

Addressing Neglected Tropical Diseases in Nigeria

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Prepared for Results for Development



RESULTS FOR
DEVELOPMENT



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Honor Pledge: On my honor as a student, I have neither given nor received unauthorized aid on this assignment.

Caroline Snead

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List of Abbreviations & Acronyms

Community Drug Distributors (CDDs)

Community-Led Total Sanitation (CLTS)

Nigeria's Federal Ministry of Health (FMOH)

Local Government Areas (LGAs)

Lymphatic Filariasis (LF)

Mass Drug Administration (MDA)

Neglected Tropical Diseases (NTDs)

Non-Governmental Organizations (NGOs)

Open Defecation (OD)

Sustainable Development Goals (SDGs)

Soil-Transmitted Helminthes (STHs)

United Nations (UN)

Water Supply, Sanitation, and Hygiene (WASH)

World Health Organization (WHO)

Executive Summary

The West African nation of Nigeria possesses the greatest burden of high-prevalence neglected tropical diseases (NTDs) in sub-Saharan Africa. The parasitic infections of schistosomiasis and the soil-transmitted helminthes (STH) are particularly harmful because they have the greatest prevalence in and impact on children, potentially reducing physical and mental capacity for a lifetime. The United Nations (UN) Sustainable Development Goals (SDGs) call for the control or elimination of most high-prevalence NTDs by 2030. In order to meet this goal and continue to progress in the fight against schistosomiasis and STH, it is critical for the Nigerian Federal Ministry of Health (FMoH) to develop policy to address the remaining high-prevalence NTDs in a sustainable and cost-effective manner.

This report examines literature and best practices, offers three alternatives to address the aforementioned policy issue, and then evaluates the alternatives using the criteria of sustainability, cost-effectiveness, cultural feasibility, equity, and administrative feasibility. The alternatives are as follows:

1. Let Present Trends Continue
2. Integrate and Scale Up Mass Drug Administration
3. Implement Community-Led Total Sanitation

After evaluating each alternative using the criteria, I recommend that the FMoH pursue Option 2- the integration and scale up of its mass drug administration (MDA) program. This alternative is highly cost-effective and provides rapid impact on the diseases of schistosomiasis and STH.

Problem Definition

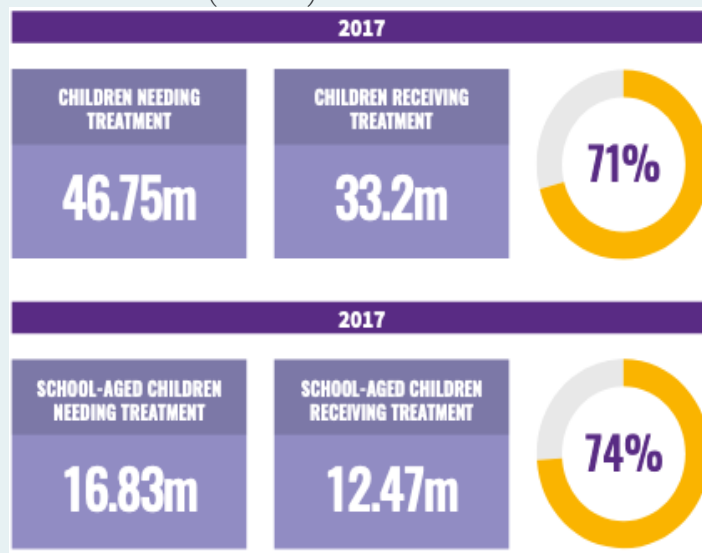
Hope was only a toddler when an aid worker found him wandering the streets in Uyo, Nigeria. The young boy had been abandoned by his family and was emaciated, barely able to stand on his own. Upon arrival at a hospital, doctors discovered that Hope was infected with intestinal worms, robbing him of critical nutrition for development. The hospital treated Hope with de-worming medications and procedures, and he is now happy and healthy (Busari, 2016). Hope is a success story. Unfortunately, many children in Nigeria are not so lucky. The worms that infected Hope were among a category of diseases collectively known as neglected tropical diseases (NTDs) and millions of Nigerians suffered from these painful and disfiguring infections in 2017 (“Nigeria and neglected tropical diseases,” 2017).

The West African nation of Nigeria has the greatest burden of high-prevalence NTDs in sub-Saharan Africa. High-prevalence NTDs include the soil-transmitted helminthes (STH), lymphatic filariasis (LF), trachoma, schistosomiasis, and onchocerciasis¹ (Peter J. Hotez, Asojo, & Adesina, 2012). Due to increased efforts by external funders (particularly the Carter Center), international health and financial institutions, and Nigeria’s Federal Ministry of Health (FMOH), Nigeria is poised to eliminate LF as a public health threat in the next few years. Although LF eradication is a noteworthy accomplishment, experts fear that external funding for other NTD treatment and control efforts will lessen after it is achieved. **Therefore, it is critical for the FMOH to develop policy to address the remaining high-prevalence NTDs (STH, trachoma, schistosomiasis, and onchocerciasis) in a sustainable manner with domestic resources. This report will focus on the diseases of STH and schistosomiasis in particular.** This is an especially appropriate time to consider future policy options as Nigeria’s six-year NTD plan draws to a close in 2020 and the FMOH begins developing its next medium-term plan (Nigeria Federal Ministry of Health, 2015).

Scope of the Problem

As previously mentioned, Nigeria has the greatest burden of high-prevalence NTDs in sub-Saharan Africa. In 2017, treatment coverage for schistosomiasis was at 74% of school-aged children (the most vulnerable population) and coverage for STH was at 71%. Treatment for other, less common NTDs was much lower, at times covering less than a third of the population. Overall, of the over a hundred-million Nigerians requiring treatment for an NTD in 2017, approximately 25% went untreated (“Nigeria and neglected tropical diseases,” 2017).

Figure 1: Treatment coverage for STH (top) and schistosomiasis (bottom) in 2017



Source: Nigeria and neglected tropical diseases, 2017

¹ See Appendix A for details on schistosomiasis and STH

This is a massive disease burden in Nigeria. One study of Nigeria's NTD burden estimated that it is equivalent to approximately one-half the disease burden of malaria in the country (measured in disability-adjusted life years)². Not only are the diseases painful and disfiguring, but they also impose a significant and negative impact on the economy, disrupting worker productivity (Peter J. Hotez et al., 2012). If left unaddressed, the impact will only worsen because schistosomiasis and STH impact child development and affect future productivity (Feasey, Wansbrough-Jones, Mabey, & Solomon, 2010).

A major factor driving the proliferation of NTDs in Nigeria is the lack of access to safe water and poor sanitation and hygiene. In 2012, 53% of Nigerians did not have clean drinking water and 70% lacked improved sanitation (Peter J. Hotez et al., 2012). Both schistosomiasis and STH are transmitted through contact with the feces of an infected individual. Inadequate water, sanitation, and hygiene significantly increase the chances of coming into contact with the parasitic worms that cause disease (Freeman et al., 2013).

Figure 2: NTD Life Cycle



Source: World Health Organization

² Disability adjusted life year (DALY) is a measure of disease burden equal to one year lost of healthy life

Background and Overview of NTD Treatment

The NTDs are a group of bacterial and parasitic infections that have widely varying characteristics but share certain key features. The first shared feature of NTDs is that they impact the poorest billion people of the world's population. This population also tends to live close to the equator—hence the inclusion of “tropical” in the name (Feasey et al., 2010). As the name implies, the other shared characteristic is that funders and researchers have neglected these diseases. The cause of their neglected quality is two-fold. First, because NTDs almost exclusively affect the very poor, there is little financial incentive for pharmaceutical research into treatment and prevention. Additionally, NTDs are typically non-life threatening, although they can cause significant pain and suffering. Because mortality from NTDs is quite low, funders tend to focus scarce resources on high-mortality diseases, such as HIV, malaria, and tuberculosis (Feasey et al., 2010).

However, the neglected quality of NTDs is beginning to change. About a decade ago, the World Health Organization (WHO) created a department to address NTDs, and a specific journal dedicated to NTD research was formed (Feasey et al., 2010). In 2012, the WHO, the Gates Foundation, national leaders, and CEOs of large pharmaceutical corporations gathered in London to pledge their support to end the NTD epidemic, signing a pact that became known as the London Declaration (“WHO | The neglected tropical diseases,” 2017). In 2015, the United Nations (UN) adopted the SDGs. The third SDG targets various aspects of health, one of which is to end the NTD epidemic by 2030 (Fitzpatrick & Engels, 2016). With new resources and a growing international focus on NTDs, a window of opportunity has opened to finally reduce and potentially eradicate these infections from the world.

Although NTDs constitute a significant disease burden in impoverished populations around the world, these infections are treatable and can also be prevented. The major challenge is organizing an NTD response in low-income countries where local infrastructure may not have the same capabilities of higher-income countries. One successful strategy to address the majority of worm-based NTDs is preventive chemotherapy via mass drug administration (MDA).

Preventive chemotherapy has been in use for the treatment of NTDs for over a decade but is being scaled up in an attempt to attain the SDG regarding NTDs by 2030. This approach utilizes a combination of drugs to interrupt the transmission of NTDs within a population (Bockarie, Kelly-Hope, Rebollo, & Molyneux, 2013). This is useful for controlling the spread of NTDs within a community and protecting vulnerable groups, such as children and pregnant women. Both schistosomiasis and the three soil-transmitted helminthes can be controlled using preventive chemotherapy (Bockarie et al., 2013). To deliver preventive chemotherapy, many countries have organized MDA campaigns. This strategy involves an annual or semi-annual delivery of drugs to a large population of patients to effectively control or eliminate NTD transmission in a region. Multiple drugs can be administered at once, and dosages are standardized to allow rapid administration (Hopkins, 2013).

In addition to individual patient care, wider public health measures are also important to truly eliminate NTDs from the entire population. Water supply, sanitation, and hygiene (known collectively as WASH) have a significant impact on schistosomiasis and STH transmission. By improving population access to clean water, adequate sanitation, and hygiene education, governments can prevent parasites from spreading from one person to another (World Health

Organization, 2015). Countries must consider health education, sanitation, and clean water improvement strategies in their approach to NTDs (Hopkins, 2013).

Finally, some countries have started to pursue integration in NTD control efforts. There is major geographic overlap among the diseases, so that some regions of the world have multiples infections within the population. They are also co-endemic with other diseases, such as HIV and malaria (Peter J. Hotez et al., 2007). For this reason, it is necessary for the various NGOs that fight NTDs and the ministries of health in nations where NTDs are endemic to integrate their control efforts. This will allow for pooling of resources and increased efficiency in the disease response (Peter J. Hotez et al., 2007). The nation of Togo, for example, has successfully eliminated LF and achieved 100% treatment coverage of STH and schistosomiasis through its successful use MDA and integration with its malaria control program (“Togo and neglected tropical diseases,” 2017).

Beyond the immediate result of reducing pain and suffering, controlling and preventing STH and schistosomiasis have a number of long-term benefits. These parasites have the greatest impact on school-aged children and can cause malnutrition, anemia, stunting, cognitive deficiencies, and missed school days. An NTD infection in childhood can lead to a lifetime of negative consequences, such as reduced productivity, infertility, and chronic poverty (King, 2011). Nations that work to control and eliminate NTDs are therefore also working to fight poverty and improve economic conditions. Schistosomiasis and STH infections can also make a person more susceptible to HIV and malaria, so NTD prevention has the added benefit of decreasing the likelihood of acquisition of these fatal diseases (Peter J. Hotez, Mistry, Rubinstein, & Sachs, 2011).

Nigeria's Baseline and Current Response

In recent years, Nigeria has improved its approach to NTD control and elimination. In 2009, the FMOH established a national NTD control program. At the time of its establishment, the goal of the program was to eliminate NTDs in Nigeria by 2020 (Peter J. Hotez et al., 2012). The national government partnered with organizations such as the WHO, UNICEF-Nigeria, the Carter Center, and other NGOs and invested millions of dollars into the control of a variety of NTDs (Peter J. Hotez et al., 2012). For example, the FMOH worked with the African Programme for Onchocerciasis Control (APOC) to provide onchocerciasis treatment for over 96% of at-risk communities (Peter J. Hotez et al., 2012). Currently, the NTD control program is housed within the Department of Public Health in the FMOH and provides direction to state governments to implement control and elimination activities.

Nigeria's most recent NTD approach was outlined in its multi-year master plan, which identified strategies and goals for the years 2015-2020. The plan built its approach around the PHASE acronym, which stands for preventive chemotherapy, health education, access to clean water, sanitation improvements, and environmental manipulation. It defined approaches for scaling up NTD interventions and strengthening capacity and government coordination (Nigeria Federal Ministry of Health, 2015). In 2014, 43 million people and 35 million people required treatment for schistosomiasis and STH, respectively, and many regions of Nigeria were still unmapped with regards to disease burden. The National Schistosomiasis Control Programme and the National STH Programme set goals of 75% treatment coverage in target populations by 2020. The total budget for the plan was \$208 million in 2015 dollars (Nigeria Federal Ministry of Health, 2015). Data on Nigeria's spending on infectious diseases indicates approximately half of its spending is financed domestically (R4D, 2019).

By 2017, Nigeria had reduced the number of untreated individuals with schistosomiasis to 4.3 million and the number of untreated individuals with STH to 13.5 million ("Nigeria and neglected tropical diseases," 2017). In 2018, the FMOH and its partners finished mapping the schistosomiasis and STH disease burdens in almost all of the 774 local government areas (LGAs) in Nigeria. My client is planning to support MDA and other NTD interventions in ten Nigerian states through 2020 (RTI International, 2019). However, as the multi-year master plan points out, a key concern is the lack of sustainability plans for the NTD program after 2020 and the fact that few interventions address the root causes of NTDs. (Nigeria Federal Ministry of Health, 2015). Nigeria has a number of potential options to address its NTD burden over the next five years, which will be described and evaluated in this report.

Evaluative Criteria

This report will present three options that the FMOH could undertake to address the issue of NTD control over the next five years. The alternatives will be evaluated based on the following criteria:

- **Sustainability**, in terms of support required to sustain control of NTDs and the extent of reliance on foreign aid
- **Cost-effectiveness** of each alternative compared to “Let present trends continue”
- **Cultural feasibility**, in Nigeria’s unique context
- **Equity**, in terms of intensity of treatment applied across socioeconomic groups
- **Administrative feasibility**, in terms of the FMOH’s ability to implement the given alternative

Sustainability

This criterion will measure the level of continuing support that is required to sustain schistosomiasis and STH control, as well as the level of external aid, whether financial or technical, required to implement each proposed policy alternative. A qualitative score of “high”, “medium”, or “low” will be assigned the alternatives, with “high” indicating significant sustainability and “low” indicating that little evidence of sustainability. I will also consider the source of external aid and include this in the evaluation of sustainability. For example, international organizations, such as the WHO and World Bank, tend to be more reliable and sustainable sources of aid than foreign governments or smaller NGOs. This is an important criterion to consider because it will take into account the likelihood that Nigeria may experience decreased external funding for its NTD response in the coming years.

Cost-Effectiveness

This criterion will establish the costs and effectiveness of each alternative, relative to the baseline set in the “Let present trends continue” option. Every alternative will include an evaluation of cost-effectiveness, with effectiveness measured in cases prevented and disability-adjusted life years (DALYs) due to schistosomiasis and STH averted and costs measured in US dollars (USD). I selected DALYs averted as the measure of effectiveness because NTDs cause significant morbidity, but low mortality. I will use a cost-effectiveness ratio (CER) to determine the alternative with the lowest cost per DALY averted. It is important to consider cost-effectiveness because the FMOH has a limited budget and should allocate resources to the most effective alternatives.

Cultural Feasibility

This criterion will evaluate the feasibility of each alternative with respect to Nigeria’s unique culture and context. This is a highly qualitative criterion and will rely on an analysis of Nigeria’s culture and its acceptance of other public health interventions. A score of “high”, “medium”, or “low” will be assigned to each alternative, with “high” indicating that the option is very culturally feasible and “low” indicating doubt of cultural feasibility. I included cultural feasibility as a criterion because the

policy alternatives must be acceptable to the populations that they intend to target and should be conscious of existing norms and contexts.

Equity

This criterion will measure if intervention is applied in an equitable manner across socioeconomic groups. This does not mean that every group receives the same intensity of treatment, but rather that the people with the most need receive the greatest level of resources. I will measure this by determining how each intervention is applied and who receives the benefits and bears the costs. A qualitative score of “high”, “medium”, or “low” will be assigned to each alternative, with “high” indicating that the option is very equitable and “low” indicating that it is not equitable.

Administrative Feasibility

This criterion will evaluate the FMOH’s practical ability to implement the recommended policy alternative. I will determine the scope of each alternative based on required manpower, infrastructure, technical knowledge, and cost. I will then assign a qualitative score of “high”, “medium”, or “low” to the alternative given the FMOH’s ability to implement it with its current structure and resources. “High” indicates that the alternative is very feasible to implement, and “low” indicates doubt of administrative feasibility. As part of this criterion, I will also include sub-criteria that evaluate the level of political opportunity that exists to implement each alternative and prospects of capitalizing on efficiency gains through current programs and infrastructure.

Policy Alternatives

Based on an analysis of literature, best practices and conversations with my client, Results for Development, I propose three possible policy alternatives that the FMOH could pursue. These alternatives are mutually exclusive based on the limited budget allocated for NTD treatment and control by the FMOH. Each option will be evaluated on the criteria described above and I will compare the interventions using a matrix. The alternatives are as follows:

1. Let Present Trends Continue
2. Integrate and Scale Up Mass Drug Administration (MDA)
3. Implement Community-Led Total Sanitation (CLTS)

Let Present Trends Continue

Currently, a variety of NGOs, such as the Carter Center and RTI International, are investing in Nigeria's NTD response (RTI International, 2019). According to my client, it is uncertain to what extent this funding will continue after these organizations successfully eradicate lymphatic filariasis (LF). This means that there may be fewer funds available to address schistosomiasis and STH (not to mention the other high-prevalence or smaller-scale NTDs that currently exist in Nigeria's population.) As of 2017, less than three-quarters of Nigerian citizens requiring NTD treatment were able to access it ("Nigeria and neglected tropical diseases," 2017). With less donor aid to rely on, and no plan of concentrated government action, these rates could decline even further, despite recent gains. This is especially true of the northern and eastern regions of Nigeria, which are plagued by instability and conflict (RTI International, 2019). The populations in these regions are especially vulnerable to government inaction and a resurgence of schistosomiasis and STH. Additionally, few current interventions explicitly address the root cause of Nigeria's NTD burden, which is poor sanitation and hygiene and the FMOH is concerned about the sustainability of its NTD plan beyond 2020 (Nigeria Federal Ministry of Health, 2015).

If the FMOH were to allow present trends to continue, one could assume that it would replicate its activities from its 2015-2020 multi-year plan. As referenced in the section on Nigeria's baseline, this plan defined approaches for scaling up MDA interventions and strengthening capacity (Nigeria Federal Ministry of Health, 2015). The plan's goal was to achieve 75% treatment coverage for schistosomiasis and STH by 2020. Assuming that the program reaches this objective, the default option, without some sort of intervention, is to continue this level of treatment for the next five years, along with the current monitoring and evaluation initiatives. The budget for the 2015-2020 multi-year plan was \$214.4 million in 2017 dollars, and would remain at this quantity. The "let present trends continue" alternative accepts the status quo and does not make significant progress toward the 2030 SDG of NTD control and elimination. A new strategy is necessary and, with the following evaluation, I will show that "let present trends continue" is not a viable option. I will also use it as a baseline with which to compare the other alternatives.

Analysis

Sustainability: The “let present trends continue” option ranks medium to low using the sustainability criterion. The FMoH itself acknowledged that the self-sustaining nature of the current policy is questionable, contributing to its low ranking (Nigeria Federal Ministry of Health, 2015). Additionally, this alternative will continue to be reliant on outside aid from international NTD control initiatives and does not consider diversifying its funding base through integration with other types of programs.

Cost-Effectiveness: As this alternative establishes the baseline with which to compare the other options, I will not calculate the cost-effectiveness of letting present trends continue. However, the cost of this option would remain at the same level as the budget for the 2015-2020 multi-year NTD plan, which was \$214.4 million in 2017 dollars.

Cultural Feasibility: This alternative ranks quite high in terms of cultural feasibility. Because this program is already being applied across the country, and does not intend to extend to new communities, it should be acceptable to those who are already willingly experiencing it.

Equity: The option to let present trends continue is inequitable. Although it continues to cover and treat 75% of school-age children in need, this alternative fails to address the burden of schistosomiasis and STH for those who do not currently have access. This group is likely to have the most limited access to resources and be the most impoverished out of the whole population. Letting present trends continue does not equitably spread resources across socioeconomic groups.

Administrative Feasibility: This alternative ranks high in terms of administrative feasibility because it is the default option and is already being implemented throughout the country. However, it ranks much lower on political opportunity and efficiency gains. This intervention does not take advantage of the boosted domestic visibility and popularity that NTD control programs will gain after the elimination of LF in 2020, nor does it capitalize on potential efficiencies from integrating with other types of initiatives.

Integrate and Scale Up MDA

As previously discussed, preventive chemotherapy utilizes a combination of drugs to interrupt the transmission of NTDs (Bockarie et al., 2013). Governments and organizations deliver these medicines to large portions of the population via MDA. In this alternative, I recommend that Nigeria's FMOH integrate its schistosomiasis and STH MDA program with the HIV/AIDS and malaria control programs and scale up to reach a larger portion of the population. This will help control and prevent the transmission of STH and schistosomiasis.

Currently, MDA is being performed in certain regions of Nigeria and by a variety of governmental and non-governmental organizations at the community level (RTI International, 2019). Schistosomiasis and STH are often targeted together in MDAs because they affect similar populations (school aged children) and have similar treatment regimens. The FMOH in Nigeria uses donated drugs in its MDA program. The pharmaceutical company Merck donates praziquantel tablets for the treatment of schistosomiasis and Johnson & Johnson supplies mebendazole tablets to treat STH free of charge (Nigeria Federal Ministry of Health, 2015). These major pharmaceutical corporations have previously stated that they will continue to donate NTD medicines for "as long as needed", so it is likely that Nigeria will be able to rely on their support until elimination is achieved (Bockarie et al., 2013). Schoolteachers are the main conduits to reach students with de-worming medications. They act as community drug distributors (CDDs) by using dose poles to measure students and dispense tablets. In areas with low school attendance, community health workers typically hold the position of CDD and deliver de-worming pills at community centers (RTI International, 2019).

However, close to 16 million school-aged children still require treatment. Within its next multi-year master plan, the FMOH could coordinate the integration of NTD control efforts with HIV/AIDS and malaria programming and scale up the program, with the goal of obtaining 95% treatment coverage. This is the maximum coverage that has been attained in other countries and contexts (Turner et al., 2016). In 2021, which will be the start of the next master plan, Nigeria would begin this intervention. The FMOH would implement this rapid-impact program for five years and could evaluate the progress in 2026. This allows for adjustments in order to meet the SDG of NTD control and elimination by 2030.

This alternative has a number of benefits. Most NTDs are co-endemic with each other (meaning that they exist in the same region), so multiple infections can be addressed with one MDA (RTI International, 2019). Many NTDs are also co-endemic with malaria and HIV. Efforts to scale up MDA in regions that currently have bed-net distribution initiatives, for example, would benefit from efficiency gains of integrating the two programs (Peter J. Hotez et al., 2007).

Although it is widely accepted that school aged children (aged 5-14) are the population most likely to have a high burden of STH and schistosomiasis, and suffer the worst outcomes, some evidence has shown that total elimination would require expanding MDA to include adults and pre-school aged children (Turner et al., 2016). One study in Myanmar found that, in areas with high transmission of STH, re-infection occurred within six months of the previous MDA round. By the time of the next round, the STH prevalence had returned to its initial level, and the same individuals were being consistently infected (Dunn et al., 2019).

Analysis

Sustainability: This alternative ranks medium in terms of sustainability. To effectively control STH and schistosomiasis, MDAs must be repeated on at least an annual basis, which detracts from the sustainability of the intervention. This is because preventive chemotherapy does not address the root cause of these NTDs, which is poor sanitation and hygiene. Additionally, the FMoH will have to rely on outside aid, both monetary and technical, in order to fully implement this alternative, as well as the continuation of donated drugs. However, the integration of STH and schistosomiasis with HIV/AIDs or malaria programs improves the sustainability score because these programs are already well established and may be able to share funds with this initiative.

Cost-Effectiveness: MDA is considered one of the lowest-cost interventions in the public health sphere. This reflects the use of donated drugs, as well as economies of scale. MDA typically has high initial fixed costs, but decreasing costs per treatment as the program scales up (Peter J. Hotez, Fenwick, Ray, Hay, & Molyneux, 2018). By integrating NTD control programs with HIV/AIDs or malaria interventions, the FMoH could take advantage of further cost savings (Peter J. Hotez et al., 2011). According to my calculations, this alternative will cost an additional \$18.04 million (in constant 2017 dollars) to Nigeria, assuming the country continues to finance approximately half of its spending domestically. The total cost to both Nigeria and external donors is \$36.08 million. This alternative will lead to an additional 630,600 DALYs due to schistosomiasis and STH averted over the course of five years, compared to the baseline. Therefore, the cost-effectiveness of this option is \$29 per additional DALY averted.³

Cultural Feasibility: This alternative ranks high in terms of cultural feasibility. MDAs to treat STH and schistosomiasis are already in place in many regions of Nigeria, highlighting the fact that these populations have accepted them. The key feature that heightens the cultural feasibility of MDA is that trusted local community members, such as teachers and health workers, carry it out (RTI International, 2019). These figures understand the unique cultural contexts within each community and how to navigate them to successfully implement MDA (Bardosh, 2018).

Equity: The MDA integration and scale up alternative ranks high in terms of equity. Rapid-impact preventive chemotherapy is pro-poor. It provides quick relief from schistosomiasis and STH with little to no cost to the individual. This intervention in particular focuses on expanding opportunities for treatment to those with no previous access, who tend to be the most disadvantaged in society (Molyneux, Hotez, & Fenwick, 2005).

Administrative Feasibility: This intervention has medium to high administrative feasibility. MDA programs already occur throughout Nigeria, so the necessary technical knowledge currently exists within the FMoH and its partners. However, it may be difficult to integrate with other control programs, such as HIV/AIDs or malaria. There is little evidence of this type of integration in other countries, so the FMoH would have little to no practical guidance (Peter J. Hotez et al., 2018). In terms of political opportunity, the soon-to-be eradication of LF will boost the visibility and popularity of this intervention, especially because MDA was quintessential in the fight against LF.

³ See Appendix B for full cost analysis

Implement Community-Led Total Sanitation (CLTS)

Nigeria's president, Muhammadu Buhari, recently declared a state of emergency on water and sanitation, saying that "statistics on...access to piped water and sanitation in the country was disturbing" ("Buhari Declares State of Emergency on Water, Sanitation," 2018). Many NTDs spread through poor sanitation. STH results from contact with soil that has been exposed to the worms in an infected individual's feces and schistosomiasis is transmitted through contact with water contaminated by parasites from an infected person. Therefore, increasing access to improved sanitation can interrupt the chain of transmission by preventing contact with human excrement (Stewart, Laksono, Park, & Wang, 2016). With this alternative, I recommend that the FMOH continue its current level of MDA and implement community-led total sanitation (CLTS) within small, rural villages (which also tend to have the highest burden of NTDs) and offer subsidies or credit to those in the communities who are unable to afford toilets.

CLTS is a relatively new strategy pioneered to address lags in sanitation development. Approximately 25% of Nigeria's population practices open defecation (OD) (Augsburg, Abramovsky, Flynn, & Oteiza, 2016). As mentioned above, this allows for the easy transmission of STH and schistosomiasis. However, very little progress has been made in the past 20 years to improve sanitation. In many cases, OD is an entrenched, traditional behavior that villages practice. It can be very difficult to change this custom, even given the enormous health benefits (Schmidlin et al., 2013). CLTS works around this issue by involving the community in the decision-making process. In a CLTS intervention, organizers mobilize respected community leaders and trigger a village-wide discussion around sanitation and OD. The community decides which type of sanitation best meets its needs (improved pit latrine, septic tank, etc.) and each village member invests in constructing and maintaining this form of sanitation for his or her household (Augsburg et al., 2016). This investment and engagement creates buy-in to the goal of improving the overall sanitation of the community (Stewart et al., 2016).

The Bill & Melinda Gates Foundation recently financed a randomized control trial to study the impact of CLTS in the Nigerian states of Enugu and Ekiti. The experiment found heterogeneous effects. In urban and peri-urban environments, with populations exceeding 20,000, the CLTS had no impact on toilet ownership and OD. However, in poor rural settings, households exposed to CLTS interventions were 10 percentage points more likely to own a toilet and 10 percentage points less likely to report that any member of the household performed OD (Abramovsky, Augsburg, & Oteiza, 2018). This is a substantively significant decline in OD for a country that has struggled to make any gains in sanitation in the past two decades. The average community size in Nigeria is 2,000-12,000 individuals and approximately 30-50% of the population lives in hamlet-sized settlements. STH and schistosomiasis also tend to be highly endemic in these small and poor rural communities (Nigeria Federal Ministry of Health, 2015). Therefore, CLTS would be an appropriate intervention to address the root cause of NTDs in these settings. Over a five-year period, the FMOH could organize CLTS in villages under 20,000 people where schistosomiasis and STH are endemic. To help participants who are liquidity constrained, the FMOH could also provide grants or credit for latrine construction. In 2026, the FMOH could evaluate the program and make necessary adjustments to achieve the SDG of NTD control and elimination by 2030. This program also has the ancillary benefit of making progress toward the SDG of improving sanitation and eliminating OD by 2030. Adequate sanitation has a wide range of benefits outside of NTD prevention. Although not specifically addressed and tabulated in this report, they include prevention of various

fatal diseases, such as cholera, environmental protection, gender equality, and private benefits, such as comfort and increased home value (Augsburg et al., 2016).

Several WASH initiatives are already active in the country (RTI International, 2019). The FMOH could coordinate NTD control and elimination activities with these groups to take advantage of potential efficiency gains and cost-savings. This may also increase the fiscal sustainability of the NTD program by linking it to initiatives of which external donors have greater knowledge and may be more likely to support.

Analysis

Sustainability: This alternative will rank medium to high in terms of sustainability. Depending on the FMOH's ability to integrate this NTD program into other WASH initiatives, it may have to rely on significant outside aid. However, this policy option addresses poor sanitation, which is the root cause of schistosomiasis and STH, and does not have to be repeated annually, unlike MDA.

Cost-Effectiveness: Although financing adequate sanitation is typically a good investment, it is not quite as cost-effective as MDA. According to my calculations, implementing CLTS will cost an additional \$139.83 million (in constant 2017 dollars) to Nigeria over the course of five years. Once again, assuming that the government and people of Nigeria only provide funding for half of the expenses, the total cost of the program is \$279.65 million to both Nigeria and external donors. This intervention will lead to an additional 879,000 DALYs averted due to schistosomiasis and STH. Therefore, the overall cost-effectiveness of the alternative is \$159 per additional DALY averted.⁴ This analysis did not account for DALYs from other diseases, such as cholera, that can be prevented with adequate sanitation.

Cultural Feasibility: The CLTS alternative ranks medium in terms of cultural feasibility. This option depends on changing the attitudes and practices of communities regarding OD, which is traditional, engrained behavior for many people. However, this grassroots alternative utilizes community leaders for implementation and allows the communities to adjust based on their own unique needs, which improves its cultural feasibility score.

Equity: This program ranks medium in terms of equity. Although CLTS is implemented at the community level, private citizens must each pay for their household's toilet. This could be detrimental to the most impoverished in society, who may be left out of the intervention. Therefore, it is of utmost importance that the FMOH and its partners successfully target these individuals with grants or credit to improve the equity of the program.

Administrative Feasibility: This alternative ranks medium in terms of administrative feasibility. It will likely be challenging to organize CLTS, as it is a relatively new program, as well as implement a grant or credit program to support very low-income individuals. However, with President Buhari's recent declaration of a state of emergency with respect to sanitation, the political opportunity to implement this program is readily available. Additionally, this option could take advantage of potential efficiency gains by cooperating with other WASH initiatives, which improves its administrative feasibility score.

⁴ See Appendix B for full cost analysis

Comparative Evaluation

To evaluate the three policy options using the specified criteria, I generated the following outcomes matrix. In my consideration, each criterion was given equal weight, but this template could be adjusted to emphasize a particular outcome with a greater weight.

Table 1: Outcomes Matrix

Goals	Impact Category	Alternatives		
		Current Policy	MDA Scale Up	CLTS
Sustainability	Self-Sustaining	Low	Medium	High
	Independence from Foreign Aid	Medium	Medium	Medium
Cost-Effectiveness	Additional cost to Nigeria (in constant 2017 USD)	-	18,038,276	139,827,452
	Additional effectiveness (in DALYs averted due to NTDS)	-	630,567	879,027
	Cost-effectiveness (\$/DALY averted)	-	29	159
Cultural Feasibility	Cultural Feasibility	High	High	Medium
Equity	Equity	Low	High	Medium
Administrative Feasibility	Administrative Feasibility	High	Medium	Medium
	Political Opportunity	Low	High	High
	Potential Efficiency Gains	Low	High	High

Recommendation: Alternative 2

I recommend that the FMoH implement policy alternative 2: Integrate and Scale Up Mass Drug Administration. This option is highly cost-effective compared to the CLTS intervention, yet still addresses a variety of concerns regarding equity and feasibility. Integrating and scaling up MDA effectively utilizes existing infrastructure and programs to extend treatment coverage for STH and schistosomiasis to up to 95% of school aged children in need.

This policy alternative is not without challenges. In terms of administrative feasibility, it may be quite difficult to integrate with other control programs, such as HIV/AIDS or malaria. Many other countries have not yet achieved this type of integration, so it is challenging to find examples of best practices for this process. However, it is worth an attempt to take advantage of the efficiency gains and economies of scale that generate cost-savings through integration. The other challenge of the MDA scale up option involves its sustainability. Except for certain diseases, such as LF, MDA will not eliminate an NTD from a region, but rather control the disease's transmission. Mass drug administration does not address the root cause of schistosomiasis and STH, which is lack of sanitation. This means that MDA must be repeated every year in order to achieve the desired increase in coverage and DALYs averted, which threatens the program's sustainability. By diversifying its funding base through integration with HIV/AIDS and malaria programs, the FMoH may be able to improve the sustainability of this intervention and decrease reliance of one type of outside aid

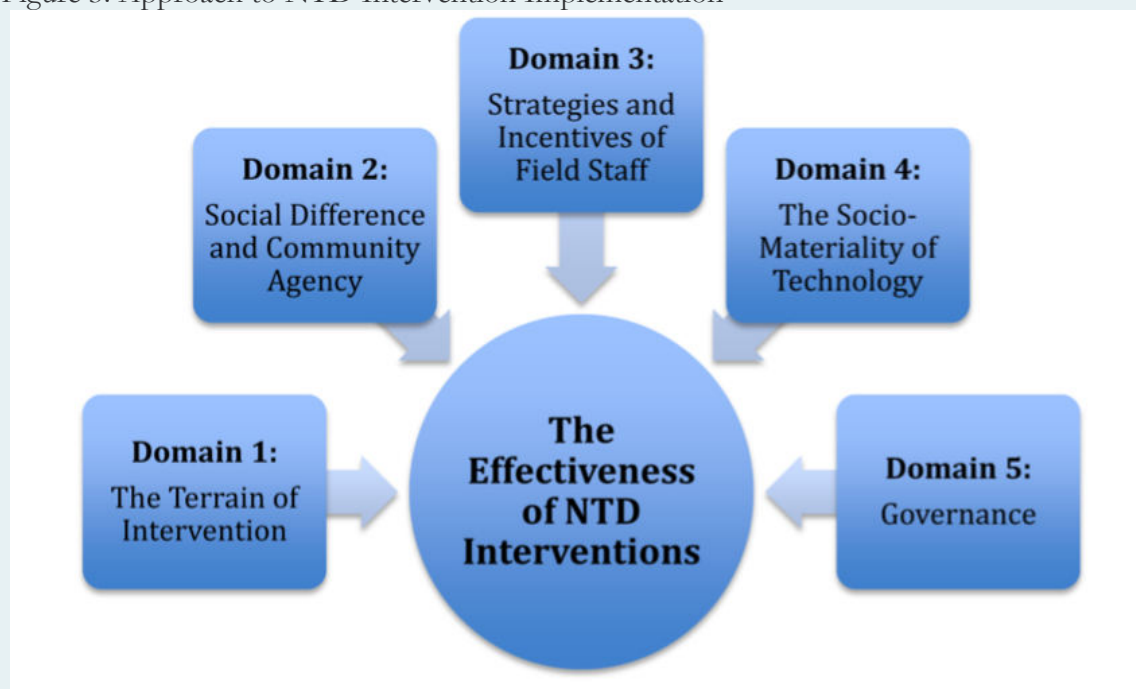
A wide range of health organizations has encouraged MDA scale up and integration because of its low cost and ability to drastically reduce the disease burden of schistosomiasis and STH without intruding significantly into community life and culture ("WHO | The neglected tropical diseases," 2017). The benefits of this option clearly outweigh the costs and the FMoH should adopt MDA scale up and integration as its key NTD strategy moving forward.

There is one caveat to this recommendation. In communities where MDA is no longer necessary or has not proven effective, the FMoH may consider implementing pilot versions of the CLTS program, if appropriate. This would allow the government and its partners to gain experience in this type of intervention and also provide assistance to areas that may be unaffected or no longer require MDA for schistosomiasis and STH. It would also generate valuable information on the effectiveness of the CLTS program in different local contexts.

Guidelines for Implementation

A policy that extends across the entirety of Nigeria will be impossible to implement in the same manner in every region. However, there are best practices from the literature that can be mimicked to promote the effectiveness of an MDA intervention. Of utmost importance is to consider the local contexts in which the policy will be applied. Bardosh recommends that the implementation of the policy reflect five domains. The first, the terrain of intervention, requires understanding the available resources, both tangible and intangible (such as knowledge, political will, etc.) in the local environment. The second domain, social difference and community agency, signifies an engagement with the social organizations and networks of relationships within the region where the policy is being applied. The necessity of understanding the field staff and their incentives encompasses the third domain, as these are the individuals who will connect the intervention with the intended recipients. In the case of MDA, the field staff are schoolteachers and community health workers. The fourth domain involves the consideration of local technologies and how they can either support or disrupt the policy. For example, the use of a dose pole to determine the number of de-worming tablets a young child needs is an illustration of the effective integration of appropriate technology into the MDA intervention. Finally, the fifth domain, governance, requires an understanding of the bureaucratic processes and authority structures in a region. In Nigeria, all of the individual states are further divided in local government areas, and it is these groups that are often charged with coordinating MDA in their communities (Bardosh, 2018).

Figure 3: Approach to NTD Intervention Implementation



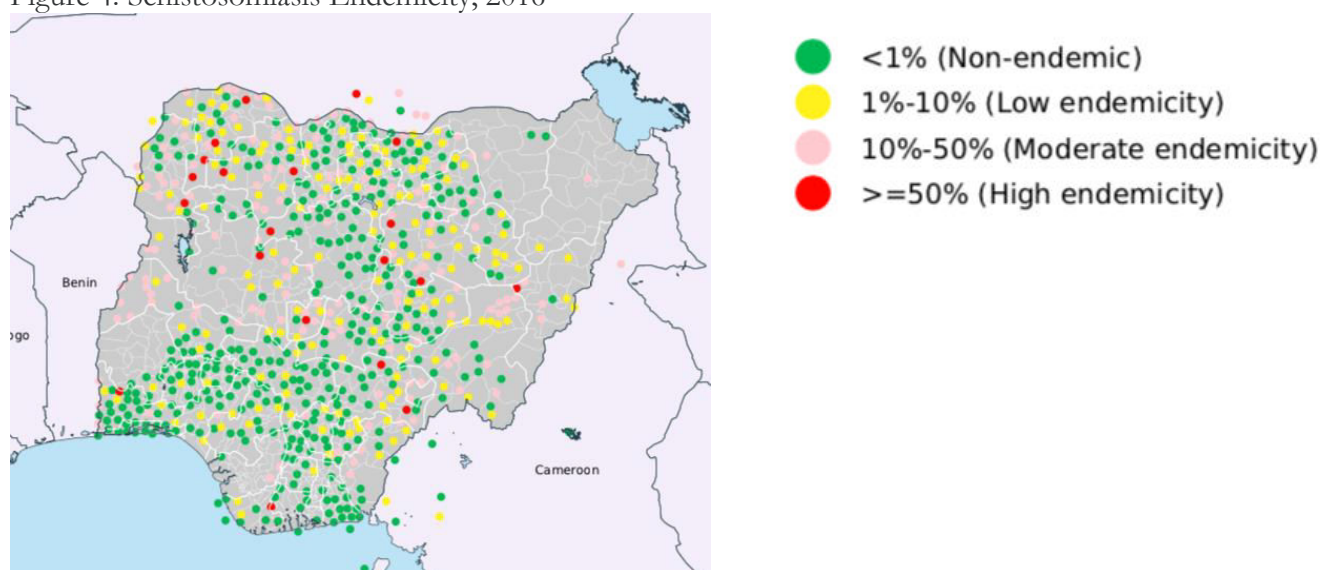
Source: (Bardosh, 2018)

Appendix A - Glossary

High Prevalence NTDs of Interest

Schistosomiasis: This disease is caused by worms and transmitted by snails into water sources and can penetrate intact human skin that comes in contact with the contaminated water. Water sources are typically contaminated through the excrement of an infected individual. This disease initially leads to fever and lethargy, but may cause more insidious issues over time, such as renal failure or bladder cancer (Feasey et al., 2010). The groups most affected by schistosomiasis are the rural poor and school-aged children. Health workers use the drug praziquantel to treat schistosomiasis and determine the correct dosage with a dose pole, administering 40mg of praziquantel per kilogram. MDA for schistosomiasis control is carried out on an annual basis in most areas (P. J. Hotez, 2009).

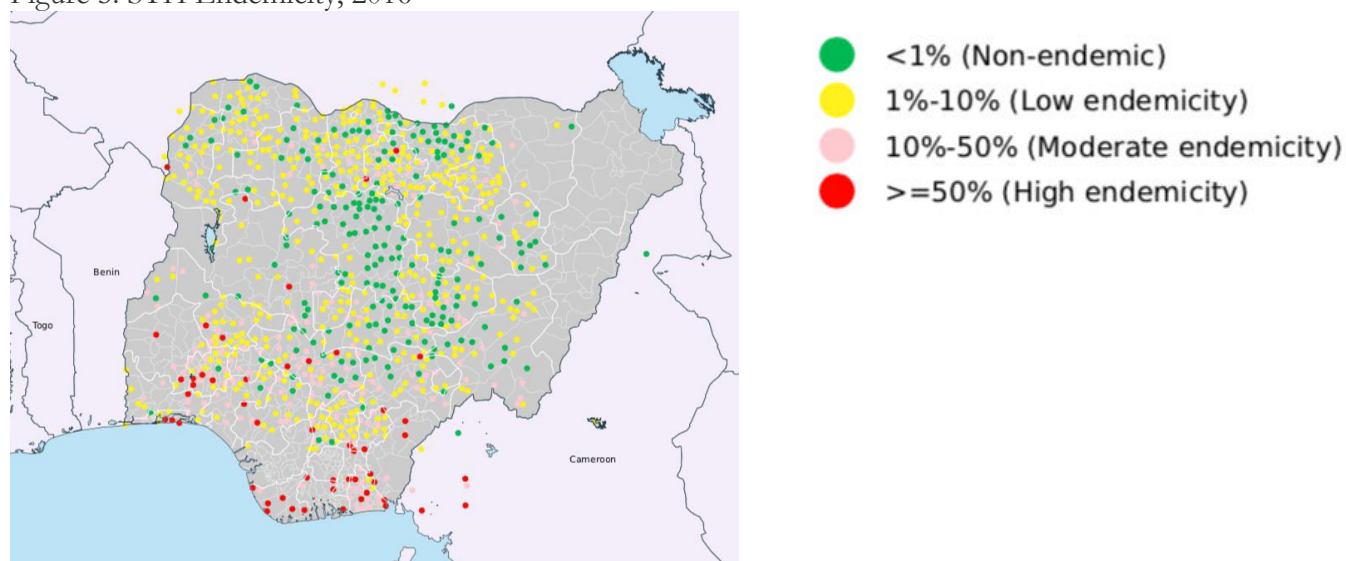
Figure 4: Schistosomiasis Endemicity, 2016



Source: WHO ESPEN

Soil-transmitted helminthes: Ascaris, trichuris, and hookworm are further grouped in a category called soil-transmitted helminthes (a term for worm), meaning that they acquired through contact with worm-contaminated soil. Soil is contaminated through the feces of an infected person. The soil-transmitted helminthes are especially problematic in children and cause stunting, as well as reduced mental fitness (Feasey et al., 2010). In Nigeria, health workers treat STH with 500mg mebendazole tablets. MDA for STH is carried out on an annual basis (P. J. Hotez, 2009).

Figure 5: STH Endemicity, 2016



Source: WHO ESPEN

Appendix B - Cost Analysis

Nigeria has the greatest burden of high-prevalence NTDs in sub-Saharan Africa and the FMOH must develop policy to address them, particularly STH and schistosomiasis, in a sustainable manner. To evaluate the policy alternatives, I conducted a cost-effectiveness analysis. I used best estimates from the literature to determine the additional costs of each option in constant 2017 USD and the additional effectiveness in DALYs due to STH and schistosomiasis averted compared to the baseline, which is to let present trends continue. The two alternatives are to integrate and scale up mass drug administrations (MDA) or to implement community-led total sanitation (CLTS). This appendix outlines key assumptions and procedures in determining the cost-effectiveness of each option.

For each analysis, I assumed a discount rate of 3.0% based on WHO CHOICE guidelines (Edejer & World Health Organization, 2003). I also assumed that the population growth of Nigeria would remain around 2.6% in order to determine the population size each year from the start of the interventions in 2021 until the conclusion in 2026 (“Nigeria Population (2019) - Worldometers,” 2019). Finally, I assumed that Nigeria would only pay for 50% of the costs of each intervention, as suggested its current spending patterns (R4D, 2019). The cost-effectiveness ratios do not take into account spending by external entities.

Integrate and Scale Up MDA

Preventive chemotherapy utilizes a combination of drugs to interrupt the transmission of NTDs (Bockarie et al., 2013). Governments and organizations deliver these medicines to large portions of the population via MDA. This alternative recommends that Nigeria’s FMOH scale up its MDA program over a period of five years from 2021-2026 and integrate with HIV or malaria initiatives to take advantage of economies of scale.

The necessary assumptions to calculate the primary social costs of MDA are tabulated below:

Table 2: MDA Scale Up Cost Assumptions

Cost Component	Assumed Value	Source
Average annual cost per person in MDA (2017 USD)	0.40	Sinick, 2011
Number of people requiring STH treatment in 2021	15,015,118	Uniting to Combat NTDs, 2017 & population data
Number of people requiring schistosomiasis treatment in 2021	4,831,433	Uniting to Combat NTDs, 2017 & population data
MDA Coverage	95%	Turner et al., 2016
Coendemicity	15%	Estimate

To calculate the costs, I multiplied the average annual cost per person in MDA by the number of people who require each type of treatment and the MDA coverage. I also accounted for coendemicity, which I assumed to be around 15% and population growth (World Health Organization, 2012).

The primary social benefit of MDA is the disability adjusted life years (DALYs) averted due to NTD prevention. This is an unpriced benefit and will remain as a measure of effectiveness in DALYs averted. The DALY burden was calculated using the 2010 study on the global burden of disease and other measures of disability weights (Peter J. Hotez et al., 2014). The assumptions to find the total effectiveness of the program are listed below:

Table 3: MDA Scale Up Effectiveness Assumptions

Benefit Component	Assumed Value	Source
Disability weight of STH	0.003	Sinick, 2011
Disability weight of schistosomiasis	0.035	Hotez et al., 2014
Number of people requiring STH treatment in 2021	15,015,118	Uniting to Combat NTDs, 2017 & population data
Number of people requiring schistosomiasis treatment in 2021	4,831,433	Uniting to Combat NTDs, 2017 & population data
Effectiveness of STH treatment	66%	Sinick, 2011
Effectiveness of schistosomiasis treatment	52.5%	Sinick, 2011

In the attached spreadsheet, I tabulated the annual costs and effectiveness of the MDA approach for five years. Using a discount rate of 3%, I calculated the NPV of the costs and outcomes. The total cost over five years was approximately \$18 million in domestic spending. The total number of DALYs averted in current terms was about 630,600. The cost per DALY averted using the MDA scale up approach is approximately \$29.

Implement Community-Led Total Sanitation

In addition to individual patient care, wider public health measures are also important to truly eliminate NTDs from the entire population. Countries must consider health education, sanitation, and hygiene strategies in their approach to NTDs (Hopkins, 2013).

Community-led total sanitation (CLTS) is the name of a method pioneered by WaterAid in Nigeria to address lack of sanitation in the states of Ekiti and Enugu. This approach tackles issues on the demand sides for sanitation. It is grassroots and mobilizes local communities to choose and implement their own sanitation strategies (Abramovsky, Augsburg, & Oteiza, 2015). A pilot study found that, in poor communities, CLTS significantly reduced open defecation (Abramovsky et al., 2018). Because many NTDs are propagated through the oral-fecal route, a reduction in open defecation can interrupt the transmission of NTDs from one person to another.

The primary costs of CLTS are toilet installation and maintenance and salaries for community organizers. These are estimated in the table below:

Table 4: CLTS Cost Assumptions

Cost Component	Assumed Value	Source
Cost per toilet installation (2017 USD)	112	Hutton & Haller, 2004
Average annual maintenance cost per toilet (2017 USD)	10.95	Hutton & Haller, 2004
Number of toilet purchases	1,692,101	Estimate based on population size and literature: Abramovsky et al., 2018
Number of community organizers	217	Estimate based on population size and literature: Abramovsky et al., 2018
Annual community organizer salary (2017 USD)	3,002	McCoy et al., 2008

To calculate the number of toilet purchases, I estimated the number of households exposed to the intervention based on demographic data from Nigeria and the effectiveness of the intervention in incentivizing toilet purchases (Abramovsky et al., 2018). I also estimated the number of community organizers based on the number of treated villages.

As before, the primary social benefit of CLTS is the disability adjusted life years (DALYs) averted due to NTD prevention. However, there may also be other secondary health benefits from preventing other oral-fecal based diseases, such as cholera. Additionally, private benefits may accrue to families and community members who utilize the improved sanitation measures and to businesses that supply them. To measure the effectiveness of CLTS at preventing NTDs, I found estimates on the effectiveness of the intervention at preventing open defecation (Abramovsky et al., 2018).

Table 5: CLTS Effectiveness Assumptions

Benefit Component	Assumed Value	Source
Disability weight of STH	0.003	Sinick, 2011
Disability weight of schistosomiasis	0.035	Hotez et al., 2014
Number of people exposed to CLTS with STH in 2021	29,611,774	Estimate based on population data and disease burden
Number of people exposed to CLTS with schistosomiasis in 2021	42,302,534	Estimate based on population data and disease burden
CLTS effectiveness at preventing NTDs	10%	Estimate based on literature: Abramovsky et al., 2018

In the spreadsheet, I calculated the annual costs and effectiveness of the CLTS approach for five years. Using a discount rate of 3%, I calculated the NPV of the costs and outcomes. The total cost over five years was approximately \$139.8 million in domestic spending. The total number of DALYs averted due to schistosomiasis and STH in current terms was about 879,000. The cost per DALY averted using CLTS is approximately \$159.

Sensitivity Analysis

Data on the costs and effectiveness of NTDs interventions is limited and may not always apply to every context. I tested the sensitivity of my analysis to a change in the annual per person price of MDA to account for the wide range of possible costs cited in literature. One study found that in rural South Sudan, the annual per person price of MDA is \$1.50 (Kolaczinski, Robinson, & Finn, 2011). When I adjusted my calculations using this number, the cost per DALY averted rose to \$116 in constant 2017 terms. Although the MDA scale up alternative is still more cost-effective than the CLTS initiative, it is important for policymakers to keep the upper bound of cost-effectiveness in mind. I also tested the effectiveness of CLTS in preventing schistosomiasis and STH. When I increased the effectiveness to 15%, the cost per DALY averted dropped to \$106. However, this alternative does not approach the cost-effectiveness of MDA (\$29/DALY averted) until its effectiveness reaches 50%, which seems unrealistic.

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