



Worms and WASH(ED) – Nicaragua –

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A case study on control of intestinal worms in youth populations

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Introduction

Soil transmitted helminths (STHs), most commonly known as intestinal worms, affect several hundred million children worldwide, inhibiting physical and cognitive development, causing disabling illness and limiting opportunities for generations of children to lead productive livelihoods and escape inter-generational cycles of disease and poverty. As three of the most common neglected tropical diseases (NTDs) – a group of 13 debilitating parasitic and bacterial infections that affect over one billion people living in poverty worldwide – STH infections (*Ascaris lumbricoides*, *Trichuris trichiura* and the hookworms) most acutely affect populations in the Americas, in addition to sub-Saharan Africa and East Asia. In past decades, intestinal worm infections that result in a high burden of morbidity have come on the radar of international development actors, with several international health and development organizations taking up the cause to control these diseases. Even more telling, the control and elimination of NTDs – have become increasingly high-priorities for many governments seeking to end the public health burden of these diseases and improve the health and socio-economic status of their populations. There are, however, still many unanswered questions regarding the most effective approaches and strategies for control and elimination, of these diseases. Many programmatic, operational and policy lessons can be learned from countries and regions where large-scale deworming activities are taking place.

In Latin America and the Caribbean, a number of governments have taken measures to address the problem of childhood intestinal worms. Despite varying degrees of action, some national health programs have developed strategies to simultaneously treat the disease itself and some of the root causes of STH. One such country is Nicaragua, where the country's ongoing efforts to control intestinal worm infections in school-aged children leverage the existing national immunization program infrastructure to distribute deworming medication. This report systematically documents Nicaragua's experience with STH control and integration with water, sanitation and hygiene education (WASH) interventions. The case study aims to explore lessons learned and to identify best practices for achieving long-term control through an integrated, cross-sectoral approach. The lessons drawn from Nicaragua's policies on and practices with STH control could be used to inform future control efforts in Nicaragua and in other Latin American countries seeking to reach regional targets on long term control of worm infections, and in turn, mitigate their devastating effects on childhood development.

Methodology

Grounded in a case study approach, the information in this report is largely informed by semi-structured interviews with NTD control experts and STH control stakeholders at the local, regional and international level. After conducting a stakeholder analysis exercise to map and identify the key actors involved in STH control in Nicaragua and the Latin America and Caribbean (LAC) region, key stakeholder interviews were conducted by a two-person, student research team. Due to time constraints and schedule conflicts, not every stakeholder perspective was ultimately included in this case study. Interview guides and a standardized set of research questions were designed to elicit a multi-stakeholder perspective on the successes and challenges inherent to STH control, both in Nicaragua and more broadly in the region. After completing the data collection, interview notes were compiled and synthesized to identify the key policies and practices that constitute Nicaragua's core activities around STH control. As both student researchers took interview notes, inconsistencies were revisited with respondents when necessary.

Partners for Solutions in Nicaragua - A stakeholder analysis

Partners for social development, including health and more specifically the control and elimination of NTDs in the Americas, play a significant role in Nicaragua's efforts to treatment of intestinal worm infections in school-aged children and prevention through water, sanitation, and hygiene education.

In its capacity as the Regional Office for the World Health Organization (WHO) in the Americas, the **Pan-American Health Organization (PAHO)** actively promotes and supports countries in Latin America and the Caribbean, including Nicaragua, in improving population health. In September 2009, PAHO Member states approved Resolution CD49.R19: Elimination Of Neglected Diseases And Other Poverty-Related Infections, which outlined the regional commitment to control intestinal worm (STH) and schistosomiasis infections and eliminate lymphatic filariasis, onchocerciasis and trachoma by 2015. PAHO provides technical assistance to countries around the development of national NTD control plans, capacity building, and strategies to prevent, control and eliminate NTDs, as well as facilitating cooperation and partnership between countries in the region

Another partner supporting control and elimination efforts in Latin America and the Caribbean is the **Global Network for Neglected Tropical Diseases (Global Network)**, an advocacy and resource mobilization organization that works with technical agencies, governments and donors to advocate, catalyze and mobilize awareness and needed resources for control and elimination of these debilitating diseases. The Global Network, **the Inter-American Development Bank (IDB)**, and PAHO have launched **the Latin America and Caribbean (LAC) NTD Initiative**, a partnership to address the devastating consequences of NTDs across the Americas. The partnership between these three regional actors is designed to help develop a regional NTD agenda, identify priorities for disease control, increase awareness about NTDs and their devastating impact on the region and mobilize resources for comprehensive NTD control and prevention throughout Latin America and the Caribbean. Leveraging IDB's financial and oversight capabilities, PAHO's technical expertise, and the Global Network's advocacy and fundraising resources, the LAC NTD Initiative has created an innovative, pooled fund that will address the treatment gap for children and adults affected by NTDs across the region.

In Nicaragua, regional organizations as well as domestic and international actors including the **Ministry of Health, Ministry of Education, Ministry of Finance, NicaSalud, international non-governmental organizations (NGOs) and faith-based organizations (FBOs)** and the **Empresa Nicaragüense de Acueductos y Alcantarillados (ENACAL)** collaborate to control and prevent intestinal worm infections through water, sanitation, hygiene education and deworming (WASH (ED)) strategies. Nicaragua has made significant strides in providing preventive chemotherapy against parasitic worm infections with the support of these organizations, key cross-sectoral agencies and **Children Without Worms**, a partnership between Johnson & Johnson and the Task Force for Global Health (Task Force).

Children Without Worms

About the Capstone Sponsor

Children Without Worms, a public-private partnership between the Task Force for Global Health and Johnson & Johnson, partners with governments throughout Africa, Asia and Latin America to provide deworming treatment for school-aged children, and break the cycle of disease. Children Without Worms is housed within The Task Force for Global Health (Task Force), a 501(c)3 non-profit organization based in Decatur, Georgia that works to address domestic and global health problems including polio eradication, elimination of onchocerciasis, trachoma and lymphatic filariasis and ensure the well-being of children. Johnson & Johnson, founded in 1886, is an American pharmaceutical, medical devices and consumer packaged goods manufacturer. The partnership between these two organizations has resulted in annual treatment of more than 20 million children in eight countries in 2010: Bangladesh, Cambodia, Cameroon, Cape Verde, Lao PDR, Nicaragua, Uganda and Zambia, receiving mebendazole, and increased efforts to address the root causes of intestinal worm through

- **Water** - Access to potable water minimizes reinfection.
- **Sanitation** - Sanitary latrines minimize the risk of infection and re-infection
- **Hygiene Education** - Hygiene education promotes positive behavior change that supports reduced risk of STH infection
- **Deworming** - Deworming with mebendazole kills intestinal worms in infected individuals (Children Without Worms)

In Nicaragua, Children Without Worms supports the Johnson & Johnson mebendazole donations to the Ministry of Health's Expanded Program for Immunization (EPI) in order to treat intestinal worm infections in school-aged children, and partners with the Ministry of Health to catalyze efforts to improve the children's access to clean water, sanitation and hygiene education.

Children Without Worms has generously provided guidance support for this case study.

Children Without Worms joins a group of pharmaceutical companies that provide access to life-improving and -saving drugs through donation programs that support global efforts to control and eliminate the most common NTDS. As this case study will document, there are critical lessons to learn from Children Without Worms' partnership with Nicaragua's Ministry of Health, and the country's approach to treatment and prevention of intestinal worm infections. The combination of drug donation programs, increased coordination of actors, strong community buy-in and high level political commitments for intestinal worm infection control can result in significant health gains for youth populations.

DISEASE	APPROACH	TREATMENT	DRUG DONATION PARTNERS
Lymphatic filariasis (where onchocerciasis is co-endemic)	Elimination	IVM according to height plus ALB 400mg	Mectizan® (ivermectin) is donated by Merck & Co., Inc for lymphatic filariasis elimination and onchocerciasis control
Lymphatic filariasis (where onchocerciasis is not co-endemic)	Elimination	DEC 6 mg/kg (using age as criterion for dose) plus ALB 400mg	Albendazole donated by GlaxoSmithKline for lymphatic filariasis elimination
Onchocerciasis	Control	IVM according to height	Mectizan® (ivermectin) is donated by Merck & Co., Inc for lymphatic filariasis elimination and onchocerciasis control
Schistosomiasis	Control	PZQ 40mg/kg	Cesol® 600 (praziquantel) is donated by Merck KGaA for treatment of schistosomiasis
Soil transmitted helminthiasis	Control	ALB 400mg or MBD 500 mg	Mebendazole donated by Johnson & Johnson Pharmaceutical for soil-transmitted helminthiasis control
Trachoma	Elimination	Azithromycin 20mg/kg max 1g in adults	Zithromax® donated by Pfizer for global, trachoma control

Neglected Tropical Diseases:

A problem globally and in the Americas

Neglected Tropical Diseases (NTDs) are a group of 13 parasitic and bacterial infections that disable and disfigure hundreds of millions worldwide. These diseases are not only associated with social stigma, but also cause an estimated 534,000 deaths per year with a disease burden similar to two of the “Big Three” – HIV/AIDS, Malaria and Tuberculosis.ⁱ Seven of the most common NTDs, onchocerciasis, lymphatic filariasis, trachoma, schistosomiasis, and the three most common intestinal worm infections – hookworm, roundworm and whipworm – account for roughly ninety percent of the global burden of NTDs.^{iiiiiv} These diseases reinforce an intergenerational cycle of poverty, causing severe morbidity that both drastically limits economic productivity and reduces quality of life.^v NTDs not only contribute to poverty in nearly all of the 58 countries that are home to the bottom billion,^{vi} but ultimately keep the 1.4 billion^{vii} who live in extreme poverty trapped in a cycle of disease, poverty and despair. Across Asia, Africa and Latin America, the health and social welfare of populations with poor access to potable water and sanitation, and sub-standard living environments^{viii} are significantly impacted by the disabling, disfiguring and chronic effects of NTDs, resulting in lower productivity and decreased economic opportunity.^{ix}

Of the 556 million people living in Latin America and the Caribbean, approximately 40 percent live below the poverty line – 47 million live on less than US\$1 dollar per day – and one third of the 213 million impoverished live in rural poverty while the remaining two thirds live in urban and peri-urban poverty where unsafe water, poor sanitation and rodent and vector reservoirs are often the norm.^x In Latin America and the Caribbean, NTDs are usually found in areas of extreme poverty where vulnerable and marginalized populations reside, including indigenous communities and Afro-descendant groups.^{xi} It is estimated that in the region, the high burden of these parasitic and bacterial infections are tied to limited access to clean water, quality housing, sanitation, healthcare and treatment, and education.^{xii} Widespread endemicity of

Neglected Tropical Diseases

a group of 13 debilitating parasitic and bacterial infections that affect over one billion people living in poverty worldwide:

Lymphatic Filariasis: also known as elephantiasis, affects more than 120 million people in 80 countries worldwide,

Onchocerciasis: commonly referred to as river blindness, the disease infects 37 million people living near the rivers and fast-moving streams of sub-Saharan Africa

Schistosomiasis: also known as bilharzia or “snail fever”, is a parasitic disease carried by fresh water snails infected with one of the five varieties of the parasite *Schistosoma*.

Trachoma: an infectious disease of the eye caused by the bacterium *Chlamydia trachomatis*, and is the world’s leading cause of preventable blindness.

Soil-transmitted Helminths

- **Ascariasis:** most commonly known as roundworm, is an intestinal infection caused by the parasitic worm *Ascaris lumbricoides*,
- **Trichuriasis:** an infection of the large intestine caused by the human whipworm (*Trichuris trichiura*).
- **Hookworm:** most commonly found in tropical and subtropical climates worldwide, particularly in Africa and Latin America, hookworm is a parasitic infection caused by *Ancylostoma duodenale* and *Necator americanus*

Buruli ulcer (Bairnsdale ulcer): caused by the bacterium *Mycobacterium ulcerans*. Most common in the developing world with severe infection causing diffuse swelling of a limb, sometimes with fever.

Dengue / Dengue Hemorrhagic Fever (DHF): common in tropical and sub-tropical areas, and caused by four closely-related virus serotypes of the *Flavivirus* family, which are transmitted to humans by infected mosquitoes. Symptoms include severe headaches, fever, joint and muscle pain, and a characteristic rash.

Dracunculiasis (guinea worm): caused by the parasitic worm (nematode) *Dracunculus medinensis*, this disease is transmitted through ingestion of stagnant water that is contaminated with guinea worm larvae. Guinea worm may be the first NTD to be eradicated.

Human African trypanosomiasis (African sleeping sickness): transmitted by the tsetse fly, this parasitic disease is caused by protozoa of the *Trypanosoma* genus of the *Trypanosomatidae* class. Endemic in approximately 36 countries, if left untreated the disease is fatal in 100percent of cases.

Leishmaniasis: caused by protozoan parasites of the genus *Leishmania* and transmitted via the bite of certain species of sand fly. The most severe form of the disease, visceral leishmaniasis, occurs when the parasites have migrated to the body’s vital organs.

Leprosy: a chronic disease caused by the bacterium *Mycobacterium leprae*. Left untreated, the disease can result in permanent damage to the skin, nerves, limbs, and eyes.

Source: Adapted from the Global Network for NTDs, 2011

intestinal worms, Chagas and dengue results in these diseases having the highest burden in the region^{xiii}. In fact, of the NTDs present in the region, intestinal worms, which affect 600-800 million globally^{xiv}, are the most prevalent, along with Chagas, and lead with the highest estimated NTD burden.^{xv}

The number of people infected with intestinal worms in the region is currently estimated to be 99 million for trichuriasis, 82 million for ascariasis and 34 million for hookworm.^{xvi} PAHO estimates that 26.3 million school-age children are at risk for intestinal infections in Latin America and the Caribbean^{xvii}. The transmission of these diseases is closely linked to sanitation and hygiene as eggs, which are unknowingly ingested by a human host, are passed in human feces, and picked up by others in settings with poor hand-washing and sanitation. Once ingested, the eggs hatch into larvae that either feed off the human host or attach to intestinal lining, living off the blood of the host.^{xviii} In children, intestinal worm infections are associated with poor education outcomes, particularly performance and attendance, low productivity and decreased future wage earning capacity in the long term.^{xix}

Chronic infections, in particular, can result in severe anemia, compromise growth and affect the immune response.^{xx} Studies have shown that infection from hookworm and trichuriasis in preschool-aged and school-aged children impairs physical and cognitive development.^{xxi} Intestinal worm parasites not only undermine cognitive development, but researchers have estimated that for each additional infection from worms, children in fact lose an average of 3.75 IQ points.^{xxii} These infections can also be life threatening in young children. Intestinal obstruction is the most frequent life-threatening consequence of ascariasis, with approximately 10,000 deaths and 12 million cases occurring annually.^{xxiii} Intestinal worm infections are present in all countries of Latin America and the Caribbean^{xxiv}, but Brazil, Mexico and Guatemala bear the highest prevalence of these diseases while Paraguay, Peru, part of Central America and Suriname also suffer from high rates of hookworm infection.^{xxv} Data from a 2005 survey conducted by the Ministry of Health in Nicaragua (MINSa) showed prevalence estimates ranging from 0-84 percent, suggesting that

communities within Nicaragua are at high-risk for intestinal worm infection.^{xxvi}

Table 1: Prevalence Estimates in the Americas^{xxvii}

Country	Prevalence	Country	Prevalence
Argentina	9.0–38.7%	Guyana	12.3–38%;
Belize	43.6–52.2%	Haiti	15–87%
Bolivia	4.5–65.4%;	Honduras	12.2–97%
Brazil	2–36%	Mexico	0.01–16.3%
Colombia	10.7– 49.3%;	Peru	1.8–80.4%;
Cuba	4.5–47.3%	Saint Lucia	35–45%;
Dominican Republic	5.3–55.3%;	Suriname	36–43%
Ecuador	28.5–71%;	Venezuela	3–19%
Guatemala	12.7–68%;		

Source: Schneider MC, Aguilera XP, Barbosa da Silva Junior J, Ault SK, Najera P, et al. (2011)

In Nicaragua, the poorest country in Central America and the second poorest country in the region, intestinal worms have a significant impact on the country's preschool-age and school-age population. 48 percent of the country's population lives below the poverty line, almost 50 percent of Nicaragua's population lives in overcrowded conditions, 73 percent of rural households lack access to clean water and 70 percent of waste is neither collected nor processed.^{xxviii} Although health services are largely provided by the public sector,^{xxix} roughly 35-40 percent of the population lacks access to health services^{xxx} and 20 percent of children under five suffer from chronic malnutrition.^{xxxi} Within this context, and with a population where 47percent are aged less than 20 years old, a national prevalence range of 0-84 percent for intestinal worms in Nicaragua is a significant public health and social development challenge.

NTDs in Nicaragua

Health in a social context

Current health outcomes are closely tied to Nicaragua's sociopolitical determinants, which in recent decades have been defined by war, poverty and the political economy of the post-war era. These sociopolitical determinants of health in Nicaragua contribute to the current epidemiological profile, in which intestinal worms significantly limit the physical and cognitive growth of the country's youth population. In fact, an evaluation of children aged 0-2 and 0-10 years in the Department of Carazo in Nicaragua showed that intestinal worm infections in children less than 2 years was associated with language, social and general motor capabilities, while infection in older children was more closely correlated with language delays indicative of cognitive ability.^{xxxii} The developmental delays and declines associated with intestinal worm infections, which impact the well-being of the country's youth population and its ability to lead healthy, productive lives over the long-term, are linked to the transformation of the health system over the course of the war and its impact on society.

While Nicaragua made significant advances in health from 1979-1982 with the introduction of innovative, primary healthcare strategies and the implementation of social programs, the tide slowly began to turn in 1983 as contra military strategies increasingly targeted the health infrastructure and its health workers as part of a conscious effort to destabilize the social system through disruption of health services.^{xxxiii} Six years into Nicaragua's civil war that lasted from 1980-1990, 42 salaried health workers were killed by the contras while another 31 were kidnapped and 17 were wounded; 65 health facilities – including a hospital – were destroyed; and 37 health units were abandoned by the government due to violence.^{xxxiv} By the end of the war, Nicaragua's Ministry of Health estimated that the health sector suffered US\$25 million worth of damage – a fraction of the estimated total war-related losses of almost US\$2 billion – while approximately 10percent of the population lost access to health services.^{xxxv} Beyond the direct impact of the war on the health infrastructure, migration patterns of persons displaced by war looking for economic

opportunity in urban centers gave rise to increased transmission of vector borne diseases including malaria and dengue.^{xxxvi} Sharing similar geographic distribution with malaria and dengue due to a shared set of environmental factors which impact vector habitats – notably poor sanitation, sub-standard living conditions and lack of clean water – higher rates of intestinal worm infections are a logical outcome of population movements to the outskirts of Nicaragua's capital city into squatter settlements that lack water, sanitation, health and social infrastructure.^{xxxvii} While the epidemiological profile of Nicaragua was significantly affected by war, particularly due to high mortality, migration, and the establishment of new communities without the accompanying health and social infrastructure^{xxxviii}, the health system also underwent a dramatic change with the introduction of structural adjustment programs in the 1990s.

During the 1980s, the Frente Sandinista de Liberacion Nacional (FSLN) government expanded healthcare and education as part of a vision of a centralized state that met the needs and supported the development of the population as a whole.^{xxxix} But in the post-war decade, liberal governments shifted to a market-driven economy that included increased activity of the private sector in healthcare, the introduction of user fees, and the decentralization of health and social services, through the creation of the Sistema Local de Atención Integral en Salud (SILAIS).^{xl} A health situation analysis carried out in 2003 by Nicaragua's Ministry of Health showed inequities in access to healthcare, particularly in poor and rural communities, and financing of health services, in addition to a health sector that overall was not meeting the growing needs of the population.^{xli} The decentralization of health services through the creation of the SILAIS continues to influence health delivery and approaches to care in Nicaragua's current health system. The return of FSLN in 2007, resulted in the implementation of a community healthcare component through the SILAIS, in addition restrictions on the private sector's role in Nicaragua's health system and the removal of user fees in public health facilities, which require significant resources and capacity building to meet the demands of the population.^{xlii}

Historical Perspectives:

Opportunities for Deworming in Nicaragua

Few governments were actively supporting large-scale deworming activities in their countries until the 1990s, including Nicaragua. Leading up to the 1990s, high levels of childhood mortality largely overwhelmed Latin American public health sectors and very few large-scale health campaigns were dedicated to preventing morbidity-related health outcomes. From 1985 to 2005, childhood mortality rates made an impressive drop from 97.7 deaths per 1,000 live births to 28.0 deaths per 1,000 live births. As infectious disease related mortality began to decrease in the under 5 population, public health programs began shifting their focus from solely preventing mortality outcomes to reducing morbidity outcomes, and in doing so, improving the quality of life for children, both in the intermediate and in the long term.

The catalyst to the decline in child mortality in Nicaragua was the launch of periodic national vaccination campaigns in the 1970s, which in later decades has become a critical delivery system for intestinal worm control efforts in Nicaragua. After multiple outbreaks of polio in 1979, the Nicaraguan Ministry of Health initiated periodic national immunization campaigns to improve vaccination coverage throughout the country.^{xliii} For nearly two decades, the National Immunization Program (EPI) carried out mass vaccination campaigns three times a year, leading to a significant reduction in vaccine preventable diseases among children in Nicaragua. As the periodic national vaccination campaigns gained visibility and acceptance among Nicaraguan families, the Ministry of Health began using the established campaign delivery mechanisms to increase the reach of other non-vaccine health interventions, including deworming and vitamin A distribution. The first safe anti-helminthics, or therapeutic drugs to expel parasitic worms from the human body, became available in the 1950s, but it was not until the 1970s that more efficacious drugs were developed, first with mebendazole in 1975 followed by albendazole in 1980.^{xliiv} By 1994, the Nicaraguan Ministry of Health formally incorporated mass preventative chemotherapy treatment of mebendazole and albendazole – deworming medication – to control STH infection into the country’s periodic health campaigns.

A decade later, the National Immunization Program reduced the number of national campaigns from three to two per year, and a year later from two to one per year. The primary reason for reducing the number of national health campaigns per year was because primary healthcare services began assuming routine vaccination responsibilities, but also the campaigns were becoming increasingly expensive. As more preventative, therapeutic and educational interventions began to piggyback off the national immunization program’s delivery strategy the costs of administering the campaigns began to overwhelm the EPI budget, which was noted by the current EPI Manager.

By the early 2000s, clinical and operational research documenting the utility and economic feasibility of community-based preventative chemotherapy treatment to control STH infection reached a critical mass and many international health organizations began advocating for routine deworming activities in areas endemic to intestinal worm infections.^{xxxiv} In May 2001, the 54th World Health Assembly passed a resolution reaffirming the control of schistosomiasis and soil-transmitted helminthiasis as a public health priority.^{xlv} By signing Resolution 54.19, the member states of the World Health Organization, including Nicaragua, committed to reaching 75 percent coverage of all school aged children with preventative chemotherapy to control STH infection by 2010.^{xlvi} Due to the relatively low costs of treatment and the prohibitively high costs of screening for intestinal worms when applied universally, the 54th World Health Assembly chose to endorse a mass treatment strategy.



Figure 1: Vaccination week: A community health post in Leon, Nicaragua

Current STH Control Strategy in Nicaragua

Leveraging existing delivery systems

Prior to the global declarations of commitment to STH control, Nicaragua had already begun administering deworming medication one time per year to pre-school aged and school-aged children between the ages of 2 and 14. Maximizing the use of an established and efficient health delivery mechanism, the deworming medication is administered to youth during the annual, national immunization campaigns.^{xlviii} These national immunization campaigns are carried out in schools and local health posts, which are often set-up in homes in rural areas for the campaign period. National Immunization Program staff emphasized that deworming for non-enrolled school-aged children is carried out in the local health posts or during “mop-up” campaigns, where staff from the Expanded Programme on Immunizations (EPI) go house to house administering vaccines, mebendazole and vitamin A in

rural and areas historically achieving low coverage. Pre-school and school-aged children 5-14 years of age are targeted for deworming activities in Nicaragua and receive the tablets during the national health campaigns.^{xlviii}

WHO recommends mass anti-helminthic drug administration (MDA) to reduce STH infection among school-aged children one time per year in areas where prevalence of STH infection among school-aged children is greater than 20 percent but lower than 50 percent.^{xlix} In communities at high risk for STH infection, or a prevalence of STH infection among school-aged children greater than 50 percent, WHO recommends deworming school-aged children two times per year.^{xxxix} Currently, MINSAs has been deworming children once per year due to resource constraints; however given WHO’s treatment strategy, there is potential need for more frequent MDA cycles in Nicaragua’s high-risk communities where prevalence of worms exceeds the WHO 50percent threshold.

Current MINSAs data from a 2005 survey identifies the prevalence of intestinal worm infection in select communities, and provides sufficient evidence to support the widespread assumption among deworming stakeholders in the country that the prevalence of intestinal worm infections in Nicaraguan youth merits administration of preventative chemotherapy at least twice per year in select departments. Moreover, a 2007 study was carried out by AMOS Health and Hope and MINSAs, in Boaco, to determine how often to deworm in Nicaragua based on prevalence and intensity, and found intensity sufficiently high to require biannual deworming in rural areas. The results of the study prompted twice yearly deworming by MINSAs in high prevalence regions for the 2007-2008 deworming year, which was halted by the 2008 deworming period. While evidence supports an increase in the current number of MDAs carried out in select communities, the need for national parasitological data to support more frequent MDA cycles, and current resource constraints means that Nicaragua will likely continue to support the once per year deworming activities at the national level over the foreseeable future



Figure 2: Distribution of mebendazole

Since 2009, MINSAs's partnership with Children Without Worms has supported yearly MDAs through antihelminthic drug donations from Johnson & Johnson to treat the country's at-risk school-aged children with deworming medication. Leveraging the drug donation from Children Without Worms, Nicaragua has not only met the WHO target of covering at least 75 percent of school-aged children with regular treatment as the global goal for intestinal worm control, but has exceeded the target; in 2010, Nicaragua reached 87 percent coverage.¹ Before the

Ministry of Health's partnership with Children Without Worms began in 2009, the country was receiving many smaller mebendazole and albendazole donations from multiple NGOs, including Save the Children, IMA World Health, Franconia Mennonite Deworming Program, World Vision, CARE, Feed the Children, MEDPHARM and Adventist Development and Relief Agency (ADRA).

While the Johnson & Johnson drug donation mediated by Children Without Worms covers the school-aged target population, Nicaragua continues to receive drug donations from several NGOs to provide preventative chemotherapy to pre-school age children and stock local health posts for treatment of infection, although many of these donations come are not provided through government-coordinated channels. In theory, the EPI at the central level of the Ministry of Health is responsible for managing drug donations and overseeing drug distributions at the local level; however, many NGOs directly donate drugs to health centers within the SILAIS, which results in significant challenges for reporting and tracking of drug donations by central level information systems. Unmediated drug donations were a noted concern for the EPI, although concrete plans to address this challenge were not shared.

For purposes of pharmaceutical tracking and quality control in the country, receiving NGO drug donations at the local level is not ideal. When NGOs work at the local level in the SILAIS, MINSAs is not always aware of all local deworming activities, and in turn, cannot effectively monitor and evaluate the administration of mebendazole and albendazole in the country. For example, field visits showed that there are no mechanisms in place to ensure that pre-school aged children are not being administered the Children Without Worms mebendazole donations that are non-chewable tablets. While the non-chewable mebendazole tablets can be pulverized to assure safe administration of the drug in children under 5, the mebendazole drug donations were intended to reach only school-age children 5 to 14 years of age, in Nicaragua. During a visit to a local pre-school in Leon, some teachers expressed that children as young as age 3 were receiving non-chewable deworming tablets. It was unclear if the tablets were from the Children

Without Worms mediated donation supply or another NGO donation. Another programmatic issue noted was the lack of water available to children when taking the deworming medication. While observing the administration of deworming medication in a local health post located 2 hours North of the capital, it was noted that no drinking water was available for young children to swallow the mebendazole medication. In speaking with the local health workers, the health post did not have any cups or drinking vessels available to administer drinking water with the medication at the schools. Some of these programmatic issues could be addressed through consistent refresher training for health workers and teachers.

Despite some of the programmatic challenges noted, the government's current approach to STH control has meant that hundreds of thousands of Nicaraguan children are treated annually with deworming medication.ⁱⁱ Nonetheless, by leveraging the existing program infrastructure of the national immunization campaigns, the Ministry of Health has been able to treat youth intestinal worm infections. As is the case with most mass preventative chemotherapy strategies, however, children continue to run the risk of chronic infection after being dewormed if the conditions of their surrounding environment do not improve simultaneously. In this sense, MDA strategies are a first-line approach to controlling intestinal worm infections and reducing morbidity, but are neither sustainable nor sufficient in ensuring protection against reinfection over the long-term.

Recognizing the limitations of MDAs as strategy to also prevent infection, the MINSA, in partnership with other ministries, community organizations, NGOs and international donors has made considerable effort to address the vulnerability of countless children in the cycle of infection and reinfection due to poor sanitation and lack of access to clean water both at school and in the home.

Moving towards Sustainable Prevention:

Efforts to Achieve Comprehensive STH Control in Nicaragua
MDAs are a proven, treatment strategy, and when complimented by water, sanitation and hygiene education (WASH) activities, can be the cornerstone of a sustainable approach to not only treat but also break the cycle of infection. For intestinal worm infections,



Figure 3: Cleaning supplies and sinks for handwashing at a preschool in Nicaragua

improvements to the sanitation infrastructure, access to clean water and hygiene education can result in decreased risk of infection, and in most cases in which treatment is distributed via MDAs, reinfection.ⁱⁱⁱ A study found that while MDAs and sanitation and health education reduced the prevalence and intensity of intestinal worm infections when administered individually, the rate of reduction in infection is significantly better when MDAs are combined with sanitation and /or health initiatives.ⁱⁱⁱ

While WASH interventions can help sustainably break the cycle of disease, the costs of these programs often exceeds government capacity. Interviews with experts in NTD control highlighted two, key challenges that countries often face in implementing a comprehensive control program for intestinal worm infections; funding and capacity. Moreover, WASH interventions have a poor track record in countries without parallel economic development, and consequently there are resources committed to long-term WASH programming.^{iv} Alternatives to the high costs of national scale WASH interventions focus on creating the environment for improved sanitation through hygiene education. Hygiene education is, to an extent, limited in its scope and impact when the accompanying sanitation infrastructure – soap for handwashing, cleaning supplies, running water and clean and safe toilets – is inadequate.^{iv} However, in low socio-economic communities, hygiene education is recommended to help increase knowledge of needs and approaches to improved sanitation and achieve

long-term behavior change around sanitation practices.^{lvi}

Efforts in Nicaragua highlight the potential for low-income countries to implement sustainable control programs where an emphasis on hygiene education encourages behavior change that supports prevention over the long-term. MINSA currently works with several partners to improve access to clean water and sanitation, with a particular focus on hygiene education. As noted by members of the EPI and Surveillance departments of MINSA, the Ministry supports UNICEF's *Escuelas Saludables* model, as it complements school-based deworming, through its emphasis on hand washing, hygiene education, and nutrition as a school-based health program. Though supported by MINSA, oversight of the sanitation infrastructure is the responsibility of the Ministry of Education to ensure that each child has access to safe and clean toilets, clean water and soap for hand washing. An in-country PAHO representative, however, noted that while the Ministry of Education oversees national policies, local authorities are in fact the ones with the most responsibility for ensuring the safe and healthy conditions of schools within the community. Commenting on the *Escuelas Saludables* program, PAHO's country office in Nicaragua noted that a sizeable percentage of Nicaragua's school-aged child population depends on the schools to meet their sanitation needs because they otherwise lack access to clean water in their homes. Where clean water is neither available in the home or at school, children are exposed to greater risk of intestinal worm infection.

The *Escuelas Saludables* project supported by UNICEF began more than 10 years ago in Nicaragua, but the country has a long history of school-based interventions that lay the groundwork for the introduction of the UNICEF model. In the 1980s, the Faculties of Medicine and Dentistry at the National Autonomous University of Nicaragua (UNAN – León) implemented several projects targeting school-aged children, with a particular focus on teeth cleaning and school discussions on disease prevention and health. By the 1990s, the Ministries of Education and Health joined in partnership to develop a coherent school-based health strategy as part of an effort to raise health awareness in schools and primary education

centers throughout the country. The Nicaraguan Water and Sewerage Enterprise (ENACAL) in 1998 developed the «*Iniciativa Nicaragüense de Higiene y Saneamiento Ambiental (INHySA)*» with the objective to improve sanitation infrastructure, with a particular emphasis on the school-aged population. With the support of UNICEF, the program expanded to 49 municipalities in 6 departments, with the results of the program leading to UNICEF's decision to select Nicaragua as a pilot site for the program, *Saneamiento Escolar y Educación en Higiene*.^{lvii} UNICEF defines un *Escuela Saludable* as a space where:

[...]Children can develop, learn and gain lifelong skills in an environment that is inclusive, healthy and protective of all children, respects gender and cultural diversity and is involved with families and communities..^{lviii1}

Building on this definition, *Escuelas Saludables* includes one sanitation facility separated by gender for at most thirty children, clean water for hand washing and consumption, trash receptacles, appropriate drainage systems and ultimately, a friendly environment that promotes hygiene and self-esteem.^{lix} A 2008 UNICEF case study, highlighting the role of ENACAL in sanitation and hygiene efforts in Nicaragua, also noted that one of the critical aspects of the ENACAL strategy was its emphasis on community buy-in and participation, which enables communities to take responsibility and contributed to the overall success of the project, beyond the initial implementation phase, and in contrast to past efforts to build up community, sanitation systems.^{lx}

In Nicaragua, the *Escuelas Saludables* project framework includes the establishment of multi-sectoral committees at the local level, including participation from representatives of the Ministry of Education, municipality officials, and civil society actors, including parent associations at schools. The project framework has always been supported by Programa Amor – an initiative of the Ministerio De La Familia, Adolescencia Y Niñez² – which is founded on

¹ Children can develop, learn and gain lifelong skills in an environment that is inclusive, healthy and protective of all children, respects gender and cultural diversity and is involved with families and communities.

² Ministry of Families, Adolescence and Childhood

the principle that the family is at the heart of Nicaragua and is an effort to promote the moral and spiritual values of society by guaranteeing the right of all children to live a happy and dignified childhood.^{lxii}

Key partners in the *Escuelas Saludables* program include the Fundación Mainel (Mainel), a Spain-based NGO that has worked in Nicaragua since 2000 where it has done work in school-health programs in addition to projects focused on improving the lives of those affected by the 2000 Masaya earthquake. MINSa collaborated with Mainel to evaluate the outcomes of integrating deworming activities with school-based water and sanitation education for school aged children. Mainel supported a baseline prevalence study in a sample of participating schools, including the John F. Kennedy Elementary School, in Leon and Chinandega. The Mainel Project – Plan Estrategico de Intervencion Xolotan 2008 to 2010 – provided funds for schools to procure cleaning products and materials to maintain a healthy school environment, and support to convene parent and local municipality committees. The idea was to evaluate STH infection ex-ante and ex-post the implementation of simultaneous deworming activities, improvements in water and sanitation school infrastructure, and education around water and sanitation for school children and their families. Due to several methodological challenges, the study findings were not considered sufficiently robust to support any conclusions regarding the success of the project. It is unknown whether Mainel will try to address methodological challenges and reevaluate the NGOs integrated WASH(ED) strategies in the future.

Mainel's work with the John F. Kennedy Elementary School in Leon -- an *Escuela Saludable* -- supported deworming activities and education on hand washing for students, teachers and parents. As part of Mainel's funding support for the school's WASH interventions, foundation activities included the development of guidebooks and pamphlets for distribution to students, teachers and parents, on hygiene and sanitation at school and at home, and donations of cleaning supplies and soap for hand washing that also support school-secured funding to improve the sanitation system. The program has been successful to the extent that there is strong community buy-in of hygiene education and sanitation efforts. School leadership has been

proactive in hosting monthly parent meetings, which includes a review of the WASH guidelines and nutrition recommendations. These monthly meetings are held not only to discuss the academic progress of children at the school but also to continue the dialogue and parent education on home-based sanitation activities. Anecdotal evidence suggests that the meetings are generally well attended in part due to a keen interest from the parents in ensuring healthy communities for their children. While the school no longer receives soap donations from Mainel, an indicator of hygiene education success is the ongoing commitment to ensuring education on hygiene and sanitation in the absence of resources. A lack of sufficient soap for hand washing -- and prospective donors -- led to the revision of messages on the need to hand wash with soap before and after meals to a message of hand washing with soap before meals and hand washing with water after meals.

In addition to its partnership with Mainel Foundation, MINSa works with several partners on WASH interventions, including NicaSalud, a Nicaragua-based umbrella organization for over 23 international and national non-governmental organizations (NGOs) and bilateral organizations, including USAID. As an intermediary organization between MINSa and NGO partners operating in the country, NicaSalud plays a critical role in coordinating partners and helping achieve consensus among stakeholders involved in health and education programs in Nicaragua. NicaSalud's work generally falls in three, key subject areas, (i) community health, (ii) education; particularly around intestinal worm infection and water, sanitation and hygiene and (iii) supporting the work of MINSa and the volunteer health workers, brigadistas. Within these three areas, NicaSalud's primary focus is on community health with a special focus on vulnerable populations, notably children under five and childbearing women.

In the area of intestinal worm treatment and control, NicaSalud primarily supports WASH projects and plays a critical role in the development of flipcharts and guidelines for use by MINSa, SILAIS authorities and schools in the treatment of intestinal worms and hygiene education. A key strength of NicaSalud is its role in the community, not only securing community

buy-in of its activities through its broad support and involvement in a wide variety of community-focused programs, but also its ability to convene community actors throughout Nicaragua. Faith-based organizations also support MINSA's deworming and WASH efforts, such as the Franconia Mennonite Deworming Program, which is one of the biggest donors in Nicaragua. AMOS Hope & Health (AMOS) is a critical partner in intestinal worm control and prevention, and helps provide treatment in addition to work in health education, chlorination of water, and improved sanitation. AMOS has been working with MINSA and deworming donation programs since 2006, and was previously the IMA World Health in-country intermediary for the MOH donation.

The aim of deworming is to reduce the number of worms, and eventually eliminate disease from the system of the child host. With increased frequency of retreatment, there is a greater chance that children will not reaccumulate moderate to heavy loads of worms, but a more sustainable approach to prevention is to invest in a broader WASH framework, including water and sanitation infrastructure improvements in the community, increased awareness about the risk of intestinal worm infection and greater education about hygiene practices to prevent worm infection. While a greater emphasis on integrating MDA with WASH activities in Nicaragua is bound to render high returns on the investment, the challenge is identifying government capacity and resource mobilization to support such an effort. There is an urgent need to mobilize resources to support the comprehensive WASH(ED) framework endorsed by Children Without Worms. At a time when political will is strong for integrating activities and focusing health interventions across the entire life span, it will be important to move the WASH(ED) agenda forward in Nicaragua.

Sustainability of STH Control Efforts and

Government Capacity in Nicaragua

Used as a control strategy, MDA for intestinal worm infection produces positive externalities by reducing worm deposition in the community and thus reducing the risk of infection for youth.^{lxii} At the same time, however, frequent treatment can produce drug resistance^{lxiii} In several studies, front line antihelminthics used for livestock have become ineffective after repeated treatment cycles^{lxiv}, which

raises concerns over the possibility of similar resistance in populations at risk for intestinal worm infections. Currently, there is no conclusive data demonstrating that anthelmintic resistance (AR) is widespread in human STH. However, the risk for AR to emerge is a potential threat and monitoring efficacy of existing anthelmintics is of paramount importance.

Despite potential drawbacks to current control strategies, alternative near-term options for controlling STH infection are limited, and as was observed in the case of Nicaragua, there is an ethical imperative to provide deworming medication to children if it is readily available.

Moreover, in 2008 the Copenhagen Consensus ranked deworming activities the sixth best intervention overall to advance human welfare globally when considering the potential health benefit to cost ratio, anticipated feasibility and sustainability.^{lxv} Deworming drugs such as mebendazole are safe and inexpensive, and periodic mass treatment without prior diagnosis of infection is considered a cost-effective strategy.^{lxvi}

Children Without Worms has confirmed a readily available stock of 200 million mebendazole doses donated by Johnson & Johnson for their country recipients for the year 2011.^{lxvii} Nicaragua has requested and received support from Children Without Worms to procure 1.5 million doses of mebendazole to treat the entire school-aged population. In exploring the sustainability of the Johnson & Johnson donations to Nicaragua, the Director of Children Without Worms commented that the donation commitments are long-term as long as the country continues to effectively use mebendazole donations and meet the documentation needs associated with distribution. Children Without Worms requests reapplications from recipient countries on an annual basis, and Nicaragua has participated in three cycles at this stage. As Children Without Worms is a model supported by WHO—the NGO is working with international experts and WHO to define the guidelines for such drug donation mechanisms. At this time, WHO does not have a concrete scale down strategy, making it reasonable to assume that Nicaragua can expect to continue to receive the Johnson & Johnson drug donations in the immediate term.

The costs, benefits and sustainability of comprehensive control building off MDAs, however, are strongly dependent on the prevalence and intensity of infection. While current drug donations are likely to continue in Nicaragua, the Ministry of Health has not explored options to procure and distribute mebendazole to youth populations using national resources, which is an important determinant of the feasibility and likelihood of achieving sustainable control. Despite the low cost of drugs to treat intestinal worms, assuming the cost of drug procurement at current market prices procurement costs present a potential burden to the budget of the government, with pricing policies designed to offset budgetary burdens and ensure sustainability of control strategies. Nicaragua's health system is currently based on universal access, but the 2011 elections raise questions about the outlook for the health sector amid political change. In the past, changes in political systems have significantly impacted deworming activities. Given the upheaval in MINSAs personnel that came with a complete shift in Nicaragua's political structure in 2006, there were significant setbacks to the level of collaboration between key deworming stakeholders in MINSAs's epidemiology and immunization departments. Another round of changes to Nicaragua's health system resulting from the 2011 elections, and health access in the country could significantly impact the long-term success of intestinal worm control efforts. A 2007 study that looked at the impact of pricing policies on deworming efforts showed that the introduction of user fees for deworming treatment resulted in an 80 percent decline in treatment rates,^{lxviii} which speaks not only to direct effect of drug pricing policies on deworming, but also the broader challenges in achieving sustainable, government ownership of programs.

The results of the 2007 pricing study highlight the significant impact of funding on health outcomes, and the need for governments – like Nicaragua – that currently partner with development organizations and donors to ensure the health and social well-being of their populations to work closely with Ministries of Finance to establish frameworks and systems that help guarantee the continued success of programs once transitioned to full, government ownership. As noted in a 2009 policy brief from the Woodrow Wilson

Center, monitoring and evaluation (M&E) programs are necessary to build an evidence-based case for budget support that links health indicators to national, budget line items.^{lxix} While the majority of the countries in Latin America and the Caribbean lack strong monitoring, evaluation and surveillance frameworks, M&E is the lynchpin of sustainability and effectiveness of deworming efforts in Nicaragua and the broader region.

Measuring Effectiveness:

Nicaragua's current STH strategy

Monitoring and evaluation (M&E) and clinic based case detection is lacking from the majority of STH control programs around the world, and despite clinical diagnoses, there is a lack of confirmation on the epidemiological profile and burden of intestinal worm infections in Nicaragua. This scenario, however, is not unique to Nicaragua with the majority of countries in the region lacking strong M&E frameworks, and routine NTD surveillance systems. PAHO technical support to Nicaragua and throughout the region is focused on the development of a national strategy to help mobilize the development of an evidence-based, integrated approach to intestinal worm and NTD control.

Recognizing the resource limitations of Nicaragua and regional peers, IDB considers M&E critical to understanding where the country started, where it is at present, and how to build an outlook for the future. Weak M&E frameworks and surveillance systems inhibit external and internal STH control partners from making any conclusions regarding the impact of the control strategies in place. Impact evaluations require prevalence and intensity assessments before and after implementation of an intervention, and while many countries could be inclined to use treatment coverage as a proxy indicator for impact, coverage data does not show causal (ex. Deworming and WASH) impact on disease outcomes.

Monitoring and Evaluation Guidelines, developed in 2010, for projects funded by the Latin America and Caribbean NTD Initiative – the partnership between PAHO, IDB and the Global Network – are a recent approach to help standardize M&E activities related to NTD control and elimination efforts in LAC. These guidelines would require that health information

systems report program, geographical and epidemiologic, coverage of MDA cycles of treatment, with the MDA program evaluated by its effect on parasitological, serological or clinical indicators.^{lxx} These region-specific guidelines expand on WHO recommendations for monitoring the impact of intestinal worm control programs through baseline survey of children aged 9-10 years who are periodically evaluated throughout the program, around the schedule of drug donations.^{lxxi} IDB efforts to address the lack of data on intestinal worms in the region will also look at integrating M&E activities for priority NTDs on a country-by-country basis. Of particular concern is that when compared to other developing regions, LAC has rather strong health systems, but national mapping of intestinal worm infection has not been carried out in many countries. In the case of Nicaragua, while MINSAs resource gap and limited capacity are key factors in developing and carrying out parasitological surveys in Nicaragua, IDB sees opportunities to better incorporate data collection and surveillance of intestinal worm prevalence into existing deworming activities.

To address M&E needs in Nicaragua, the local PAHO country office, is currently looking at opportunities to include the promotion of operational research in the national plan to control NTDs, which is currently in development, in order to boost the number of prevalence studies carried out to better determine the parasitological landscape. In its technical capacity, PAHO is a critical stakeholder in Nicaragua's routine surveillance and monitoring and evaluation efforts through its role in helping build an evidence-based case for intervention.

Current efforts to improve tracking and coverage data in Nicaragua resulted in the 2011 launch of new immunization cards with deworming included as a category. PAHO offices in Nicaragua and PAHO headquarters noted that the integration of deworming tracking into the monitoring systems for national immunization programs is unique to Nicaragua, and offers a potential 'best practice' lessons to regional peers, although 2012 will be the earliest that the impact of this new approach can be assessed. Nonetheless, significant challenges remain for M&E and assessing the impact of deworming efforts.

Current approaches are based on record keeping on the municipality level in ledgers provided by MINSAs that are then sent back to the central Ministry at the end of the deworming campaigns. Both SILAIS and MINSAs officials, however, acknowledged a number of coordination challenges with the current system.

Lessons Learned

This case study documented Nicaragua's ongoing commitment to the reduction of intestinal worms in the country's youth population. Despite noted challenges, the case study identified many opportunities to apply lessons learned from the current experiences in Nicaragua to future deworming activities in the country and in the wider LAC region. Lessons learned from Nicaragua's experience deworming youth populations can fall into three distinct categories related to a comprehensive STH control framework:

- **Managing Partnerships: effectively Implementing MDA Strategies;**
- **Advocating for an Integrated WASH(ED) Agenda: integrating MDA with long-term behavioral, social and environmental change to prevent STH infection**
- **Bolstering Government Commitment and Capacity: to foster the long-term sustainability of STH control.**

As can be noted in the Nicaraguan experience, each component of this comprehensive STH control framework complement the other, and in the absence of one, outcomes are not as favorable.

Managing Partnerships

Nicaragua has successfully garnered support from both regional and international partners to increase access to and equity of deworming activities in the country. Over the past two years, the country has engaged with stakeholders, namely Children Without Worms, to procure sufficient quantities of treatment medication to protect the country's entire school-aged population from the destructive effects of intestinal worms. While most stakeholders underscored the sustainability of these partnerships, long term strategic planning of deworming activities and goals will help formalize MINSAs relationships. In doing so, the Ministry of Health would have the opportunity to better

document the ongoing activities of the multiple NGO partners in the country, improve communication between external actors and avoid overlap of activities. Nonetheless, the Nicaraguan government has successfully built effective relationships with several NGOs. When looking to community level buy-in, local partnerships are critical. The Nicaraguan experience demonstrates the potential for local and international partnerships to greatly heighten the impact and to increase reach of deworming activities. Through social mobilization and wide-reaching community participation, the EPI has increased its coverage double-fold in recent years. Other countries in the region have developed similarly successful EPI programs, achieving national childhood immunization coverage of 95 percent or greater. These high coverage programs strongly grounded in community involvement could be an important vehicle for deworming activities across the region. School-based WASH messaging and activities are only effective if the lessons and behaviors are carried into the homes by children. Partnering with parents and teachers, WASH interventions will be the key to controlling intestinal worms in children.

Effectively Implementing MDA Strategies

Considering the challenges related to tracking deworming drugs donated at the local level, Nicaragua would benefit from formalizing MDA strategies for intestinal worm infection control in the country. Currently, the Ministry of Health has functional policies in place to support the targets for annual deworming activities, but there is no central-level policy that formally endorses MDA for STH control and sets forth a unified plan for all SILAIS. Such a documented policy could address the problems related to drug donations not coordinated through the central level, and require SILAIS to report drug donation information through a standardized reporting system.

Advocating for an Integrated WASH(ED) Agenda

While a formal STH control policy could potentially serve as a platform to bring together the set of partners involved in STH control activities (i.e. Ministry of Health's EPI management, local health workers, Ministry of Education, teachers, parents associations and NGO partners), the policy, also, could delegate roles and responsibilities for each government actor

involved in STH control, beyond MDA. The existing EPI infrastructure continues to be the most logical mechanism for delivery of MDA strategies, but, as noted by the country's EPI manager, all partners need to formalize their role if they are working in the arena of intestinal worm infection control in order to foster a more efficient, effective and integrated strategy. The EPI's vertical mandate to reduce vaccine-preventable diseases has created challenges for breaking down silos within MINSAL and between external actors. In order to move forward with the integration of MDA and WASH activities, the Ministry will need to provide the EPI with greater support, and build a space and platform where the multiple actors involved in STH control can dialogue more openly, resulting in more efficient planning and execution of deworming activities at the local level. As noted by Children Without Worms' Director, this awareness curve among partners and cross-sectoral actors will no doubt take time. MINSAL, however, can foster this process by advocating for integration of activities in the short term and executing strong leadership over the disjointed ongoing WASH(ED) initiatives in youth by establishing policy to formalize STH control strategies in the country. The Ministry of Health has been able to lower costs associated with deworming activities by leveraging the existing EPI delivery mechanisms and actively seeking external partnerships to secure sustainable drug donations. Still, the government will need to monitor the EPI's workload and be responsive to funding and resource needs in order to sustain the progress made with deworming in the country.

Additionally, more operational research needs to be carried out in order to evidence the effectiveness of Nicaragua's approach to integrating MDA & WASH, even if this continues to occur on a small scale. Building up an evidence base for WASH(ED) could potentially attract more support from international donors to improve water and sanitation systems in the country. PAHO, IDB and the World Bank are logical partners to spearhead such a research agenda in the country, and research findings could inform much of the work they do in terms of technical assistance and funding prioritization. At the same time, partners should make a concerted effort to build monitoring and evaluation skills at the local level as well.

Bolstering Government Commitment and Capacity

Nicaragua as a case study for comprehensive STH control has demonstrated how important high level political support is for sustaining the continuity of WASH(ED) interventions, and eventually the interventions' impact on intestinal worm infections. Since 1994 the country's deworming activities have gone uninterrupted despite changes in Ministerial leadership and shifting public health agendas. Housed in the EPI, community-based deworming initiatives have benefited from the program's strong political leadership, community support and historical continuity. At the same time, the historical and political determinants of health in Nicaragua have significantly contributed to the continuity of the deworming activities.

Conclusion

While the challenges are formidable, especially in the case of securing sufficient investment to spur

improvements in the water and sanitation sector in the country, the opportunities for improving the quality of life of children across the country are numerous as well. Nicaragua as a case study for comprehensive control of intestinal worm infections in children has demonstrated that the combination of increased coordination of actors, strong community buy-in and high level political commitments for WASH(ED) activities can result in significant health gains for youth populations. In a country where the per capita income barely surpasses US\$ 1000, the Ministry of Health has maximized limited resources to mitigate the devastating long-term effects of reoccurring intestinal worm infections in youth. While there is limited scientific evidence to validate the country's functional policies and strategies to reduce STH infection in children, there is political will and a strong interest to pursue research agendas and seek support to integrate ongoing activities.

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