INTERNATIONAL
MEDICAL
OUTREACH

Rapid Appraisal on
Soil-transmitted helminthiasis in

El Paraiso, Honduras

May 2014

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Introduction

Soil-transmitted helminthiasis (STH) refers to a set of parasitic diseases caused by a group of intestinal worms collectively called soil-transmitted helminths (STHs) that are transmitted primarily through contaminated soil. Approximately two billion people worldwide are infected with STHs and an additional four billion are at risk. Of these, children are most susceptible to infection due to their frequent exposure to a contaminated environment through playing, eating raw vegetables and fruits, and exposure to contaminated water. Heavy infections of STHs decrease nutritional status, affect school performance, and lower resistance to other infectious diseases while chronic infections lead to malnutrition, stunted growth, and diminished intellectual capacity.

Explanation of Rapid Appraisal

In March 2014, the International Medical Outreach Administrative Team (IMOAT) conducted its own independent testing for STH in El Paraiso, Honduras. This independent testing, or Rapid Appraisal, measured a sample group of children throughout the area on four parameters: stool analysis, blood analysis, height, and weight. A malaria smear is typically performed as part of the Rapid Appraisal but was not performed in El Paraiso because testing was unavailable. These parameters are described below.

Stool Analysis

Microscopic examination of simple stool smears is sufficient in diagnosing STH because of the enormous daily output of eggs by gravid female worms. The procedure is simple: collect stool sample, prepare slide, examine sample under a microscope, and record findings. This process of finding eggs in the feces is sufficient in determining the diagnosis of ascariasis, enterobiasis, hookworm infection, and strongyloidiasis and can be performed on site, given that there is a power source for the microscope.

Blood Analysis

The blood analysis involves performing a Complete Blood Count (CBC). The CBC is a common blood test that evaluates overall health and detects a wide range of disorders including anemia, infection, and leukemia. The CBC test measures the following components:

- **White blood cells,** which fight infection
- **Red blood cells,** which carry oxygen
- **Hemoglobin,** which carries the oxygen within the red blood cells
- **Hematocrit,** which is the proportion of red blood cells to the fluid in the blood
- **Platelets,** which help with blood clotting

Abnormal levels of any of these components, high or low, may indicate an underlying condition that calls for further evaluation.

Anemia occurs when there is an insufficient number of red blood cells (RBCs) necessary to carry nutrients and oxygen to the tissues of the body. It is identified by a decrease in the number of red blood cells, hemoglobin (HGB) and hematocrit (HCT) and can cause symptoms such as lightheadedness, fatigue, and weakness.

All intestinal parasites can contribute to the incidence of anemia. Hookworms, for example, feed on red blood cells from cut vessels and mucosal tissues. The loss of blood is exacerbated by an anticoagulant released by the parasite that remains active even after the worm has migrated to another site along the intestinal wall. This blood loss contributes to anemia, especially in countries where the dietary intake of iron is already marginal and malaria is widespread.

Height and Weight

Children are highly susceptible to dietary deficiencies that lead to malnutrition. Malnutrition causes a higher susceptibility to disease, a significant drop in IQ, and stunted physical growth. Because STH exacerbates a developing child's already compromised nutritional status, height and weight measurements are important parameters to consider.

Malaria Smear

Malaria infects RBCs, causes them to break up, and results in anemia. Malaria is a treatable disease that can be assessed easily by a blood smear or rapid testing. The Centers for Disease Control and Prevention (CDC) reports that malaria is both present and significant in El Paraiso; therefore, it is logical to expend resources to perform such testing. Performing the malaria smear serves two purposes: (1) a negative result rules out malaria as a cause of anemia, and (2) a positive result exposes the disease and the need for treatment.

Results of Rapid Appraisal

The Rapid Appraisal performed in El Paraiso included 134 children representing 27 villages. The breakdown of these 134 children according to gender and age is represented in the table below.

Number of children tested according to gender and age

TOTAL NUMBER OF MALES TESTED	TOTAL NUMBER OF FEMALES TESTED	TOTAL NUMBER OF 5-YEAR-OLDS TESTED	TOTAL NUMBER OF 13-YEAR-OLDS TESTED
63	71	69	55
TOTAL NUMBER OF 5-YEAR-OLD MALES TESTED	**TOTAL NUMBER OF 5-YEAR-OLD FEMALES TESTED**	**TOTAL NUMBER OF 13-YEAR-OLD MALES TESTED**	**TOTAL NUMBER OF 13-YEAR-OLD FEMALES TESTED**
37	32	21	34

Testing at least two hundred children (100 five-year-olds and 100 thirteen-year-olds) reveals legitimate trends despite the presence of outliers. A sample of this size allows for a more accurate estimation while a smaller sample size becomes unreliable in adequately predicting trends across the general population. The total number of children tested in El Paraiso is well short of IMO's goal of two hundred. Analyses deduced from smaller than desired sample sizes can lead to unsound treatment strategies that could invariably lead to an inefficient program with negligible results.

In addition to a smaller than desired sample size in El Paraiso, the samples were spread over several villages with different socioeconomic populations and many of the children tested were those already visiting the clinic with other health problems. An assessment with so many variables increases the difficulty in pinpointing actual cause and effect. It also may skew the baseline data, making it difficult to ascertain the success or failure of the program. Nevertheless, the collected data still reveals important information on the influence of STH on the children of El Paraiso, Honduras.

Stool Analysis

All 134 children included in the Rapid Appraisal underwent stool analysis. Because of the lower than desired sample size, however, children of other ages were included in the stool analysis but not the height and weight measurements. IMO's protocol entails testing and measuring only five-year-old and thirteen-year-old children in order to conduct a fair comparison.

Of the 134 children that underwent stool analysis, 50.75% tested positive for STH. The percentage of children testing positive for STH according to gender and age is represented in the table below.

Percentage of positive stool tests according to gender and age

TOTAL PERCENTAGE OF POSITIVE RESULTS		TOTAL NUMBER OF POSITIVE RESULTS	
50.75%		68	
PERCENTAGE OF MALES POSITIVE FOR STH	**PERCENTAGE OF FEMALES POSITIVE FOR STH**	**PERCENTAGE OF 5-YEAR-OLDS POSITIVE FOR STH**	**PERCENTAGE OF 13-YEAR-OLDS POSITIVE FOR STH**
57.14%	45.07%	46.38%	54.55%
PERCENTAGE OF 5-YEAR-OLD MALES POSITIVE FOR STH	**PERCENTAGE OF 5-YEAR-OLD FEMALES POSITIVE FOR STH**	**PERCENTAGE OF 13-YEAR-OLD MALES POSITIVE FOR STH**	**PERCENTAGE OF 13-YEAR-OLD FEMALES POSITIVE FOR STH**
54.05%	37.50%	61.90%	50.00%

As the table above illustrates, males have a higher rate of STH than females and thirteen-year-olds have a higher rate of STH than five-year-olds. Thirteen-year-old males have the highest rate of STH among the four age/gender groups while five-year-old females have the lowest rate of STH among the four age/gender groups.

Four types of helminths were found: *Ascaris*, pinworm, hookworm, and *Strongyloides*. The overwhelming majority of children that tested positive for STH in El Paraiso harbored *Ascaris* while pinworm, hookworm, and *Strongyloides* were present but less prevalent. All four are described in detail beginning on page 11. Some of the children were found to harbor more than one type. The distribution of each helminth among those testing positive is represented in the table below.

Distribution of types of helminths among those positive for STH

TYPE OF HELMINTH	NUMBER OF CHILDREN	PERCENTAGE OF POSITIVE STH RESULTS
Ascaris lumbricoides	56	82.35%
Enterobius vermicularis (pinworm)	6	8.82%
Necator americanus, Ancylostoma duodenale (hookworm)	5	7.35%
Strongyloides stercoralis, *Strongyloides fuelleborni*	2	2.94%

Blood Analysis

Complete blood counts (CBCs) were performed on 130 children in El Paraiso. Of these 130 children that were blood tested, 67 were found to be positive for STH via stool analysis. As previously described in the Introduction on page 5, the purpose in performing the CBCs was to evaluate general health and detect abnormality including anemia and infection.

The percentages of those with low red blood cells (RBC) and low hemoglobin (HGB) are represented in the table below.

Low RBC and HGB among children positive for STH and negative for STH

	NUMBER OF CHILDREN	PERCENTAGE OF THOSE WITH LOW RED BLOOD CELLS (RBC)	PERCENTAGE OF THOSE WITH LOW HEMOGLOBIN (HGB)
ALL CHILDREN TESTED	130	13.08%	6.15%
CHILDREN POSITIVE FOR STH	67	11.94%	8.96%
CHILDREN NEGATIVE FOR STH	63	14.29%	3.17%

There was no correlation between anemia (identified by low RBC and HGB) and STH in those tested in El Paraiso. It would be expected that there would be a linear correlation between anemia and STH. However, there are other factors among the population tested – other than the previously noted smaller than desired sample size – that could cause anemia and explain the discrepancy between rates of anemia and STH.

The discrepancy between anemia and STH is multifactorial. Some medications, for example, cause anemia as a direct side effect either by suppressing the bone marrow where the RBCs are generated or by causing RBCs to break up after they are in circulation. Coexisting or concurrent health problems such as malaria, hereditary blood and hemoglobin disorders, unusually small or abnormally shaped RBCs, inflammation of the duodenum or stomach lining, gastrointestinal bleeding, tumors, or blood loss elsewhere may also cause anemia. Infections are another notable cause of anemia as they cause the body to preferentially generate more white blood cells to fight off the infection while decreasing RBC production. Some infections can even cause the breakup of circulating RBCs. Hydration status, resulting in increased or decreased concentration of RBCs in the blood, also causes discrepancies in RBC and HGB values. Malnutrition is a significant cause of anemia as well.

These other factors were not tested; therefore, the discrepancy between anemia and STH remains unexplained. Curiously, there was a higher rate of anemia among the children that tested negative for STH.

Height and Weight

The averages and percentiles of height-for-age and weight-for-age according to gender are represented in the table below.

Averages and percentiles of height and weight according to gender and age

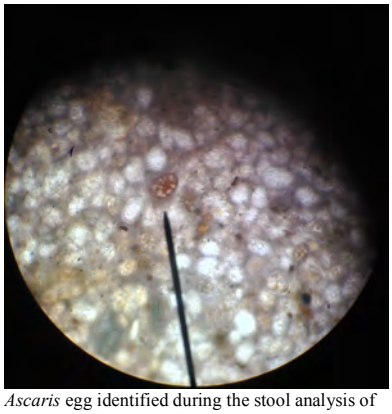
	AVERAGE HEIGHT	PERCENTILE HEIGHT	AVERAGE WEIGHT	PERCENTILE WEIGHT
5-YEAR-OLD MALES	106.71 cm	30th	17.82 kg	39th
5-YEAR-OLD FEMALES	104.55 cm	24th	16.40 kg	24th
13-YEAR-OLD MALES	145.39 cm	8th	38.34 kg	17th
13-YEAR-OLD FEMALES	146.88 cm	7th	41.46 kg	29th

As illustrated in the table above, there is a significant drop off in height-for-age for both males and females from age 5 to 13 years old. There is also a significant drop off in weight-for-age in males from age 5 to 13 years old. These analyses support the fact that *Ascaris* is robbing nutrients from the children of El Paraiso during their most important developmental years. In addition to hindering growth in height and weight, it is likely that STH is also impeding mental and physiological development. Short stature, therefore, is unlikely to be genetic and more likely to be acquired.

Soil-transmitted Helminthiasis (STH) Explained

1.1 Causative Agents

***Ascaris lumbricoides*:**



Ascaris egg identified during the stool analysis of IMO's Rapid Appraisal in El Paraiso.

Ascaris is the most common form of STH, affecting about 800 million to 1.2 billion people globally. Ascariasis is transmitted by the ingestion of infective eggs from soil, water, or vegetables that have been contaminated with the feces of already infected persons. Once ingested, the eggs hatch in the intestines, burrow through the gut wall, and migrate via venous blood through the liver and heart to the lungs. There they break into the alveoli. Once mature, they pass up to the trachea where they are coughed up and swallowed. The larvae then pass through the stomach for a second time into the intestine where they become adult worms. A single worm has a life span of one to two years and may produce two hundred thousand eggs a day. The high prevalence of ascariasis worldwide is a consequence of the tremendous egg output from female worms and the remarkable ability of ova to resist unfavorable external environments.

As *Ascaris* travel through the body, they can cause visceral damage, peritonitis and inflammation, enlargement of the liver or spleen, and an inflammation of the lungs. They may also cause coughing or gagging, vomiting, wheezing, or shortness of breath. Once the worms make it to the intestine, they steal nutrients from the partially digested host food and cause malabsorption, contributing to malnutrition. They may also cause gastrointestinal discomfort, nausea, irregular stools, stomach or abdominal pain, weight loss, fatigue, and fever. Ascariasis has been shown to depress appetite and food intake by children and can interfere with absorption of proteins, fats, lactose, vitamin A, and iodine. The impact on nutrition, intellectual development, cognitive performance, and growth is likely the most important health related consequence of ascariasis worldwide. Treatment of heavily infected children with anthelmintics has been shown to improve nutritional status, but provision of micronutrients, protein, and energy is necessary for underweight or stunted children to achieve catch-up growth.

Ascariasis is associated with poor personal hygiene and poor sanitation, including places where there are no latrines or other sanitation infrastructure. Preventative measures taken against ascariasis include avoiding the ingestion of soil that may be contaminated with human feces; washing hands with soap and warm water before handling food; teaching children the importance of washing hands to prevent infection; and washing, peeling, or cooking all raw vegetables and fruits before eating, particularly those that have been grown in soil that has been fertilized with manure. Not defecating outdoors and establishing effective sewage disposal systems can also prevent the transmission of ascariasis.

Pinworm *(Enterobius vermicularis)*:

Pinworm, called *Enterobius vermicularis*, is highly prevalent throughout the world and is particularly common among children. Pinworms are small, thin, white roundworms that reside in the large intestine, appendix, and adjacent gut. Female worms, containing an average of 10,000 ova at a time, migrate to the perianal and pelvic regions where they deposit their eggs and die. The eggs become infective within six hours and are transferred to clothes, bedding, dust, and air. The most common mode of transmission, however, is via the hands of the host, particularly underneath the fingernails, through scratching or handling clothes and bed linen. On ingestion, the embryos hatch in the duodenum, molt twice, and develop within five or six weeks into adult worms that live for about a month.

Enterobiasis, or pinworm infection, is not associated with any particular social class, gender, race, or culture. The prevalence of enterobiasis is lowest in infants and reaches its maximum in schoolchildren from five to fourteen years old. Pinworm eggs are infective within six hours of the time that they are laid and may remain so for up to twenty days. Pinworm is primarily a familial or institutional infection associated with crowding. Because of the relatively brief life span of the worms, long-standing infections are due to continuous reinfection.

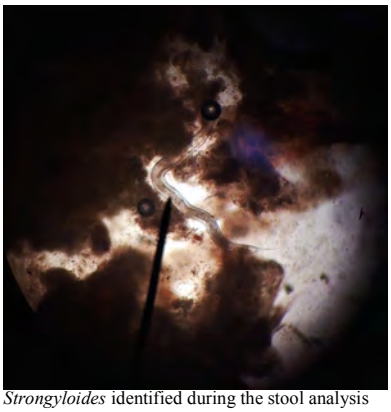
Most pinworm infections are asymptomatic; however, symptoms that do appear are largely related to perianal and pelvic itching and scratching. Painful urination, inability to control urine, vaginal infection, and vaginal discharge can also occur due to pinworm. The migration of the parasite may also lead to pelvic, cervical, vulvar, and kidney inflammation. Large numbers of larval pinworms have caused inflammation of the digestive tract in both adults and children.

Hookworm *(Necator americanus* and *Ancylostoma duodenale*):

Hookworms affect approximately 576 million people globally and is the leading cause of maternal and child morbidity in developing countries of the tropics and subtropics. Infective hookworm larvae penetrate human skin through hair follicles and small fissures within minutes of contact with contaminated soil. The larvae are carried by circulation to the lungs, penetrate the alveolar walls, and make their way up the trachea to be swallowed and carried to their final habitat in the small intestine.

Migration of larvae through the lungs may provoke the inflammation of lung tissue. Once in the intestine, hookworms may cause chronic abdominal pain and persistent eosinophilia. The major manifestations of hookworm infection, however, are iron-deficiency anemia and protein energy malnutrition resulting from blood loss. Features of hookworm-induced anemia include smaller than normal red blood cells that are poorly filled with hemoglobin, skin paleness, weakness, physical or mental weariness, lack of energy, difficulty or uncomfortable breathing, and swelling of the organs due to an abnormally low level of protein in the blood, especially in malnourished children. Moderate infections and anemia can impair physical, cognitive, and intellectual growth in children, diminish productivity of workers, and threaten the outcome of pregnancy for both mother and child. The development of anemia depends on the intensity and duration of the infection, yet in the most sever cases, anemia caused by hookworms can lead to congestive heart failure.

Strongyloides (*Strongyloides fuelleborni* and *Strongyloides stercoralis*):



Strongyloides identified during the stool analysis of IMO's Rapid Appraisal in El Paraiso.

Estimates of the global prevalence of strongyloidiasis vary between 3 million and 100 million people infected, making it considerably less common than infections with other major intestinal nematodes. The semitransparent, colorless female worms measuring 2.2 mm in length embed themselves and deposit their eggs in the upper small intestine. Females lay eggs without the need for fertilization and hatch in the mucosa. Then, the noninfectious larvae work their way into the lumen of the bowel. If excreted with feces onto soil in a warm, humid environment, they develop into infective larvae that can penetrate human skin, migrate to the lungs, pass up to the trachea where they are swallowed, and eventually make their way back down into the GI tract. There they eventually mature into adult worms that produce eggs in the small intestine.

A crucial feature of *Strongyloides* that sets it apart from all other major parasitic worms is that non-infective larvae have the ability to develop into infective larvae within the bowel, reenter the host through the colonic mucosa or perianal skin, and complete their life cycle without ever leaving the host. This process of autoinfection explains how the parasite can increase without external reinfection, persist indefinitely in a single host, and be transmitted directly from one person to another during close physical contact. Its medical significance lies in its ability to produce overwhelming infection in immunocompromised hosts, a consequence of its unique ability to replicate and increase in numbers without leaving its host.

While more than half of chronically infected people are asymptomatic, acute infections of strongyloidiasis yield a localized, itchy, red, raised rash soon after larval penetration. Diarrhea and abdominal pain may develop just before the appearance of larvae in the stool. Adult worms and larvae traversing the upper small bowel mucosa may produce abdominal pain, nausea, diarrhea, and blood loss. With hyperinfection, defined as repeated reinfection with larvae produced by worms already in the body due to their ability to complete the life cycle within a single host, increased numbers of larvae are found in the intestines, lungs, central nervous system (CNS), kidneys, liver, and almost any other organ. Gastrointestinal manifestations are common and include abdominal pain, nausea, vomiting, diarrhea, ileus, and edema of the bowel, which can lead to intestinal obstruction. Ulceration of the mucosa may produce massive hemorrhage, inflammation, or bacterial sepsis. Larvae migrating beyond the gastrointestinal tract produce pneumonitis with cough, hemoptysis, and respiratory failure. CNS invasion may cause meningitis and brain abscesses, with larvae in the cerebrospinal fluid and tissue. When Gram-negative bacteria gain access to the bloodstream via migrating larvae, bacterial sepsis, meningitis, and pneumonia occur frequently.

Strongyloides is primarily transmitted through contact with soil contaminated with infected feces. In ordinary hygienic conditions, human-to-human transmission does not appear to occur. Appropriate methods of human fecal sanitation and sewage disposal as well as the use of shoes are of paramount importance. Thus, the infection can be prevented by implementing public health measures aimed at ensuring proper disposal and treatment of excrement and by avoiding skin contact with contaminated soil.

1.2 Symptoms of Infection and Impact on Health

The symptoms of STH are nonspecific and only become evident when the infection is particularly severe. The nonspecific symptoms include nausea, fatigue, weakness, abdominal pain, and loss of appetite. STH causes morbidity through various different mechanisms. Three of particular significance are listed below.

- **Anemia**. All human cells depend on oxygen for survival; therefore, a decrease in the number of red blood cells can result in feelings of weakness, fatigue, malaise, and poor concentration. In severe cases of anemia, the body increases cardiac output in an attempt to compensate for the lack of oxygen. This may lead to palpitations, angina, and even heart failure.
- **Intestinal Obstruction**. In cases of massive infection, a bolus of parasites can cause intestinal obstruction. Obstruction is usually partial but when it is lasting, it can become complete. Additionally, obstruction can occur where parasites excrete neurotoxins that cause contractions of the small bowel. A lingering obstruction gets complicated with the probability of intussusception, volvulus, necrotic bowel, or perforation, all of which are life threatening.
- **Malnutrition**. Malnutrition becomes life threatening in association with STH as STHs feed on host tissues, including blood, leading to a loss of iron and protein. Additionally, STH impairs the body's ability to absorb or assimilate food, decreasing the absorption of essential nutrients. In particular, STHs compete for already low levels of vitamin A in the intestine of the host. Because vitamin A maintains the integrity of the epithelium in the respiratory and gastrointestinal tracts, its deficiency increases the risk of developing respiratory disease and chronic diarrhea. Malnutrition weakens every part of the immune system, which increases the risk of infection and infectious disease. Infectious diseases like malaria, measles, persistent diarrhea, and pneumonia can also keep the body from absorbing adequate food.

The impact of STH on an infected person's life can be significant. Some examples include:

- **Stunting**. Chronic malnutrition occurring over time interferes with a child's ability to develop and grow. Malnutrition and recurrent infections in combination with STH are major contributors to growth stunting. A stunted child may appear normal, but is significantly smaller and shorter than children who are adequately nourished. Their immune system is weaker, leaving them more vulnerable to disease and they are five times more likely to die from diarrhea. Once established, stunting and its effects typically become permanent. Stunted children may never regain the height lost as a result of stunting, and most children will never gain the corresponding body weight. It also leads to premature death later in life because vital organs never fully develop during childhood. Height-for-age, weight-for-age, and weight-for-height are frequently used indicators of nutritional status of children. Because these represent the long-term effects of malnutrition and are not sensitive to recent, short-term changes in dietary intake, height and weight are measured as part of the Rapid Appraisal.
- **Need for surgery**. When their numbers in the body become extremely high, STHs build up in the child's intestines causing obstruction, hindering normal function, and eventually blocking the intestine entirely. The only solution in this situation is an emergent surgical intervention that in most cases is not possible in remote areas, causing the child's premature death.
- **Reduced ability to learn**. In an already malnourished child, STHs further rob the body of the nutrients required for physical and mental development. In the formative years of a child's growth, this chronic malnutrition results in a significant and irreversible drop in IQ. Children with STH are therefore less able to concentrate or process information, compromising their formal education that is, in most cases, already limited.

1.3 Who is most at risk?

According to the World Health Organization (WHO), children are at risk as soon as they stop breastfeeding and start crawling on the ground, frequently putting their hands in their mouths. Without treatment and prevention, children are infected and repeatedly re-infected, causing the number of STHs they harbor to steadily increase. By the time they reach school, they can be harboring hundreds of STHs or more.

Preschool and primary school-age children should be targeted for treatment and prevention of STH for the following reasons:

- They typically have the highest burden of STH.
- They are more susceptible to other infections.
- They are at a critical time of their physical and mental development.
- Primary school is foundational for secondary and higher levels of learning.
- Decreased STH prevalence among this group reduces the level of contaminate in the environment.

1.4 Treatment

IMO's preferred anthelmintic is Albendazole. Not only is Albendazole effective against each type of helminth found in El Paraiso, it is also:

- Safe for young children and pregnant women
- Easy to administer due to its standard dose regardless of weight
- Chewable
- Relatively inexpensive.
- Readily available for purchase in Tegucigalpa

The recommended dose is Albendazole 400mg, once, every six months.

1.5 Prevention

WHO advocates administering anthelmintic medication at regular intervals to populations at risk. This approach may lower the prevalence and intensity of STH but is unlikely to eliminate transmission in the absence of sanitation, clean water supplies, and overall economic development. The improvement of infrastructure, sanitation standards such as properly washing and cooking food and hand washing, and environmental factors such as housing conditions and access to clean water are broad steps toward prevention of STH.

Regular mass treatment is a commonly accepted remedy of STH because of the ease with which controlled doses of safe, effective, and relatively inexpensive anthelmintic medication can be administered. However, a disturbing aspect of this widespread practice of annual or semi-annual deworming of children and other groups is the concern about resistance developing to Albendazole and other anthelmintics. Prevention is, therefore, paramount.

General Recommendations for STH Prevention

Regular treatment in a target population will only result in a short-term reduction of infection, as re-infection is frequent within a relatively short period of time. The long-term key preventive interventions mentioned below are the basic requirements necessary to break the cycle of transmission and thus eliminate STH as a public health problem.

Behavior modification

- Education and practice are the most important activities to motivate children to change their behavior.
- Children can be effective agents to convince parents, family members, and community members to change their behaviors.
- Teaching should be presented in a positive rather than a negative context.
    - "Clean hands feel good" instead of saying "Dirty hands cause disease"
    - Encourage the children to try new ways of doing things
    - Rewards of developing good habits — personal satisfaction and a sense of accomplishment
- Self-respect — mind, body, and spirit
    - Take proper care of your body
    - Maintain privacy
    - Practice modesty
- Establish new habits
    - Wash hands at appropriate times
    - Keep hands away from the face
    - Schools are important in the training process
        - Lead by example — administrators and teachers should also wash their hands
        - Consistency where all the children wash their hands at the same time (in a line)
        - Make it easy and practical for the children and teachers to wash
            - Set up a hand-washing area at the school
            - Have clean (boiled or filtered) water always available at the station

Health Education

- Anatomy and physiology
    - Teach general information about the body
    - Teach proper care and disease prevention
- Biology of the body — how the body functions in general
- Helminthiasis and its physiology within the body
    - How helminths enter the body
    - How helminths migrate throughout the body and eventually reside in the intestines
    - The effect of helminthiasis on the body
- Nutrition
    - Define and discuss a balanced, nutritional diet
    - Incorporate a nutritional diet within a cultural diet
        - Identify available foods
        - Explore options to meet nutritional requirements

Hygiene

- Wash hands with soap
    - When the hands are dirty
    - After using the toilet
    - Before meals/snacks
    - Before taking medication
    - Before feeding children
- Exercise oral hygiene
- Bathe and take care of the body

Safe Water

- Practice one or more of the many options for establishing a safe water system. (http://www.cdc.gov/safewater/resources.html - manuals)
    - Ceramic Filtration
    - Chlorination
    - Rainwater collection
    - Safe Water Storage
    - Slow Sand Filtration
    - Solar Disinfection
- Practice proper food preparation
    - Clean food preparation areas and allow to dry thoroughly
    - Wash vegetables and fruits thoroughly, especially when eating them raw
    - Cook food and vegetables properly
- Drink safe, filtered water
    - Instruct and encourage people to do what is necessary to provide safe drinking water for children
    - At the very least, each family should boil water each morning
    - Train children to only drink safe water

Sanitation

- Wear shoes always
- Discourage open defecation
- Properly dispose of children's stools
    - Only when absolutely necessary:
        - Dig a hole in the ground for defecation
        - Cover the hole with soil afterward to avoid exposed excreta
- Latrines
    - One of the most effective measures to break the cycle of transmission
    - Train and encourage all family members to use latrines
    - Proper construction including barrier between user and excreta
    - Clean, well maintained

Treatment

- Take medication at regular intervals
- Go to health services to provide treatment of symptomatic illness

Next Step

Thank you Good Works Honduras for inviting IMO to visit and perform our Rapid Appraisal assessment on the people for whom you clearly have great concern and compassion. Based on the assessment we performed in March 2014, we believe a definite need exists for the treatment and prevention of soil-transmitted helminthiasis (STH) in El Paraiso. Although the IMO treatment and prevention process has demonstrated its ability to successfully minimize STH, our experience has shown that our treatment process has minimal value unless the people of the community receiving the treatment accept our recommendations for the prevention of this formidable infection and put them into practice.

In accordance with our findings and recommendations to further prevent STH, IMO is proposing to provide assistance to the people of El Paraiso providing that certain conditions are met. IMO's proposed responsibilities and these conditions are itemized below.

IMO proposes to:

1. Meet with the people, NGOs, or institutions that have been identified as prominent, influential, or otherwise active in the area in order to promote a cooperative effort.
2. Focus on the children and their families that sincerely need assistance.
3. Fund the treatment of STH, including providing the needed pharmaceuticals Albendazole and vitamin A.
4. Assist in the instruction and implementation of preventive measures.

The following conditions must be met:

1. Local NGOs or institutions that will work with IMO in the treatment and prevention processes must be identified.
2. Specific information on governmental (national or local) deworming programs and their details must be provided before we begin treatment.
3. The following must be identified and listed by name and position:
    a. Health officials
    b. School officials
    c. Community leaders
    d. Key people who may know the culture, politics, limitations, area, etc.
4. Areas and people that sincerely need assistance must be identified.
5. The layout of El Paraiso including the following must be provided:
    a. Map of area including schools
    b. List of schools including numbers
6. A local coordinator must be identified and designated. He/She must:
    a. Have permanent residence in the area.
    b. Be proficient in both English and Spanish.
    c. Be reliable.
        i. Follows through on instructions
        ii. Provides pertinent, correct information
    d. Be accessible via email.
    e. Be knowledgeable of the area and culture.
    f. Be willing to be responsible and accountable.
7. Community officials and leaders must commit to:
    a. Accept treatment.
    b. Actively adopt preventative measures.

Children Requiring Further Evaluation

IMO recommends that the four children listed in the table below be further evaluated. Two children showed abnormal lab values and should be thoroughly evaluated and treated accordingly. The other two children tested positive for *Strongyloides* and should be treated.

Recommended Treatment for Children Identified During Rapid Appraisal

	NAME	LOCATION	SEX	AGE	STOOL TEST	RECOMMENDATION
28.	Jose Santos Lopez	Ojo de Agua	M	5	-	Further checkup: WBC 38K - recheck CBC (WBC) - perform detailed physical exam - treat accordingly
30.	Jose Luis Duron	Ojo de Agua	M	5	*Strongyloides*	Ivermectin 200mg/kg x 2 (2 weeks apart)
39.	Karol Dayana Rodrigues	Las Crucitas	F	5	-	Further checkup: PLT 95 - recheck CBC (PLT) - physical exam - R/O malaria, virus, or other non infectious etiology
99.	Julihana Dorithed Padilla	Chaguite Sur	F	5	*Strongyloides*	Ivermectin 200mg/kg x 2 (2 weeks apart)