because they weren't meeting the admissions criteria. And then of course they would come back in a week and meet admissions criteria. So for us it got us to thinking... this is ridiculous, kids shouldn't have to wait until they are near dead to receive a safe, effective treatment. [We needed to treat] at earlier stages of their malnutrition.

With newly defined criteria, in 2006 MSF treated similar numbers of children with similar results. However, 90% fewer children with SAM were admitted to a hospital that year than the previous one. By treating children with MAM before their condition deteriorated, MSF effectively reduced the peak in incidence of SAM during the lean season.<sup>39</sup> This program cost approximately USD 2.7 million or USD 83 per child.

Despite the success of this program, however, Briend remarked:

There are no recommendations for feeding RUTF to moderately malnourished children in the literature. The main reason is because it is an artificial food, which is okay to use for severely malnourished children because they need rapid weight gain by all means possible. But, it is more important to have sustainable local foods... The challenge over the next few years will be to find alternatives for MAM.

Dr. Kay Dewey, a leading expert in complementary and supplementary feeding in the developing world, cautioned that the use of RUTF for young children with moderate malnutrition can displace breastfeeding intake, which can be as harmful as malnutrition. Additionally, she argued:

The current [RUTF] formulation is not appropriate for both [children with SAM and children with MAM]. RUTF has a lot of calories. If children with MAM can't eat or don't need the entire quantity of RUTF, then they don't get all of the micronutrients either. It would be a lot less costly if micronutrients were packed into a less dense product, which would work better.<sup>40</sup>

Using RUTF for MAM had the same constraints as using RUTF for children with SAM, including production capacity and cost. Since MSF's successful experiment with RUTF for treating MAM, others had sought alternative, more appropriate RUTF formulations for a moderately malnourished child. They explored soy-based RUTF, administering RUTFs with reduced levels of vitamins and minerals, or using smaller portions of these products as a supplementary food (see **Exhibit 12** for summary chart of studies looking at use of RUTF for prevention or treatment of moderate malnutrition).

In 2008 the WHO had few references and recommendations for the management of children with moderate malnutrition. Moderate malnutrition was mentioned in Integrated Management of Childhood Illness (IMCI) materials, teaching materials on the use of the WHO growth standards, and in the WHO and other UN documents regarding nutrition emergencies.<sup>40</sup> Nutritional assessment, education, and counseling were prescribed in the first two references and take home rations, including dried cereal blends, were prescribed in nutrition emergencies. The most common take home ration was fortified corn-soy blend (CSB) which cost 0.55 USD per kilogram. CSB and other fortified blended foods had been used by WFP and in US food aid programs since the 1960s. According to a WHO technical report, however, “there was a growing consensus that the current composition of CSB was not ideal for children under two years old and moderately malnourished children. There was an urgent need to develop new, affordable, effective products to address malnutrition in these age groups.”<sup>41</sup>

A review of supplementary feeding programs using CSB and other similar products in emergency settings found that 69% of children recovered, but only 40% of programs attained acceptable recovery rates when they included defaulters or children lost to follow up.<sup>42</sup> Locally available treatments had mixed results, but some had shown that in a hospital setting, weight gain increased and mortality dropped to under 10% when switching from a milk-based porridge to a porridge made with locally available cereals, protein sources, oil, and water.<sup>43</sup>

As of June 2008, there was no WHO recommendation on how to therapeutically feed a moderately malnourished child.

## **Haiti’s Nutrition Programs**

In 2008 Dr. Joseline Marhone Pierre was the director of the Coordination Unit for the National Food and Nutrition Program of Haiti’s Ministry of Public Health and Population (MSPP). Marhone had worked with the MSPP Nutrition Program since 1977, when she joined the unit for a three-year internship after medical school. Marhone, originally from Jean-Rabel, a town in the north of Haiti, trained as both a pharmacist and a medical doctor. Aside from her post in the ministry, she was also on the faculty of Haiti’s state university and Notre Dame Catholic University, a private school in Haiti, where she taught basic, applied, and therapeutic nutrition.

Marhone’s department was responsible for coordinating the country’s nutrition programs as well as designing policy and training. It consisted of six employees – Marhone, another doctor, a public health nurse, a nutritionist, and two medical student interns. A public health nurse in each of the 10 health departments was responsible for coordinating nutrition-related activities as well as vaccination campaigns, which included vitamin A distribution and sanitation. A 2009 UNICEF survey found that over 20 NGOs were implementing nutrition-related projects; some were targeting children under three while others targeted children under five; some targeted mothers of malnourished children while others were aimed at pregnant and lactating mothers. Program activities of these NGOs included nutrition education, varying kinds of food distribution, and treatment of SAM.<sup>7</sup> There was no national nutritional surveillance system.

### **Malnutrition Rates**

According to Haiti’s 2005-2006 Demographic and Health Survey, the number of wasted children was 9% for the country, with 7% of those moderately wasted and 2% severely wasted. In Port-au-Prince the prevalence of wasting was 4.9%, and in Artibonite, a department (province) in the west-central part of the county, it was 18%. Twenty-two percent of children around the country were underweight, and the prevalence of stunted children was 24%, with 16% of children moderately stunted and 8% severely stunted.

Two departments – the Southeast and Central Plateau – had the highest prevalence of stunted children, 34.7% and 37.3% respectively, compared to 16.2% in the capital.

### ***Treatment of Malnutrition***

In 2008 national protocols for treatment of malnutrition were based on the PAHO/WHO guidelines; however, Haiti used weight-for-age measurements for admission and discharge criteria instead of weight-for-height. Moderately underweight children were treated at home, and parents were instructed to how to make “Akamil,” a grain and legume mix that resembled porridge. Akamil contained the same ingredients as F-75 and F-100 but was not fortified with vitamins or minerals unless produced commercially. Pediatricians in Haiti created Akamil in 1975 as a weaning or treatment food made from local sources. Mothers were advised to continue breastfeeding if appropriate and to participate in educational mother’s clubs if available.

Treatment for SAM was also based on the WHO guidelines. Children were referred to one of the departmental hospitals and treated with enriched milk. In June 2008, 9 out of the 10 departments had a pediatrician based in a referral hospital, but supplies were often unavailable. A Haitian pediatrician who used to work in a government hospital said, “I knew many of these children would die when they came to the hospital. We had no supplies”.

### ***SAM Pilot***

In 2007 three international NGOs—the Children’s Nutrition Project of Haiti, Concern Worldwide, and Save the Children US—formed a consortium to implement a trial following Community Management of Acute Malnutrition (CMAM) guidelines for the treatment of severe acute malnutrition in Haiti (see **Exhibit 13** for more on the NGOs). The consortium approached Marhone to recruit the government’s support so that the trial could be used to inform the discussion of national guidelines and build capacity within the MSP. Marhone had read about RUTF’s success in Senegal and other African countries, and she had been seeking an implementing partner to start such a trial in Haiti. She was eager to proceed when the consortium came to her with its proposal. The consortium had received funding from UNICEF for supplies as well for trainings and hosting the initial and final meetings. If Haiti decided to adopt the CMAM protocols, it would be the first in the Americas to do so. With Marhone’s approval from the ministry, the trial began.

### ***Results***

When the consortium reconvened in June 2008, each of the three partners presented its experiences and results. Each NGO collaborated with different partners in the field and had to adapt the protocols so that its partners accepted the program. Some sites provided care for free, but others charged small fees of USD 0.26 to USD2.60 to see a doctor. The inpatient treatment centers where children with complications were referred were not operated by the implementing NGOs but instead by the ministry staff or other facility-based NGOs.

The group concluded that the trial was a mixed success and that there were important components of the model that needed to be strengthened. The overall indicators of the trial for both inpatients and outpatients fell below international standards. Of 312 (104 inpatient and 208 outpatient) children treated, 51% were discharged, 44% abandoned the program, and 5% died. NGO health workers originally hired and trained for other programs did the community screening and referrals. The number of children they referred for treatment was low compared with the expected number of cases from these regions. Given the high

default rate, distance to the clinic was judged to be a barrier to access. Also, the adoption of the new protocols required high levels of training for staff that they did not always receive.

The consortium realized that discharge criteria differed between programs during the trial. The traditional CMAM model suggested that children admitted based on a MUAC measurement remain in the program at least eight weeks and that they get discharged after that time if their MUAC met a certain goal for two consecutive visits. If a child was admitted based on weight-for-height, then there was no time limit on the amount of time they needed to remain in the programs long as they met a certain WFH goal. Some NGOs required that children remain in the program a certain duration, regardless of their admission values, and another released children before reaching discharge criteria because mothers did not want to return weekly.

### ***Creating a Protocol for Treating MAM***

Even with these challenges, Marhone was pleased with the work of the consortium and stated her desire to expand treatment of SAM to at least one hospital in every department in the country. She proposed changes to the protocol, including the distribution of antibiotics to children with MAM as well as SAM, keeping children in treatment programs for 8-12 weeks instead of the standard 6-8, and changing admissions criteria to treat children with higher WFH values, values more consistent with a diagnosis of MAM. Marhone argued that strictly treating severely malnourished children with RUTF and not providing anything to children with MAM was short sighted (see **Exhibit 14** for June 2008 MSPP provisional SAM protocols). She said:

It's a shame. And, you know, it is not a financial problem. Because look at the amount of money that is spent sometimes on really typical results... And to save (a malnourished) child... [it only takes] six weeks of Plumpy'nut [RUTF]. How much does it cost? About USD 60. That is cheaper than one pair of shoes and a dress.

The NGOs and funders were opposed to the suggestion of using RUTF to treat MAM. While they agreed that there was no current nationwide program to confront the problem of moderate malnutrition, they did not believe Marhone's plan was realistic. One member of the committee expressed frustration, "I cannot say there was an agreement about these criteria. It's still in discussion for me. No, it did not come from the trial. I think this information [about treating children with MAM] came outside of the trial from other initiatives." Based on the scientific body of evidence and the human capacity and funding of these NGOs, they believed that it would be impossible and unnecessary to provide RUTF for the estimated 80,150 children who suffered from MAM in Haiti. Even reaching the 22,900 children with SAM looked like a daunting task, given the available resources and the experience of low coverage and cure rates during the trial.

In June 2008 there were two main purchasers of RUTF in Haiti. UNICEF donated RUTF for the trial that it purchased from Nutriset. It procured 7,500 kilograms of RUTF in 2008, approximately enough to treat 500 severely malnourished children. This was based on NGOs' forecasts of needs and a signed agreement with the government cooperation plan. However, without a national protocol and a clear national nutrition strategy, UNICEF was reluctant to increase its RUTF procurement. As one official remarked, "There needs to be a plan, with protocols, training, and supply."

The second purchaser, PEPFAR, bought RUTF from an NGO that locally produced it in the north of Haiti. In January 2008 a Nutriset franchise called Vitaset opened in the Dominican Republic and was positioned to sell in the Haitian market.

The NGOs argued that the newly designed protocols did not align with the existing ones. This could lead to confusion regarding when to refer children to referral centers. For example, SAM measurements were based on weight-for-height, but the national “Road to Health Charts” using growth monitoring programs were based on weight-for-age.

This left the NGOs and donors in a quandary. Ultimately, they recognized the need for the MSPP to dictate policy and to support the transition to deliver RUTF as the national standard. “If Marlone says yes, we will,” a United States Agency for International Development worker said, “But how?” Marhona was not offering financial or human resource assistance to implement the program and said that it was up to the NGOs and donors to find the money.

**Exhibit 1** *Common Anthropometric Measurements*

<b>ANTHROPOMETRIC MEASUREMENT</b>	<b>BELOW AVERAGE INDEX SCORE TERM</b>	<b>INDICATES</b>	<b>CAUSES</b>	<b>TIME FRAME AND REPORTING</b>
<b>Weight-for-height (WFH)</b>	Wasting	Acute malnutrition	Changes in seasonal food supply; short-term nutritional stress brought on by illness; inadequate food intake; incorrect feeding practices; or a combination of factors	Can change rapidly; used to evaluate in emergencies and possibly for annual reporting
<b>Height-for-age (HFA)</b>	Stunting	Chronic malnutrition	Indicator of past growth failure, chronic undernourishment, frequent infection, sustained inappropriate feeding practices, and poverty	Long term measure; if used for evaluation purpose, not more than once per year
<b>Weight-for-age (WFA)</b>	Underweight	Past chronic and/or current acute undernutrition	Can't distinguish between short- or long-term undernourishment	Used to assess changes in magnitude of malnutrition over time
<b>Middle upper arm circumference (MUAC)</b>		Easy to take, good predictor of immediate risk of death	Typically used in emergency situations	

Source: Cogill B. *Anthropometric Indicators Measurement Guide*. Washington, DC: Food and Nutrition Technical Assistance; 2003.

**Exhibit 2** *Classifications of Global Acute Malnutrition*

STAGE OF MALNUTRITION	DEFINED BY ANY ONE OF THE FOLLOWING:
<b>Moderate acute malnutrition (MAM)</b>	<ul style="list-style-type: none"> <li>◆ weight-for-height between -2 and -3 standard deviations from the mean</li> <li>◆ between 70% and 79% of the median</li> <li>◆ middle upper arm circumference (MUAC) below 125 mm</li> </ul>
<b>Severe acute malnutrition (SAM)</b>	<ul style="list-style-type: none"> <li>◆ weight-for-height below 3 standard deviations from the mean</li> <li>◆ below the 70<sup>th</sup> percentile of median weight-for-height</li> <li>◆ MUAC under 110 mm</li> <li>◆ presence of nutritional edema</li> </ul>

Source: Valid International. *Community-based Therapeutic Care: a field manual*. Oxford: Valid International 2006.



**Exhibit 3** *Decision Chart for Implementation of Selective Feeding Programs*

<b>FINDING</b>	<b>ACTION REQUIRED</b>
Food availability at household level less than 2100kcal/person/day	Unsatisfactory situation: <ul style="list-style-type: none"> <li>◆ Improve general rations until local availability and access can be made adequate</li> </ul>
Malnutrition rate* 15% or more OR 10-14% with aggravating factors**	Serious situation: <ul style="list-style-type: none"> <li>◆ General rations (unless situation is limited to vulnerable groups); plus</li> <li>◆ Supplementary feeding for all members of vulnerable groups, especially children and pregnant and breastfeeding women;</li> <li>◆ Therapeutic feeding for severely acutely malnourished individuals</li> </ul>
Malnutrition rate 10-14% OR 5-9% with aggravating factors	Risky situation: <ul style="list-style-type: none"> <li>◆ No general rations; but</li> <li>◆ Supplementary feeding targeted to individuals identified as malnourished in vulnerable groups;</li> <li>◆ Therapeutic feeding for severely acutely malnourished individuals</li> </ul>
Malnutrition rate under 10% with no aggravating factors	Acceptable situation: <ul style="list-style-type: none"> <li>◆ No need for population interventions;</li> <li>◆ Attention to malnourished individuals through regular community services</li> </ul>

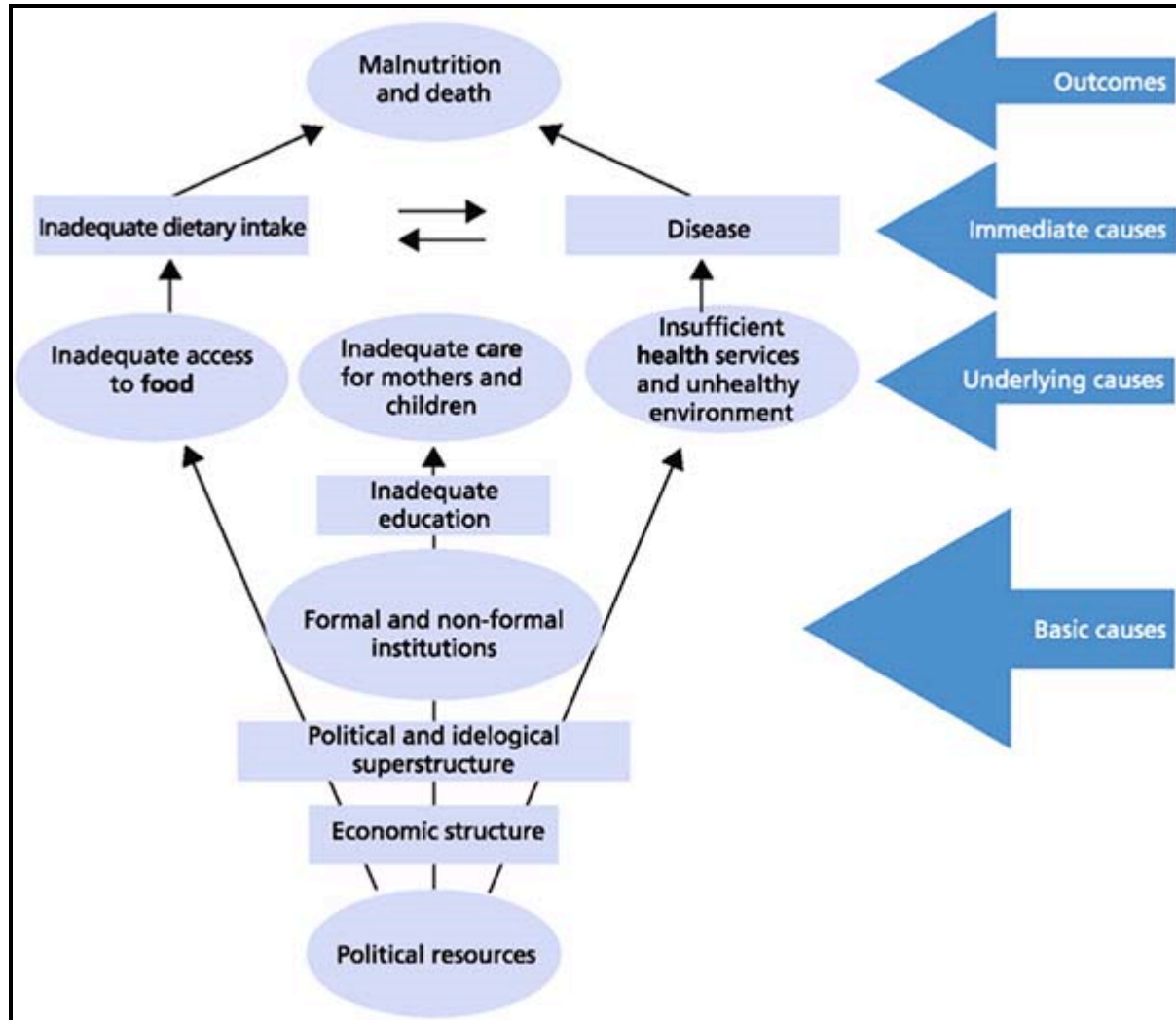
\*Malnutrition rate is defined as the percentage of child population (six months to five years) less than -2 standard deviations below the median weight-for-height of the international reference distribution and 80% of the reference median weight-for-height.

\*\*Aggravating factors are:

- ◆ General food rations below the mean energy requirement (<2,100kcal/person/day)
- ◆ Crude death rate greater than 1/10,000/day
- ◆ Epidemic of measles or whooping cough
- ◆ High incidence of respiratory or diarrheal diseases

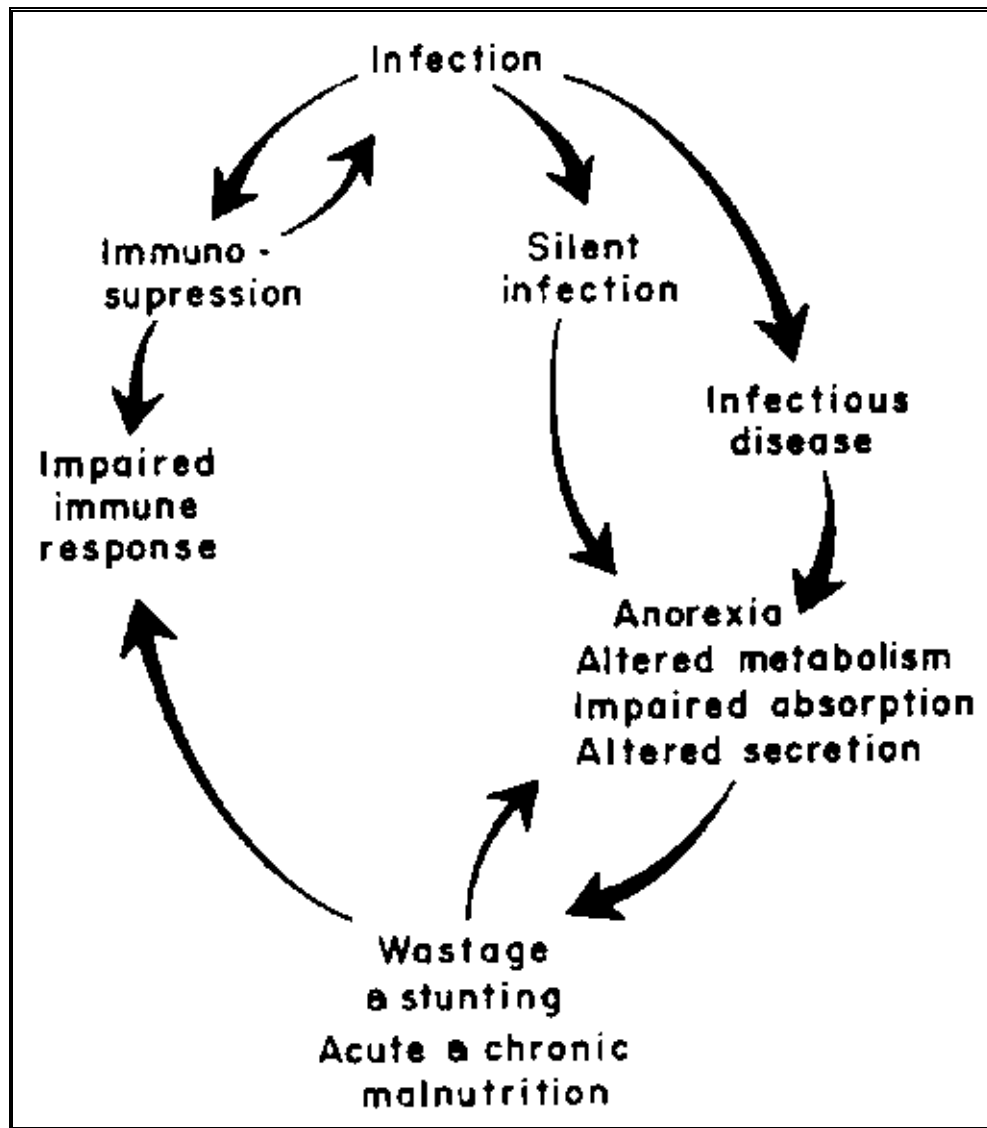
Source: The Management of Nutrition in Major Emergencies, 2000  
<http://whqlibdoc.who.int/publications/2000/9241545208.pdf>.

**Exhibit 4** UNICEF Malnutrition Framework



Source: Food and Agriculture Organization of the United Nations.  
<http://www.fao.org/docrep/005/Y4249E/y4249e04.jpg>. Accessed June 17, 2009.

**Exhibit 5**    *Malnutrition-Disease Cycle*



Source: United Nations University Press. <http://www.unu.edu/Unupress/food2/UINo9E/uino9eob.gif>. Accessed June 17, 2009.

**Exhibit 6** *Time Frame for the Management of a Child with Severe Malnutrition*

Activity	Initial treatment:		Rehabilitation:	Follow-up:
	days 1-2	days 3-7	weeks 2-6	weeks 7-26
Treat or prevent: hypoglycaemia hypothermia dehydration	----->	----->		
Correct electrolyte imbalance	----->			
Treat infection	----->			
Correct micronutrient deficiencies	← without iron		* with iron →	
Begin feeding	----->			
Increase feeding to recover lost weight ("catch-up growth")			----->	
Stimulate emotional and sensorial development	----->			
Prepare for discharge			----->	

Source: WHO. Management of Severe Malnutrition: a manual for physicians and other senior health workers. Geneva: World Health Organization; 1999.

**Exhibit 7** *Model Plumpy'nut Sachet*



Source: [http://www.lle.rcs.k12.tn.us/Teachers/guidance\\_page/Images/plumpybag.jpg](http://www.lle.rcs.k12.tn.us/Teachers/guidance_page/Images/plumpybag.jpg). Accessed June 17, 2009.

**Exhibit 8** *Sphere Project Key Indicators for Correction of Severe Malnutrition*

Recovered	>75%
Died	<10%
Defaulted	<15%
Weight gain	8g/kg/day, however lower rates may be more acceptable in out- patient programs
Coverage – urban	>70%
Rural	>50
Camps	>90%

Source: Sphere Project. Sphere Humanitarian Charter and Minimum Standards in Disaster Response. Revised edition (2004). <http://www.sphereproject.org/content/view/66/84/lang,English/>

**Exhibit 9** *Ingredient and Nutrient Composition of Therapeutic Milks and RUTF*

Ingredient amount	F-75	F-100	RUTF
Dried milk	25g	80g	30g
Sugar	70g	50g	28g
Cereal flour	35g	--	--
Vegetable oil	27g	60g	15g
Mineral and Vitamin mix	160ml	160ml	1.6g
Water	1000ml	1000ml	---
Peanut butter	---	---	25g

	F-75 per 100ml	F-100 per 100ml	RUTF per 100g
Energy	75kcal	100kcal	520-550kcal
Total energy from protein	5%	12%	10-12%
Total energy from fat	32%	53%	45-60%
Protein	0.9g	2.9g	10-12 g
Potassium	3.6mmol	5.9mmol	1100-1400mg
Sodium	0.6mmol	1.9mmol	29mg maximum
Magnesium	0.43mmol	0.73mmol	80-140mg
Zinc	2.0mg	2.3mg	11-14 mg
Copper	0.25mg	0.25mg	1.4-1.8mg
Iron	0 mg	0 mg	10-14mg

Source: WHO. Management of Severe Malnutrition: a manual for physicians and other senior health workers. Geneva: World Health Organization; 1999.

**Exhibit 10** *Malnutrition Treatment Program Costs*

CMAM Programs*	Cost per Beneficiary (USD)
Malawi	170
South Sudan	131
Ethiopia	69

\*CMAM program costs include operating costs, capital and local office overhead costs

Non-CMAM Programs	Cost per Beneficiary (USD)	Treatment
Day care center Bangladesh 1993, in Food and Nut Bulletin SAM consultation	140	4 weeks in day care plus 5 follow up visits, food given
Bangladesh, 1994	156	Inpatient
	59	Day care (No food given)
	29	Home care (No food given)
MSF	82 (SAM) 61 (MAM)	RUTF given at distribution centers, children with complications treated inpatient

Sources: Caldwell R, Hallam A. The Cost of Selective Feeding. In: Khara T, Collins S, eds. *Community-based Therapeutic Care*. Oxford: Emergency Nutrition Network; 2004.

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Khanum S, Ashworth A, Huttly SR. Controlled trial of three approaches to the treatment of severe malnutrition. *Lancet*. 1994; 344(8939-8940):1728-32.

**Exhibit 11** RUTF Evidence Base Efficacy Trials

	STUDY TYPE	AGE	ADMISSION CRITERIA	CHILDREN STUDIED	HOSPITAL TREATMENT	TREATMENT DURATION	FOOD GIVEN OUT	MORTALITY (%)	WEIGHT GAIN/OTHER PROGRESS	COVERAGE RATE/COST	FOLLOW UP
Diop et al, 2003	RC T-S	6-36 mos	WFH <2	70 a. F-100 in hospital b. RUTF in hospital	Both stabilization and recovery phase treated in hospital	a. 17.3 days b. 13.4 days	All given 3 meals a day in addition to a. F100 b. RUTF	a. 3% b. 0%	a. 10.1 g/kg/day b. 15.6 k/kg/day Difference significant	NR	NR
Diop et al, Senegal, 2004	RC T	6-59 mos	<3 Z WFH or edema	47 total At home a. local RUTF b. Imported RUTF	Mean stay 7 days	Until reached 85% WFH	RUTF 175 kcal/kg/day, twice monthly with clinic visits	2.1	Mean weight gain a. 7.9 g/kg/day b. 8.1 g/kg/day Difference not significant	NR	NR
Sandige, Malawi, 2004	RC T-S	12-60 mos	<2Z WFH or edema	At home a. 135 local RUTF b. 125 imported RUTF	Mean stay 12 days, then systematic allocation	16 weeks or reached >.5 WFH	RUTF 175 kcal/kg/day, twice monthly with clinic visits	a.3 b. 2.5	Mean weight gain after 4 weeks* a. 5.6 g/kg/day b. 5.5 g/kg/day Dif not significant	NR/ a. \$22 b. \$55	After 6 mos mean WFH -.6Z.  No differences between groups
Manary et al, Malawi, 2004	RC T-S	>12 mos	HIV negative	At home a. 69 RUTF b. 96 RUTF-S c. 117 maize soy flour	Mean stay 11-14 day then systematic allocation	Until 100% WFH or assessed at 16 weeks	Twice monthly clinic visits and food distribution a. RUTF 175 kcal/kg/day b. RUTF snack c. maize/soy flour and multi-micronutrients	a.4 b. 12 c. 19	Mean weight gain after 4 weeks a. 5.2 g/kg/day b. 3.1 g/kg/day c. 3.1 g/kg/day Difference is significant	NR	66% returned for follow-up. After 6 mos mean WFH -.5Z. No differences between groups
Cilberto et al, Malawi, 2005	Non-random	10-60 mos	<2SD or edema	a. 186 inpatient standard treatment b. 992 at home RUTF	a. mean stay 22d b. 35% had prelim stay (11 day mean)	8 weeks	a. 50 kg maize soy take home upon discharge b. RUTF 175 kcal/kg/day, twice monthly with clinic visits	a.5 b. 3	Mean weight gain after 4 weeks a. 2.0 g/kg/day b. 3.5 g/kg/day Difference is significant	NR	After 6 mos mean WFH a. -.9Z b. -.5Z
Gabourland, Niger, 2004	O	6-59 mos	WFH <3SD or edema or MUA C <110mm	a. 794 inpatient b. 354 home RUTF c. 106 mixed	?	Until ≥2SD WFH	Weekly supply of RUTF (1000 kcal/day) and biscuits for family)	a. 18 b. 2 c. 0	a. 20.2 g/kg/day (average 15d) b. 9.8 g/kg/day (av 29 day) c. 10.1 g/kg/day (average 35 day) Difference significant between a and b/c	NR/ 91-105 euro	NR

\*Non-HIV infected children

Table acronyms: RCT – Randomized Controlled Trial; RCT-S – Systematic allocation; RCS - Retrospective Cohort Study (Observational); O – Observational; NR – Not reported; SD – standard deviations

Sources (for **Exhibit 11**):

- Diop EHI, Dossou NI, Ndour MM, Briend A, Wade S. Comparison of the efficacy of a solid ready-to-use food and a liquid, milk-based diet for the rehabilitation of severely malnourished children: a randomized trial. *American Journal of Clinical Nutrition*. 2003;78:302-307.
- Diop EI, Dossou NI, Briend A, Yaya MA, Ndour MM, Wade S. *Home-based Rehabilitation for Severely Malnourished Children Using Locally Made Ready-to-use Therapeutic Food (RTUF) Reports from the 2nd World Congress of Pediatric Gastroenterology, Hepatology and Nutrition*. Paris: Medimond, Monduzzi Editore;2004.
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- Gaboulaud V. Stratégies pour la réhabilitation nutritionnelle des enfants de 6 mois à 5 ans malnutris sévères département de Maradi, Niger. Report, Epicentre MSF. 2004.



**Exhibit 12** Use of Ready-to-Use Foods for Prevention or Treatment of Moderate Malnutrition

	STUDY TYPE	AGE (mos)	ADMISSION CRITERIA	CHILDREN STUDIED	HOSPITAL TREATMENT	TREATMENT DURATION	MORTALITY %/RELAPSE/%	REPORTED PROGRESS	COST/CHILD
Patel et al, 2005	RCT-S	10-60	80-85% WFH	a. 331 RUTF b. 41 fortified CSB	none	8 weeks	a. 2% (combined mort and relapse) b. 2% (combined mort and relapse)	Weight gain: a. 3.1 g/kg/day b. 1.4 g/kg/day	NR
Defourney, MSF, Niger, 2007	O	NR	WFH<80% or MUAC<110 mm or edema	a. 49,517 uncomplicated b. 7,514 complicated	If complications	Until >80% WFH for 4 weeks	a. 0.1%/NR b. 4.0%/NR	Weight gain: a. NR/ b. NR Cure rate a. 96.4% b. 90.1%	NR
Adu-Afarwuah, Ghana, 2007	RCT	6	Not malnourished	a. 106 Sprinkles (multivitamin packets) b. 105 crushable Nutritabs (fortified food tablets) c. 103 Nutributter (RUTF with less energy and nutrients)	None	6 months	NR	Weight gain: Nutributter greater weight and height gains; Stand independently @ 12 mos: No statistical differences; Walk independently @ 12 mos: a. 39% b. 36% c. 49%	NR
Phuka et al, 2008	RCT	6	>-2.0 Z WFH	a. 61 CSB b. 61 RUF, 50 g/day c. 60 RUF 25g/day	None	1 year	NR	Mean weight (kg)/height (cm) gain a. 2.37/12.7 b. 2.47/13.5 c. 2.37/13.2 Ever developed severe stunting: a. 12.% b. 0.0% c. 3.5%	NR

Sources:

Patel MP, Sandige HL, Ndekha MJ, Briend A, et al. Supplemental Feeding with Ready-to-Use Therapeutic Food in Malawian Children at Risk of Malnutrition. *Journal of Health, Population and Nutrition*. Dec 2005;23(4):351-357.

Defourney I, Seroux G, Abdelkadar I, Harzi G. Management of moderate acute malnutrition with RUTF in Niger. *Field Exchange, Emergency Nutrition Network*. 2007:2-4.

Adu-Afarwuah S, Lartey A, Brown KH, Zlotkin S, et al. Randomized comparison of 3 types of micronutrient supplements for home fortification of complementary foods in Ghana: effects on growth and motor development. *American Journal of Clinical Nutrition*. 2007;86:412-420.

Phuka JC, Maleta K, Thakwalakwa C, Cheung YB, et al. Complementary Feeding with Fortified Spread and Incidence of Severe Stunting in 6- to 18-Month-Old Rura Malawians. *Archives of Pediatrics and Adolescent Medicine*. 2008;162(7):619-626.

**Exhibit 13** *NGOs Participating in Trial*

	<b>SUMMARY OF HAITI PROGRAMS</b>	<b>NUTRITION ACTIVITIES IN HAITI</b>
<b>Children’s Nutrition Project of Haiti</b>	Worked in Haiti since 1998  Activities: nutrition education, microcredit, water sanitation	Positive Deviance/Hearth Model, nutritional education
<b>Concern Worldwide</b>	Worked in Haiti since 1994  Activities: education, maternal and child health, peace building	Nutritional education, community screening for malnutrition, stabilization of malnourished children
<b>Save the Children US</b>	Worked in Haiti since 1985  Activities: advocacy, reinforcement of government social services and supporting community-based development programs in protection, education, health, food security, livelihoods and humanitarian relief	Growth monitoring, distribution of micronutrients, community screening for malnutrition, food aid distribution, nutritional education/hearth model

Sources:

CNP of Haiti. History and Overview. <<http://cnphaiti.org/about.htm>>. Accessed June 22, 2009.

Concern Worldwide. Haiti. <<http://www.concern.net/where-we-work/Caribbean/haiti>>. Accessed June 22, 2009.

Save the Children. Haiti. <<http://www.savethechildren.org/countries/latin-america-caribbean/haiti.html>>. Accessed June 22, 2009.

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**Exhibit 14** *Haiti MSPP Provisional SAM Protocols, June 2008*

<p><i>Ministry of Health and Population</i></p> <p>Coordination Unit for the National Food and Nutrition Program</p> <p><i>Protocol for the treatment of outpatient severe acute malnutrition</i></p> <p>Admission criteria:</p> <ul style="list-style-type: none"> <li>◆ Bilateral edema, grade + and ++</li> <li>◆ MUAC &lt; 110-125mm</li> <li>◆ Weight-for-Height &lt; -2 standard deviations from the mean or 70-80% of reference population</li> <li>◆ No medical complications</li> <li>◆ Appetite</li> </ul> <p>Exit criteria:</p> <ul style="list-style-type: none"> <li>◆ MUAC ≥ 125mm</li> <li>◆ Weight-for-height &lt; -1 standard deviation from the mean or above 90% of reference population</li> </ul> <p>Length of time in program:</p> <ul style="list-style-type: none"> <li>◆ 8-12 weeks</li> <li>◆ Until referred to a referral center after 3 weeks if:             <ol style="list-style-type: none"> <li>(1) Stationary weight</li> <li>(2) Appearance or no decrease in edema</li> </ol> </li> </ul> <p>Consumption of RUTF:</p> <ul style="list-style-type: none"> <li>◆ 200/kcal/kg/jr</li> </ul> <p>Follow up:</p> <ul style="list-style-type: none"> <li>◆ Monthly for at least 1 year by the following activities:             <ol style="list-style-type: none"> <li>(1) Home visit (every 3 months)</li> <li>(2) Nutritional surveillance program and growth monitoring in community</li> </ol> </li> <li>◆ Integration into existing development programs in the area</li> </ul> <p>Complications of this protocol:</p> <ul style="list-style-type: none"> <li>◆ Non use of WFH in referral centers</li> <li>◆ Absence of tapes to measure height in referral centers</li> <li>◆ Availability of RUTF</li> </ul>
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Note: Translated from French by case writer.

**Appendix** *List of Abbreviations*

AED	Academy for Educational Development
CMAM	community-based management of acute malnutrition
CSB	corn soy blend
DOTS	directly observed treatment short-course
DTP3	third dose of diphtheria toxoid, tetanus toxoid, and pertussis vaccine
g	gram
GAM	global acute malnutrition
GDP	gross domestic product
HFA	height-for-age
IMCI	Integrated Management of Childhood Illness
kg	kilogram
MAM	moderate acute malnutrition
MSP	Ministry of Public Health and Population
MUAC	middle upper arm circumference
MSF	Doctors Without Borders
NGO	non governmental organization
OFDA	The Office of US Foreign Disaster Assistance
PPP	purchasing power parity
RUTF	ready-to-use therapeutic food
SAM	severe acute malnutrition
UN	United Nations
UNICEF	United Nations Children's Fund
USD	United States' dollar
WFA	weight-for-age
WFH	weight-for-height
WFP	World Food Program
WHO	World Health Organization

## Appendix *Glossary of Nutritional Terms*

**Anthropometry** – measurement of the human body (often used to obtain information about nutritional status).

**Edema** - The presence of excessive amounts of fluid in the intracellular tissue. A child with nutritional edema should be counted as severely malnourished due to the strong association between edema and mortality.

**Food insecurity** - A situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life. It may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate use of food at the household level. Food insecurity, poor conditions of health and sanitation, and inappropriate care and feeding practices are the major causes of poor nutritional status. Food insecurity may be chronic, seasonal, or transitory.

**Food security** - A situation that exists when all people at all times have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

**Macronutrients** - The proteins, carbohydrates, and fats that are required by the body in large amounts and available to be used for energy.

**Malnutrition** - An abnormal physiological condition caused by deficiencies, excesses, or imbalances in energy, protein, and/or other nutrients.

**Micronutrients** - The vitamins, minerals, and certain other substances that are required by the body in small amounts.

**Minimum dietary energy requirement** - In a specified age/sex category, the amount of dietary energy per person that is considered adequate to meet the energy needs for light activity and good health. For an entire population, the minimum energy requirement is the weighted average of the minimum energy requirements of the different age/sex groups in the population. It is expressed as kilocalories per person per day.

**Overnourishment** - Food intake that is in excess of dietary energy requirements continuously.

**Undernourishment** - Food intake that is insufficient to meet dietary energy requirements continuously.

**Undernutrition** - The result of undernourishment, poor absorption, and/or poor biological use of nutrients consumed.

**Vulnerable group** - A group of people with common characteristics, a high proportion of whom are food-insecure or at risk of becoming food-insecure.

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