Parasites in Paraguay: An Analysis of the Presentation and Management of Intestinal Parasites by Short-Term Medical Mission Volunteers in Paraguay

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An Analysis of the Presentation and Management of Intestinal Parasites by Short-Term Medical Mission Volunteers in Paraguay

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PARASITES IN PARAGUAY

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Abstract

Introduction. International medical aid in the form of short-term medical missions (STTM) receives more than $250 million in annual donations. Needs assessments prior to the STTM and outcomes analysis for improvement are often lacking.

Objective. Describe the patient population attended to during a one-week STTM in Paraguay, South America, while examining “parasites” as a presenting concern, as a diagnosis by the providers, and the prescription of antiparasitic treatment. This analysis identified variance in intestinal parasite presentation and management by age, gender, and location. The administration frequency of antiparasitic medication was considered as prophylactic versus disease-treatment based.

Methods. This study was a chart review of de-identified clinic records from a temporary primary care clinic in the Capital District, Paraguay, in June, 2011.

Results. Thirty percent of patients presented with “parasites,” most prevalent among females and adults (p = 0.0520 and p = 0.0730, respectively). Forty-six percent of patients were diagnosed with “parasites” and 51% were prescribed antiparasitic medication. Females more frequently received antiparasitic medication (p = 0.0660). Seventy-eight percent of patients were indicated for prophylactic antiparasitic administration; only 48% received medication. Eighty-eight percent of patients indicated for antiparasitic administration (either prophylactically or by diagnosis) received medication.

Conclusion. Antiparasitic medication prescription tended toward treating newly diagnosed clinical disease, as opposed to broad prophylactic administration of antiparasitic medication to at-risk populations. Future STMMS should focus on an approach to the prevention, treatment,
and eradication of intestinal parasites via education, improved sanitation, and longitudinal presence in conjunction with local medical infrastructure.

*Keywords:* Short-term medical missions, Paraguay, neglected tropical diseases, intestinal parasites, albendazole, mebendazole
Parasites in Paraguay: A Descriptive Analysis of the Presentation and Management of Intestinal Parasites by Short-Term Medical Mission Volunteers in Paraguay

This analysis focused on two neglected tropical diseases—ascaris lumbricoides and trichuris trichiura. The presentation of these diseases in three Paraguayan communities, as well as their management by volunteer North American healthcare providers, was examined in the context of cross-cultural volunteerism. The results of this investigation will form recommendations to improve future volunteer care efforts directed at addressing neglected tropical diseases in this and similar cross-cultural clinical environments.

This analysis was based upon data collected during a short-term medical mission in Paraguay, South America, in June, 2011. The mission organization directing this trip, a 501(c)(3) entity1, conducts once yearly medical service trips to various non-U.S. countries, typically in Latin America or Africa. While there have been repeat missions to the same location, the group most often visits a new location each year.

The short-term medical mission (STMM) teams for this organization, typically composed of 40 to 50 members—including primary care physicians, surgeons, anesthesiologists, nurse practitioners, nurses, and non-medical volunteers, function as two independent units, one surgical and one medical. The medical arm consists of a primary care clinic, dental clinic, and vision clinic. Data collected from the primary care medical clinic formed the basis of this secondary data analysis.

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1 A 501(c)(3) entity, defined by the Internal Revenue Service as an organization "organized and operated exclusively for exempt purposes set forth in section 501(c)(3), and none of its earnings may inure to any private shareholder or individual. In addition, it may not attempt to influence legislation as a substantial part of its activities and it may not participate in any campaign activity for or against political candidates," typically labeled “charitable organizations” (Internal Revenue Service, 2012, http://www.irs.gov/Charities-Non-Profits/Charitable-Organizations/Exemption-Requirements-Section-501(c)(3)-Organizations).
Background

**Short-term medical missions.**

The provision of international medical assistance via STMMs receives much funding from private donors in many nations around the world, totaling more than $250 million in donations annually (Maki, Qualls, White, Kleefield, & Crone, 2008). These trips often last from 1 to 4 weeks. An assessment of 543 organizations participating in STMMs revealed that the characteristics of such organizations vary in terms of size; number of medical volunteers; funding, length, cost, and annual number of volunteer trips; and purpose (Maki et al., 2008).

The organization through which the data comprising this descriptive analysis was collected operates on a relatively small scale. The Paraguay STMM consisted of approximately 45 volunteers; included five days of patient care divided between independently operating surgical and medical branches; was funded by a combination of participants funding their own trips and various fundraising efforts; and had the primary aim of medical and surgical outreach, though there were religious and spiritual inclinations motivating some members as well.

Some have criticized short-term medical missions, and international development aid in general, for the lack of consistent evaluation and outcome assessment aimed at improving results and ensuring that the capital investment is producing tangible health benefit for the targeted population (Easterly, 2006; Maki et al., 2008). Maki, Qualls, White, Kleefield, and Crone (2008) have proposed a broad-based schema for evaluating the efficacy of short-term medical missions based on six criteria—cost, efficiency, impact, preparedness, education, and sustainability. In light of the fact that critical evaluations of STMMs have largely been absent in literature, the institution of such a critical eye with regard to international health volunteerism may offer the benefit of improved health outcomes, improved patient safety, better integration with national
health infrastructure already in place, more culturally appropriate patient care, and more efficient use of financial resources.

Though such an in-depth analysis, inclusive of the six criteria above (Maki et al., 2008), is an elaborate process beyond the scope of this assessment, it is the aim of this paper to conduct a broad, descriptive study of the patient population attended to during the one-week Paraguay STTM, to examine common presenting concerns by patients, the common diagnoses made by volunteer providers, and common treatments prescribed. Additionally, an analytic review focused solely on the presentation by patients complaining of parasites, the diagnosis of parasites by the volunteer providers, and the prescription of antiparasitic treatment by the providers will be conducted to identify variance in intestinal parasite presentation and management along key demographic variables. With the recommendations from the World Health Organization (WHO) (2006) on the prophylactic administration of antiparasitic medications against soil transmitted helminths, which include ascaris lumbricoides and trichuris trichiura, in mind, the prescription of antiparasitic medication will be considered under two potential models – one in which medication is given to all at-risk, eligible individuals as part of a broad prophylactic campaign, and another in which only those diagnosed with active intestinal parasitism are given medication. It is the hope that these results will inform future volunteer care efforts directed at addressing neglected tropical diseases in this and similar cross-cultural settings.

**Paraguay.**

Roughly the size of the U.S. state of California in terms of land area, Paraguay is centrally located in South America, landlocked between Bolivia, Argentina, and Brazil (Pan American Health Organization, 2008), a region of South America designated the Southern Cone sub region (Pan American Health Organization, 2013). The population of Paraguay is estimated
at approximately 6 million individuals, greater than 2.2 million of which (37.1%) are under the age of 15 years. Conversely, approximately 300,000 (4.9%) of Paraguay’s population is above 65 years of age (Pan American Health Organization, 2008). Urban dwellers comprise 56.7% of the population, while 43.3% reside in rural settings. The population density of Paraguay is very heterogeneous, with nearly 40% of the population concentrated in Asunción, the capital, and the surrounding Capital District—only 1% of the entire landmass of the nation (Pan American Health Organization, 2008).

Socially and ethnically, Paraguay is rather unique among South American nations, with indigenous Guarani culture and ethnicity integrated throughout the majority of the Paraguayan populace. The large majority of Paraguayans, greater than 90%, are of Spanish, indigenous Guarani, or mixed ethnicity (Pan American Health Organization, 2008). The diffuse integration of both indigenous and colonialist origins among the Paraguay population is reflected in the high prevalence of individuals that speak both Spanish and Guarani, which are both official languages in Paraguay. Anecdotally, the farther one travels outside of the capital, Asunción, and the surrounding Central District, the less Spanish is spoken by the population, with a marked predominance of Guarani.

Though indigenous ethnic origin, in terms of both language and culture, remains largely integrated into the lives of many Paraguayans, traditional Guarani communities and individuals account for less than 2% of the total population (Pan American Health Organization, 2013). The largest group within the indigenous population is the Guarani. Specific barriers to equality among the indigenous include lack of access to education, electricity, clean water, and basic hygiene and sanitation. Compared to the national literacy rate—greater than 90%—only 49% of indigenous peoples in Paraguay are literate. Additionally, only 10% have access to electricity,
and approximately 2.5% have access to drinking water, compared to 63% for the population in general (84.5% for urban dwellers and 35.5% for rural dwellers) (Pan American Health Organization, 2013).

Indeed, poverty and the subsequent lack of sanitary conditions and basic public health infrastructure are of major concern in Paraguay. Nearly 7% of the population has been labeled as “extremely poor,” with over 37% labeled as either “extremely poor” or “poor” by the Pan American Health Organization (2013). Compounding the high prevalence of poverty is a lack of basic sewage system access—only reaching 9.4% of the population, as of the year 2002. One percent of the entire population, nearly 60,000 individuals, has no access to any form of excrement disposal (Pan American Health Organization, 2008). Within these impoverished, marginalized groups, infectious diseases, including parasites, related to the sanitary and environmental results of poverty are prevalent.

Principal among major health problems in Paraguay is childhood morbidity and mortality, especially among the infant population, with greater than 15% of infant deaths in Paraguay attributed to intestinal infections and diarrheal illness (Pan American Health Organization, 2008). The large health burden of communicable diseases does not end in infancy, with infectious diseases, specifically pneumonia and diarrhea, as a main cause of death among school age children. Paraguay has received scores of “Insufficient Progress” with regard to their fight against the majority of the communicable diseases addressed by the United Nations’ (U.N.) Millennium Development Goals (for more, see Literature Review) (United Nations [U.N.], 2005), with the exception of “Impressive Progress” regarding the reduction of malaria. Among school age children, malnutrition also ranks highly in terms of burden of disease, with acute malnutrition affecting as many as 5% of those under the age of five. The severity of this health
problem is amplified when one considers children living in the rural setting, where the prevalence of acute malnutrition rises to 6.3 for those under the age of five (Pan American Health Organization, 2008).

**Literature Review**

**Global Infectious Diseases**

“To have, by [2015], halted, and begun to reverse, the spread of HIV/AIDS, the scourge of malaria and other major diseases that afflict humanity.” —U.N. Millennium Declaration (U.N., 2000, p. 13, emphasis added).

The U.N. Millennium Declaration (U.N., 2000) provided a structure for the formation of the Millennium Development Goals (MDGs), eight objectives (see Figure 1) with corresponding quantitative targets, intended to eliminate “extreme poverty, hunger, and disease by 2015” (Hotez et al., 2007a, p. 1018) by improving global access to “peace, security, development, human rights, and fundamental freedoms” (U.N., 2005, Resolution adopted by the General Assembly).

![Figure 1](attachment:image.png)


The sixth MDG, posited to “combat HIV/AIDS, malaria, and other diseases,” is targeted at reducing the global burden of morbidity and mortality related to some of the most prevalent
infectious diseases (U.N., 2005). Both in terms of the initial framing of the sixth goal and the subsequent coalition and campaign formation to address this goal, there exists an apparent dichotomy regarding the diseases garnering the highest priority. Emphasis is placed on HIV/AIDS and malaria, with a clear relegation of other targeted infections into the category “and other diseases.” Tuberculosis is often grouped with malaria and HIV/AIDS in terms of the conceptualization of international infectious disease, prompting a distinction between “the ‘big three’ (HIV/AIDS, tuberculosis, and malaria)” and “other diseases” (Molyneux, 2008, p. 510).

As a result of the significant morbidity and mortality attributed to tuberculosis, HIV/AIDS, and malaria over the last three-plus decades, there has been a concerted and largely well-funded campaign of public and private players, with the aim of averting the loss of millions of lives, and even more lost quality-adjusted life years (QALYs), by addressing the need for prevention and control of these diseases (Katz, Komatsu, Low-Beer, & Atun, 2011; Komatsu et al., 2010; The Global Fund to Fight AIDS Tuberculosis and Malaria, 2010). While the merits of addressing the vast morbidity and mortality associated with tuberculosis, HIV/AIDS, and malaria appear quite clear, the narrow focus on these three diseases in the face of hundreds of other infectious diseases with significant health and societal burdens have led to criticism. As a direct result of these narrowly focused initiatives, there is little resource or room left to address those “other diseases,” which are “some of the most prevalent diseases and causes of morbidity and mortality amongst the poorest and most marginalized in society” (Molyneux, 2008).

The tight international focus on a non-majority of infectious diseases is not without consequence. The burden caused by many viral, bacterial, ectoparasitic, fungal, and helminthic diseases has remained largely unaddressed on the international stage, and neglected in terms of public and private funding (Hotez, Ottesen, Fenwick, & Molyneux, 2006; Lammie, Fenwick, &
Utzinger, 2006; Molyneux, Hotez, & Fenwick, 2005; Utzinger et al., 2009 & 2012). Due to the shifting dynamics of resource channeling toward a limited number of infectious diseases and away from a more extensive set of what are largely tropical illnesses, this latter group has been referred to collectively as neglected tropical diseases (NTDs). Much of the drive for significant and sustained funding of the “big three” has been derived from the well-defined epidemiology of malaria, tuberculosis, and HIV/AIDS, specifically in terms of the quantification of morbidity and mortality outcomes (Hotez et al., 2006; King & Bertino, 2008). This sort of epidemiologic burden quantification has thus far been lacking for the neglected tropical diseases (Allotey, Reidpath, & Pokhrel, 2010), which has hampered the effort to seek adequate funding and intervention for the “other diseases.” The neglect of significant, sufficient attention and funding for this group of infectious diseases is multifaceted and includes economic, epidemiologic, social, and geographic determinants (Allotey et al., 2010).

**Prevalence of the neglected tropical diseases.**

What began as a group of 13 infectious diseases (see Table 1)—seven helminthic, three bacteria, and three protozoal—the neglected tropical diseases now number greater than 40 and include ectoparasitic, fungal, and viral infectious agents as well (Utzinger et al., 2009).

Table 1

*The 13 Original Neglected Tropical Diseases*

<table>
<thead>
<tr>
<th>Bacterial</th>
<th>Protozoan</th>
<th>Helminths (parasitic intestinal worms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trachoma (bacterial)</td>
<td>Human African trypanosomiasis</td>
<td>Hookworm</td>
</tr>
<tr>
<td>Leprosy (bacterial)</td>
<td>Chagas disease (protozoan)</td>
<td>Trichuriasis</td>
</tr>
<tr>
<td>Buruli ulcer (bacterial)</td>
<td>Leishmaniasis (protozoan)</td>
<td>Ascariasis</td>
</tr>
</tbody>
</table>
<pre><code>                                                         | Schistosomiasis                      |
                                                         | Filariasis                           |
                                                         | Onchocerciasis                       |
                                                         | Dracunuliasis                        |
</code></pre>
Among the neglected tropical diseases, the intestine-dwelling nematodes rank among the most common chronic infectious diseases in low-income countries (de Silva et al., 2003). Globally, three of the most common nematodes—ascaris lumbricoides, trichuris trichiura, and hookworms—have prevalence estimates ranging from 1.5 billion individuals (Bundy, 1994) to 2.0 billion individuals (Savioli, Engels, & Endo, 2005). This accounts for global prevalence estimates of 25% for ascaris lumbricoides, 20% for hookworm, and 17.5% for trichuris trichiura (Crompton, 1999). Regionally, prevalence of infection by this dominant subset of nematodes varies, reaching 50% in many sectors of India (Mani et al., 2002), with estimated prevalence ranges among certain regions in Bangladesh of 70–95% for ascaris lumbricoides, 38–79% for trichuris trichiura, and 2–71% for hookworm (Mascie-Taylor et al., 2003).

With prevalence of infection reaching a maximum at school age (Bundy, 1994), intestinal nematode infections are one of the most common infectious diseases among children (Watkins, Cruz, & Pollitt, 1996). An estimated one-third of children worldwide are infected (Awasthi et al., 2008). As was the case among the general population prevalence estimates, childhood disease prevalence varies markedly by region. In stool analysis of preschool children in Uzbekistan, greater than 80% had infection with one or more intestinal parasites (Gungoren, Latipov, Regallet, & Musabaev, 2007). Similarly, among children in Zanzibar, there was 99.7% helminth prevalence, with 38% exhibiting infection with two organisms, and 55% with three organisms (Simeon, Grantham-McGregor, Callender, & Wong, 1995). In terms of the disease burden on individual causative agents, among Guatemalan school children aged 7–12 years, Watkins et al. (1996) found a prevalence of 91% for ascaris lumbricoides and 82% for trichuris trichiura on stool analysis. Similar studies produced regional ascaris prevalence estimates.
among Uzbeki children ranging from 1–24% (Gungoren et al., 2007), and of 33% among preschool children in northern India (Mani et al., 2002).

**Morbidity and mortality of the neglected tropical diseases.**

Intestinal parasite infections and their deleterious consequences represent a significant public health worry globally, specifically among children (Awasthi, Bundy, & Savioli, 2003; Gungoren et al., 2007). In broader terms, concerted effect of improper sanitation, lack of access to safe drinking water, and poor hygiene result in approximately 6,000 childhood deaths daily, with a direct correlation between intestinal parasite infection and crude infant mortality rate (Esrey, Potash, Roberts, & Shiff, 1991; Gungoren et al., 2007). Indeed, the relation of public health and sanitation deficits and the resultant infectious disease morbidity and mortality is multifaceted. Esrey et al. (1991) showed a 26% reduction in mean mortality upon screening for, treating, and eliminating diarrheal illness. When this approach was taken with the additional step of treating and eliminating ascaris lumbricoides, however, there was a 55% reduction in mean mortality.

The harmful effects of intestinal parasite infection, specifically nematode infection, have been studied and described largely in relation to the childhood demographic and the impedance of growth and development. However, concern for effects among adults have been highlighted in the literature, including enhanced susceptibility to (Nacher et al., 2002; Spiegel, Tall, Raphenon, Trape, & Druilhe, 2003) and severity of malarial disease (Druilhe, Tall, & Sokhna, 2005), decreased work ability and productivity (Crompton, 2000; O'Lorcan & Holland, 2000; Stephenson, Latham, & Ottesen, 2000), and iron deficiency (Beasley et al., 1999; Crompton, 2000; Mebrahtu et al., 2004; O'Lorcan & Holland, 2000; Stephenson et al., 2000; Stoltzfus et al., 1997). Moreover, conjecture has been made as to other potential effects, including more
rapid advancement of HIV/AIDS (Fincham, Markus, & Adams, 2003), immunodeficiency, bronchial asthma, appendicitis, and infertility (Moore et al., 2001; van den Biggelaar et al., 2004).

Among children, there has been significant concern regarding the chronic effects of intestinal parasite infection (Awasthi et al., 2003), largely centered on cognitive and physical development. In addition to the aforementioned concerns and effects of intestinal parasite infection, consequences of infection that are a specific worry in children include malnutrition (Crompton, 1999; Stephenson, Latham, Adams, Kinoti, & Pertet, 1993; Tanumihardjo et al., 1996); stunted physical growth, development, and fitness (Adams, Stephenson, Latham, & Kinoti, 1994; Bagi et al., 2004; Crompton, 2000; Egger et al., 1990; O’Lorcan & Holland, 2000; Raj, Sein, Anuar, & Mustaffa, 1996; Stephenson et al., 1993; Stephenson, Holland, & Cooper, 2000; Thein-Hlaing, Thane-Toe, Than-Saw, Myat-Lay-Kyin, & Myint-Lwin, 1991); and decreased cognitive function with subsequently impaired educational achievement (Crompton, 1999; Jukes et al., 2006; Nokes, Grantham-McGregor, Sawyer, Cooper, & Bundy, 1992; Nokes & Bundy, 1994; O’Lorcan & Holland, 2000; Taylor-Robinson, Jones, & Garner, 2009; Watkins & Pollitt, 1997). Taken in concert, these potential and likely effects of chronic intestinal parasite in children merit concern. Furthermore, Pelletier, Frongillo, Schroeder, and Habicht, (1994) assert that there exists a direct correlation between weight and risk of death in preschool children, some of the most susceptible to intestinal parasites (Bundy, 1994).

In addition to the prevalence estimates for the neglected tropical diseases, it is beneficial to consider the disease burden in terms of subsequent disability and death, often presented as disability-adjusted life years (DALYs). There is a relative dearth of data regarding the morbidity and mortality of the neglected tropical diseases (Allotey et al., 2010), which has been a
significant cause for the relative inability to garner substantial financial and resource backing of campaigns targeted at these diseases (Hotez et al., 2006; Molyneux, 2008; Utzinger et al., 2009; Weiss, 2008). This lack of epidemiologic backing is in stark comparison to the plethora of data supporting the morbidity and mortality ramifications of the “big three” of HIV/AIDS, malaria, and tuberculosis. And, while disease and disability burden estimates exist in the literature, it has been asserted that they represent gross underestimations of the actual disease load caused by the neglected tropical diseases (Finkelstein, Schleinitz, Carabin, & McGarvey, 2008; Hotez et al., 2006; Jia et al., 2007).

The 2004 World Health Report (WHO, 2004) included extensive estimates of global disease burden, represented as disability-adjusted life years (DALYs). These data, stratified among various disease etiologies, included global and regional estimates for the burden caused by the neglected tropical diseases. With some expressing concern that these estimates of morbidity and mortality for the neglected tropical diseases undersold the true effect, upward revisions of disability estimates were made for several in this group of infectious diseases (Hotez et al., 2006). As depicted in Table 2 and Figure 2, upward revisions were made for four of the 13 original NTDs—hookworm, ascariasis, schistosomiasis, and trichuriasis. In these instances, a DALY range is provided, in which the lower limit of the range represents the original WHO estimates, and the upper limit represents the revision presented by Hotez et al. (2006).
Table 2

The Global Burden of Disease of the 13 Original Neglected Tropical Diseases

<table>
<thead>
<tr>
<th>Agent</th>
<th>Global Disease Burden (DALYs / 1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hookworm</td>
<td>59 - 22100</td>
</tr>
<tr>
<td>Ascariasis</td>
<td>1817 - 10500</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>1702 - 4500</td>
</tr>
<tr>
<td>Trichuriasis</td>
<td>1006 - 6400</td>
</tr>
<tr>
<td>Filariasis</td>
<td>5777</td>
</tr>
<tr>
<td>Trachoma</td>
<td>2329</td>
</tr>
<tr>
<td>Leishmaniasis</td>
<td>2090</td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td>1525</td>
</tr>
<tr>
<td>Chagas disease</td>
<td>667</td>
</tr>
<tr>
<td>Onchoderciasis</td>
<td>484</td>
</tr>
<tr>
<td>Leprosy</td>
<td>199</td>
</tr>
<tr>
<td>Buruli ulcer</td>
<td>*</td>
</tr>
<tr>
<td>Dracunuliasis</td>
<td>*</td>
</tr>
</tbody>
</table>

Note: When present, range minimum depicts WHO estimates (2004) and maximum depicts corrected estimates by Hotez et al. (2006). Buruli ulcer and dracunuliasis burdens are insignificantly low.

Figure 2. Graph of the global burden of disease of the 13 original neglected tropical diseases, in disability-adjusted life years (DALYs). Dark gray shows baseline WHO estimates (2004). Light gray shows corrected estimates by Hotez et al., 2006. Vertical axis represents disease burden (in DALYs), while horizontal axis represents the disease.
By the more conservative estimates, as depicted in Figure 2, the three NTDs accounting for the largest disease burden, in dark gray, are filariasis, trachoma, and leishmaniasis. The revised estimates (light gray), however, point to hookworm infection, ascariasis, and trichuriasis as the most burdensome of the NTDs.

A different profile of disease burden is seen when the NTD are considered solely in the context of the Americas (Table 3 and Figure 3). As portrayed by the WHO’s more conservative estimates, the three most burdensome NTDs in the Western Hemisphere are Chagas disease, trachoma, and schistosomiasis. Conversely, upon revision, the most burdensome of the NTDs in the Americas are trichuriasis, Chagas disease, and ascariasis.

Table 3

The Burden of Disease of the 13 Original Neglected Tropical Diseases in the Americas

<table>
<thead>
<tr>
<th>Agent</th>
<th>Americas Disease Burden (DALYs / 1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schistosomiasis</td>
<td>74 - 196</td>
</tr>
<tr>
<td>Trichuriasis</td>
<td>72 - 751</td>
</tr>
<tr>
<td>Ascariasis</td>
<td>62 - 218</td>
</tr>
<tr>
<td>Chagas disease</td>
<td>662</td>
</tr>
<tr>
<td>Trachoma</td>
<td>164</td>
</tr>
<tr>
<td>Leishmaniasis</td>
<td>44</td>
</tr>
<tr>
<td>Leprosy</td>
<td>18</td>
</tr>
<tr>
<td>Filarisis</td>
<td>10</td>
</tr>
<tr>
<td>Onchocercias</td>
<td>2</td>
</tr>
<tr>
<td>Hookworm</td>
<td>0</td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td>0</td>
</tr>
<tr>
<td>Buruli ulcer</td>
<td>*</td>
</tr>
<tr>
<td>Dracunuliasis</td>
<td>*</td>
</tr>
</tbody>
</table>

*Note: When present, range minimum depicts WHO estimates (2004) and maximum depicts corrected estimates by Hotez et al., 2006. Buruli ulcer and dracunuliasis burdens are insignificantly low.*
The global burden of disease for the NTDs, per the conservative, initial estimates, is 17,655 DALYs per 1000 (WHO, 2004). Comparatively, the revised estimates of disease burden represent a greater than three-fold increase, at 56,600 DALYs per 1000 (Hotez et al., 2006). The disease burden of the NTDs is considered in light of the burden of the most prevalent global infectious diseases in Table 4 and Figure 4. Given the upward revision of 56,600 DALYs per 1000, the NTDs burden ranks below HIV/AIDS, at 84,458 DALYs per 1000, but above the other two “big three” diseases, with the burden from malaria at 46,486 DALYs per 1000, and the burden from tuberculosis at 34,736 DALYs per 1000.
Table 4

*The Global Burden of Prevalent Infectious Diseases*

<table>
<thead>
<tr>
<th>Disease / Class</th>
<th>Global Disease Burden (DALYs / 1000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Respiratory Infection</td>
<td>91374</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>84458</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>61966</td>
</tr>
<tr>
<td>NTD</td>
<td>17655 - 56600</td>
</tr>
<tr>
<td>Malaria</td>
<td>46486</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>34736</td>
</tr>
</tbody>
</table>

*Note:* When present, range minimum depicts WHO estimates (2004) and maximum depicts corrected estimates by Hotez et al., 2006.

![Graph of the global burden of prevalent infectious diseases, in disability adjusted life years (DALYs). Dark gray shows baseline WHO estimates (2004). Light gray shows corrected estimates by Hotez et al., 2006. Vertical axis represents disease burden (in DALYs), while horizontal axis represents the disease.](image)

In the Americas, the infectious disease subset with the greatest burden of illness is HIV/AIDS, followed by lower respiratory tract disease, and acute diarrheal illness, as depicted in Table 5 and Figure 5. Below that of HIV/AIDS, the revised NTD burden ranks above the estimates for tuberculosis and malaria, the other two “big three” diseases.
Table 5

*The Burden of Prevalent Infectious Diseases in the Americas*

<table>
<thead>
<tr>
<th>Disease / Class</th>
<th>Americas Disease Burden (DALYs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV/AIDS</td>
<td>3211</td>
</tr>
<tr>
<td>LRI</td>
<td>3044</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>2350</td>
</tr>
<tr>
<td>NTD</td>
<td>1108 - 2066</td>
</tr>
<tr>
<td>Tb</td>
<td>928</td>
</tr>
<tr>
<td>Malaria</td>
<td>111</td>
</tr>
</tbody>
</table>

*Note:* When present, range minimum depicts WHO estimates (2004) and maximum depicts corrected estimates by Hotez et al., 2006.

*Figure 5.* Graph of the burden of prevalent infectious diseases in the Americas, in disability adjusted life years (DALYs). Dark gray shows baseline WHO estimates (2004). Light gray shows corrected estimates by Hotez et al., 2006. Vertical axis represents disease burden (in DALYs), while horizontal axis represents the disease.

Given the significant contribution of NTDs to the burden of infectious diseases, both worldwide and regionally in some of the most impoverished nations of the Western Hemisphere, the importance of understanding the characteristics of infection, as well as modes of treatment and elimination, cannot be overstated. With the global predominance of three nematodes (ascaris, trichuris, and hookworms) as leading causes of disease burden among the neglected
tropical diseases, focusing on nematodes in terms of modes of infection and treatment is well merited. The relevancy of considering the nematodes in the context of Paraguay, a South American nation, is underscored by the predominant role of two nematode species—ascaris and trichuris—among the top three NTDs in terms of disease burden.

While the exact burden of ascaris and trichuris in Paraguay are unknown, the WHO has estimates for the number of school-age children and preschool children requiring “preventive chemotherapy” with antiparasitic medication for soil-transmitted helminths (STHs) (WHO, 2013). Depicted below, in Table 6, are the counts of preschool and school age children in Paraguay requiring antiparasitic treatment / prophylaxis for STH infections, from the year 2008 through 2011. While many countries within the WHO’s STH database have accompanying data regarding outcomes and success of treatment campaigns, such data is not available for Paraguay. When first reported in 2008, 587,561 preschool children and 1,411,519 school children met the WHO criteria for prophylaxis, which will be discussed in detail. By 2011, however, the number in at risk groups, necessitating treatment, fell to 271,130 preschool children and 655,081 school age children (WHO, 2013).

Table 6

*Count of Children at Risk of Soil-Transmitted Helminth Infection*

<table>
<thead>
<tr>
<th></th>
<th>Preschool</th>
<th>School Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>587,561</td>
<td>1,411,519</td>
</tr>
<tr>
<td>2009</td>
<td>269,558</td>
<td>648,859</td>
</tr>
<tr>
<td>2010</td>
<td>270,369</td>
<td>652,052</td>
</tr>
<tr>
<td>2011</td>
<td>271,130</td>
<td>655,081</td>
</tr>
</tbody>
</table>

*Note:* Above populations are at risk and indicated for antiparasitic medication. Adapted from World Health Organization data (2013).

These counts of the number of children eligible for prophylactic administration of antiparasitic medication are tallied for all soil-transmitted helminths, of which the two focal
organisms in this study – ascaris lumbricoides and trichuris trichiura – are two of the most prevalent members. It is upon these two organisms, ascaris lumbricoides and trichuris trichiura, that the remainder of this analysis will focus.

**Characteristics of infection.**

Ascaris lumbricoides and trichuris trichiura are parasitic intestinal worms with transmission characterized by fecal-oral ingestion of the organisms’ eggs (Bundy & Medley, 1992; Dold & Holland, 2011), often from utensils, food, water, and soil (Bradley & Jackson, 2004; Hagel & Giusti, 2010; Stephenson, Holland, & Cooper, 2000). Largely confined to tropical and subtropical regions, most infected individuals are asymptomatic or exhibit mild symptoms (Bradley & Jackson, 2004). In many cases, individuals are infected with both organisms (Stephenson et al., 2000), with the severity of infection of ascaris lumbricoides highly correlated with the severity of trichuris trichiura infection, and vice versa (Kightlinger, Seed, & Kightlinger, 1995; Norhayati et al., 1997).

**Ascaris lumbricoides.**

Ascaris lumbricoides is the most prevalent gastrointestinal helminth infection, and ranks among the most detrimental of the neglected tropical diseases worldwide, especially among children (Hagel & Giusti, 2010), with the greatest intensity of infection occurring between ages 5 and 15 years (Hagel & Giusti, 2010). Infecting 1.2 billion individuals globally, the ascaris lumbricoides organism is the largest of the nematodes that infect humans (de Silva et al., 2003), as well as the most abundant egg-laying nematode (Guerra et al., 1991), able to produce greater than 200,000 eggs daily (Hagel & Giusti, 2010). The eggs of ascaris are capable of surviving for more than a decade, and, like the eggs of other nematode species, are able to adhere to “utensils, furniture, money, fruits, vegetables, doors, hands and fingers” (Hagel & Giusti, 2010, p.349).
The abundant egg production of a single ascaris organism, in combination with the impressive durability of the infectious eggs, necessitates that efforts at treatment and elimination must, in addition to providing medication therapy, address the larger environmental and public health picture in terms of long-term infectivity of eggs secondary to poor sanitation practices (Hotez et al., 2004).

The burden of ascaris is most striking in those of that are impoverished or of lower socio-economic status (Dold & Holland, 2011). Due to the social, economic, and societal marginalization experienced by such groups, poor housing and the lack of adequate sanitation are typical characteristics of their living environments (Hagel & Giusti, 2010; Holland et al., 1988), often resulting in unhygienic means of voiding feces (Haswell-Elkins, Elkins, & Anderson, 1989), which serves to promote the continued infection of the community via the ascaris eggs that are shed in feces.

Though most individuals infected with ascaris are free of symptoms, approximately 8% to 15% of those infected will be symptomatic (Albonico, Crompton, & Savioli, 1999). The most common symptoms of those presenting with ascaris infection include abdominal bloating and pain, nausea, diarrhea, and loss of appetite (Crompton, 2001; Hadju et al., 1996). The prevalence and intensity of ascaris infection, and subsequent symptomatology, are factors of individual human characteristics such as age, immune system, and behavioral influences, as well as such environmental factors as housing and sanitation conditions (Kightlinger, Seed, & Kightlinger, 1998).

*Trichuris trichiura.*

Similar to ascaris lumbricoides in many ways, the nematode trichuris trichiura is also most prevalent in tropical and sub-tropical regions. Though not generally as prevalent as ascaris,
prevalence values for trichuris can reach greater than 90% among certain childhood populations (Stephenson et al., 2000). Indeed, the highest infection rates are among children, as well as those without proper sanitation resources and those of low socio-economic status (Guerra et al., 1991; Kabatereine, Kemijumbi, Kazibwe, & Onapa, 1997).

As with ascaris, minor infections with trichuris often occur without symptomatology. Moderate infections, however, present most commonly with patient signs and symptoms including nausea, vomiting, decreased appetite, diarrhea, abdominal pain, protein malnutrition, and anemia, with the most severe presentations often among children (Stephenson et al., 2000).

**Patient perception of infection.**

As previously highlighted, the prevalence and intensity of infection with ascaris and trichuris intestinal parasites is enhanced by poor socio-economic status and underdevelopment, conditions which often lead to inadequate housing, lack of drinkable water, improper disposal of human waste, and a lack of health and hygiene education (Cooper, 1991). It is clear, then, that there exist behavioral, social, and economic determinants of infection prevalence and severity, just as there exist biological determinants, such as immune status. With this realization, the importance of considering patient perceptions of behaviorally and socially related transmission of infection when developing and implementing treatment and elimination strategies is quite evident (Dold & Holland, 2011).

The causes, implications, and prevention of intestinal parasite infection are often not appreciated by the community of affected individuals (Kamunvi & Ferguson, 1993). Mascie-Taylor et al. (2003), in their analysis of intestinal parasite awareness and knowledge among the people of rural Bangladesh, found that while 43% of those surveyed noted that eliminating worms from one’s body was positive in terms of health, 23% asserted that having intestinal
worms itself offered positive health benefits. In terms of the acquisition of infection, 70% were either mistaken about or not aware of the mode of entry of the worms into the body. Similarly, in terms of behavioral and sanitary practices that increase the risk of infection, 50% of individuals noted that defecating in their home courtyard was a risk, though only 27% noted that defecating along a river bank was also a risk. In terms of food consumption that increases the risk of parasite infection, 93% associated worms with eating sweet foods, while only 6% associated worms with unwashed vegetables. Regarding prevention, 99% of individuals reported hand washing following defecation, food preparation, feeding their children, and prior to eating. When the technique for hand washing was assessed, however, 33% of individuals used only soap, 18% used mud, 6% used only water, and 3% used ash, all methods known to be less effective than washing with soap and water in eliminating bacteria, parasites, and other communicable agents.

Treatment, Eradication, and Prevention of Intestinal Parasite Infection

The importance of an intestinal parasite management approach that incorporates the multiplicity of determinants that contribute to infection and the subsequent morbidity and mortality is crucial. As discussed, these determinants are not simply biological. In the same vein, the solution to the burden of intestinal parasite infection is not purely biomedical. As emphasized by Hotez et al. (2004) in their analysis of the management of tropical infectious diseases, the long-term effectiveness of measures aimed at addressing these diseases must include three components—addressing the need for development aimed at improving sanitation infrastructure, improved health and hygiene education, and an anti-helminthic medication program. Additionally, as the soil-transmitted helminthic infections are often endemic, the directed medical therapy for anthelminthic treatment must target each of the endemic organisms
PARASITES IN PARAGUAY

(Dold & Holland, 2011). The importance of an approach that integrates control measures aimed at the frequently co-endemic infections is echoed by the World Health Organization (2002), as they recommend a combined approach to treatment that addresses the regionally prevalent helminth infections, whether nematode or trematode species. With this in mind, the importance of a multifaceted approach to reducing the morbidity and mortality associated with ascaris and trichuris will be considered as treatment and preventive modalities are examined.

**Antihelminthic medication.**

While the medical treatment of existing egg and organism loads in infected individuals is not the only effort needed to combat intestinal parasites, it plays a vital role in tandem with improvements in health education and sanitation. Specifically, while elimination of infection from a community cannot be accomplished solely by antihelminthic medication—due to the ever-present possibility for re-infection in conditions with inadequate sanitation practices—medical treatment of individuals leads acutely to a significant reduction in infectious loads, as well as a reduced morbidity secondary to infection (World Health Organization, 2002).

The medical treatment of soil-transmitted helminthiasis (STH), such as ascariasis and trichuriasis, is based largely upon benzimidazoles, a class of medications first discovered in 1961 (Bennett & Guyatt, 2000). While the WHO endorses four single-dose medications as options for the treatment of STH, including ascariasis, trichuriasis, and hookworm, the two preferred medications, albendazole and mebendazole, are both benzimidazoles (World Health Organization, 1995; World Health Organization, 2006). The favorability of albendazole and mebendazole over the other two compounds—levamisole and pyrantel pamoate—is related to their broad coverage of other co-endemic infections, ease of dosing and administration, effectiveness, low cost, and low rate of side effects (Bennett & Guyatt, 2000; Hotez, Raff,
Fenwick, Richards, & Molyneux, 2007b; Hotez et al., 2006; Molyneux et al., 2005; World Health Organization, 1995). The ease of dosing and administering albendazole and mebendazole are of great advantage. Albendazole and mebendazole are administered by mouth. Albendazole is administered as a one-time 400 mg dose for individuals greater than or equal to two years of age (World Health Organization, 2006). For those between 12 and 24 months of age, the World Health Organization (2006) recommends a halved dose of 200 mg. Mebendazole, however, is typically administered as 500 mg total spread over 3-5 days. These two benzimidazoles target a plethora of pathogenic agents, highlighted below in Table 7. Of note is the characteristic that both compounds are effective against ascaris, trichuris, and hookworm – two of which, ascaris and trichuris, are prevalent in Paraguay.

Table 7

<table>
<thead>
<tr>
<th>Organisms Treated by Albendazole and Mebendazole</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Albendazole</strong></td>
</tr>
<tr>
<td>ascarisis</td>
</tr>
<tr>
<td><em>ascariasis</em></td>
</tr>
<tr>
<td>trichurisis</td>
</tr>
<tr>
<td><em>trichurisis</em></td>
</tr>
<tr>
<td>hookworm</td>
</tr>
<tr>
<td><em>hookworm</em></td>
</tr>
<tr>
<td>cutaneous larva migrans</td>
</tr>
<tr>
<td><em>cutaneous larva migrans</em></td>
</tr>
<tr>
<td>cysticercosis</td>
</tr>
<tr>
<td><em>cysticercosis</em></td>
</tr>
<tr>
<td>echinococcosis</td>
</tr>
<tr>
<td><em>echinococcosis</em></td>
</tr>
<tr>
<td>enterobiasis</td>
</tr>
<tr>
<td><em>enterobiasis</em></td>
</tr>
<tr>
<td>eosinophilic enterocolitis</td>
</tr>
<tr>
<td><em>eosinophilic enterocolitis</em></td>
</tr>
<tr>
<td>gnathostomiasis</td>
</tr>
<tr>
<td><em>gnathostomiasis</em></td>
</tr>
<tr>
<td>capillariasis</td>
</tr>
<tr>
<td><em>capillariasis</em></td>
</tr>
<tr>
<td>lymphatic filariasis</td>
</tr>
<tr>
<td><em>lymphatic filariasis</em></td>
</tr>
<tr>
<td>microsporidiosis</td>
</tr>
<tr>
<td><em>microsporidiosis</em></td>
</tr>
<tr>
<td>strongyliasis</td>
</tr>
<tr>
<td><em>strongyliasis</em></td>
</tr>
<tr>
<td>clonorchiasis</td>
</tr>
<tr>
<td><em>clonorchiasis</em></td>
</tr>
<tr>
<td>visceral larva migrans</td>
</tr>
<tr>
<td><em>visceral larva migrans</em></td>
</tr>
</tbody>
</table>

| Mebendazole                                    |
| ascarisis                                     |
| *ascariasis*                                  |
| trichinelliosis                               |
| *trichinelliosis*                             |
| trichostrongylia                              |
| *trichostrongylia*                            |
| hookworm                                      |
| *hookworm*                                    |
| eosinophilic enterocolitis                    |
| *eosinophilic enterocolitis*                  |
| enterobiasis                                  |
| *enterobiasis*                                |
| visceral larva migrans                        |
| *visceral larva migrans*                      |

*Note:* Soil-transmitted helminths (STHs) are italicized. Adapted from Table 208-1: *Overview of Agents Used for the Treatment of Parasitic Infections* in Moore (2012).
Antihelminthic drug efficacy.

The efficacy of antiparasitic treatment varies, dependent upon the targeted pathogen and the chosen compound. Measurements of antiparasitic medications are typically presented as reported cure rate and/or reduction in egg count. As reported by Bennett and Guyatt (2000) in their review of the efficacy of albendazole and mebendazole treatment, the cure rate for ascaris after single-dose albendazole is greater than 80%. Comparatively, with the mebendazole regimen of 500 mg over 3-5 days, the median reported cure rate is greater than 90%. In terms of reduction in egg count, both albendazole and mebendazole resulted in nearly undetectable egg counts after treatment (Bennett & Guyatt, 2000).

The efficacy of albendazole and mebendazole against trichuris is much more variable than that of ascaris. The mebendazole regimen over 3-5 days has a media reported cure rate of approximately 80%, though the 95% confidence interval ranges from 40% to 100% (Bennett & Guyatt, 2000). Even more varied, Bennett and Guyatt (2000) found that the median cure rate for trichuris using albendazole was 38%, with the 95% confidence interval stretching from 4.9% to 99.3%. The variance of efficacy in the treatment of trichuris continues when considering reduction in egg count, with a median reduction of approximately 90% when using mebendazole (95% CI of 55% - 100%), and 80% when using albendazole (95% CI of 5% - 100%) (Bennett & Guyatt, 2000).

While the heterogeneity of treatment efficacy for trichuris is quite stark, literature has pointed to significant regional variance in terms of reported cure rates and reduction in egg count. Bennett and Guyatt (2000) note that the global median reported cure rate of 38% is skewed secondary to the observation that albendazole treatments is less effective in Asia than it is in other regions. Of note, when the markedly lower reported cure rate for the treatment of
trichuris with albendazole in Asia (33.3%) are excluded from analysis, the global mean cure rate climbs from 38% to 61% (Bennett & Guyatt, 2000).

*Indications for antihelminthic drug administration.*

The World Health Organization’s recommended prophylactic medication approach for soil transmitted helminth (STH) infections, including ascaris and trichuris, is based upon risk stratification of the targeted community (WHO, 2006). Based upon the prevalence of infection among school children, the schema for medication administration differentiates between high-risk and low-risk populations. High-risk populations are those with a school-age prevalence of greater than or equal to 50%, while low-risk populations are those with a prevalence of greater than or equal to 20% and less than 50%.

Just as the risk stratification of a community is defined in regard to the childhood population, so too are the treatment efforts, with a focus on the treatment of school age children. The World Health Organization recommends prophylaxis of all school-age children twice annually in high-risk populations, with annual treatment of school-age children in low-risk communities. For both risk-stratified populations, additional groups recommended for medication administration include women of childbearing age, lactating women, second and third trimester pregnant women, and preschool children (WHO, 2006). For populations with STH prevalence less than 20%, the World Health Organization (2006) recommends against broad antiparasitic treatment programs, largely due to the lack of benefit in the face of potential risk associated with large-scale, repeated medication administration within a population. However, in these non-endemic circumstances, disease specific treatment of diagnosed intestinal parasite cases is merited.
Side effects and risks of treatment.

The potential risks of treatment can be conceptualized in terms of immediate side effects experienced by the patient and more global, ecologic effects resulting from the repeated blanket treatment of targeted populations. The most common side effects experienced by patients after ingestion of either albendazole or mebendazole, depicted below in Table 8, are gastrointestinal in nature, with at a rate of 1% (Urbani & Albonico, 2003). In addition to short-term gastrointestinal disturbances, patients given albendazole may have intermittent, reversible hair loss and asymptomatic, transient elevations in liver enzymes. More rare side effects of albendazole ingestion include an acute decrease in white blood cell count and skin rash (Moore, 2012).

Table 8

Side Effects of Albendazole and Mebendazole Treatment

**Albendazole**

*Occasional*  
nausea  
vomiting  
abdominal pain  
headache  
reversible hair loss  
elevated liver function tests

*Rare*  
decreased white blood cell count  
rash

**Mebendazole**

*Occasional*  
diarrhea  
abdominal pain  
elevated liver function tests

*Rare*  
severe decrease in white blood cells  
decreased blood platelets  
hairloss

*Note:* Adapted from Table 208-1: Overview of Agents Used for the Treatment of Parasitic Infections in Moore (2012).

Beyond the gastrointestinal upset typical of the benzimidazoles class of drugs, use of mebendazole, like albendazole, can lead to a transient, asymptomatic elevation of liver enzymes.
More rare effects of mebendazole ingestion include an acute, more severe decrease in white blood cells, decreased blood platelet counts, and short-term hair loss (Moore, 2012).

While there has been a dearth of human studies assessing the fetal risk of albendazole or mebendazole administration to pregnant women, models in pregnant rats given mebendazole have indicated teratogenic effects (Bethony et al., 2006). However, due to the balance of risk and benefit, the practical recommendation is the avoidance of albendazole and mebendazole during the first trimester of pregnancy (Albonico et al., 2003).

Decreasing antihelminthic drug efficacy in certain regions has led to the concern for the development of resistance among soil-transmitted helminths that infect human populations (Brun, Schumacher, Schmid, Kunz, & Burri, 2001; Osei-Atweneboana, Eng, Boakye, Gyapong, & Prichard, 2007; Sundar et al., 2000). Specifically, repeated multi-drug treatment campaigns raise alarm for the emergence and dissemination of rug-resistant intestinal parasites (Smits, 2009).

While the concern for resistance among human intestinal parasites is of relatively recent onset, the veterinary and livestock fields have been aware of this trend in animal models for at least two decades, with prevalent resistance arising secondary to regular large-scale treatment programs (Geerts, Coles, & Gryseels, 1997). While the deleterious effects of such resistance among animal and livestock populations has been described in terms of economic loss, the effects of prevalent resistance among human intestinal parasites would result in a even more marked increase of morbidity among some of the world’s poorest.

As a result of the concern for emerging antiparasitic resistance, there has been a call for more in-depth safety and efficacy investigations of antiparasitic medications (Reddy et al., 2007), as well as the importance of implementing schemas for detecting drug resistance early in
the course via monitoring of treatment efficacy (Scherrer, Sjöberg, Allangba, Traor, & Utzinger, 2009). Measures to monitor for the emergence of resistance to antiparasitic medications, such as parasitic egg hatching assays, have been in place for greater than two decades (Coles et al., 1992). However, such laboratory technique and application has yet to become prevalent in the care of human patients. Than being said, there has been an adaptation of such veterinary monitoring and resistance detection tools for the human population, targeting resistance to human hookworm infections (Albonico et al., 2005).

Methods

This retrospective study is a chart review of de-identified clinic records from consecutive patients presenting to three temporary primary care clinics in the Capital District of Paraguay, South America, between June 20 and June 24, 2011. The clinics, functioning as the medical arm of a short-term medical mission, were conducted at three different sites—Village 1 from June 20–21, Village 2 on June 22, and Village 3 from June 23–24.

Each of the villages, rather impoverished barrios outside of the capital city of Asunción, varied in terms of the predominant language spoken. While nearly every patient presenting to clinic in Village 1 and Village 3 spoke Spanish, this was not the case at Village 2. In Village 2, a large majority of patients spoke only the indigenous language, Guarani. This necessitated an extra interpreter in many instances—often from English to Spanish, then Spanish to Guarani, and the reverse. Additionally, as may be deduced from the predominance of patients whose primary language was Guarani, a large proportion of patients seen in Village 2 were more traditionally indigenous compared to the populations attended to in Village 1 and Village 3.
**Data Collection**

The clinic records that formed the basis of this analysis were history and physical forms that were completed as the individual patient was seen in clinic (see Appendix A). The patient flow typically began with patients presenting to an intake table staffed with Paraguayan nursing students for the recording of demographic information, vital signs, and presenting concerns and symptoms on the clinic form. Patients would then be directed to the appropriate available services, including vision clinic, dental clinic, or medical clinic, depending on the presenting concern(s).

While attended to in medical clinic by one of four volunteer providers from North America (one physician, two nurse practitioners, and one medical student), the provider completed clinic records for the individual patient. These volunteer healthcare providers staffed the primary care medical clinic, which was conducted alongside a dental and vision clinic staffed by other foreign volunteers. Only those patients attended to by one of the four North American primary care clinic providers are included in this analysis; those only presenting to the dental or vision clinic are not included in the analysis.

Following the provider encounter, patients prescribed treatments were directed to the pharmacy, staffed by other members of the mission trip, and the patient’s prescriptions were filled. Each portion of the patient’s visit consisted of completion of a given portion of the clinic record.

**Analysis**

Descriptive analysis of patient demographics and presenting problems, as well as the diagnostic and treatment decisions of the providers, formed the basis of this study. The original clinic records were hard copy sheets completed by hand. This hard copy was de-identified by
project staff and entered into a Microsoft Excel spreadsheet. De-identification consisted of the removal of patient names, location identifiers more specific than state or district, patient-specific dates, health record numbers, and all other patient-identifying numbers, in accordance with the Safe Harbor Method for the de-identification of protected health information (U.S. Department of Health & Human Services, 2013).

As the data upon which this analysis was based are previously collected medical records with proper de-identification of protected health information, an Exempt Research Proposal was submitted to the Institutional Review Board of Wright State University, Office of Research and Sponsored Programs, in July 2012 (see Appendix B). Institutional Review Board approval was received in August 2012.

All patient chief complaints, physician diagnoses, and physician treatment options were treated as dichotomous variables and were binomially coded in Microsoft Excel. Counts of chief complaints, diagnoses, and treatments were calculated by summing binomially coded columns, and stratified based on age (under 18 years of age or over 18 years of age), gender (female or male), location (Village 1, Village 2, or Village 3), and provider (Provider 1, Provider 2, Provider 3, or Provider 4).

Prevalence values for chief complaints, diagnoses, and treatments were calculated in Microsoft Excel as the count of positive values divided by the total population or stratified sub-population, and were presented as percentages. Additionally, via IBM’s SPSS Statistics software Version 20.0.0, $t$-test and ANOVA values were calculated to ascertain the statistical significance of demographic differences and variance in prevalence across the sub-stratified categories (i.e. “parasites” as a presenting concern at Village 1 versus Village 3, etc.). An alpha value of 0.05 was used to mark significance in this analysis, with marginal significance as alpha of 0.10. For
the continuous variable age, across all stratified categories, standard deviations and 95% confidence intervals were calculated using Microsoft Excel.

All core variables, both dependent and independent, are depicted in Table 9. Relevant dependent variables for analysis of parasitism and management of parasitism were: the prevalence of patients presenting with the concern of “parasites,” the prevalence of a diagnosis of “parasites,” and the prevalence of prescription of antiparasitic medication (albendazole 400 mg by mouth once, or mebendazole 100 mg by mouth daily for three days).

Table 9

*Variables for Analysis*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Variable Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variables</strong></td>
<td></td>
</tr>
<tr>
<td>&quot;Parasites&quot; as a Presenting Concern</td>
<td>Continuous (frequency)</td>
</tr>
<tr>
<td>&quot;Parasites&quot; as a Diagnosis</td>
<td>Continuous (frequency)</td>
</tr>
<tr>
<td>Anti-parasitic Medication Prescription</td>
<td>Continuous (frequency)</td>
</tr>
<tr>
<td><strong>Independent Variables</strong></td>
<td></td>
</tr>
<tr>
<td>Patient Age</td>
<td>Continuous (years)</td>
</tr>
<tr>
<td>Patient Age Category</td>
<td>Categorical (U18 or 18+)</td>
</tr>
<tr>
<td>Clinic Location</td>
<td>Categorical (Village 1 or 2 or 3)</td>
</tr>
<tr>
<td>Patient Gender</td>
<td>Categorical (Male or Female)</td>
</tr>
</tbody>
</table>

The dependent variable was considered to be a function of the independent variables, including age category (under 18 years (-18) or 18 years and above (18+), clinic location, and patient gender.

Counts of patients seen are depicted in Table 10. In sum, 505 patients were seen by medical providers in clinic and included in analysis. During the two-day clinic in Village 1, 197 patients were seen. During the one-day clinic in Village 2, 76 patients were attended to. Finally, over the course of the two-day clinic in Village 3, 232 patients were seen.
Female patients outnumbered male patients overall, with 327 females seen, compared to 178 male patients. This was the case at each of the three clinic locations. Additionally, in terms of age category, children (under age 18 years) outnumbered adults (age 18 years or older); the number of children attended to amounted to 310, compared to 195 adults overall. This was not consistent between the 3 clinic locations, however: in Village 2, more adults (43) were seen than children (33).

Results

Descriptive Results

Patient age.

The age distribution across the entire population of patients seen is depicted in Figure 6, as are the age distributions by gender. The median patient age for all clinic attendees, as depicted in Table 11, was 10 years, with a significant difference (p < 0.0001) between median ages for females (17 years) and males (5 years). Subdivided by village, the median age was significantly different (p < 0.0001) between females and males for Village 1 (F = 23 years, M = 6 years) and Village 3 (F = 12 years, M = 5 years). The median age by gender for Village 2 (F =
24.5 years, M = 18.5 years) was not significantly different than those of Village 1 or Village 3 (p = 0.3036).

Figure 6. Histograms depicting the cumulative age distribution and distribution by gender.
Table 11

Median Age of Patients Seen in Clinic by Location and Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Village 1</th>
<th>Village 2</th>
<th>Village 3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>23 (8, 37.8) b</td>
<td>24.5 (5, 46.8) c</td>
<td>12 (5, 31) d</td>
<td>17 (6, 36) a</td>
</tr>
<tr>
<td>Male</td>
<td>6 (3, 9) b</td>
<td>18.5 (5.3, 53.3) c</td>
<td>5 (2.4, 8) d</td>
<td>5 (3, 10) a</td>
</tr>
<tr>
<td>Total</td>
<td>10 (5, 32)</td>
<td>24.5 (5, 48.5)</td>
<td>8 (3, 26)</td>
<td>10 (4, 32)</td>
</tr>
</tbody>
</table>

Note:
- a Median age by gender significantly different overall (Female = 17, Male = 5, p < 0.0001).
- b Median age by gender significantly different for Village 1 (Female = 23, Male = 6, p < 0.0001).
- c Median age by gender not significantly different for Village 2 (Female = 24.5, Male = 18.5, p = 0.3036).
- d Median age by gender significantly different for Village 3 (Female = 12, Male = 5, p = 0.0067).
- e Median age by location significantly different between Village 1 and Village 2 (V1 = 10, V2 = 24.5, p < 0.0001).
- f Median age by location not significantly different between Village 1 and Village 3 (V1 = 10, V3 = 8, p = 0.2875).
- g Median age by location significantly different between Village 2 and Village 3 (V2 = 24.5, V3 = 8, p < 0.0001).

The median patient age by clinic location, as depicted in Table 11, was significantly different (p < 0.0001) between Village 1 (10 years) and Village 2 (24.5 years), and between Village 2 (24.5 years) and Village 3 (8 years), with p < 0.0001. The difference in median age between Village 1 (10 years) and Village 3 (8 years) was not statistically significant (p = 0.2875).

Patient presenting concerns.

The presenting concerns for patients are illustrated in Table 12. The most prevalent presenting concerns for the population as a whole, across all three clinic locations, age categories, and genders, were cough (43%), headache (32%), parasites (30%), and runny nose (30%). These four complaints were the most common for both children and adults. Presenting concerns and the frequency of concerns among children included cough (41%), headache (33%), runny nose (29%), and parasites (27%). Similarly, among adults, the most prevalent presenting concerns and frequencies were cough (47%), parasites (34%), headache (32%), and runny nose (31%).
The most common presenting concerns at the clinic in Village 1 were cough (44%), parasites (32%), headache (31%), and runny nose (28%). Comparatively, the most frequent concerns presented in Village 2 were cough (47%), headache (34%), runny nose (33%), and sore throat (30%). Finally, in Village 3, the most abundant concerns were cough (42%), headache (32%), runny nose (30%), and parasites (29%).

Table 12

**Prevalence of Gastrointestinal and Constitutional Patient Presenting Concerns**

<table>
<thead>
<tr>
<th>Presenting Concern</th>
<th>Total Prevalence</th>
<th>Prevalence by Clinic Location</th>
<th>Age Category</th>
<th>Village 1</th>
<th>Village 2</th>
<th>Village 3</th>
<th>Total by Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>0.1802</td>
<td></td>
<td>Adult</td>
<td>0.1750</td>
<td>0.2558</td>
<td>0.1918</td>
<td>0.1990</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child</td>
<td>0.1368</td>
<td>0.3030</td>
<td>0.1635</td>
<td>0.1683</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Combined</td>
<td>0.1523</td>
<td>0.2763</td>
<td>0.1724</td>
<td>0.1802</td>
</tr>
<tr>
<td>Vomiting</td>
<td>0.0317</td>
<td></td>
<td>Adult</td>
<td>0.0250</td>
<td>0.0233</td>
<td>0.0411</td>
<td>0.0306</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child</td>
<td>0.0342</td>
<td>0.0000</td>
<td>0.0377</td>
<td>0.0324</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Combined</td>
<td>0.0305</td>
<td>0.0132</td>
<td>0.0388</td>
<td>0.0317</td>
</tr>
<tr>
<td>Parasites</td>
<td>0.299</td>
<td></td>
<td>Adult</td>
<td>0.4125</td>
<td>0.2558</td>
<td>0.3151</td>
<td>0.3418</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child</td>
<td>0.2564</td>
<td>0.2727</td>
<td>0.2830</td>
<td>0.2718</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Combined</td>
<td>0.3198</td>
<td>0.2632</td>
<td>0.2931</td>
<td>0.2990</td>
</tr>
<tr>
<td>Headache</td>
<td>0.3228</td>
<td></td>
<td>Adult</td>
<td>0.3000</td>
<td>0.3256</td>
<td>0.3288</td>
<td>0.3163</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child</td>
<td>0.3248</td>
<td>0.3636</td>
<td>0.3208</td>
<td>0.3269</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Combined</td>
<td>0.3147</td>
<td>0.3421</td>
<td>0.3233</td>
<td>0.3228</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>0.0317</td>
<td></td>
<td>Adult</td>
<td>0.0375</td>
<td>0.0465</td>
<td>0.0274</td>
<td>0.0357</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child</td>
<td>0.0256</td>
<td>0.0303</td>
<td>0.0314</td>
<td>0.0291</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Combined</td>
<td>0.0305</td>
<td>0.0395</td>
<td>0.0302</td>
<td>0.0317</td>
</tr>
<tr>
<td>Pain</td>
<td>0.0614</td>
<td></td>
<td>Adult</td>
<td>0.0625</td>
<td>0.0465</td>
<td>0.0411</td>
<td>0.0510</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Child</td>
<td>0.1282</td>
<td>0.0606</td>
<td>0.0252</td>
<td>0.0680</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Combined</td>
<td>0.1015</td>
<td>0.0526</td>
<td>0.0302</td>
<td>0.0614</td>
</tr>
</tbody>
</table>

**Diagnoses made in clinic.**

The diagnoses made in clinic by the volunteer providers, as well as the corresponding frequencies, are depicted in Table 13. The most prevalent diagnoses made across all patients seen in the three clinic locations were parasites (46%), upper respiratory infection (29%)
headache (9%), and hypertension (5%). Among the childhood population, the most frequent
diagnoses made were parasites (43%), upper respiratory infection (27%), headache (10%), and
allergic rhinitis (5%). Comparatively, among adults, the most abundant diagnoses were parasites
(50%), upper respiratory infection (32%), hypertension (8%), and headache (7%).

The most prevalent diagnoses varied by clinic location. In Village 1, the most frequently
diagnosed entities were parasites (45%), upper respiratory infection (28%), hypertension (8%),
and headache (8%). Comparatively, in Village 2, the most common diagnoses were parasites
(49%), upper respiratory infection (34%), hypertension (8%), acute otitis media (7%), and
headache (7%). Finally, in Village 3, the most abundant diagnoses were parasites (45%), upper
respiratory infection (28%), headache (11%), and allergic rhinitis (4%).

Table 13

*Prevalence of Gastrointestinal Diagnoses Made in Clinic*

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Total Prevalence</th>
<th>Adult</th>
<th>Child</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Gastroenteritis</td>
<td>0.0119</td>
<td>0.0250</td>
<td>0.0000</td>
<td>0.0411</td>
</tr>
<tr>
<td>Gastroesophageal Reflux</td>
<td>0.0158</td>
<td>0.0000</td>
<td>0.0233</td>
<td>0.0137</td>
</tr>
<tr>
<td>Parasites</td>
<td>0.4554</td>
<td>0.5500</td>
<td>0.3846</td>
<td>0.4518</td>
</tr>
<tr>
<td>At Risk / Malnutrition</td>
<td>0.0277</td>
<td>0.0250</td>
<td>0.0171</td>
<td>0.0203</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Prevalence by Clinic Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Village 1</td>
</tr>
<tr>
<td>Acute Gastroenteritis</td>
<td>0.0250</td>
</tr>
<tr>
<td>Gastroesophageal Reflux</td>
<td>0.0000</td>
</tr>
<tr>
<td>Parasites</td>
<td>0.5500</td>
</tr>
<tr>
<td>At Risk / Malnutrition</td>
<td>0.0250</td>
</tr>
</tbody>
</table>

**Treatments Prescribed in Clinic.**

The treatments prescribed in clinic by the volunteer providers, as well as their
corresponding frequencies, are depicted in Table 14. The most prevalent treatments prescribed
over all patients seen were antiparasitic medication (51%), vitamins (37%), analgesics (29%), and antibiotics (15%). Among children, the four most frequently prescribed treatments were the same as those for the total population, and included antiparasitic medication (49%), vitamins (35%), analgesics (31%), and antibiotics (15%). Comparatively, among the adult population, the most frequently prescribed treatments consisted of the same four medications as the entire population, and included antiparasitic medication (53%), vitamins (39%), analgesics (27%), and antibiotics (15%).

The most prevalent treatments prescribed varied by clinic location. In Village 1, the most frequently prescribed treatments were antiparasitic medication (51%), vitamins (32%), analgesics (28%), and topical ointments (12%). Comparatively, in Village 2, the most commonly prescribed treatments were antiparasitic medication (58%), vitamins (47%), analgesics (34%), and antibiotics (18%). Finally, in Village 3, the most abundantly prescribed treatments were antiparasitic medication (47%), vitamins (38%), analgesics (28%), and antibiotics (18%).

Table 14

**Prevalence of Treatments Prescribed in Clinic**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Total Prevalence</th>
<th>Age Category</th>
<th>Village 1</th>
<th>Village 2</th>
<th>Village 3</th>
<th>Total by Age</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Antibiotics</strong></td>
<td>0.1505</td>
<td>Adult</td>
<td>0.1250</td>
<td>0.1860</td>
<td>0.1507</td>
<td>0.1480</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Child</td>
<td>0.0940</td>
<td>0.1818</td>
<td>0.1887</td>
<td>0.1521</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combined</td>
<td>0.1066</td>
<td>0.1842</td>
<td>0.1767</td>
<td>0.1505</td>
</tr>
<tr>
<td><strong>Antiparasitic Medication</strong></td>
<td>0.505</td>
<td>Adult</td>
<td>0.5500</td>
<td>0.5814</td>
<td>0.4795</td>
<td>0.5306</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Child</td>
<td>0.4872</td>
<td>0.5758</td>
<td>0.4717</td>
<td>0.4887</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combined</td>
<td>0.5127</td>
<td>0.5789</td>
<td>0.4741</td>
<td>0.5050</td>
</tr>
<tr>
<td><strong>Analgesic</strong></td>
<td>0.2911</td>
<td>Adult</td>
<td>0.2375</td>
<td>0.3488</td>
<td>0.2466</td>
<td>0.2653</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Child</td>
<td>0.3077</td>
<td>0.3333</td>
<td>0.3019</td>
<td>0.3074</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combined</td>
<td>0.2792</td>
<td>0.3421</td>
<td>0.2845</td>
<td>0.2911</td>
</tr>
<tr>
<td><strong>Vitamins</strong></td>
<td>0.3683</td>
<td>Adult</td>
<td>0.3250</td>
<td>0.4651</td>
<td>0.4247</td>
<td>0.3929</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Child</td>
<td>0.3162</td>
<td>0.4848</td>
<td>0.3522</td>
<td>0.3528</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combined</td>
<td>0.3198</td>
<td>0.4737</td>
<td>0.3750</td>
<td>0.3683</td>
</tr>
</tbody>
</table>
Analytic Results

Prevalence of “parasites” as a presenting concern by patients.

The frequencies of the presenting concern “parasites” are depicted in Table 15 and Figure 7, stratified by age category, gender, and clinic location. Among the entire population of patients seen in clinic, the frequency of the presenting concern “parasites” was 30%. When considered by age category, there existed a marginally significant difference ($p = 0.073$) between the frequencies of this presenting concern, with increased prevalence among adults (35%) compared to children (27%). When grouped by gender, the presenting concern of “parasites” was more common among females (33%) than males (25%). This difference was of marginal significance ($p = 0.052$).

Table 15

<table>
<thead>
<tr>
<th>Village 1</th>
<th>Village 2</th>
<th>Village 3</th>
<th>Gender Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Male</td>
<td>Female Male</td>
</tr>
<tr>
<td>Adult</td>
<td>0.4058</td>
<td>0.2807</td>
<td>0.3492</td>
</tr>
<tr>
<td>Child</td>
<td>0.5455</td>
<td>0.2333</td>
<td>0.2817</td>
</tr>
<tr>
<td>Age Total</td>
<td>0.5000</td>
<td>0.3846</td>
<td>0.5023</td>
</tr>
<tr>
<td>Total</td>
<td>0.5507</td>
<td>0.4351</td>
<td>0.5134</td>
</tr>
</tbody>
</table>

|           | Male      | Male      | Female Male   | By Age       |
|-----------|-----------|-----------|---------------|
| Adult     | 0.5652    | 0.4912    | 0.5317        | 0.5127       |
| Child     | 0.4545    | 0.4833    | 0.4789        | 0.4868       |
| Age Total | 0.5567    | 0.6154    | 0.5385        | 0.5789       |
| Total     | 0.5664    | 0.4844    | 0.5337        | 0.4741       |

Note:

- Difference in prevalence by patient age category is marginally significant (Child = 0.27, Adult = 0.35, $p = 0.073$)
- Difference in prevalence by patient gender is marginally significant (Female = 0.33, Male = 0.25, $p = 0.052$)
- Difference in prevalence by clinic location is not significant (Village 1 = 0.32, Village 2 = 0.26, Village 3 = 0.29, $p = 0.573$, ANOVA model)
- Overall ANOVA corrected model by village not significant with $p = 0.335$, R Squared = 0.025, and adjusted R Squared = 0.003.
- Difference in prevalence by patient age category is not significant (Child = 0.43, Adult = 0.50, $p = 0.11$)
- Difference in prevalence by patient gender is not significant (Female = 0.48, Male = 0.42, $p = 0.187$)
- Difference in prevalence by clinic location is not significant (Village 1 = 0.45, Village 2 = 0.49, Village 3 = 0.45, $p = 0.836$, ANOVA model)
- Overall ANOVA corrected model by village not significant with $p = 0.672$, R Squared = 0.017, and adjusted R Squared = -0.005.
- Difference in prevalence by patient age category is not significant (Child = 0.49, Adult = 0.53, $p = 0.359$)
- Difference in prevalence by patient gender is marginally significant (Female = 0.54, Male = 0.45, $p = 0.066$)
- Difference in prevalence by clinic location is not significant (Village 1 = 0.51, Village 2 = 0.58, Village 3 = 0.47, $p = 0.275$, ANOVA model)
- Overall ANOVA corrected model by village not significant with $p = 0.655$, R Squared = 0.017, adjusted R Squared = -0.005.
When grouped by clinic location, there was no statistically significant difference ($p = 0.573$) in prevalence of the presenting concern “parasites” across Village 1 (32%), Village 2 (26%), and Village 3 (29%). Indeed, the composite ANOVA model of clinic location in relation to the presenting concern of “parasites” explained less than 1% of the variance in frequency across villages (adjusted $R^2 = 0.003$).

Prevalence of “parasites” diagnosis.

The frequencies of the diagnosis of “parasites” made in clinic are depicted in Table 15 and Figure 8, stratified by age category, gender, and clinic location. The differences in frequency were not statistically significant across age category ($p = 0.1100$), gender ($p = 0.1870$), or clinic location ($p = 0.8360$). Among the entire population of patients seen in clinic, the frequency of the diagnosis of “parasites” was 46%. When considered by age category, the
prevalence among adults was 50%, compared to 43% among children. Grouped by gender, the prevalence of the presenting concern “parasites” was 48% among females and 42% among males. When grouped by clinic location, there was no statistically significant difference ($p = 0.836$) in prevalence of the diagnosis of “parasites” among Village 1 (45%), Village 2 (49%), and Village 3 (45%). The composite ANOVA model of clinic location in relation to the diagnosis of “parasites” explained less than 1% of the variance in frequency across villages (adjusted R-squared value of -0.005).

**Figure 8.** Graph of the frequency of “parasites” as a diagnoses made in the clinic by clinic location, patient age, and patient gender. Vertical axis represents frequency.

**Prevalence of antiparasitic treatment prescription.**

The frequencies of the prescription of antiparasitic treatment are depicted in Table 15 and Figure 9, stratified by age category, gender, and clinic location. Among the entire population of patients seen in clinic, the frequency of the prescription of antiparasitic treatment was 51%.
When considered by age category, the difference in antiparasitic prescription rates between children (49%) and adults (53%) was not statistically significant ($p = 0.359$). When grouped by gender, the prescription of antiparasitic medication was more common among females (54%) than males (45%). This difference between females and males was marginally significant ($p = 0.0660$).

![Graph of the frequency of antiparasitic treatments prescription made in the clinic by clinic location, patient age, and patient gender. Vertical axis represents frequency.](image)

Figure 9. Graph of the frequency of antiparasitic treatments prescription made in the clinic by clinic location, patient age, and patient gender. Vertical axis represents frequency.

When grouped by clinic location, there was no statistically significant difference ($p = 0.2750$) in prevalence of antiparasitic treatment prescription across Village 1 (51%), Village 2 (58%), and Village 3 (45%). The ANOVA model evaluating clinic location in relation to antiparasitic treatment prescription explained less than 1% of the variance in frequency across villages (adjusted R-squared value = -0.005).
Discussion

Two foci are central to this analysis of data collected from a short-term medical mission in Paraguay—a general description of the patient population seen in clinic and a more in-depth analysis of the management of intestinal parasites within this patient population. The management of parasitic disease is considered with respect to the rates of “parasite” as a presenting concern, “parasite” as a diagnosis, and antiparasitic treatment prescription. Additionally, the prescription of antiparasitic treatment is examined in light of World Health Organization (2006) recommendations for antiparasitic prophylaxis against soil-transmitted helminthes.

Patient Population

As depicted in Figure 6, the age distribution of the entire population of patients seen (505 individuals) was skewed toward childhood, most markedly under the age of 13 years. Several prominent peaks in the age histogram occur at approximately age 5 years, as well as adults aged 20, 30, and 50 years. As each of the clinics for Villages 1–3 were conducted in out of session schools, it may be of little surprise that children were the most prevalent patient population.

The most marked variance in patient population occurred along lines of patient gender and patient age. The distribution of age in terms of gender points to a male population largely skewed toward childhood ages (median age = 5 years), and a female population less skewed in this direction (median age = 17 years), as shown in Figure 7. This distribution of ages for males indicates a male patient population largely comprising children under the age of 11 years. Comparatively, the distribution of female patients, while still skewed toward younger ages, had substantially more adults, clustered in the 20s, 30s, and 50s. In contrast, there was a dearth of male adults, with only 33 visiting clinics the entire week. Synthesizing this data with anecdotal
experience from the Paraguay STMM, a likely cause for this distribution of ages by gender is the
caregiver – child relationship. Though not analyzed in this study, adult caregivers, typically
female, accompanied the large majority of school-age children. It was rare that a male caregiver
would accompany the children to the clinic. While it seemed that most of the adult males
presented alone, the large majority of adult females presented alongside their children—often in
family groups of up to 8 family members.

These data suggest that the household dynamics in Paraguay are such that the female
caregiver may be responsible for caring for the children to a much greater extent than the male
caregiver, at least during the daytime, when each of the five days of clinic were held.
Additionally, due to the peaks in adult female ages in the 20s, 30s, and 50s, it seems likely that
the female caregivers included both mothers and grandmothers. This distribution of patient age
with a skew toward childhood was evident for Villages 1 and 3, and for the aggregate population.
The fact that the distribution of ages was not as skewed for Village 2 may be due to the small
sample size (n = 76) compared to Village 1 (n = 197) and Village 3 (n = 232).

**Intestinal Parasite Presentation and Diagnosis**

The frequency of patients presenting with a concern for parasites, as well as the
frequency of clinical diagnosis of intestinal parasitism by the volunteer health care providers, are
considered here as proxy measurements of actual disease prevalence within the community. The
complaint of “parasites” was consistently within the top four presenting concerns across the core
sub-groups examined in this study—divided along lines of age, gender, and clinic location—with
30% of all patients presenting to clinic with this as a concern. From the perspective of clinical
diagnosis by the volunteer providers, “parasites” was the most common diagnosis made, with
45.5% of all patients receiving this diagnosis. Taken together, and allowing for these measures
to act as proxy values of the actual prevalence of intestinal parasite disease in the entire sample population, the frequency of “parasites” as a presenting concern and as a diagnosis indicates a possible prevalence between 30% and 46%. These estimates may grossly underestimate the actual prevalence of intestinal parasite disease in the sample population, considering that only 15% of those infected are symptomatic (Albonico et al., 1999).

Although attempting to estimate the prevalence of intestinal parasite disease using such markers as a patient’s concern of having the disease and a health care provider’s clinical suspicion of a disease is far from ideal, these estimates are the best that can be produced from the available data and methods used in chart review. The gold standard for intestinal parasite diagnosis, stool analysis, would offer the most thorough and precise means of estimating the disease prevalence within a given population. No method for estimating the presence and load of intestinal parasites is flawless, however, as the sensitivity of even stool collection and analysis is dependent on the timing of the test in regard to the laying of eggs by the female parasites while in the host, leading to potential false negatives when there is a paucity of egg-laying activity (Cho & Kang, 1975; Yang, Kim, Jung, Huh, & Lee, 1997).

Relative to the global prevalence of ascaris lumbricoides (25%) and trichuris trichiura (18%), the estimated combined prevalence of intestinal parasite disease in the patient population examined herein—30% to 46%—may indicate a higher-than-average prevalence of intestinal parasites relative to the aggregate world population. Prevalence estimates more regionally specific for Latin America are sparse, with most of the existing literature reporting on the childhood population. Compared to a prevalence of 91% for ascaris and 82% for trichuris among Guatemalan school children (Watkins et al., 1996), the composite prevalence range found in this study (30% to 46%) is markedly lower. The values derived in this study specific for the
PARASITES IN PARAGUAY

childhood population—27% to 43%—less than half the prevalence reported by Watkins et al. (1996) among Guatemalan school children.

**Age category.**

Subdivided by age category (child of less than 18 years versus adult of 18 years or more), the marginally significant \( p = 0.0730 \) difference in the prevalence of a “parasite” presenting concern (35% for adults versus 27% for children) is not what might be expected when the highest prevalence of intestinal parasites by age in the literature is found among school age children (Awasthi et al., 2008; Bundy, 1994; Watkins et al., 1996). In contrast, when examining the frequency of the diagnosis of intestinal parasitism made by the clinic providers, there was not a statistically significant difference between child and adult populations. As the prevalence of intestinal parasitism is expected to peak in childhood, this is not the expected outcome.

As the prevalence of the presenting concern “parasites” and the diagnosis of “parasites” by the volunteer providers in clinic serve merely as proxy estimations of the actual prevalence within this patient sample, any statistically significant difference seen in the groups may be due to factors other than the main independent variables examined—age, gender, and clinic location. Possible confounding factors that could cause the observed prevalence outcomes with respect to age to be different than what would be expected based upon the literature may include hidden cases among the childhood age category, or the difficulty of parsing a child’s presenting concerns compared to those of an adult. In many clinical encounters, the caregiver acted as the presenter of the child’s concerns, which may have hampered an accurate presentation of the actual biological or pathological experience of the child from being presented in full.
Gender.

Females more frequently presented with the concern of parasitism than males, a difference that was statistically significant. In contrast, the difference in the rate of parasite diagnosis between males and females was not significant. Taken as a marker or proxy estimation of the actual parasite prevalence in the patient sample, the greater prevalence of presenting with “parasites” among females versus males may be due to the gender roles within the home and the relation of adults to children in the caregiver setting. The prevalence and intensity of intestinal parasite infection is highest among school age children (Bundy, 1994) and that the environmental, hygiene, and sanitation structure in the immediate vicinity of a home has a strong relationship to the risk of infection (Hagel & Giusti, 2010; Haswell-Elkins et al., 1989; Holland et al., 1988; Hotez et al., 2004). The increased concern for parasite infection among female versus male patients may be attributed to female caregivers being traditionally involved in childcare and domestic work close to home, with increased exposure to infectious parasitic eggs via their children as hosts and in communities lacking proper sanitation infrastructure. In the population of patients seen during this STMM, it seemed apparent that females spent more time with the children and around the home, and, hence, may be more likely to be infected due to these environmental and sociological factors.

Clinic location.

There was no statistically significant difference in the frequency of presenting concern of parasites or the clinical diagnosis of parasites across the three clinic locations. The finding of similar frequencies of presentation and diagnosis among the three villages may be expected, as all three are located within the Capital District are less than 20 miles apart, and are of low socio-economic standing, therefore representing a relatively homogenous patient sample. While
Village 2 stood out, anecdotally, as rather different from Village 1 and Village 3 due to cultural, language, and economic differences, there were no statistically significant differences in intestinal parasite prevalence by location. There may be a veiled difference among the population in Village 2 that is not statistically clear due to the relatively small sample size (n=76) compared to Village 1 (n=197) and Village 3 (n=232).

**Prescription of Antiparasitic Treatment**

The central question in this analysis, regarding antiparasitic treatment, was whether the prevalence of intestinal parasite disease among the Paraguayan patient population seen in clinic during the STMM falls within a risk group that merits medical prophylaxis as defined by the World Health Organization (2006). Secondarily, given this risk-stratified recommendation regarding medical treatment and prophylaxis against intestinal parasites, it is of interest to consider the frequency of antiparasitic medication prescription in clinic and whether the approach to prescription matched the standards of the recommendations for prophylaxis from the World Health Organization (2006).

The World Health Organization’s (2006) risk stratification is based upon intestinal parasite prevalence thresholds of 20% (low-risk group) and 50% (high-risk group)—both of which merit administration of antiparasitic medication, albeit at different frequencies. High-risk communities (those with a prevalence of greater than 50%) merit twice-yearly administration of antiparasitic medication to school age children, while low-risk communities, those with a prevalence between 20% and 50%, merit once-yearly treatment. Additionally, preschool children, women of childbearing age, lactating women, and pregnant women in the second or third trimester who live in low-risk or high-risk communities should be treated. Broad
antiparasitic medication campaigns are not recommended for communities outside of these risk-stratification recommendations (communities with a prevalence less than 20%) WHO, 2006).

**Antiparasitic administration as prophylaxis.**

If the clinical and public health approach taken by the Paraguay STMM matched the threshold of recommended antiparasitic prophylaxis, despite being prescribed based on newly diagnosed instances of parasitic disease, all children seen in clinic over the age of one year, as well as all women of childbearing age, excluding those in the first trimester of pregnancy, were indicated for administration of antiparasitic medication, in light of the recommendations from the World Health Organization (2006) and the post facto intestinal parasite prevalence estimations of 30% to 46%. This group of individuals indicated for antiparasitic prophylaxis accounts for 78% of the entire population seen in the five days of clinic, as depicted in Table 16. Of those individuals indicated for prophylaxis, only 48% were actually given medication. Conversely, 22% of all individuals seen fell outside of the recommendation criteria for prophylaxis, largely due to being adult males, women outside of childbearing age, or pregnant females. While the World Health Organization recommendation (2006) is that pregnant women in the first trimester not receive antiparasitic medication, all pregnant women were excluded from receiving medication during this STMM, regardless of trimester. For the overall population of those not indicated for prophylactic medication, 60% received treatment regardless—a higher proportion than those that were actually indicated for prophylactic administration (60% versus 48%).
Table 16

*Prophylaxis or Treatment – Percent of Patients Seen Indicated for and Receiving Antiparasitic Medication*

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>To Receive Antiparasitic Medication</th>
<th>To Not Receive Antiparasitic Medication</th>
<th>To Receive Antiparasitic Medication and Did</th>
<th>To Not Receive Antiparasitic Medication but Did</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>If Medication Given as Prophylaxis</strong>&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.7982</td>
<td>0.2018</td>
<td>0.5019</td>
<td>0.6667</td>
</tr>
<tr>
<td>Male</td>
<td>0.7528</td>
<td>0.2472</td>
<td>0.4254</td>
<td>0.5227</td>
</tr>
<tr>
<td>Combined</td>
<td>0.7822</td>
<td>0.2178</td>
<td>0.4759</td>
<td>0.6091</td>
</tr>
<tr>
<td><strong>If Medication Given as Treatment</strong>&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.4771</td>
<td>0.5229</td>
<td>0.9038</td>
<td>0.1988</td>
</tr>
<tr>
<td>Male</td>
<td>0.4157</td>
<td>0.5843</td>
<td>0.8378</td>
<td>0.1731</td>
</tr>
<tr>
<td>Total</td>
<td>0.4554</td>
<td>0.5446</td>
<td>0.8826</td>
<td>0.1891</td>
</tr>
<tr>
<td><strong>Composite Medication as Prophylaxis or Treatment</strong>&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.9205</td>
<td>0.0795</td>
<td>0.5548</td>
<td>0.3077</td>
</tr>
<tr>
<td>Male</td>
<td>0.8652</td>
<td>0.1348</td>
<td>0.4740</td>
<td>0.2917</td>
</tr>
<tr>
<td>Total</td>
<td>0.9010</td>
<td>0.0990</td>
<td>0.5275</td>
<td>0.3000</td>
</tr>
</tbody>
</table>

*Note:*

<sup>a</sup> If medication administration viewed as a broad prophylactic campaign and not treatment of existing disease diagnosis. Recommendation criteria for prophylaxis based on World Health Organization (2006) protocol.

<sup>b</sup> If medication administration viewed as treatment of existing disease diagnosis and not a broad prophylactic campaign. Recommendation criteria for treatment based on positive clinical diagnosis of intestinal parasitism.

<sup>c</sup> If medication administration viewed as *either* a broad prophylactic campaign or treatment of existing disease diagnosis, a composite of<sup>a</sup> and<sup>b</sup>.

**Antiparasitic administration as treatment of newly diagnosed parasitism.**

The cause of such discordance with respect to the application of the prophylactic recommendations—leaving more than half of those indicated for prophylaxis untreated—while potentially due to improper application of the recommendations, is most likely due to a different set of clinical drivers influencing prescribing behavior among the providers. This second prescribing ideology, depicted in the second row of data in Table 16, is based upon the clinical diagnosis of intestinal parasite disease and the prescription of antiparasitic medication as a means of treatment, not prophylaxis—hence the discordance between those indicated to receive
medication per the World Health Organization (2006) prophylaxis guidelines and the percent that was actually given the medication.

This difference is apparent when considering the indication for the administration of antiparasitic medication as a diagnosis of parasitism, as opposed to falling within a risk category for prophylactic administration. Nearly 46% of all individuals seen in clinic were diagnosed with intestinal parasites, with 88% actually receiving treatment—a more appropriate coverage rate of those indicated for treatment compared to the 48% that were properly given medication if the goal for administration were prophylaxis. Consideration of the prescription of antiparasitic medication during the Paraguay STMM in light of these two approaches—prophylactic administration of medication to at-risk populations versus treating only those with diagnosed disease—it seems apparent that the volunteer providers favored administration of medication based on diagnosed disease, not upon a broader, public health-oriented treatment campaign.

It is worthwhile to consider these antiparasitic administration approaches in composite, examining the population that merits administration for either prophylaxis or treatment—i.e. all of those patients seen that were indicated for antiparasitic medication, regardless of approach (prophylaxis or treatment). Of all patients seen, 90% were indicated to receive antiparasitic medication, either because they fell within the World Health Organization recommendations for prophylaxis, or because they were diagnosed with intestinal parasitism in clinic. However, of this composite group indicated for medication administration, only 53% received albendazole or mebendazole.

Consideration of the prescription of antiparasitic medication during the Paraguay STMM in light of these two approaches—prophylactic administration of medication to at-risk populations versus treating only those with diagnosed disease—it seems apparent that the
volunteer providers favored administration of medication based on diagnosed disease, not upon a broader, public health oriented treatment campaign. While more analysis of this finding is merited, both to confirm statistical relevance and to examine provider decision making in a more in-depth, thorough manner, it is worth highlighting possible reasons that the administration of antiparasitic medication during the Paraguay STMM was employed in a disease-treating manner as opposed to a public health minded, prophylactic and preventive manner to address a broader portion of the population.

As there is a dearth of prevalence data for neglected tropical diseases in Paraguay, and Latin America in general, one may consider it difficult to plan a broad-based campaign to administer antiparasitic prophylaxis aligned with the World Health Organizations recommendations without availability of the relevant disease prevalences needed for risk stratification prior to a STMM. While such estimates have been derived in this analysis, this is a post facto examination of patient presenting concerns and clinical management seen on the ground, and nothing of this sort was conducted prior to the STMM in Paraguay to assess the rates of disease and resultant need for management, largely due to the logistic and monetary impracticality of such an additional endeavor. This fact, as well as potential supply constraints regarding the availability of antiparasitic medication in the STMM may be causes for parasitic management that is more disease-treatment oriented than preventive or prophylactic.

**Conclusion**

The patient population attended to over the five days of the Paraguay STMM clinic was skewed toward school age children of both genders, as well as females of childbearing age, likely representing caregivers of the children visiting clinic. There was a dearth of adult males presenting to clinic, both individually and as caregivers of children. These descriptive findings
are exemplified by the median patient age by gender—17 years for females and 5 years for males.

Patients most commonly noted health concerns of headache, fevers, cold symptoms, and parasite infection, leading to common diagnoses by the volunteer healthcare providers of parasite infection, viral illness (common cold) and migraine headaches. Individuals seen in clinic were most commonly prescribed antiparasitic medication, vitamins, analgesics (i.e. acetaminophen, ibuprofen), and antibiotics.

Nearly one-third of all patients seen in clinic presented with a concern for intestinal parasite infection, with significantly higher prevalences for adults versus children and females versus males, with no notable difference by clinic location. The higher prevalence of parasitism as a presenting concern among adults versus children is opposite to what is expected when considered in light of the literature, which indicates higher reported parasite prevalence among children. This difference is possibly due to the inability of children to voice their concerns or ailments compared to the ability of the adult population. The increased concern for parasite infection among female versus male patients may be attributed to female caregivers being traditionally involved in childcare and domestic work close to home, with increased exposure to infectious parasitic eggs via their children as hosts and in communities lacking proper sanitation infrastructure.

Of note, there was no significant difference in the frequency of the diagnoses of “parasites” by gender, age category, or clinic location, with nearly half of all patients diagnosed with parasites in clinic.

The administration of antiparasitic medication—albendazole or mebendazole—was more frequent among female versus male patients, though this difference was not significant among
stratification by age category or by clinic location. This may reflect a preference by the
providers toward treating women before men, due to a limited supply of antiparasitic medication.
While there are many possible reasons for this preference, it may be that the children and women
were viewed as more marginalized and had less resources than male members of the population.

Central to this analysis of intestinal parasite management is the question of how one
prioritizes and administers a limited supply of antiparasitic medication. There have been two
general approached discussed—one based upon broad, mass, prophylactic administration to
nearly all individuals within a community, the other a case-based administration to only those
currently infected. The observation that, of those eligible for prophylactic treatment, only half
received the antiparasitic medication indicates that the providers may have been approaching the
matter of intestinal parasitism from a case-based, clinical standpoint, as opposed to a broader,
public-health-oriented approach of prophylactic management. This case-based, clinical approach
to administering the antiparasitic medication is highlighted by the finding that nearly 90% of
those diagnosed with intestinal parasites received treatment, a stark difference compared to the
48% of those indicated for prophylaxis that received treatment. This variance merits further
evaluation and examination of significance, as it likely points toward key differences of approach
between a clinical, shortsighted approach to patient care and a more longitudinal, public-health­
oriented, prophylactic approach to disease management.

As the long-term effectiveness of a campaign against ascaris lumbricoides and trichuris
trichiura, and indeed most of the neglected tropical diseases, is dependent upon a multifaceted
approach to prevention, treatment, and eradication, continued efforts to address these diseases
and reduce the subsequent morbidity must consist of multidisciplinary action. This multifaceted
approach must be aimed at the development of improved sanitation and water infrastructure,
improved education to enhance the understanding of disease-causing behavior, and correct application of broad-based antiparasitic treatment protocols aimed at the proper and most vulnerable subpopulations.

Aiming for the future improvement of the prevention, treatment, and eradication of these neglected diseases necessitates a long-term approach to engaging those affected, as well as the current healthcare infrastructure in those nations. This requisite approach to success may negate any possibility for success or progress from a STMM that visits a new nation every year, providing one round of antiparasitic treatment to populations that likely require multiple rounds of treatment yearly, as well as drastic changes in water and sanitation structure for any improvement in long-term health outcomes.

Potential improvements to the model used when the data for this analysis was collected include the addition of a multi-year cycle of trips and commitment to a given locale, as opposed to a one-year cycle with a new location each trip. This format of engaging the community may allow for a more intentional, long-term approach to community health. This multi-year cycle may consist of new stage each year, including: 1) assessment and consultation alongside local, native health workers, 2) implementation of community-targeted interventions consisting of medical attention, public health education, and health infrastructure foci, and 3) outcomes evaluation and improvement of interventions. With this longitudinal, community-minded approach to engaging a cross-cultural setting as an outsider and guest, one may have the opportunity to apply clinical and community health skills in a directed and intentional manner, with the aim of improving health outcomes related to intestinal parasitism, and global infectious disease in general.
References


Appendix A: Patient History & Physical Form

**HISTORY & PHYSICAL EXAMINATION/Historia Medica y Reconocimiento**

<table>
<thead>
<tr>
<th>Date/Fecha</th>
<th>Location/Ubicación</th>
<th>DOB/Fecha de nacimiento</th>
<th>Age/Edad</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name/Nombre</th>
<th>Community/Barrio</th>
<th>Phone/Telefoné</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight/Peso</th>
<th>Temp</th>
<th>HR</th>
<th>BP/presión sanguínea</th>
<th>Resp</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pregnant/Embarazada</th>
<th>Yes/No</th>
<th>Nursing/Amamantando</th>
<th>Yes/No</th>
<th>LMP/menstruación mas reciente</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- P = Parteras, P=partos > 20 semanas, A=abortos natural o provocado, L=nacido vivo

**Chief complaint/queja:**
- Fever/Fiebre
- Cough/Tos
- Runny Nose/Fluo nasal
- Sore Throat/Dolor de garganta
- Headache/Dolor de cabeza
- Tooth/Toothache
- Vomiting/Vomito
- Diarrhea/Diarrrea
- GU/Gesitosmíntico
- Parasites/Parásitos
- Skin Problems/Problemas de la piel
- Other/Otra

**Medications/Medicaciones:**
- Name/Nombre
- NKDA/Ninguna

**PHYSICAL EXAM (pertinent) /Reconocimiento Médico**

<table>
<thead>
<tr>
<th>ASSESSMENT (circle if) / Evaluación</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age/diabetes Glaucoma/glaucoma</td>
</tr>
<tr>
<td>Gastrectomy/gastro</td>
</tr>
<tr>
<td>Reflux: Acid Reflux</td>
</tr>
<tr>
<td>Parasites</td>
</tr>
<tr>
<td>Otitis Media Aguda</td>
</tr>
<tr>
<td>At risk/malnutrition</td>
</tr>
</tbody>
</table>

**PLAN**
- Vitamins kids/adult
- Ibuprofen/Tylenol/Ester
- Flagyl/Metronidazole
- Amoxicillin/Antacid
- Cipro/Ciprofloxacin
- Peptic/Antacid
- Other

- Vaccinations needed / given:
- Classes needed / given:

**Return to clinic**
- Regresar ala clínica

**Referral**
- Referencia

**Signature**
- Firma
Appendix B: IRB Exempt Study Approval

Office of Research and Sponsored Programs
2011 University Hall
3640 Col. Glenn Hwy.
Dayton, OH 45435-0001
(937) 775-2425
(937) 775-3781 (FAX)
e-mail: rsp@wright.edu

DATE: August 2, 2012

TO: Robert A. Eick, MD/MPH Candidate
    Center for Global Health
    Nikki Rogers, PhD, Fac. Adv.
    Center for Global Health

FROM: B. Laurel Elder, Chair
      WSU Institutional Review Board

SUBJECT: SC# 4857

'Assessment of a Short-Term Medical Clinic in Paraguay, South America'

At the recommendation of the IRB Chair, your study referenced above has been
recommended for exemption. Please note that any change in the protocol must be
approved by the IRB; otherwise approval is terminated.

This action will be referred to the Full Institutional Review Board for ratification at
their next scheduled meeting.

NOTE: This approval will automatically terminate two (2) years after the above
date unless you submit a "continuing review" request (see http://www.wright.edu/rsp/IRB/CR_sc.doc) to RSP. You will not receive a notice from the IRB Office.

If you have any questions or require additional information, please call Robyn Wilks,
IRB Coordinator at 775-4462.

Thank you!

Enclosure
## Appendix C: List of Tier 1 Core Public Health Competencies Met

**Domain #1: Analytic/Assessment**
- Identify the health status of populations and their related determinants of health and illness (e.g., factors contributing to health promotion and disease prevention, the quality, availability and use of health services)
- Describe the characteristics of a population-based health problem (e.g., equity, social determinants, environment)
- Use variables that measure public health conditions
- Use methods and instruments for collecting valid and reliable quantitative and qualitative data
- Identify sources of public health data and information
- Recognize the integrity and comparability of data
- Identify gaps in data sources
- Adhere to ethical principles in the collection, maintenance, use, and dissemination of data and information
- Describe the public health applications of quantitative and qualitative data
- Collect quantitative and qualitative community data (e.g., risks and benefits to the community, health and resource needs)
- Use information technology to collect, store, and retrieve data
- Describe how data are used to address scientific, political, ethical, and social public health issues

**Domain #2: Policy Development and Program Planning**
- Gather information relevant to specific public health policy issues

**Domain #3: Communication**
- Identify the health literacy of populations served
- Solicit community-based input from individuals and organizations
- Participate in the development of demographic, statistical, programmatic and scientific presentations

**Domain #4: Cultural Competency**
- Recognize the role of cultural, social, and behavioral factors in the accessibility, availability, acceptability and delivery of public health services
- Respond to diverse needs that are the result of cultural differences
- Describe the need for a diverse public health workforce

**Domain #5: Community Dimensions of Practice**
- Recognize community linkages and relationships among multiple factors (or determinants) affecting health (e.g., The Socio-Ecological Model)
- Describe the role of governmental and non-governmental organizations in the delivery of community health services

**Domain #6: Public Health Sciences**
- Describe the scientific evidence related to a public health issue, concern, or, intervention
- Retrieve scientific evidence from a variety of text and electronic sources
- Discuss the limitations of research findings (e.g., limitations of data sources, importance of observations and interrelationships)
- Describe the laws, regulations, policies and procedures for the ethical conduct of research (e.g., patient confidentiality, human subject processes)

**Domain #7: Financial Planning and Management**
- Report program performance

**Domain #8: Leadership and Systems Thinking**
- Incorporate ethical standards of practice as the basis of all interactions with organizations, communities, and individuals
- Identify internal and external problems that may affect the delivery of Essential Public Health Services
- Use individual, team and organizational learning opportunities for personal and professional development