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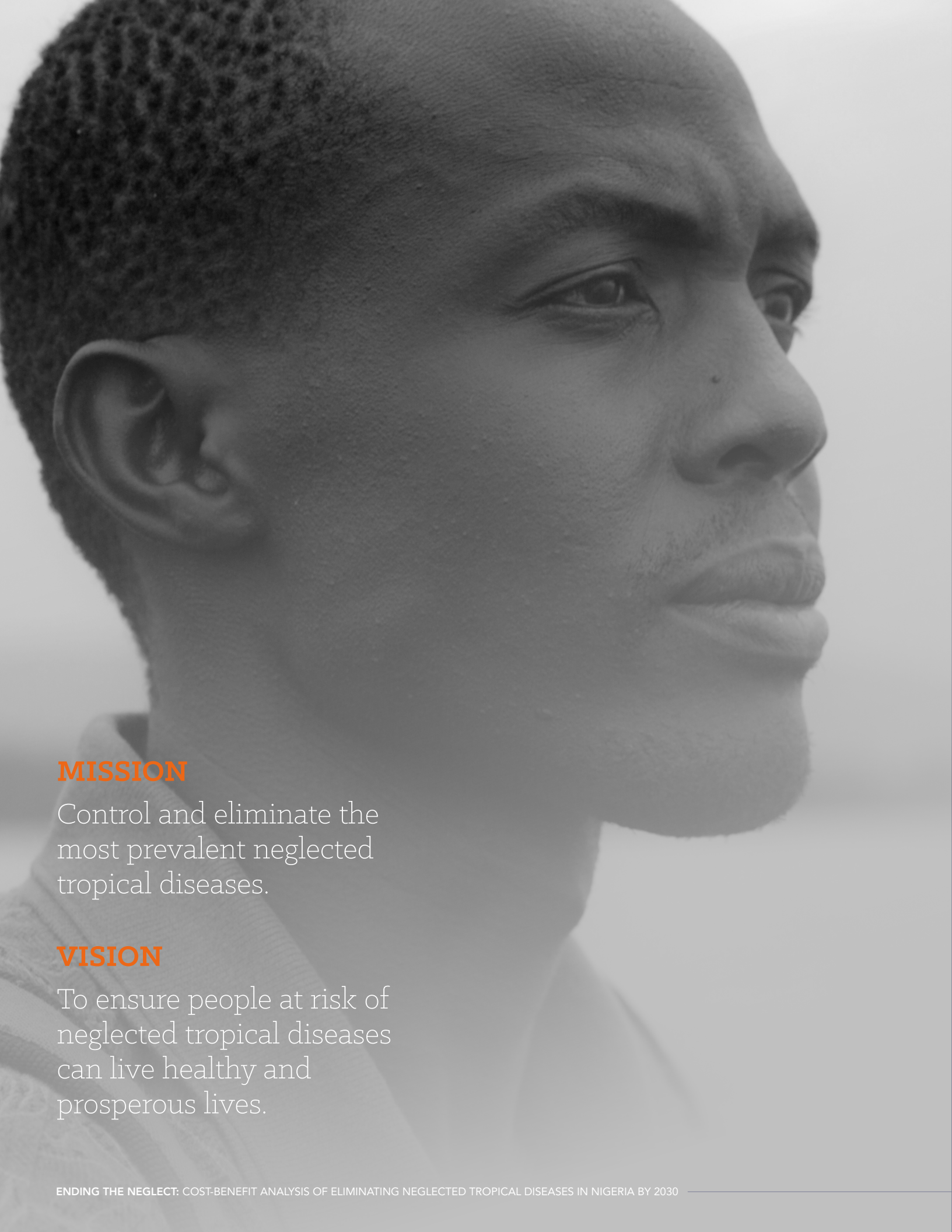
ENDING THE NEGLECT: COST-BENEFIT ANALYSIS OF ELIMINATING NEGLECTED TROPICAL DISEASES IN NIGERIA BY 2030



MISSION

Control and eliminate the most prevalent neglected tropical diseases.

VISION

To ensure people at risk of neglected tropical diseases can live healthy and prosperous lives.

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EXECUTIVE SUMMARY

1.

The END Fund has commissioned Deloitte to prepare this economic impact study on the elimination of the five most common **Neglected Tropical Diseases** (NTDs) in Nigeria to advance the elimination of NTDs.

The report's main objective is to holistically present the key economic and social benefits of eliminating the five most prevalent NTDs in Nigeria by 2030, including long-term financial returns and a cost-benefit assessment of elimination programs.

Although the overall progress regarding the control and elimination of NTDs has accelerated in the last decade, neglected tropical diseases still constitute a major risk for a significant part of the world's population, devastatingly affecting the most economically disadvantaged communities. The analysis presented in this report shows that in Africa, the share of the population suffering from NTDs is negatively related to wealth, meaning that as countries develop their economies, they become better at handling NTDs through investment. Additionally, the elimination of NTDs is correlated with good educational outcomes. Studies suggest a bidirectional causative relationship between the two, eliminating the diseases and advancing education, including fostering combatting NTDs.

Nigeria has the most significant NTD burden on the continent, accounting for about 25% of Africa's NTD cases. About 165 million Nigerians currently need treatment for

84%

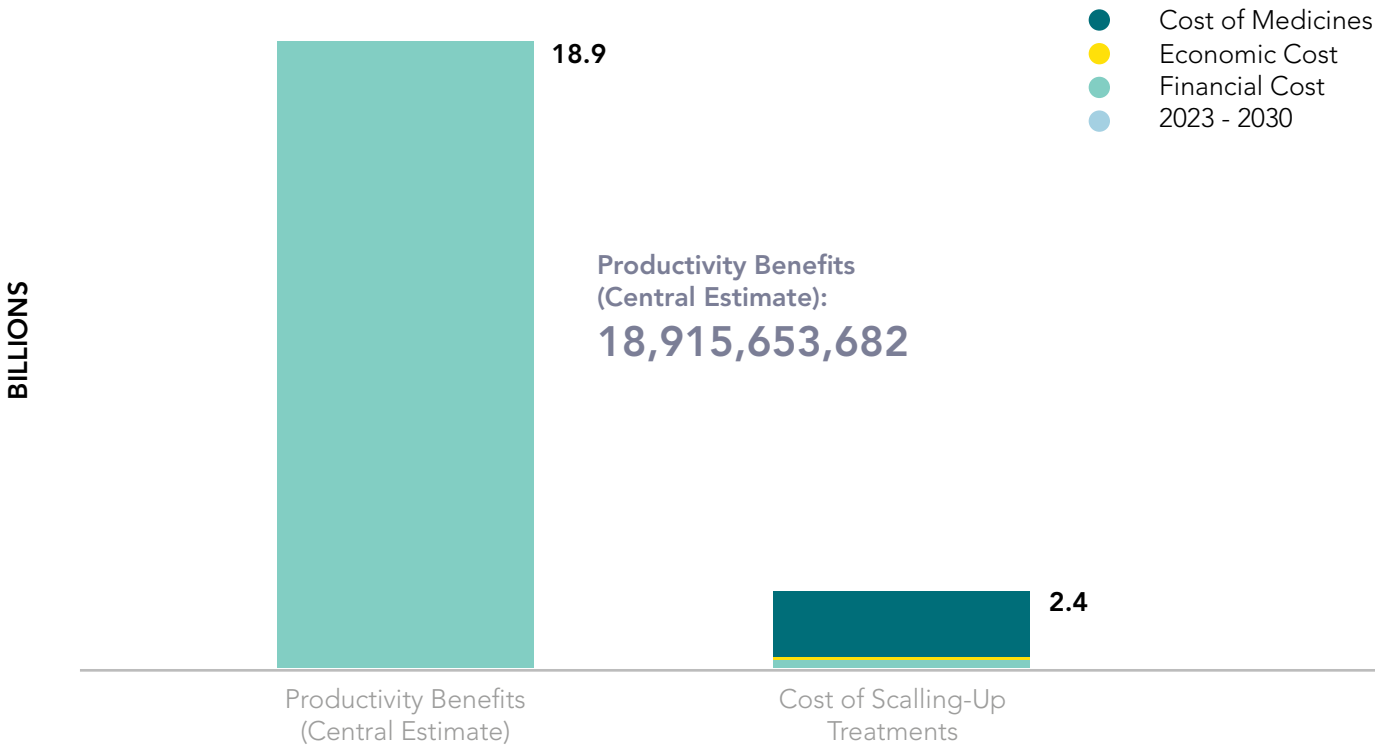
OF THE NIGERIAN POPULATION NEED TREATMENT FOR ONE OR MORE TYPES OF NTDS

one or more types of NTDs, representing 84% of the entire population. With a projected population increase of 263 million by 2030, NTDs must be effectively addressed. Most of this increase will come from children and young adults, which is accounted for in the subsequent cost-benefit analysis with

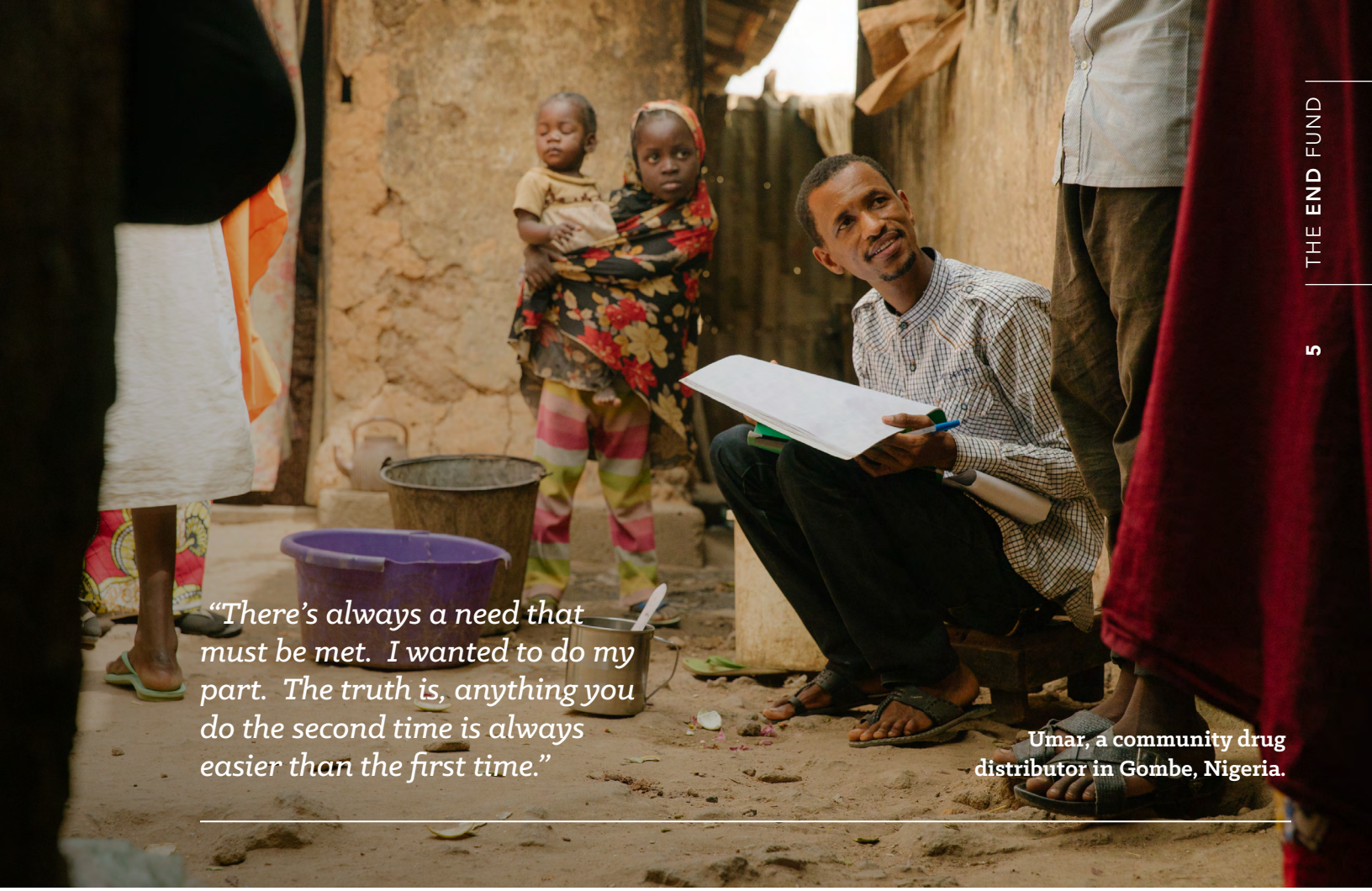
trends in age- and sex-specific prevalence rates, as well as United Nations age- and sex-specific population projections. Nigeria has achieved a certain degree of progress in its bid to fight NTDs and currently ranks 7th in the Africa league of countries addressing them. However, a lot more effort in terms of financing and resource allocation is still needed to control and ultimately eliminate NTDs in Nigeria and, in so doing, mitigate their impact on well-being, education, and productivity. Additional resources are required from all relevant stakeholders to achieve this, including the Federal and State Ministries of Health, multilateral and development organizations, local NGOs, businesses, community-based associations, philanthropical organizations, and the media.

The Nigerian economy will reap USD 18.9 billion from its citizens' increased productivity in 2023-2030 if NTD elimination is achieved by 2030. These gains would also continue beyond 2030, as individuals who are cured or avoid infection live more productive and fulfilling lives. The most significant benefits are the elimination of Soil-Transmitted Helminths (STH) and Schistosomiasis (USD 6.8 billion and USD 8.3 billion, respectively). While these are not the most severe NTDs, their elimination would have a significant economic impact due to the very high numbers of infected individuals. In the case of Onchocerciasis, Lymphatic Filariasis (LF), and Trachoma, total gains for the 2023-2030 period would equal USD 1.9 billion, USD 1.8 billion, and USD 67.4 million, respectively. The total cost of scaling up treatments is estimated at USD 2.4 billion over the 2023-2030 horizon, conservatively assuming that the Nigerian government is paying for all the medicines, even though they are usually donated. Their cost is estimated at USD 2.0 billion. The remaining components of the scale-up costs are the economic cost (amounting to USD 69 million) and the financial cost (i.e., an extension of financial costs amounting to USD 333 million). These benefits and costs associated with eliminating the five studied NTDs in Nigeria until 2030 are shown in Figure 1.

Figure 1. Cost-benefit analysis of productivity gains (central estimate) and total costs 2023-2030 discounted to 2022



Source: Own calculation



Although productivity gains are the largest, backed by the most reliable data and widely acknowledged in the scientific literature, they are not the only benefits of eliminating NTDs. **Additional economic benefits include avoided out-of-pocket expenses, freed-up productivity of caregivers, and gains due to increased school attendance.** Total accumulated gains from avoided out-of-pocket expenses for LF treatment for the 2023-2030 range would amount to USD 463.3 million. Gains to the Nigerian economy from the freed-up productivity of caregivers for the same period could yield USD 5.8 billion for all five most common NTDs in Nigeria. Additionally, this study shows that Nigerian school-age children infected with NTDs could lose as much as USD 7.2 billion in discounted earnings over their working lives if they are not treated.

Even the most conservative cost estimates of additional preventive chemotherapy treatments needed to achieve elimination by 2030 are vastly outweighed by the estimated economic benefits. The overall net productivity gains of eliminating the five studied NTDs in the 2023-2030 horizon amount to USD 18.5-18.6 billion, assuming that the drugs are donated. That said, even if Nigeria were to pay for the medicines, the net benefits would still be as high as USD 16.5 billion. Net economic benefits are even more significant, swelling to USD 22.6 billion when additional increases resulting from the freed-up productivity of caregivers and avoided out-of-pocket treatment expenses for LF are taken into account.

Since this study follows a very conservative approach to calculating costs and benefits, net gains from NTD elimination are likely to be larger than those stated here. Due to a lack of reliable data, certain elements that reduce the cost of treatment delivery (such as using volunteers or school-based delivery) have not been considered. In the baseline analysis, the cost of drugs is also included, accounting for more than 80% of the program's total cost. Therefore, the estimated USD 2.4 billion over 2023-2030 presented in this report should be treated as an upper limit of the cost associated with scaling up the current programs to achieve elimination by 2030.

Delaying elimination programs or reducing the scale of ongoing mass administration of medicines (MAM) campaigns not only leads to lost gains from previous efforts but can also increase costs in the long run. Thus, it is much more cost-effective to make a considerable initial investment to combat NTDs as quickly as possible rather than taking small steps over a long period.

NEGLECTED TROPICAL DISEASES (NTDS):

CURRENT GLOBAL SITUATION AND LONG-TERM TRENDS

2.

DEFINITION AND ESSENTIAL FEATURES OF NTDS

Neglected Tropical Diseases are a group of conditions that prevail primarily in tropical areas, affecting predominantly economically disadvantaged segments of society. The diseases are often chronic and cause severe symptoms that significantly hinder the ability of an infected individual (of whom there are more than 1 billion worldwide) to lead an independent life. The diseases are labeled "neglected" since they have not received due attention historically. They are primarily present in countries with inadequate water quality, sanitation, and access to health care. Currently, the World Health Organization (WHO) lists 20 NTDs. However, this study focuses on Nigeria's five most common NTDs. An overview is presented in Table 1.

Disease	Cause and source of infection	Symptoms	Persons needing treatment worldwide in 2020	Population living in Implementation Units requiring treatment in Nigeria in 2020
Lymphatic Filariasis (Elephantiasis)	Caused by infection with filarial parasites Wuchereria bancrofti, Brugia malayi and B. timori. Transmitted by mosquito species Culex, Anopheles, Mansonia and Aedes	Chronic, overt manifestations of lymphoedema and hydrocele as	859m	135m
Onchocerciasis (River blindness)	Caused by infection with the worm Onchocerca	well as acute episodes of adenolymphangitis	220m	52m
Schistosomiasis (Snail fever)	Volvulus. Transmitted through repeated bites of infective Simulium blackflies	Itching, skin changes, and visual impairment which can lead to permanent blindness	240m	26.4m
Soil-transmitted helminths (STH, Intestinal worms)	Larval forms of trematode worms released by freshwater snails penetrating human skin during contact with freshwater	Abdominal pain, diarrhea, blood in the stool, liver enlargement	835m (children only, as counted by WHO)	46.2m
Trachoma	Caused by infection with intestinal parasites, hookworms, and roundworms. Transmitted by parasites' eggs or larvae which end up in human faeces, contaminating the soil in areas where sanitation is poor	Anaemia, malnutrition, impaired physical and cognitive development, abdominal pain and diarrhoea	136m	9.3m

Sources: For diseases causes, sources of infection, and symptoms: WHO (2020) Ending the neglect to attain the Sustainable Development Goals: a road map for neglected tropical diseases 2021–2030; For population needing treatment & living in Implementation Units: WHO ESPEN & Global Burden of Disease databases

Available literature provides an overview of the socio-economic burden caused by these diseases and the estimated economic cost. This is presented below:

Lymphatic Filariasis

Lymphatic Filariasis (LF) is estimated to directly affect 859m people worldwide. Its principal effects are skin thickening and scrotal / tissue swelling. These substantially mar the physical capabilities of those infected, and the resulting skin deformations make them prone to social stigma, leading to sub-optimal mental health.

In a 2020 study by Mathew et al., the average burden of a chronic case of LF was estimated at USD 115, with a significant part of this resulting from productivity losses and subsequently lost income at the household level. The total productivity estimates were measured in several ways, and their results vary between US USD1.5 billion to US USD13.2 billion, depending on the selected economic approach. However, a different study from 2017 by Bettis et al. found that the projected cost-effectiveness of global MAM for LF was high and robust over a wide range of costs and assumptions.

Trachoma

Trachoma is a major cause of blindness of infectious origin and strongly correlates with poverty. As a result, a bidirectional causative relationship between poverty and TTrachoma was found to be likely .

In 2003, the total productivity loss caused by TTrachoma was estimated at USD 5.3 billion, and visual loss caused by Trachoma worldwide was estimated at 3.6 million disability-adjusted life years (DALYs). Meanwhile, in 2009, the WHO estimated the burden of trachoma-induced visual loss at 1.3 million DALYs. These estimates differ primarily due to variations in the assessment of induced productivity loss (Frick et al. assume a 100% productivity loss caused by blindness, while the WHO assumes a 60% productivity loss). Moreover, estimates of the burden caused by Trachoma are subject to a margin of error due to limited data from surveys taken in endemic regions

Onchocerciasis (River Blindness)

Onchocerciasis is one of the major causes of blindness, particularly in Central and West Africa. In 2019, there were 3.8 million cases of blindness and 5.3 million cases of low vision caused by Onchocerciasis, resulting in a potential productivity loss of USD 2.9 billion.

The estimated cost per disability-adjusted life year (DALY) averted by annual MAM varies between USD 3 and USD 30 (cost year variable). In endemic African regions, switching from control to elimination induced cost-savings of USD 1.5 billion and USD 1.6 billion, respectively.

School boy washing his hand using a tippy tap

Soil-Transmitted Helminths (STH, Intestinal Worms)

STH infections significantly impact the social and economic development of communities where prevalence is high. This is because the worms affect an adult's ability to work and cause school absenteeism among children.

A study by Turner et al. found that the optimum STH treatment strategy targeting different age groups or frequency of treatment is particular to the local epidemiology. Moreover, in some areas (particularly those with high transmission rates), it may be more cost-effective to use more expensive but intensive treatments at the onset. In another study, Turner et al. confirmed economies of scale for STH treatment, indicating that assuming a fixed treatment cost per person leads to overestimations.

Schistosomiasis (Snail Fever)

SSchistosomiasis causes malnutrition, absenteeism, and impaired intellectual development. Children suffering from persistent and severe infections are likely to have chronic and irreversible diseases later in life, such as scarring (fibrosis) of the liver, bladder cancer, or kidney failure.

In the Global Burden of Disease Study 2016, the global burden of Schistosomiasis was estimated at 1.9 million DALYs, while earlier studies put the number at 1.7–4.5 million DALYs. Estimating the number of deaths caused by Schistosomiasis infections is challenging due to hidden pathologies, e.g., liver or kidney failure, bladder cancer, or ectopic pregnancies caused by female genital Schistosomiasis.

More detailed information on NTDs in Nigeria is covered in Section 3.1.

GLOBAL TRENDS AND CORRELATIONS

Despite nearly 1.7 billion people being affected and hundreds of thousands dying yearly, NTDs are given much less attention globally than other similarly harmful diseases. The programs addressing them have not reached all those affected. Many places remain where NTDs are still a cause of significant burden, disabling those infected from everyday life and limiting the scope of possibilities for those caring for them. The COVID-19 pandemic brought significant disruptions to the programs aimed at controlling and eliminating NTDs. While many South American and European countries are currently (as of Spring 2022) enjoying a return to pre-COVID life, meager vaccination rates in African countries (e.g., in Nigeria, only 7.7% of the population was fully vaccinated as of 10 May 2022) impose additional risks on activities addressing NTDs.

It should be noted that overall progress towards controlling and eliminating NTDs has accelerated in the last decade, primarily due to the WHO's first road map for the prevention and control of NTDs, published in 2012. In 2019 (the latest WHO data available), 1.74 billion people were reported to require mass or individual treatment for NTDs, down from 2.19 billion in 2010. The share of people who reported needing treatment for NTDs in 2010 and 2019 is shown below.

Source:
`WHO, The Global Health Observatory

Figure 2. Share of the population reported needing interventions against NTDs in 2010

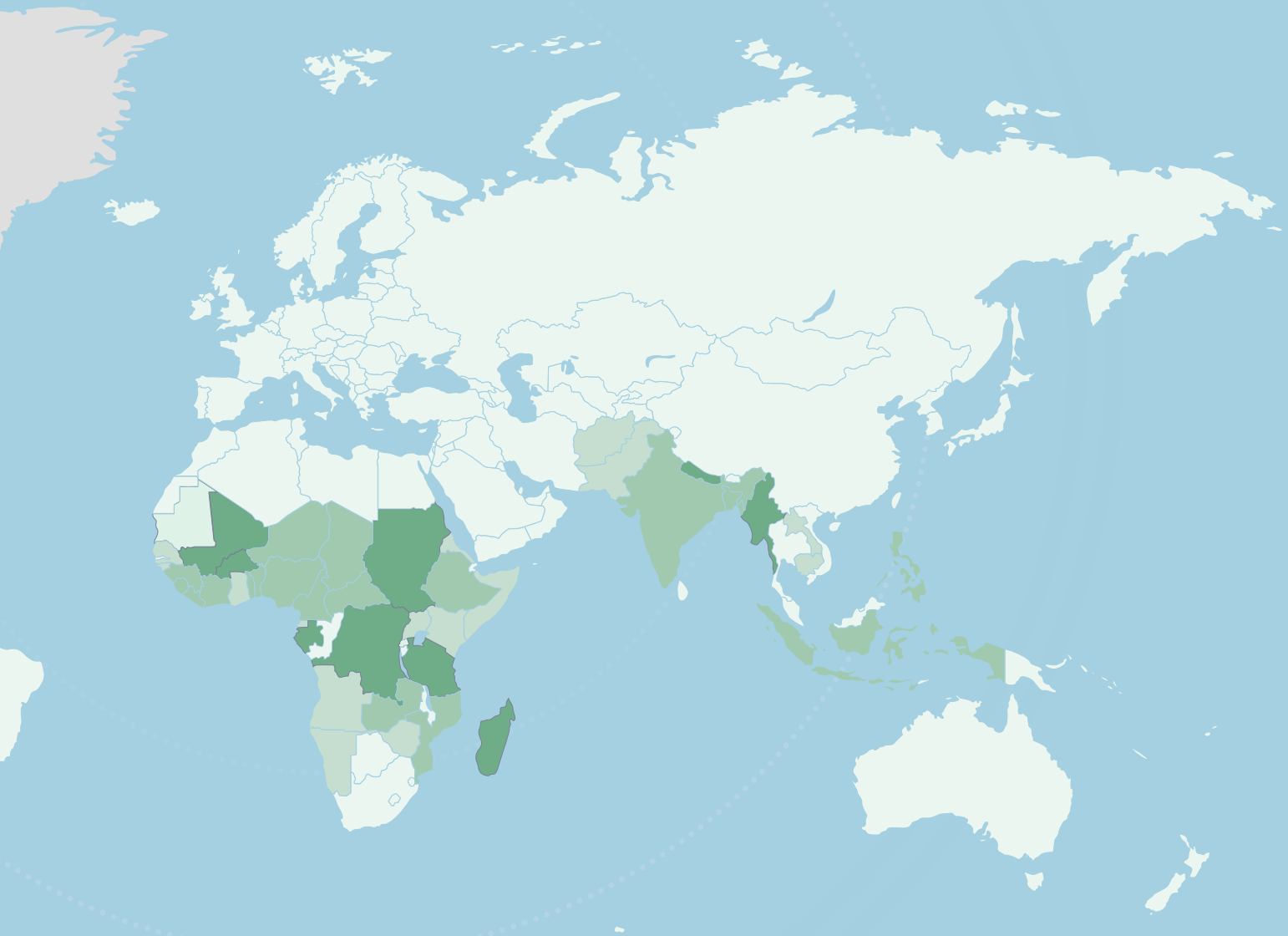
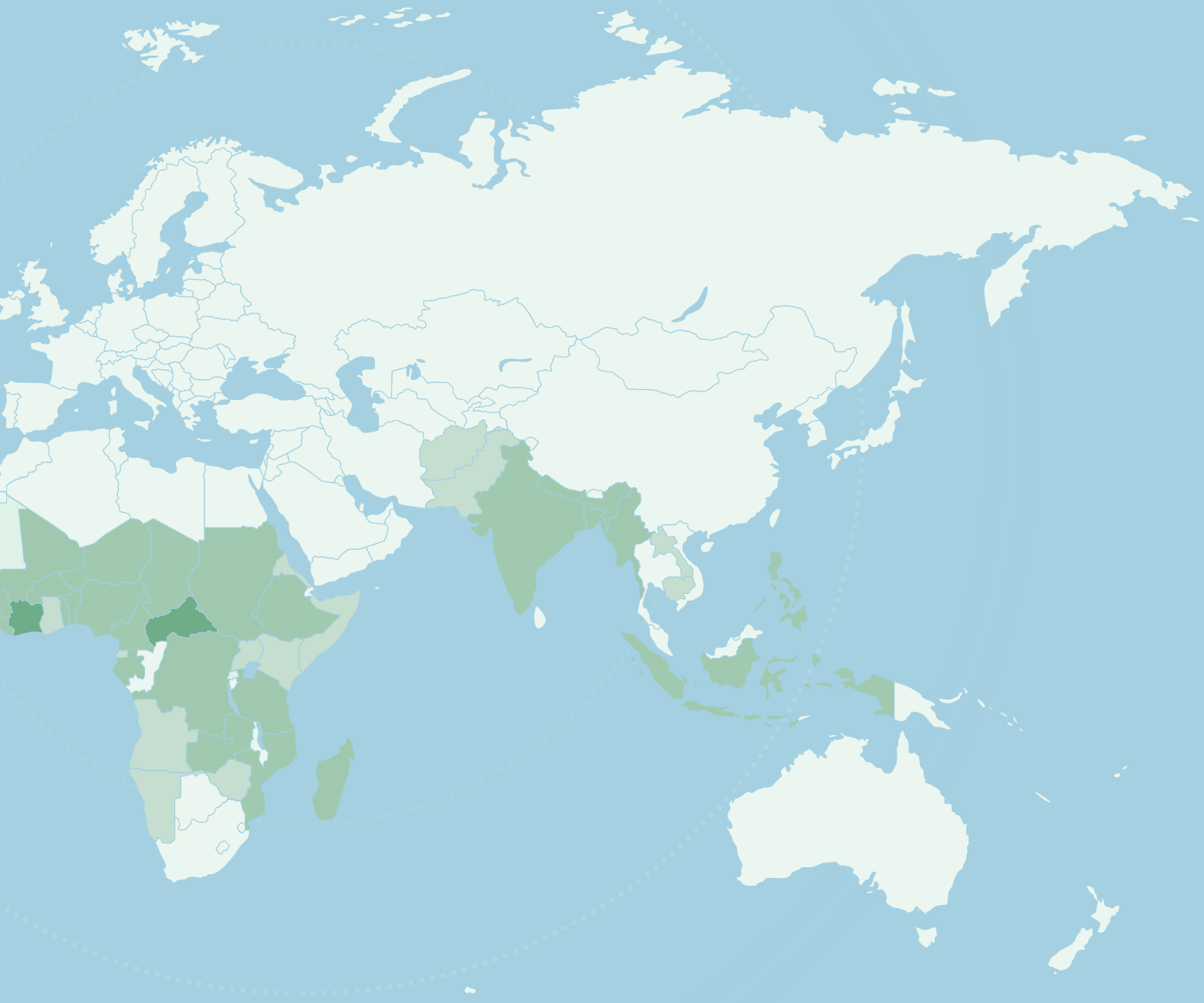


Figure 3. Share of the population reported needing interventions against NTDs in 2019

Source: WHO, The Global Health Observatory

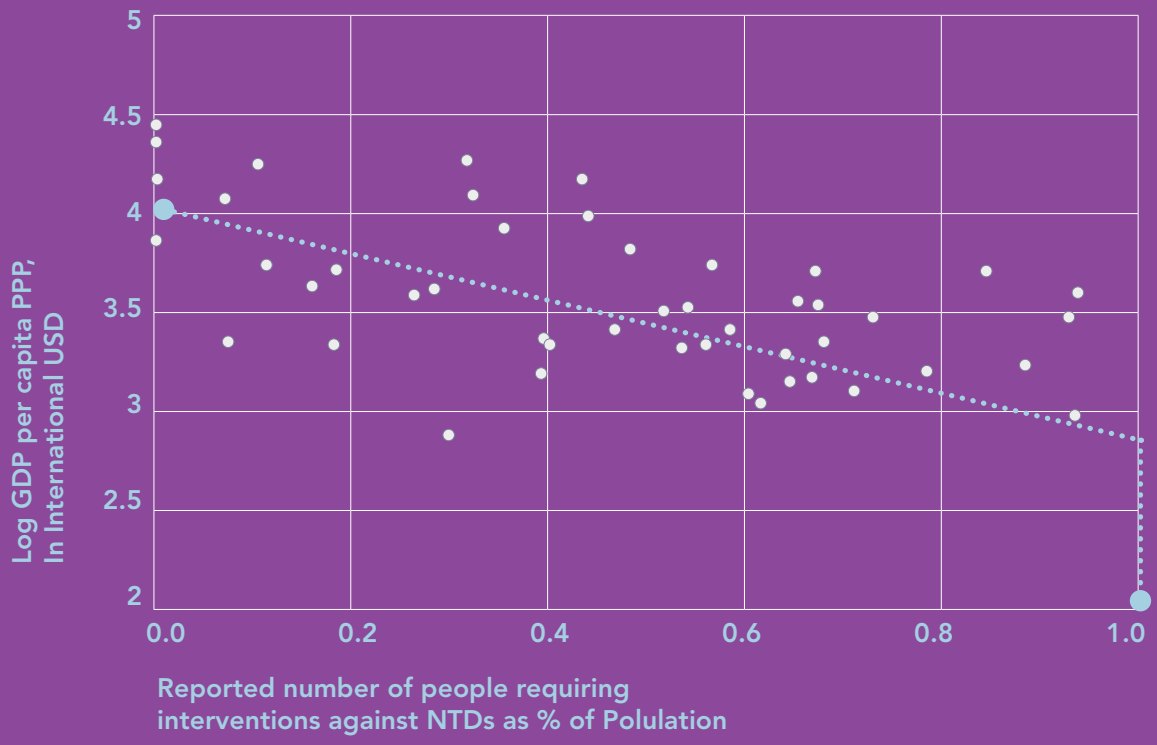


Powered by Biing

Notwithstanding, neglected tropical diseases still constitute a major risk for a significant part of the world's population, having disastrous consequences for the most economically disadvantaged. However, further accelerating the increasing progress in their prevention gives hope for a safer future for many who currently remain at risk.

Across Africa, it is visible that the share of the population reported as suffering from NTDs is negatively correlated with wealth, meaning that NTDs are more common in countries with a relatively high number of economically disadvantaged people.

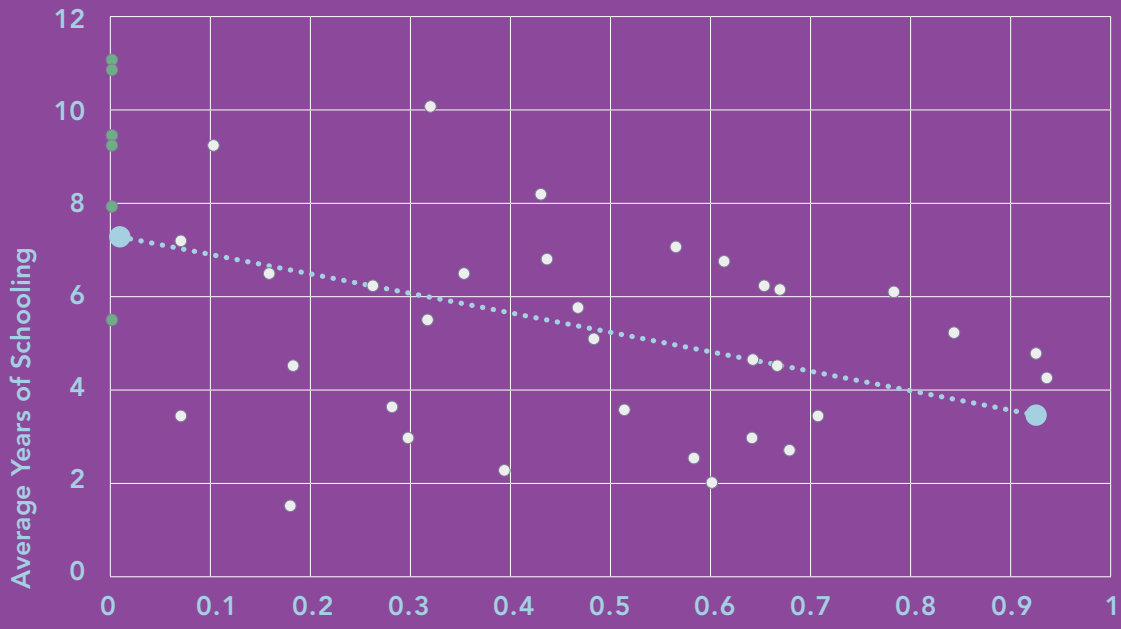
Figure 4. Reported number of people requiring interventions against NTDs as % of population and GDP per capita PPP in African countries (2019)



Source: Own elaboration based on the Number of people requiring interventions against neglected tropical diseases (NTDs), 2019 (ourworldindata.org) for NTDs data and GDP per capita, 2020 (ourworldindata.org) for GDP

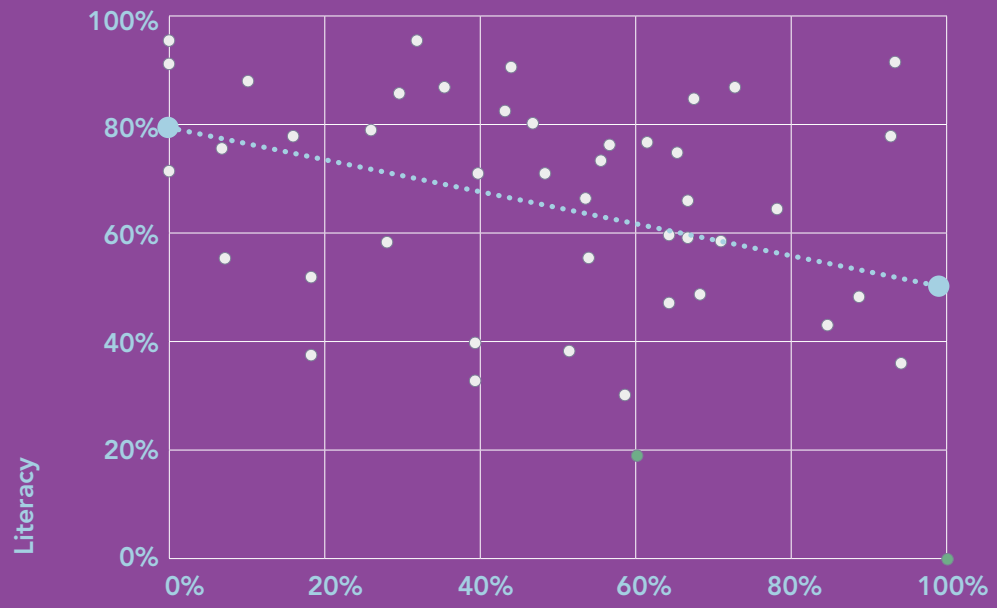
The prevalence of NTDs is also negatively correlated with education levels, reflected by, e.g., average years of schooling or literacy levels. This is primarily because countries with more economically disadvantaged people tend to have lower rates of access to education. Still, NTDs, play a part in limiting access to schooling by causing symptoms that make it challenging to participate in educational activities. This amounts to a vicious circle of lack of education and poverty.

Figure 5. Reported number of people requiring interventions against NTDs as % of the population and Average years for schooling in African countries (2019)



Source: Own elaboration based on the Number of people requiring interventions against neglected tropical diseases (NTDs), 2019 (ourworldindata.org) for NTDs data and Average years of schooling, 2017 (ourworldindata.org)) for average years of schooling

Figure 6. Reported number of people requiring interventions against NTDs as % of population and Literacy levels in African countries (2019)



Source: Own elaboration based on the Number of people requiring interventions against neglected tropical diseases (NTDs), 2019 (ourworldindata.org) for NTDs data and Literacy - Our World in Data for literacy

SUCCESS STORIES OF COMBATING NTDS

Despite the relatively low attention generally attributed to NTDs, examples of successful interventions to address the diseases can be found, demonstrating that effective control and elimination of them is achievable.

Lymphatic Filariasis

Togo

Togo eliminated Lymphatic filariasis as a Public Health problem in 2017, being the first African country to do so.

The national LF elimination program started in 2000 and was based on three pillars:

- Interrupting transmission and preventing occurrence of new transmissions
- Treating or managing disease due to LF

In its elimination program, Togo followed the steps recommended by the WHO. The program started with conducting surveys aiming to determine where active transmission was occurring. They later conducted at least five rounds of MAMs in these areas, followed by post-MAM surveillance activities. Consistency and continuity of the program were important contributors to its success.

Source:
Togo_eng (unitingtocombatntds.org) Togo: first country in sub-Saharan Africa to eliminate lymphatic filariasis (who.int); Togo is Saying Goodbye to Elephantiasis | WHO | Regional Office for Africa

Sri Lanka

Sri Lanka was one of the first countries that ran a Lymphatic Filariasis elimination program based on WHO guidelines, starting in 1999. The MAMs were initially run only in a few areas, but it rapidly expanded and from 2002, an annual MAM was conducted in all endemic zones until 2006. After this, the microfilaria prevalence rate fell to 0.05%.

In 2016, after years of low prevalence rates, Sri Lanka, together with Maldives, was recognized by the WHO to have eliminated LF as a public health problem, the first countries in the WHO South-East Asia region to do so.

Source:
Anti Filariasis Campaign :: (health.gov.lk); Global program to eliminate lymphatic filariasis: progress report, 2019 (who.int); Reassessment of areas with persistent Lymphatic Filariasis nine years after cessation of mass drug administration in Sri Lanka (plos.org)

Trachoma

Mexico

2017, Mexico became the first country in the Americas and the third in the world to eliminate Trachoma as a public health problem. In Mexico, the SAFE program strategy was adopted as its preferred approach to controlling and eliminating trachoma. The four components of this strategy are:

- Surgery for trichiasis
- Antibiotic treatment
- Facial cleansing
- Environmental improvements to reduce transmission

Over the course of its elimination program, Mexico spent USD 5,905,878.70 representing USD 38.92 per person. This amount is much less than the cost of high-quality surgery for Trachoma.

Source:
Fernández-Santos, N. A., Prado-Velasco, F. G., Damián-González, D. C., Unnasch, T. R., & Rodríguez-Pérez, M. A. (2021). Historical Review and Cost-Effectiveness Assessment of the Programs to Eliminate Onchocerciasis and Trachoma in Mexico. Research and Reports in Tropical Medicine, 12, 235; PAHO/WHO | Mexico eliminates trachoma, leading infectious cause of blindness; PAHO/WHO | How Mexico eliminated trachoma, the leading preventable cause of blindness

Ghana

In 2018, Ghana was recognized by the WHO to have eliminated Trachoma as a public health problem. The country's elimination program was based on the WHO's SAFE strategy, and trichiasis surgery was provided for no cost to those that needed it.

Ghana's program included valuable innovative solutions, such as height-based azithromycin dosing, systematic door-to-door trichiasis case-searches and intensive counselling of patients with trichiasis with an offer of immediate surgery, which considerably improved surgical uptake. Facial cleanliness was promoted through community events, dramas, and school events.

Source:
Ghana eliminates trachoma, freeing millions from suffering and blindness | WHO | Regional Office for Africa

Morocco

Morocco eliminated Trachoma as a public health problem in 2016. The key factors identified as contributing to the program's success were:

• Cooperation of relevant organisations including the Ministry of National

Education, the Ministry of Employment, Social Development and Solidarity, the Ministry of Equipment, the National Office of Drinking Water, Helen Keller International Morocco, Hassan II Ophthalmology Foundation and local development associations

• Integration of trachoma control in primary health care
• Implementation of all components of the SAFE strategy · Adoption of evaluation as a fundamental component of monitoring and planning
• Decentralization of planning, monitoring and evaluation
• Communication to the general public on the progress of the fight against trachoma

Sources:
WHO EMRO | Morocco eliminates trachoma – the leading infectious cause of blindness | News | Media centre; Elimination of Trachoma in Morocco, a historical review (2020).

Trachoma surgeon in Bahir Dar, Ethiopia checking patient.

Onchocerciasis

Mexico

The principle of Mexico's elimination program was based on the mass administration of ivermectin. The program was strengthened due to strong institutional cooperation between the PAHO/WHO, the Onchocerciasis Elimination Program for the Americas, as well as federal and state authorities.

The program began its path to elimination by selecting a group of communities in each of the three foci to serve as sentinels. These were selected through data collected as part of prior detailed epidemiological assessments in all communities in the three foci.

Over 26 years (1994-2020, the program is ongoing due to post-elimination surveillance activities) USD 57,510,669.73 was spent on the program, amounting to USD 310.68 per person.

Source:
Fernández-Santos, N. A., Prado-Velasco, F. G., Damián-González, D. C., Unnasch, T. R., & Rodríguez-Pérez, M. A. (2021). Historical Review and Cost-Effectiveness Assessment of the Programs to Eliminate Onchocerciasis and Trachoma in Mexico. Research and Reports in Tropical Medicine, 12, 235.

Niger

In August 2021, Niger became the first African country to declare elimination of Onchocerciasis as a public health problem. The declaration was made by the country's Ministry of Public Health, Population and Social Affairs, and the country is currently pending formal approval of this status by the WHO, which would make it the fifth country in the world to successfully eliminate the disease.

Niger's program encompassed delivering over 2 million individual treatments and was coordinated by the Ministry in cooperation with health workers, drug distributors, and the affected communities. The program obtained funding from the END Fund's Reaching the Last Mile Program, as well as the USAID, WHO, Hellen Keller Intl, and other organizations.

Source:
Élimination de la transmission de l'onchocercose ou cécité des rivières au Niger Une première africaine : le Niger est le premier pays d'Afrique à déclarer l'élimination de l'onchocercose – Ministère de la Santé Publique, de la Population et des Affaires Sociales du Niger (gouvne.org)

Soil-Transmitted Helminths

Japan

A country that has successfully eliminated intestinal worms as a public health problem is Japan. In 1949, the national prevalence of Ascaris lumbricoides was 62.9%, which decreased to 0.6% by 1973.

Source:
Soil-transmitted helminthiasis control program in Japan. (cabdirect.org)

Niger

In 2004 Niger established a large-scale schistosomiasis and soil-transmitted helminths control program targeting children aged 5–14 years and adults. In two years 4.3 million treatments were delivered in 40 districts using school based and community distribution.

Source:
Leslie, J., Garba, A., Boubacar, K., Yayé, Y., Sebongou, H., Barkire, A., ... & Jackou, M. L. B. (2013). Neglected tropical diseases: comparison of the costs of integrated and vertical preventive chemotherapy treatment in Niger. International Health, 5(1), 78-84.

Schistosomiasis

China

A country with significant progress towards elimination is China, where the transmission of schistosomiasis is almost interrupted, and the country is steadily moving toward schistosomiasis elimination
The success of China's strategy was based on:
- Snail Control
- Continued and assured financial support
- Importance in planning and conducting the program directed from the national level

Source:
Elimination of schistosomiasis in China: Current status and future prospects (plos.org)

Boniface is a fisherman in Kenya who relies on Lake Victoria for his livelihood. However, doing so puts him at risk of contracting schistosomiasis, caused by parasitic worms that live in certain types of freshwater snails living in the lake. The parasite enters the skin of people who come in contact with contaminated water. Over 230 million people are at risk. Schistosomiasis is all too familiar to Boniface, as he has lost three friends to the disease who did not know they were infected. It has the highest mortality rate among the most prevalent NTDs in sub-Saharan Africa.

Boniface Opinya on Lake Victoria in Kisumu, Kenya.

NTDS IN NIGERIA:
CURRENT SITUATION AND LONG-TERM TRENDS

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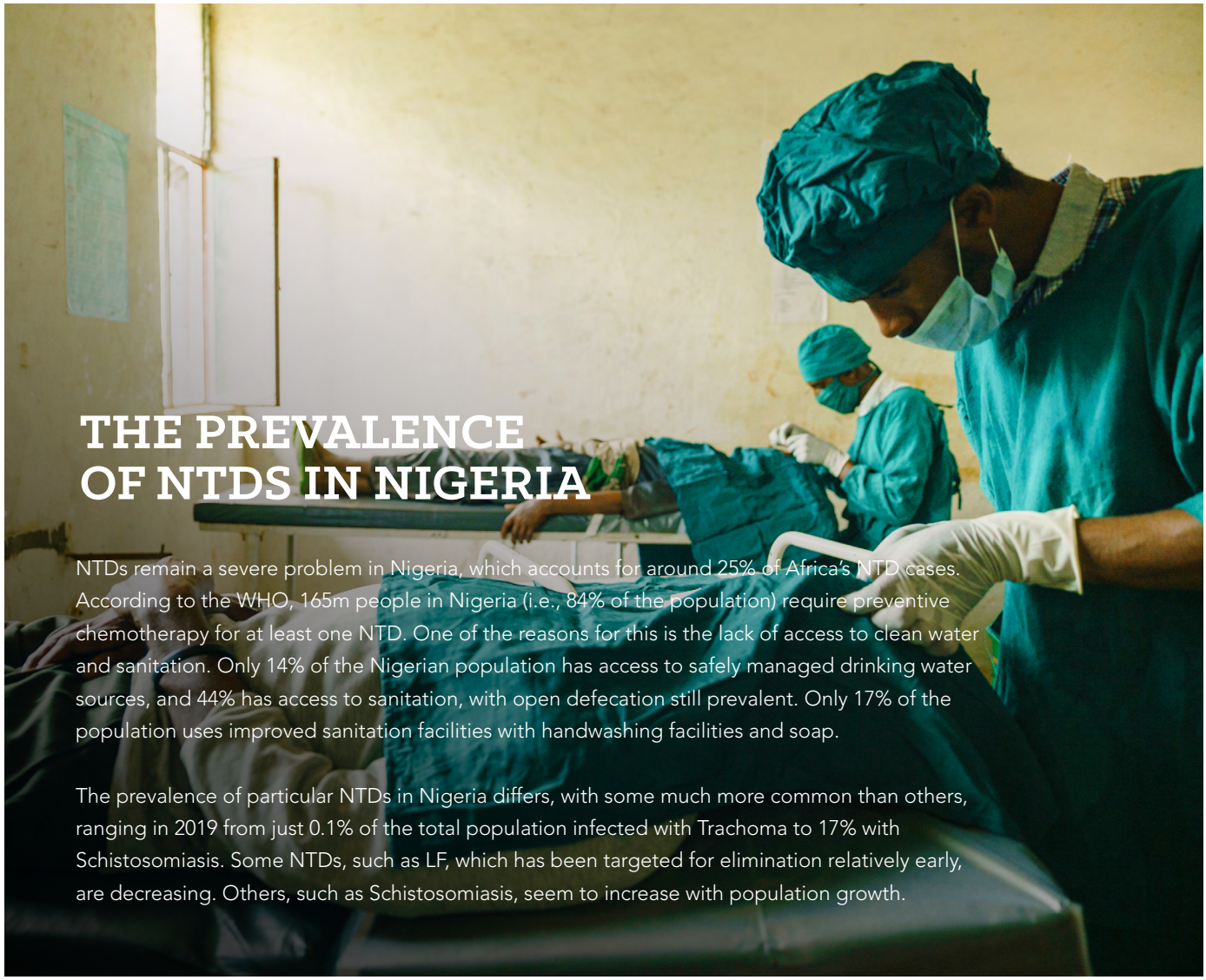
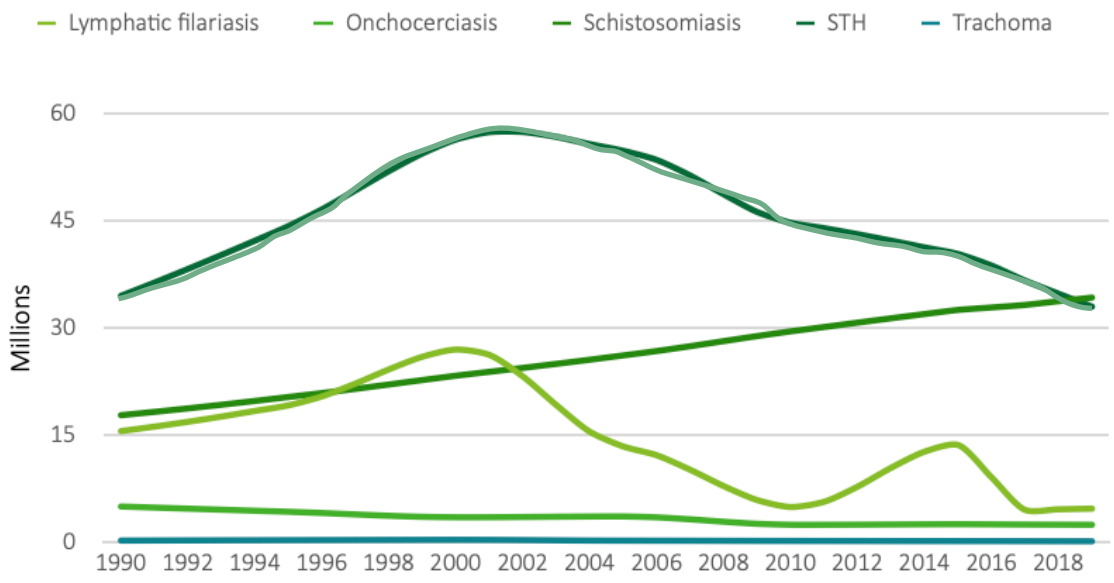


THE PREVALENCE OF NTDS IN NIGERIA

NTDs remain a severe problem in Nigeria, which accounts for around 25% of Africa's NTD cases. According to the WHO, 165m people in Nigeria (i.e., 84% of the population) require preventive chemotherapy for at least one NTD. One of the reasons for this is the lack of access to clean water and sanitation. Only 14% of the Nigerian population has access to safely managed drinking water sources, and 44% has access to sanitation, with open defecation still prevalent. Only 17% of the population uses improved sanitation facilities with handwashing facilities and soap.

The prevalence of particular NTDs in Nigeria differs, with some much more common than others, ranging in 2019 from just 0.1% of the total population infected with Trachoma to 17% with Schistosomiasis. Some NTDs, such as LF, which has been targeted for elimination relatively early, are decreasing. Others, such as Schistosomiasis, seem to increase with population growth.

Figure 7. Number of cases of the 5 studied NTDs in Nigeria, 1990-2019

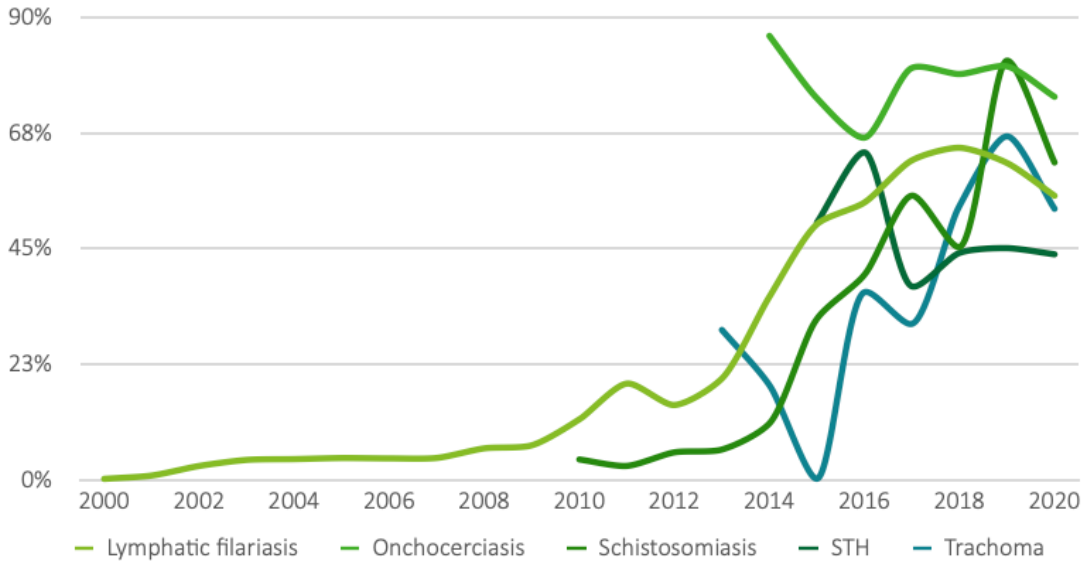


Source: Deloitte's elaboration based on GBD 2019 prevalence rates and UN WPP 2019 population

The share of the population requiring treatment covered by MAM programs (i.e., the coverage rate of MAMs) for the five studied NTDs in Nigeria ranged from around 40% for STH to approximately 80% for Onchocerciasis in 2020.

In the last decade, there has been a significant scaling up of these programs. However, due to COVID-19, most activities have stalled, and 80% of government funding allocated to NTD-related activities was shifted to programs directly addressing COVID-19. This has resulted in a clear drop in these programs' coverage in 2020, and a rapid return to the previous pace of MAM programs is necessary to minimize the losses caused by this retreat.

Figure 8. MAM coverage rate per disease in Nigeria, 2000-2020



Note that this data is provided to WHO by the government through its reporting process; data quality may vary with time, e.g., as the at-risk population is better estimated. Source: Own elaboration based on WHO data

Despite an overall improvement in MAM coverage for the studied NTDs in Nigeria, some African countries still significantly outperform it, achieving notably high coverage rates approaching 100% (see Table 2). These figures and the successful elimination examples from the previous chapter show that effective initiatives addressing NTDs are achievable given proper planning and funding.

Table 2. NTD treatment coverage in 2020 for Nigeria and the respective best-performing country in Africa

Disease	Nigeria	Top performers in Africa
Lymphatic filariasis	55%	95% (Kenya)
Onchocerciasis	75%	100% (Sudan)
Schistosomiasis	62%	96% (Burundi)
STH	44%	98% (Burundi)
Trachoma	53%	91% (Guinea)

SOCIAL IMPACT OF NTDS IN NIGERIA

The social impact of NTDs is immense. The diseases, by often causing long-lasting, chronic symptoms, frequently exclude the infected from professional life and drastically change their social life. Notwithstanding, the social impact of these diseases has not been extensively studied. According to an analysis of Nigerian NTDs literature, out of 211 studies conducted between 2006 and 2017, only eight (i.e., 4%) were conducted in social sciences to understand the behavior and attitude of people living with NTDs, and their perceptions of NTD prevention and control programs.

One of these studies, also covering Cameroon, the Democratic Republic of Congo, and Uganda, found that 84.7% of respondents considered ivermectin treatment valuable. Due to its social (e.g., improved ability to work or attend school, increased peer acceptance), individual (e.g., improved self-esteem), and health benefits (e.g., improved overall health). These findings demonstrate that mapping the perceived benefits and fostering awareness among affected communities can motivate them to follow long-term treatments. This also allows us to map prevalence areas and conduct MAM communication activities. Another social science study in Nigeria's NTDs literature covered a comparative cost-effectiveness analysis of urinary Schistosomiasis screening methods in Ibadan, Nigeria's second-largest city. This study did not directly analyze the social impacts of NTDs.

Given the substantial number of studies on NTDs in Nigeria, the insufficient number of those that focus on assessing the social impact of these diseases is notable. This concerns both quantitative and qualitative assessments. The consequences of these diseases are diverse and have an enormous impact on those directly infected and the communities in which they live. Analysis of this impact presents a significant opportunity for further study, and the personal experiences of those affected by NTDs are an indispensable source of information in this area. The following section presents these experiences based on interviews conducted for this study to complement its quantitative estimates.

PERSONAL EXPERIENCES OF PEOPLE AFFECTED BY NTDS

The qualitative findings presented cover six major themes and four sub-themes.

Major Themes:

1.

NTDs Status

This looked at whether or not participants have previously suffered NTDs and the type of NTDs.

2.

Access to NTDs Treatment

This looked at participants' access or lack of access to treatment, efforts made to access treatment, and reasons, if any, for not accessing treatment.

3.

Impact of Treatment on Sufferers of NTDs

This included whether or not they were able to resume school, work, or community activities; the differences that treatment made.

4.

Current Challenges Faced

This looked at challenges faced by participants even after accessing treatment.

5.

Perception of Differences that Access to Treatment or Cure will make

This includes hopes and what they would do if treated or cured.

6.

Suggestions for Programmes and People Receiving Treatment

This looked at recommendations for NTDs programme improvement or people receiving treatment from such programmes.

Sub Themes:

- Length of the suffering of NTDs,
- Impact of NTDs on sufferers,
- Challenges resulting from NTDs, and
- Experience with Treatment.

For seamless communication, we have codified the attributes (identifiers) as seen in the table below:

Table 3. Codes Used for NTDs Impact Assessment

Serial number	Item	Code
1	**LGA Context**	
	Rural	RL
	Urban	UB
2	**Gender**	
	Female	F
	Male	M
3	**NTDs**	
	Hydrocele	HYD
	Lymphodema	LYM
	Onchocerciasis	ONC
	Schistosomiasis	SCH
	Soil-Transmitted Helminth	STH
	Trachoma	TT
4	**Treatment status**	
	Treated	T
	Not treated	NT

"I pray that my children live a good life and that they stay healthy, because even if they are poor, they can work and survive. They can go to school and end up having a good life. In order to do all of that, health is the most important. Health comes first and is the most important thing."

Lelamo Mukhtar Turgemu lives in Sankura, Ethiopia with his wife and ten children

NTDS STATUS

All participants across gender categories, urban and rural, Local Government Areas (LGAs), and age categories mentioned that they were or had been infected with various forms of NTDs. These NTDs range from **Hydrocele, Lymphodema, Onchocerciasis, Schistosomiasis (SCH), Soil-Transmitted Helminths (STH)**, and **Trachoma** to varying degrees. Most participants made efforts to describe their conditions in ways they best understood them.

"I left school for home, when I got home my mother went to get me some drugs. But before then I have had discomfort from worms in my stomach… Yes, I had stomach worms before then."

Fatima - F - 9yrs - STH - T - UB

"I am infected with a disease called trachoma. I have had 2 eye surgeries in the past. This is the 3rd one I just had."

Maimuna - F - 53yrs - TT - T - UB

"Yes, I have suffered from NTDs… Hydrocele."

Patrick - M - 34yrs - HYD - T - UB

"Yes, I have had schistosomiasis in the past. I believe I got infected from the streams since we usually play and spend time around such wetlands."

Sanusi - M - 15yrs - SCH - T - UB

"I have a condition with my eyes. Since from my young age, I began having issues with my eyes. My vision became increasingly difficult as I grew up."

Rabiu - M - 65yrs - ONC - T - RL

"Yes, I have a problem with my leg. At first, it started swelling gradually and is more prominent when I am pregnant. But when I give birth it reduces, so then people thought it had to do with cold (rheumatism). It is when I become pregnant that it will swell, but once I deliver, it will reduce. When I gave birth to one of my sons, I was given an injection after delivery because I had stomach pain. It was after then that the leg became very swollen; it was even larger than this at that time."

Bilikisu - F - 52yrs - LYM - NT - UB

LENGTH OF SUFFERING FROM NTDS

Most participants across gender, age, and disease were able to mention the number of years, months, or days they suffered from NTDs. Many participants who suffered from lymphodema, Onchocerciasis, and TTrachoma have had their conditions for 16 years or more.

"This was about 14 years ago, though I have suffered the condition for about sixteen years now."

Bilikisu - F - 52yrs - LYM - NT - UB

"This eye infection began when I was still a boy."

Saidu - M - 56yrs - TT - T - RL

"I think it has been for about 40 years."

Simon - M - 90yrs - ONC - T - UB

Though Mocé has been blind for over 30 years, he is confident his grandchildren will never go blind from the disease that stole his eyesight because they take their medicines every year.

Mocé lives in the town of Tienfala, in south-west Mali

Participants affected with hydrocele and SCH were infected for relatively few years, **between 2 to 6 years,** respectively.

"It has been over two years or about three years. It has not been more than three years."

Siaku - M - 75yrs - HYD - NT - UB

"It lasted for as long as 5 to 6 years"

Sanusi - M - 15yrs - SCH - T - UB

Most participants with STH had been infected for periods ranging from a few days to a month.

"It was for about a month."

Hajara - F - 8years - STH - T - UB

"It was for about two days."

Fatima - F - 9yrs - STH - T - UB

IMPACT OF NTDS ON SUFFERERS

Most participants across diseases, gender, age, and LGA context of urban and rural mentioned that they had been affected in various ways by NTDs, which they suffered, often leading them to be unable to carry out basic tasks. Some participants infected by Trachoma and Onchocerciasis stated that they suffered discharge from the eyes, itchiness, teary eyes, declining vision, and in some cases, complete blindness.

"I experience itchiness around the eye, and while I scratch it hard, it becomes teary."

Maryam - F - 27yrs - TT - T - RL

"He can no longer see with the eyes now."

Simon - M - 90yrs - ONC - T - UB

"I actually made efforts to seek help at the hospital, and I received medication, the discharge on my eye was removed by my wife, say 2 to 3 times daily before I could feel some relief. My wife was the only person who assisted in doing this for me because my children all said they could not do that for me. Though she complained about doing it, I usually pleaded with her, and she turned around to assist me."

Siaku, M, 75yrs, HYD, NT, UB

Most participants infected with STH mentioned that they suffered from one form of stomach discomfort or another.

"My stomach hurts so bad that there were days I could not go to the shop with my dad, and I had to stay back at home with my brother."

Emmanuel - M - 8yrs - STH - T - UB

"I started feeling stomach pain. It was for about two days then I felt relief and returned to school. But when I returned home I started feeling the pain again. I told my mum about this who got some drugs for me to get relief. I feel churned inside my stomach."

Fatima - F - 9yrs - STH - T - UB

The common complaints among participants infected by SCH were pain when urinating and passing out blood in their urine during infection.

"I just found myself passing out bloody urine, and it also comes with much pain. I did not feel good at all because it deprived me of studying."

Ahmed - M - 16yrs - SCH - T - UB

"I usually encounter pains while urinating… At my waist, I felt some pains… It was a sharp pain but not like the pain of a wound."

Labaran - M - 18yrs - SCH - NT - UB

SOME PARTICIPANTS INFECTED BY **HYDROCELE** AND **LYMPHODEMA** MENTIONED THAT THEY EXPERIENCED **SWELLING AND PAINS IN THEIR GENITALS AND LEGS**, RESPECTIVELY.

"Actually, I felt less than a person and for the implication of the health challenge; I am not always comfortable and with the pain associated with it. I am just grateful for the rescue for NTD, the help they have granted and the impact to the society."

Patrick - M - 34yrs - HYD - T - UB

"If not for periods where I feel pains, it does not stop me from carrying out my activities."

Bilikisu - F - 52yrs - LYM - NT - UB

Interestingly, some participants infected by Hydrocele and Lymphodema argued that they felt no pain and had not been impacted by their condition. They maintained that they could carry out their regular activities irrespective of the enlargement of the affected parts.

"It has to do with the dropping and swelling of my scrotum. And I have never gone to the hospital to complain about this because I find it does not really disturb me. Well, I have never had any problem. The only thing I can say is that I notice that I urinate frequently since then. But I have not had any wound around it or any other problem."

Isiaku - M - 75yrs - HYD - NT - UB

"It does not really hurt me; it is as soft as a loaf of bread if you touch it. The only thing is that it is swollen and sometimes when an object cuts my leg you see water coming out of the leg. But as soon as I get cotton wool to clean it and have it bandaged after taking injections from the hospital, then it will dry up."

Aminu - M - 72yrs - LYM - NT - UB

CHALLENGES RESULTING FROM NTD'S STATUS

Most participants across diseases, gender, urban-rural context, age, and treated or not treated mentioned that they experienced several challenges due to the NTDs. Some participants, especially the females, stated that they could not carry out their regular day-to-day activities, such as doing the dishes, laundry, cooking, house cleaning, etc., because of their condition.

"I am only incapable of doing my house chores during those times when it causes me pain. At such times, I would not be able to walk around and have to remain in the bed sometimes for about four days. There was a time when I was bedridden for about a month in this condition. Sometimes, I feel very hot inside the leg as if it is being cooked and it often looks reddish during those times... I am just sometimes worried that I cannot carry out my tasks as expected because of my health status. Maybe sometimes when one has occasion to attend to but could not due to my condition. This keeps me worried but I have rescinded myself to fate, perhaps one-day God will bring an end to this once there is life."

Bilikisu - F - 52yrs - LYM - NT - UB

"Firstly, there are things that the person will not be able to do such as house chores, farm work, visitation, business and other things that a completely healthy person can do."

Rebecca - F - 75yrs - ONC - T - UB

Some older male and female participants, prominent among those affected by Trachoma and Onchocerciasis, mentioned that they faced challenges, including the inability to engage in business, work, or trade to earn a living leading to difficulty in catering for personal and family needs.

"Actually, I used to make rice cakes over open fire so some people suspected that the fire must have caused the disease and therefore advised me to stop the trade. I also had to acquire glasses to enable me read better though I paused my reading if the pain becomes unbearable. Every morning when I wake up, it takes a few minutes before I am able to see with this eye and this has been on for a long while now... Also, I faced the challenge of inability to afford my medical bills. I even went to National Eye Centre and the medicine prescribed for me cost about ten thousand naira (₦10,000). I was only able to purchase the medicine twice and after that, I stopped making effort to do so."

Maimuna - F - 53yrs - TT - T - UB

"He cannot engage in farming activities because he can no longer see; we cook for him, wash his clothes, help to make his bed. We use to escort him to his place of worship."

Simon - M - 90yrs - ONC - T - UB

Note: This was as narrated by his brother

One participant infected by Trachoma mentioned that he had to endure **being mocked by people close to him and in the neighborhood.**

"Well, I faced so many challenges that some even teased me as being a blind man. I experienced so much pain and discomfort for a long period of time... I didn't feel good at all. I felt hurt being referred to as a blind man knowing very well I was not blind. Even a little granddaughter of mine teased me by calling me 'Sa'ida dan makaho' meaning Sa'idu the blind man. We all laughed over it but deep inside me, I was not happy at all."

Saidu - M - 56yrs - TT - T - RL

Another participant affected by hydrocele also mentioned that he experienced low productivity resulting from an inability to concentrate on the task because of constant pain.

"To be very honest, the productivity is really affected because once I am very healthy, I think the productivity will be high. Because when I feel the pain I have to go and attend to myself and I feel less than a person."

Patrick - M - 34yrs - HYD - T - UB

Most children affected by SCH and STH face the challenge of absenteeism from school due to frequent urination, passing out of blood in urine, and painful sensations in their stomachs.

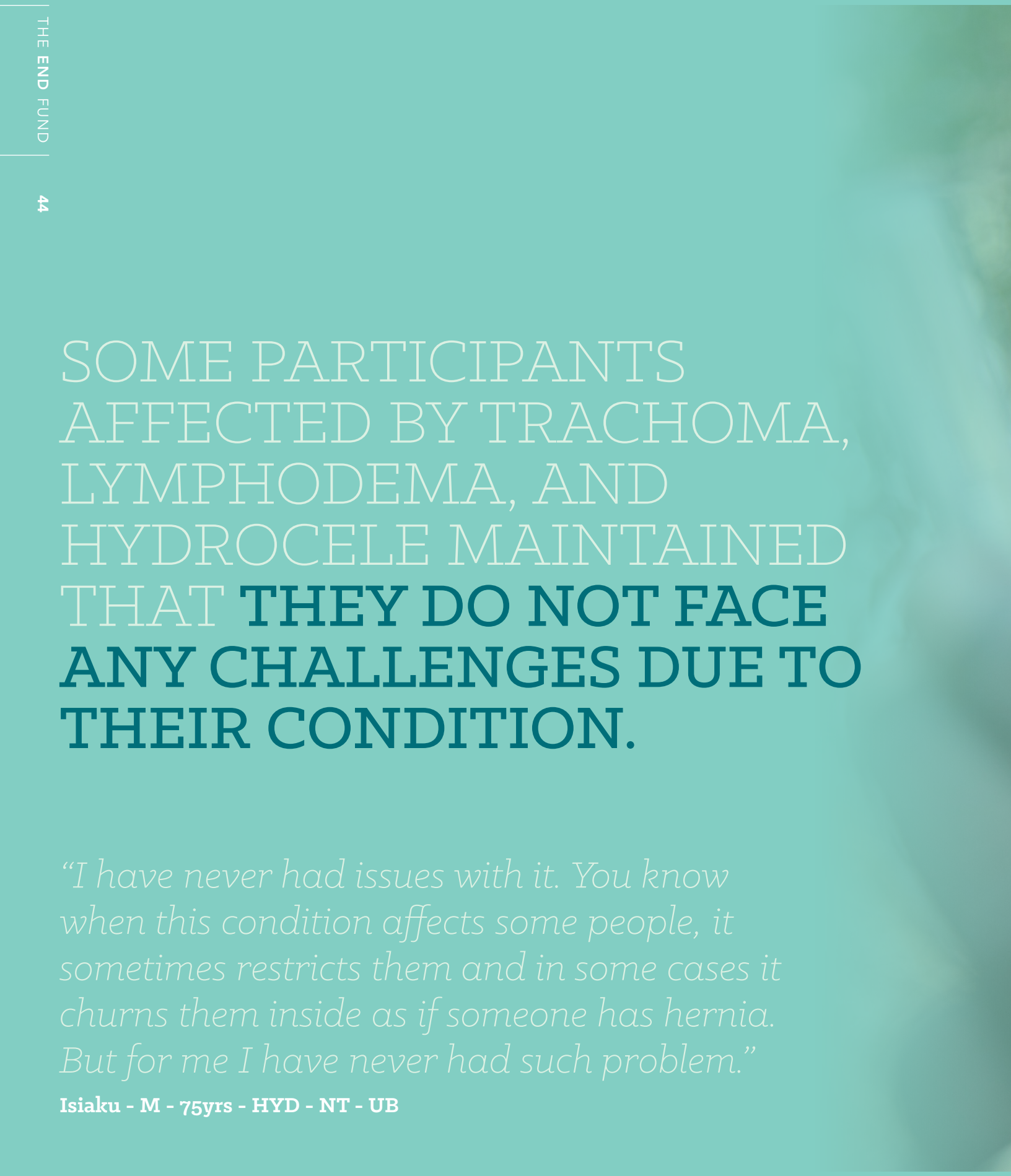
"I experienced frequent urination especially when I was seated in class. Truly, this has caused so much discomfort to me in class. The frequent urination caused me to miss parts of some lessons since those parts were taught while I was out at the restroom. Truly I was always at school but with the disease, there were times I had to skip school."

Ahmed - M - 16yrs - SCH - T - UB

"My brother usually bathed me after bathing himself. When my stomach hurt at school, I was unable to write because my fingers became very weak. No I was not able to study."

Emmanuel - M - 8yrs - STH - T - UB

Note: This was as narrated by his brother



SOME PARTICIPANTS AFFECTED BY TRACHOMA, LYMPHODEMA, AND HYDROCELE MAINTAINED THAT **THEY DO NOT FACE ANY CHALLENGES DUE TO THEIR CONDITION.**

"I have never had issues with it. You know when this condition affects some people, it sometimes restricts them and in some cases it churns them inside as if someone has hernia. But for me I have never had such problem."

Isiaku - M - 75yrs - HYD - NT - UB

"But despite the condition of the leg I can still carry out all my tasks such as farming, my trading activities as well as every other activity that requires strength."

Aminu - M - 72yrs - LYM - NT - UB

"Sincerely this disease has not deprived me from carrying out any activity. I still do the same activities I have always done"

Maryam - F - 27yrs - TT - T - RL

ACCESS TO NTDS TREATMENT

Most participants affected with Lymphodema, Trachoma, and Onchocerciasis across different gender, ages, and within the urban or rural context mentioned that they had access to medical treatment to alleviate their condition. Most participants in this category sought help from the hospital and traditional healers.

"I sought traditional and hospital medicines."

Suleiman - M - 60yrs - ONC - T - UB

"When it started, my parents used to get some herbal medicine and apply to my eyes. When I got married, I visited the hospital to seek medication and I was scheduled/contacted for this treatment."

Maryam - F - 27yrs - TT - T - RL

"I actually went to this old hospital (ABU Teaching Hospital) before it was relocated from here. I then met an old doctor, a white man both here and where the hospital was relocated to… I have gone as far as Jimeta and Chad Republic to obtain traditional medicines to cure this disease."

Aminu - M - 72yrs - LYM - NT - UB

Most participants (5 SCH and 3 STH), consisting mainly of school-aged children, mentioned that **they had access to treatment at the hospital or school during the school-based MAM.**

"While in school at GSS Ikara, the medicine was administered to us and we were given directives on how to take the medicine. Some health workers were assisted by some of our teachers and the medicine was administered class to class."

Sanusi - M - 15yrs - SCH - T - UB

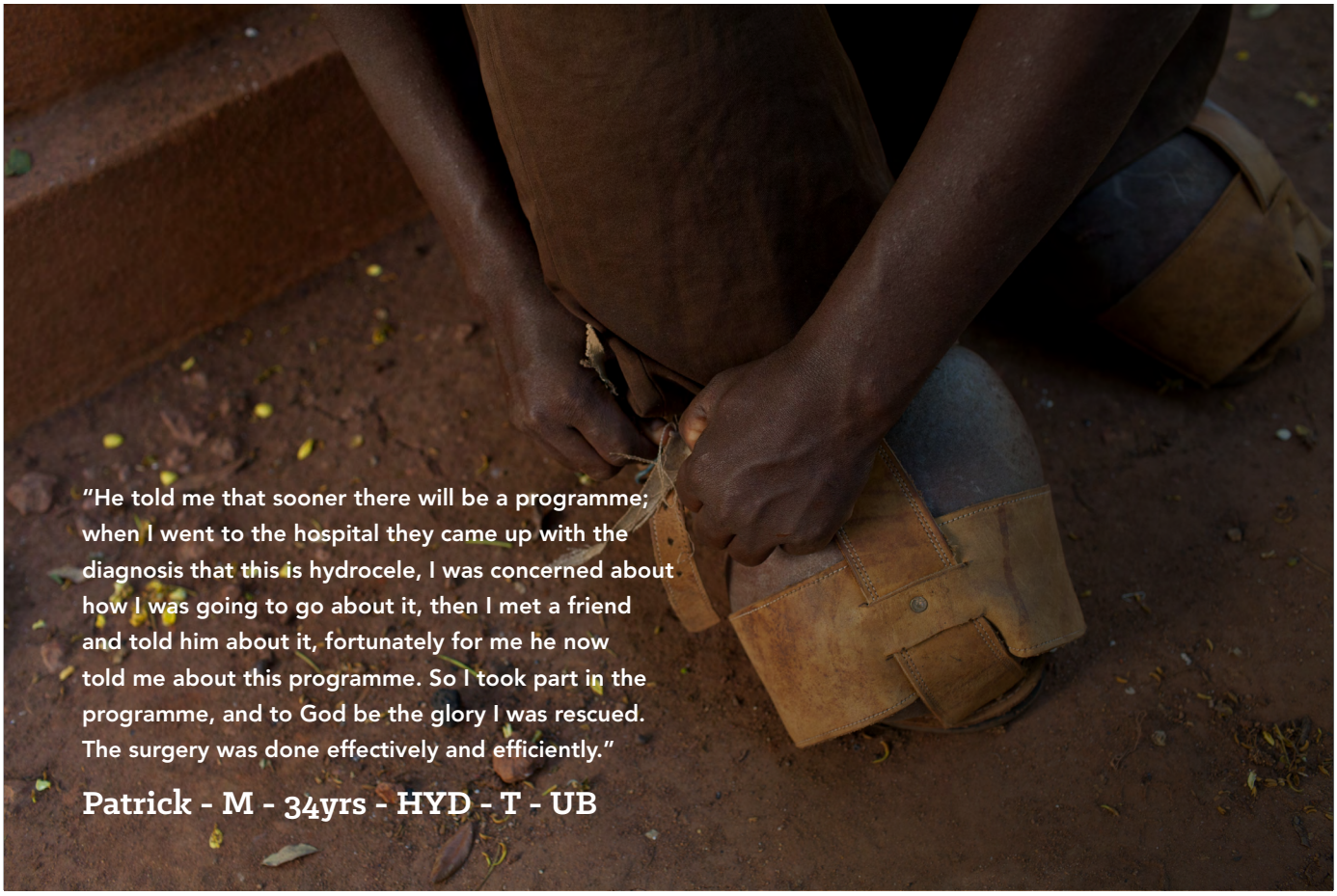
"When I informed my parents about the stomach pain, they bought medicines for me… Some people came to my school with something in a box and they administered the medicine to us."

Emmanuel - M - 8yrs - STH - T - UB

"It was some people that brought the drugs and handed them over to the head teacher. We were made to stand on a queue on the assembly ground where she gave us the drug to take. I was given drugs at school."

Fatima - F - 9yrs - STH - T - UB

One participant affected by hydrocele could access treatment during a partner-funded surgery in Kaduna state.



However, two participants affected by Hydrocele and Trachoma mentioned that they did not need to seek treatment because their condition did not prevent them from carrying out their regular activities.

"The reason I had not seek for treatment is that it does not disturb me although I often think about going to the hospital but God has not allowed me to pay much attention to that. But I do know that it is a problem but I have never sought for medical attention since it does not really trouble me health wise."

Isiaku - M - 75yrs - HYD - NT - UB

"I did not consult anyone to tell them about my eye. This eye infection has never deprived me from doing anything. I have nothing more to say. Well, I was not ready to seek treatment because I could not afford to and more so, it was not that I was blind so I did not really feel the need to seek treatment. I also told them to search for those who were more at risk of losing their eyesight as they were more in need of the treatment than I was."

Danasabe - M - 60yrs - TT - NT - UB

EXPERIENCE WITH TREATMENT

Some female participants affected by Trachoma mentioned that although they have had access to surgery for trichiasis, they have had some relapses for which they had to seek further surgery.

"10 years ago I had the surgery on both eyes which I funded from my purse. 3 years ago, I had another surgery on one eye but that surgery was free of charge at Soba hospital and now I am here for a third surgery on my second eye. For every medicine I have tried, I expected to find a lasting solution to this problem but my hope always gets dashed when I discover the relief is a temporal one. I was so discouraged that I almost did not show up for this surgery but I was encouraged to just try it out since I had nothing to lose."

Maryam - F - 27yrs - TT - T - RL

"I visited the hospital and I was given some medication which actually cleared the eyes for a while even though I still felt pains on my eyeballs. After sometimes, I realized that the eyes could not open properly so I went to the hospital to lay a complain. The health workers I met kept removing the discharge on my eyes but no surgery was done for me. I spoke with someone who told me I could be scheduled for a surgery at Makarfi but it would cost me 11 thousand naira. About 2 months after the paid surgery, I noticed that the infection relapsed and it came with pain and a burning sensation. I continued visiting the hospital for medication but I never got a solution for this condition until I got information that we were to receive free eye surgeries. I went to the hospital where my eyes were checked and arrangement was made for surgery, making it the second surgery I had. After that, the pains still did not go away so I went to the hospital to complain to the eye specialists that showed up for free surgeries. I described how I felt and thought that maybe the actual solution I needed was not hospital treatment or if possibly it was a cancerous disease. They said it was not cancerous and kept encouraging me not to give up hope on treatment until I was scheduled for this surgery today."

Maimuna - F - 53yrs - TT - T - UB

Two participants affected by Trachoma expressed their happiness for having received treatment, this being their first time undergoing surgery for their condition. They expressed hope that their condition would significantly improve.

"This is the first eye surgery I have had. The surgery has just been done and sincerely, I was not asked to pay for the surgery or anything else. I was simply brought down here for the surgery. We kept hoping that I would have a surgery as a final solution to this disease but it was not possible until now."

Ibrahim - M - 30yrs - TT - T - RL

"I have a neighbour who advised me to go for the surgery but I also declined. Every morning, my wife assisted in cleaning off all the discharges that came out of my eyes with the aid of a small metal and I got relief for the day. Eventually, I got informed that there was an intervention that has come up and I was to receive surgery but I was still very much afraid till my family encouraged me to trust God for the best. I felt very good and also relieved when I heard the specialist comment that the surgery was successful. Actually, some people tried to discourage me from having the surgery because they claimed there was no cure for Trachoma. I later agreed on my own to go through with the surgery, and I am happy that it was successful."

Saidu - M - 56yrs - TT - T - RL

A **male** and a **female** participant affected by **Lymphodema** mentioned that although they made concerted efforts to seek treatment using medical science and traditional means, **they could not readily find a solution to their condition.**

"It was after then that the leg became very swollen, it was even larger than this at that time. It was then we started looking for solution both at the hospital and traditional medicine, but there was no relief. At some point it will look as if I was getting better only for the swelling to return again. We even went to leprosy center, Saye Zaria where they told us then that they do not have the medicine for my case then. I was told that even if we go to ABU teaching Hospital in Zaria, we will not get the medicine. They then referred us to, I think Enugu; as at then my husband was not financially capable and as such we couldn't go there. As a result, we focused on using traditional medicines. This was about 14years ago, though I have suffered the condition for about sixteen now. After seeking for medical help and could not get one I quietly resolved to the traditional means which I have also stopped for some time now since I got no relief."

Bilikisu - F - 52yrs - LYM - NT - UB

"I actually went to this old hospital (ABU Teaching Hospital) before it was relocated from here. I then met an old doctor, a white man both here and where the hospital was relocated to; I asked him what can be done about my condition, and he said he doesn't know what precisely should be done about the leg. And you know knowledge keeps increasing; for some people surgery is usually conducted to reduce the swelling. I also met one doctor Kehinde at the general Hospital who told me he does not know want kind of intervention that can be applied to my leg, but he prescribed some drugs for me which he said can bring me some relief. He prescribed that I should get Ampiclox; he said if I have injuries on the leg, I should just take Ampiclox to get relief. At that time when I met the white doctor, he asked me to pay I think ₦70,000 or ₦60,000, although I am no longer so sure what the amount was. It was beyond my reach. Although Chief Sunny Okogwu (a philanthropist) wanted to assist but unfortunately nothing was done… A friend of mine who was a police officer… told me that his father was into traditional medicine. I even spent up to a month in their home at times. I appeared to feel better for a while but the way I see it; this thing has eaten deep into my system. Since then I never bothered to go anywhere in search of any cure. So if I have headache or body ache, I simply meet a doctor to prescribe drugs for me to buy. And I am grateful that the condition of my leg does not cost me malaria or headache. I could even go for ten years without falling ill. And there is no task that any healthy person will do that I cannot do."

Aminu - M - 72yrs - LYM - NT - UB

Most participants, mainly urban dwellers across gender affected by SCH and STH, reported that they experienced positive and almost immediate outcomes after accessing treatments for their conditions. Those with STH reported passing out worms in their stool.

Some participants infected with SCH also reported cessation of passing urine in their blood shortly after accessing and taking medicines.

"While in school at GSS Ikara, the medicine was administered to us and we were given directives on how to take the medicine. We were asked to ensure we ate proper meals before taking the medicine which was a single tablet per student. We were assured that by God's grace, we would feel changes in our bodies after taking the medicine and truly our health improved after taking the medicine"

Sanusi - M - 15yrs - SCH - T - UB

One participant who had hydrocele mentioned that he had a pleasant experience with the health workers and felt good about the whole treatment process.

"The experience was good; they were hospitable, welcoming and medication was provided. Everything was properly done and I really want to sincerely appreciate them. A follow up was done after the surgery to find out how we the patients were doing. So I really, really appreciate them. The same NTDs programme people; they followed us up to examine how successful the surgery was in order to be sure it was properly done."

Patrick - M - 34yrs - HYD - T - UB

IMPACT OF TREATMENT ON SUFFERERS OF NTDS

Most participants, of both genders and all ages, across Hydrocele, Lymphodema, Onchocerciasis, SCH, STH, and Trachoma from both urban and rural contexts had access to treatments for their various conditions. However, they reported varying degrees of success or none in some cases. One participant who had Hydrocele mentioned being able to return to school with increased productivity after surgery.

"Before the surgery, there was intense pain; the productivity in terms of the result from my exams was not how it was supposed to be. But now, even in my last semester exams I was able to do very well than before the time I had the surgery. I am able to know now that there are people who are concern about the well-being of others and that has really given me a sense of belonging in the society. Knowing that there are people who have made funds available for the well-being of other people, sincerely it has given me a sense of belonging. Since the surgery, I have not had any pain nor feel like I am less of a human and my productivity is now high."

Said - M - 56yrs - TT - T - RL

Participants affected by SCH and STH who had access to treatment mentioned that they got relief from pain. They could also return to school activities and resume house chores such as doing the dishes, laundry, and house cleaning, among other things, after accessing treatment.

"I felt relieved completely from the stomach ache after three days of taking the drug. I no longer feel the stomach pain, and I can now do my tasks. I do the dishes, laundry and assist my dad to buy fire woods. I run errands for my mum and assist her to sell in her shop. Yes, I can now go to school. I feel happy, I can now play with my friends."

Fatima, F, 9yrs, STH, T, UB

"After about 1 or 2 months of taking the medicine, I stopped seeing blood in my urine. After taking the medicine, the pain I experienced while urinating gradually came to an end. I felt very happy. I felt happy because my health was restored and I think anyone who receives healing must learn to appreciate God; with the disease, I frequented the bathroom at least 5 times while at school but after I received the treatment, I could stay a whole day without a need to urinate. With the disease, I missed parts of some lessons due to my frequent bathroom visits but after the treatment, I became fully present in all my classes without missing any lesson. With the NTD, there were days I had to skip school but with the treatment, I became consistent in school and I was available for learning."

Ahmed - M - 16yrs - SCH - T - UB

Some participants affected by Onchocerciasis mentioned that although they experienced general well-being, such as a reduction in itchiness after taking medicines, they did not mention specifically if the condition of their eyes did improve.

"She gets relief from the itchiness on her skin for a period of… between six to eight months after taking the drugs."

Rebecca - F - 75yrs - ONC - T - UB

Note: As narrated by Rebecca's brother.

"I want to appreciate the doctors for the work that had done for me because I currently have improved health."

Rabiu - M - 65yrs - ONC - T - RL

Some participants affected by Trachoma and accessing treatment for the first time on the same day they were interviewed mentioned that they felt immediate relief but expressed the hope that the treatment lead to a lasting solution to their condition.

"As compared to the pain and discomfort I experienced in the past, I now feel that my health has been restored totally. Though I just came out of surgery and the affected eye is completely covered, I feel very relieved from pain and discomfort. This is because the discharge and lining covering the eyeball have been taken off. Whenever the lining was on my eyeball, it felt like I had sand in my eyes and the sensation resulted to pain and discomfort. I feel very happy that my health has been restored."

Saidu - M - 56yrs - TT - T - RL

CURRENT CHALLENGES FACED

One female participant affected by trichiasis mentioned that apart from the second eye now requiring surgery, she has no current challenges.

"Since the last surgery, I have not had any issue with the eye. I am only here for the second eye."

Maryam - F - 27yrs - TT - T - RL

Most participants affected by SCH maintained that they have no current challenges since they took treatment for their cases.

"After receiving treatment, I have not faced any challenge."

Sanusi - M - 15yrs - SCH - T - UB

Another male participant affected with hydrocele also mentioned that he has had no challenges after accessing treatment.

"There are no challenges."

Patrick - M - 34yrs - HYD - T - UB

However, a participant affected by lymphodema stated that he is ashamed of attending occasions and mixing with other people because of the largeness of his leg, which does not allow him to wear clothing that suits him.

"The only challenge is that being an adult with this condition, people will look down on you. That is, it. We have very important people during the time of Mr. Dimkin, I even went to his house in Abuja. But now I am just shy to go there. Sometimes I just feel that the leg should be amputated. But what can I do? If God causes something to happen to you, it is imperative that you submit to his will. One should embrace whatever comes their way, perhaps God will one day bring you relief and it will become history."

Aminu - M - 72yrs - LYM - NT - UB

Most participants infected by Onchocerciasis, who are mostly aged and have wholly or partly lost their sight, mentioned that they could no longer engage in business activities, do house chores, and attend places of worship without assistance from others.

"There are quite a number of them; baba has become more like an area of concern for his siblings because they are the ones now taking care of him in terms of daily needs and when he might be in need of some medical intervention such as when he comes down with malaria. Baba cannot also engage in activities that can earn him some income. He cannot also go to his place of worship as frequently as he would want to due to his condition. He cannot also socialize with other members of the community."

Simon - M - 90yrs - ONC - T - UB

Note: This was as narrated by his brother.

"Her vision is not very clear and as a result she cannot do the things that she ought to do as a human. Things like farming and visitation. If she must go for visitation she must be with a guide moving ahead of her. Somebody to help her with fetching of water and other things. She cannot also engage in business."

Rebecca - F - 75yrs - ONC - T - UB

Note: As narrated by Rebecca's brother.

PERCEPTION OF DIFFERENCES THAT ACCESS TO TREATMENT OR CURE WILL MAKE

Many participants across Trachoma, Onchocerciasis, Lymphodema, and SCH from urban and rural LGAs, males and females, believed that access to treatment and cure would make a difference and bring about some changes in their lives. Most participants who hold this view believe access to treatment will allow them to engage in business to earn income, participate in their places of worship, and interact with others.

"It will be helpful by the grace of God. I will be able to do… things like my little business and being able to visit people and interact with members of the community in their various activities. You know once one gets well he can then engage in regular activities he/she is used to doing."

Bilikisu - F - 52yrs - LYM - NT - UB

"By the grace of God, his life will surely change. Firstly, he will be able to engage in business and earn income to take care of his needs. Secondly, he will be able to attend his place of worship and then become more devoted to his God. Thirdly, he will be able to visit and interact with people such as his children, grandchildren as well as others. He will also be able to make his own contributions to community projects."

Simon - M - 90yrs - ONC - T - UB

Note: This was as narrated by his brother.

One participant affected with Lymphodema mentioned that if he could gain access to treatment or find a cure for his condition, he would be able to wear clothes of his choice again and feel more comfortable interacting with other members of society.

"If God allow me to get cure for this, my life will surely change. For example, I can wear any style of cloth I so desire so that I can go anywhere that other people go to freely. I can as well mix freely with others and be unafraid to embrace them."

Aminu - M - 72yrs - LYM - NT - UB

Another participant infected by SCH, who had dropped out of school due to his condition, believes that access to treatment will enable him to feel relief from pain and return to school to continue his education.

"My life will change because receiving treatment will be beneficial to me. If I am to receive treatment, I will not feel pains while passing urine, and the waist pain will also go away. With regards to my education, I will return to school and fully concentrate on achieving success."

Labaran - M - 18yrs - SCH - NT - UB

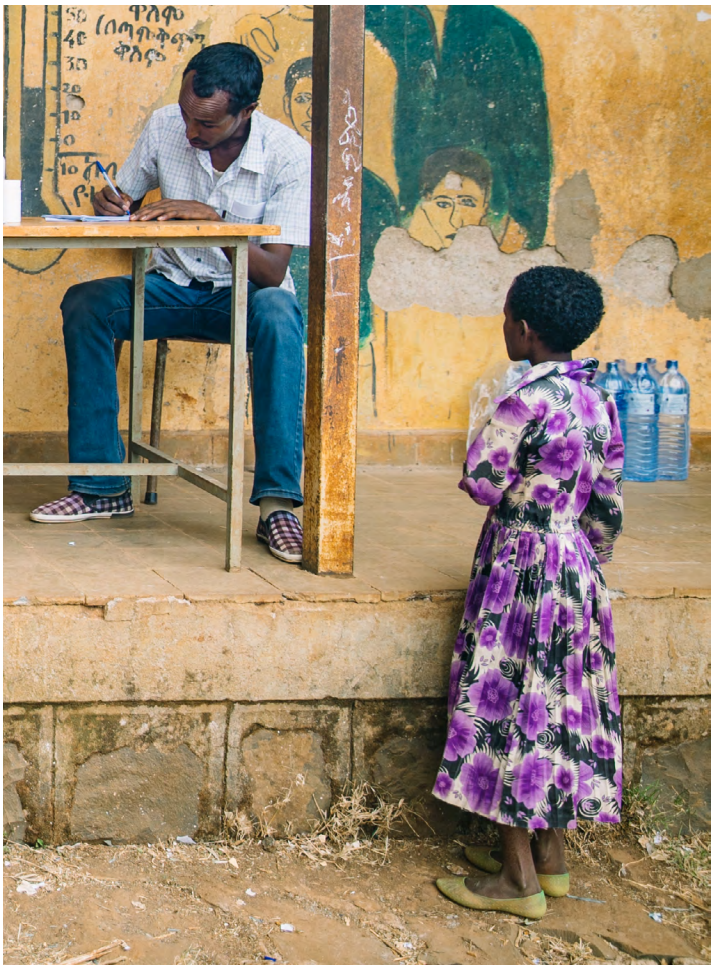
Another female participant infected with Trachoma stated that access to cure and treatment would free her from worry and discomfort associated with her condition.

"Of course it will bring difference to my life. If one gets cured from a disease, you will definitely become free from any worry and discomfort. It usually comes with headache and a person with headache cannot function effectively so you will have to rest and then continue your activity when you feel well or relieved."

Maryam - F - 27yrs - TT - T - RL

SUGGESTIONS FOR PROGRAMME AND PEOPLE RECEIVING TREATMENT

In addition to promising to engage in sensitization, some participants affected by STH suggested that their friends should accept the NTD treatment whenever it is being carried out in their communities or school.



"I have some of my friends who usually throw the medicines away when they are given. I will tell them to stop throwing the drugs away whenever they are given at school."

Fatima - F - 9yrs - STH - T - UB

"I will advise my friends to accept the drugs whenever it is being distributed."

Ibrahim - M - 10yrs - STH - T - UB

"We will sensitise people who do not know about this drugs so that if their children have similar experience, they can go to their primary school where this drug can be gotten. We are also grateful, and may God bless you. We shall continue to enlighten others since they are not aware. May God bless you and grant you safe travel."

Hajara - F - 8years - STH - T - UB

Note: This is as stated by Hajara's uncle.

A person receiving treatment from the state hydrocele programme advised the NTDs programme team not to relent in their efforts to help affected persons get better.

"I want to still encourage them (NTDs Programme) to keep this gesture going; to keep helping people and watch over the health of others and that their reward will come even hereafter."

Patrick - M - 34yrs - HYD - T - UB

Another participant treated for TTrachoma offered a prayer for sponsors and wished that other members of the society would embrace the NTDs programme.

"Truly I have received information that this was a sponsored intervention, and I pray that God blesses every donor and stakeholder that has contributed in making this a success. And I hope God grants the ignorant ones the knowledge to understand that this is a needful gesture that they must maximize."

Saidu - M - 56yrs - TT - T - RL

One participant who recovered from SCH after accessing treatment advised his peers to avoid going to the stream to protect themselves from infection.

"My advice to them is that anyone involved with going to the stream should endeavour to stop because it is hazardous to their health."

Sanusi - M - 15yrs - SCH - T - UB

COST-BENEFIT ANALYSIS OF INCREASED PRODUCTIVITY DUE TO NTD ELIMINATION

4.

OBJECTIVES AND APPROACH

The objective of the cost-benefit analysis conducted for this study is to estimate the economic benefits of eliminating the five most common NTDs in Nigeria by 2030. To this aim, two scenarios for the years 2023-2030 have been prepared, and a cost-benefit analysis comparing them has been conducted. The two scenarios are:

Baseline Scenario:

where it is assumed that sex- and age-specific prevalence rates follow the 2010-2019 trend and population projections from UN World Population Prospects (WPP) (2019) are used

Elimination Scenario:

It is assumed that all 2019 reversible cases will be eliminated until 2030. Therefore, the percentage of irreversible cases in 2019 (e.g., cases of blindness, which is incurable) is assumed, as are the projected case numbers in 2030.

Scenarios are extrapolated from the 2019 GBD case numbers, as these are the most recent detailed estimates available for all 5 NTDs in Nigeria.

The approach to estimating the benefits associated with eliminating the five studied NTDs by 2030 is shown in the figure below:

Figure SEQ Figure. * ARABIC 9
Approach to estimation of benefits under the elimination scenario

Source: Own elaboration

Calculating the value of benefits resulting from, first, cases productivity gains, and second, avoided out-of-pocket expenses and caregivers freed-up productivity.

Subtracting from them the estimated costs of scaling up MAM programs based on estimateddelivery cost, disease-specific drug regimen, and most recent drug prices.

The approach to estimating case numbers and calculating the benefits and costs is described in more detail below. It follows most closely the approaches taken by Chu et al., Turner et al., De Vlas et al., Redekop et al., Fitzpatrick et al., and Matthew et al.

CASE NUMBER ESTIMATES

For the analysis, case numbers for the five studied diseases were analyzed from 1990 to 2019, which made it possible to project them into the future to 2030 (i.e., until the target elimination date). From this, two scenarios were constructed – a Baseline Scenario showing how NTDs would progress with no new measures and an Elimination Scenario showing the elimination of all reversible NTD cases by 2030.

The overview of the approach to case numbers is shown in Table 3.

Table 3. Case numbers used in the study

All NTDs 2020-2022:	It was assumed that the 2010-2019 trends in sex- and age-specific coverage rates from the Global Burden of Disease Database (2019) have continued over the 2020-2022 period, while the population followed the UN WPP (2019) projections.
All NTDs 2023-2030 Baseline Scenario:	It is assumed that sex- and age-specific prevalence rates continue to follow the 2010-2019 trend and population projections from UN WPP (2019)
All NTDs 2023-2030 Elimination Scenario:	It is assumed that cases decrease linearly to the minimal value in 2030 (percentage of cases considered to be irreversible in 2019)

Prevalence rates and population numbers are used separately to have consistent historical and projected population numbers.

It should be noted that the elimination scenario is imperfect, as although some of the 2019 irreversible cases will die by 2030, some new irreversible cases are very likely to emerge. The lack of data for incidence rates makes a more precise calculation impossible.

The number of cases under the baseline and elimination scenarios are shown in Table 4.

Table 4. Number of cases of five studied NTDs in Nigeria under baseline and elimination scenarios

	Cases in 2019 (GBD, 2019):	Percentage of 2019 cases assumed to be irreversible:	Target in 2030:	The baseline in 2030:	Difference between Baseline & Elimination scenarios in 2030:
Lymphatic filariasis (Elephantiasis)	4.7m	33% (Hydrocele and lymphedema in Mathew et al., 2020)	1.5m	3.7m	2.3m
Onchocerciasis (River blindness)	25.0m	10% (Vision impairment due to Onchocerciasis in GBD 2019)	0.2m	2.4m	2.1m
Schistosomiasis (Bilharzia, snail fever)	34.3m	5% (Our estimate is based on de Vlas et al., 2016)	1.8m	41.4m	39.6m
STH (Soil-Transmitted Helminths, intestinal worms)	33.0m	0% (de Vlas et al., 2016)	0	21.9m	21.9m
Trachoma	0.2m	60% (Our estimate is based on de Vlas et al., 2016)	0.1m	0.13m	0.03m

Note that the costs due to irreversible cases will last beyond our 2030 estimation horizon, similarly to (much larger) benefits from the cured cases. Sources: Global Burden of Disease Database (2019); Christopher G Mathew, Alison A Bettis, Brian K Chu, Mike English, Eric A Ottesen, Mark H Bradley, Hugo C Turner, The Health and Economic Burdens of Lymphatic Filariasis before Mass administration of medicines Programs, Clinical Infectious Diseases, Volume 70, Issue 12, 15 June 2020, Pages 2561–2567; de Vlas, S. J., Stolk, W. A., le Rutte, E. A., Hontelez, J. A., Bakker, R., Blok, D. J., ... & Richardus, J. H. (2016). Concerted efforts to control or eliminate neglected tropical diseases: how much health will be gained? PLoS neglected tropical diseases, 10(2), e0004386.

The case numbers from 2019 to 2030, according to the approach outlined in Table 3, are shown in Appendix B.

BENEFIT ANALYSIS

The benefits of eliminating the five studied NTDs by 2030 are estimated by calculating the value of productivity gains for those who get cured and those who avoid getting infected. In the principal analysis, only productivity gains are considered because they are the largest, backed by the most reliable data, and are widely covered in the scientific literature. Additional benefits are also estimated in this study; however, they are not included in the principal cost-benefit analysis due to a higher number of assumptions in their calculation caused by a lack of data. The additional benefits are described in Section 5.

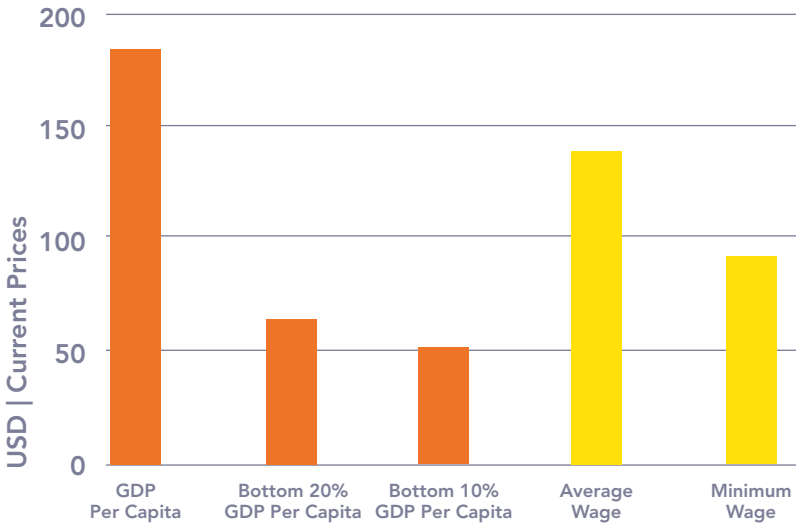
Productivity Gains of Those who Avoid Infection

To properly frame productivity gains, we must first calculate productivity losses. This is accomplished by combining the infection frequency and associated productivity loss from the disease once an individual becomes infected. Productivity gains are then calculated by deducting the total projected loss resulting from the 2030 target scenario (elimination scenario) from the loss in a scenario where there is no additional intervention before 2030 (i.e., the pre-intervention situation and trends continue unabated until 2030).

This study assumes that the baseline productivity of individuals infected with NTDs is equal to the Gross Domestic Product per capita of the bottom 20% of the population, as NTDs prevail among the poorest. The bottom 20% benchmark is the most common assumption in peer-reviewed cross-country studies (e.g., in Fitzpatrick et al., Redekop et al., or Mathew et al., 2020). Although data for the bottom 10% of GDP per capita is also available, the bottom 20% has become the asserted functional tranche in other studies because it is closer to the prevalence of the more widespread NTDs in Nigeria (which for STH and Schistosomiasis is at 16% and 17% respectively). In any event, due to the nature of wealth distribution, both averages are similar.

It is worth noting that here that GDP is the income generated by an economy in a year, which is then divided on a per capita basis, not just per worker. Wage data is not used due to limitations in its availability and also because those suffering may be subsistence or seasonal farmers who do not earn a market income, resulting in an income that may be lower than the minimum wage. As such, our approach may be considered conservative, as the average and minimum wage are much higher than the GDP per capita of the bottom 20%. To sum up, the productivity of people suffering from NTDs is estimated based on the income stream received by the bottom 20% of the Nigerian population, including all persons (i.e., children and elderly) and not just workers earning a market wage. The prevalence rates for the studied diseases and relevant factors related to income are shown in the figures below.

Figure 10. Monthly incomes per inhabitant and wage incomes in Nigeria in 2019



Therefore, in this study, productivity gains are understood as follows:

$$\text{Economic gains}_t == \text{Bottom 20\% GDP per capita} \cdot (\text{Baseline\_cases}_{t,n} - \text{Target\_cases}_{t,n}) \cdot \text{Productivity\_loss}_n$$

Where **t** stands for the year and **n** for the disease (Lymphatic filariasis, Onchocerciasis, Schistosomiasis, STH, or Trachoma).

Source: IMF, ILO

It is difficult to precisely estimate productivity losses from each NTD due to the heterogeneity of cases and severity of symptoms varying between patients and diseases. Redekop et al. (2017) point out that inferring productivity losses from GBD disability weights often yields implausible results. They, as well as Fitzpatrick et al. (2017), take the approach of deriving a plausible range of productivity losses for each of the NTDs based on a comprehensive review of the pertinent medical literature. The estimates presented in the table below are sourced from these two studies:

Figure 11. Percentage of individual annual productivity loss caused by the five studied diseases

	Lower limit	Point estimate	Upper limit
Lymphatic filariasis (Elephantiasis)	10%	15%	20%
Onchocerciasis (River blindness)	14%	17%	30%
Schistosomiasis (Bilharzia, snail fever)	1%	4%	18%
STH (Soil-Transmitted Helminths, intestinal worms)	0%	6%	12%
Trachoma	16%	32%	63%

Source: Own elaboration based on Redekop et al. (2017) and Fitzpatrick et al. (2017)

COSTS ANALYSIS

This study estimates the costs of scaling up MAMs (i.e., delivering treatment to more people) from the Baseline to the Elimination scenario. The aim is to calculate the costs associated with eliminating the five studied NTDs by 2030. This cost comprises estimated delivery cost, typical drug regimen, and most recent drug prices. Three types of costs are calculated:

01

Financial Costs

Assuming that:
THE DRUGS ARE DONATED

02

Economic Costs

Assuming that:
THE DRUGS ARE DONATED

03

Economic Costs

Assuming that:
THE DRUGS ARE PURCHASED

Economic costs are an extension of financial costs. The scope covered by both types of costs is presented in Table 5.

This study conservatively estimates the costs of scaling up respective MAMs to match the elimination scenario for each NTD.

In reality, conducting mass treatment is likely to be done in an integrated manner, which would allow for a decrease in treatment cost, possibly very significantly, if all of the five diseases were to be targeted simultaneously. However, this also presents challenges, as the specific NTDs have disparate susceptible populations distributed unevenly across Nigeria. Cost-savings are also likely with volunteers and school-based delivery, but it is difficult to estimate the share of treatments that could be delivered in such a way. This study assumes a significant scaling-up of MAMs, making it more difficult to find volunteers (more readily available for smaller programs), while school-based delivery targets only school-age children. **That said, our cost estimates are conservative and likely higher than the cost under the elimination scenario.**

Table 10. Monthly incomes per inhabitant and wage incomes in Nigeria in 2019

Type of cost	Financial	Economic
Drug Delivery (I.e., Shipment)	Yes	Yes
Fuel And Maintenance	Yes	Yes
Office And Other Supplies	Yes	Yes
Office Utilities	Yes	Yes
Planning And Mapping	Yes	Yes
Project Staff Salaries	Yes	Yes
Per Diems	Yes	Yes
Training	Yes	Yes
Vehicles (Rented)	Yes	Yes
Vehicles (New)	Yes (annualized)	Yes (annualized)
Vehicles (Existing)	No	Yes (annualized)
Ministry Of Health Buildings	No	Yes (annualized)
Ministry Of Health Staff Time	No	Yes
Volunteer Time	No	No
Treated Person's Time Or Other Costs	No	No

Source: Fitzpatrick, C., Fleming, F. M., Madin-Warburton, M., Schneider, T., Meheus, F., Asiedu, K., ... & Biswas, G. (2016). Benchmarking the cost per person of mass treatment for selected neglected tropical diseases: an approach based on literature review

Source: Own elaboration based on Redekop et al. (2017) and Fitzpatrick et al. (2017)

The proper comparison of monetary values across time requires discounting, which corrects the notion that people value the costs and benefits today as higher than in the future. This is dictated not by the fact that the value of money is inflated away with time (which is corrected by expressing all values in US dollars from 2022) but by society's time-preference rate when choosing between different investments. Discounting future monetary values to 2022 allows us to compare the 2023-2030 benefits and costs. The discount rate is assumed to be at 3% by relevant literature.

Delivery Costs

Drug delivery costs are estimated using a tool developed in a meta-analysis by Fitzpatrick et al.. The tool models NTD MAM costs per person across 33 studies, with control variables like population density, GDP per capita, population, coverage rate, school-based delivery, etc. This allows for forecasting the economic and financial unit delivery costs based on the coefficients of these control variables. Forecasting is based on the following inputs:

- Population To Be Treated
- Target Coverage Rate
- Number Of Integrated Diseases
- Number Of Rounds Per Year
- Gdp Per Capita
- Population Density
- Whether The Mam Would Be National Or Sub-National
- Whether The Delivery Would Be School-Based

The input data used for the analysis and the resulting per-person cost estimates are presented in Table 6 below.

Table 6. MAM per person cost estimates per disease - input data and results from the benchmarking tool developed by Fitzpatrick et al. (2016)

	Lymphatic Filariasis	Onchocerciasis	Schistosomiasis	STH	Trachoma
Input Data					
Rounds Per Year	1	2	2	2	1
Population To Treat (Million)	34.6	11.7	211.8	27.9	5.8
Number Of Years	7	8	8	8	8
Other Assumptions	• Each NTD is estimated separately • Nigerian GDP per capita in 2022 • The population density in 2022 • No use of volunteers • No school-based delivery				

Source: Tool developed by Fitzpatrick et al. (2016), DOI:10.1371/journal.pntd.0005037. Input data generated by Deloitte: rounds per year are assumed based on expert consultations conducted for this study, as well as on Fitzpatrick, C., Nwankwo, U., Lenk, E., de Vlas, S. J., & Bundy, D. A. (2017); Population is sourced from UN WPP data, the land area from the World Bank, and GDP from the IMF WEO (April 2022).

Drug Regimen and Prices

Drug regimens are assumed based on Fitzpatrick et al. (2017), and they are shown in Table 7 below.

Table 7. Drug regimen assumed in the study

Disease	Drugs
Lymphatic filariasis	• Albendazole 400 mg • Ivermectin 150-200 mcg/kg or • Albendazole 400 mg • Diethylcarbamazine 6 mg/kg
Onchocerciasis	Ivermectin 150 mcg/kg
Schistosomiasis	Praziquantel 40 mg/kg
STH	Albendazole 400 mg Mebendazole 500 mg
Trachoma	Azithromycin 20 mg/kg to a maximum of 1g

Source: Table 17.4, Fitzpatrick C, Nwankwo U, Lenk E, de Vlas SJ, Bundy DAP. An Investment Case for Ending Neglected Tropical Diseases. In: Major Infectious Diseases. 3rd ed. The International Bank for Reconstruction and Development / The World Bank, Washington (DC)

Drug prices are meanwhile assumed based on MSH International Medical Products Price Guide 2015 and are shown in Table 8 below.

Table 8. Drug prices used for the calculation of MAM costs

Drug	Tablet size	USD 2022
Albendazole	400 mg	0.34
Azithromycin	500 mg	0.22
Diethylcarbamazine Citrate	50 mg	0.01
Ivermectin	6 mg	0.06
Mebendazole	500 mg	0.25
Praziquantel	600 mg	0.13

Source: MSH International Medical Products Price Guide 2015

RESULTS

Benefit Analysis

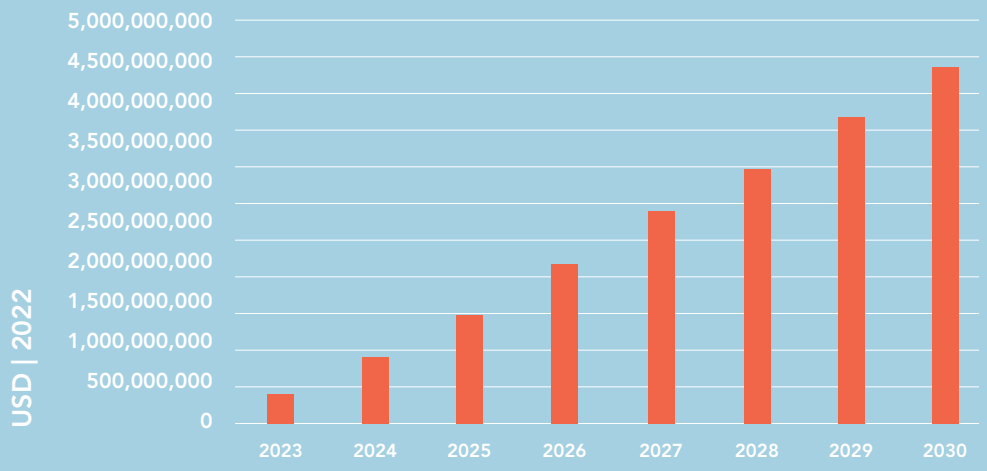
Drug delivery costs are estimated using a tool developed in a meta-analysis by Fitzpatrick et al.. The tool models NTD MAM costs per person across 33 studies, with control variables like population density, GDP per capita, population, coverage rate, school-based delivery, etc. This allows for forecasting the economic and financial unit delivery costs based on the coefficients of these control variables. Forecasting is based on the following inputs:

The benefits considered in the baseline cost-benefit analysis are limited to the productivity gains of those who are cured or avoid infection.

This study takes such an approach as productivity gains are the most broadly described and calculated benefit in the literature. The estimates of additional benefits are covered in Section 5.

Yearly productivity gains associated with eliminating the five studied diseases in Nigeria by 2030 are estimated to increase yearly due to the rising number of cases eliminated annually (not solely because they are cumulative).

Table 6. MAM per person cost estimates per disease - input data and results from the benchmarking tool developed by Fitzpatrick et al. (2016)



Source: Own calculation based on the approach described in Section 4.1.2.

Note that these are yearly, non-cumulative figures. They increase yearly due to the rising number of cases eliminated annually.

$18.9Bill

THE TOTAL BENEFITS RESULTING FROM PRODUCTIVITY GAINS UNDER THE ELIMINATION SCENARIO

The total benefits resulting from productivity gains under the elimination scenario (i.e., the sum of the yearly figures shown above) are estimated at USD 18.9 billion. The benefits resulting from the elimination of each of the studied diseases by 2030 are outlined below.

Lymphatic Filariasis

Yearly gains from eliminating LF under the elimination scenario are estimated to be USD 38.1 million in 2023 and USD 422.5 million in 2030. The total accumulated gains for the 2023-2030 period are USD 1.8 billion. The gains for each year until 2030 are shown in Figure 13.

YEARLY GAINS:
FROM ELIMINATING LF UNDER THE ELIMINATION SCENARIO

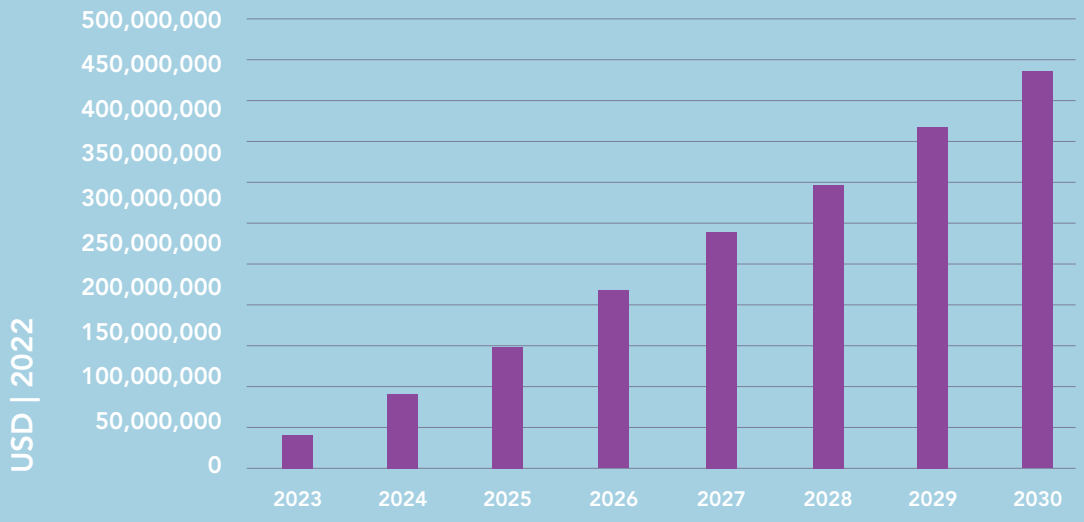
$38.1Mill
2023

$422.5Mill
2030

TOTAL GAINS:
ACCUMULATED

$1.8Bill
2023-2030

Figure 13. Yearly productivity gains associated with eliminating LF under the Elimination scenario, 2023-2030 (non-cumulative, discounted to 2022)



Source: Own calculation based on the approach described in Section 4.1.2.

Note that these are yearly, non-cumulative figures. They increase yearly due to the rising number of cases eliminated annually.

Trachoma

The productivity gains associated with combatting Trachoma under the elimination scenario are significantly lower than those for LF despite Trachoma being more detrimental to an infected person's health because Trachoma is much less prevalent in Nigeria. The yearly gains in 2023 are estimated to be USD 1.3 million in 2023 and USD 16.4 million in 2030, while total gains for 2023-2030 are estimated at USD 67.4 million. The gains for every year until 2030 are shown in Figure 14 below.

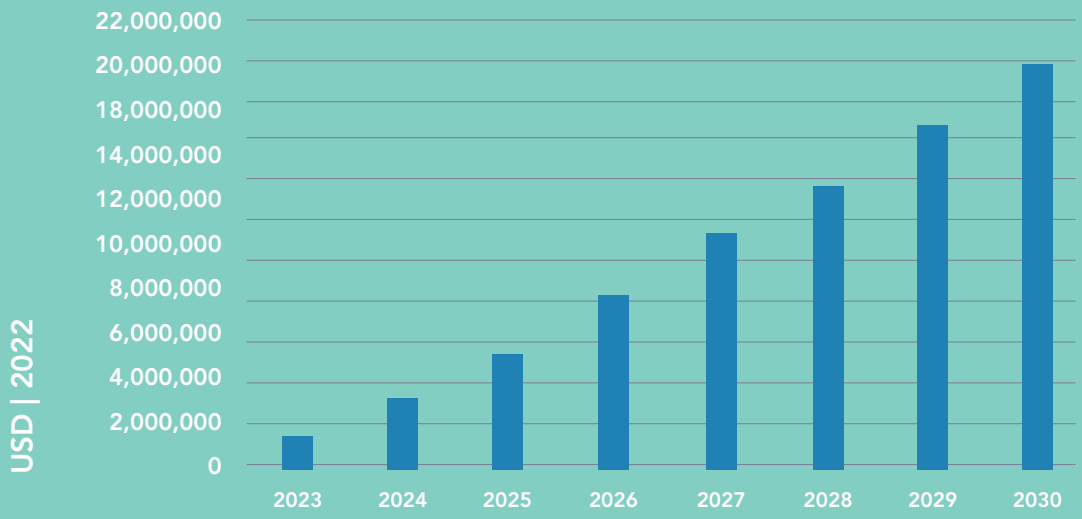
YEARLY GAINS:

$1.3Mill 2023 | **$16.4Mill** 2030

TOTAL GAINS:

$67.4Mill 2023-2030

Figure 14. Yearly productivity gains associated with eliminating Trachoma under the Elimination scenario, 2023-2030 (non-cumulative, discounted to 2022)



Source: Own calculation based on the approach described in Section 4.1.2.

Note that these are yearly, non-cumulative figures. They increase yearly due to the rising number of cases eliminated annually.

Onchocerciasis

The productivity gains from eliminating Onchocerciasis under the elimination scenario are similar to those associated with eliminating LF. The yearly gains are estimated to be USD 41.8 million in 2023 and USD 450.8 million in 2030, whereas the total gains for 2023-2030 are estimated at USD 1.91 billion. The gains for each until 2030 are shown in Figure 15.

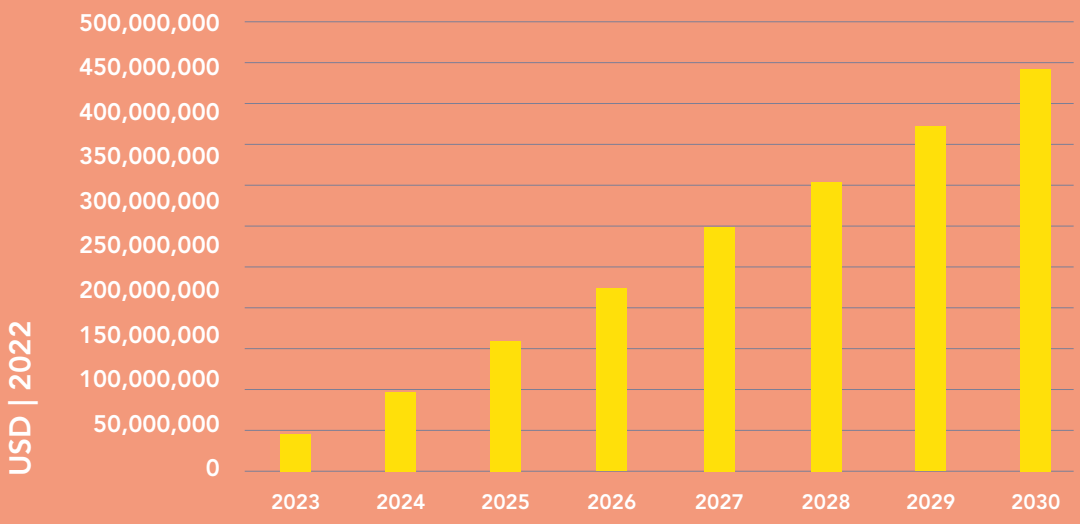
YEARLY GAINS:

$41.8Mill 2023 | **$450.8Mill** 2030

TOTAL GAINS:

$1.91Bill 2023-2030

Figure 15. Yearly productivity gains associated with eliminating LF under the Elimination scenario, 2023-2030 (non-cumulative, discounted to 2022)



Source: Own calculation based on the approach described in Section 4.1.2.

Note that these are yearly, non-cumulative figures. They increase yearly due to the rising number of cases eliminated annually.

Soil-Transmitted Helminths (STH)

Freed-up productivity gains of those avoiding infection or cured under the elimination scenario for STH are high compared to other diseases (except for Schistosomiasis) due to the prevalence of this disease in Nigeria. The yearly gains in 2023 are estimated to be USD 146 million in 2023 and USD 1.63 billion in 2030. The total gains for 2023-2030 are estimated at USD 6.84 billion. The gains for each year until 2030 are shown in Figure 16.

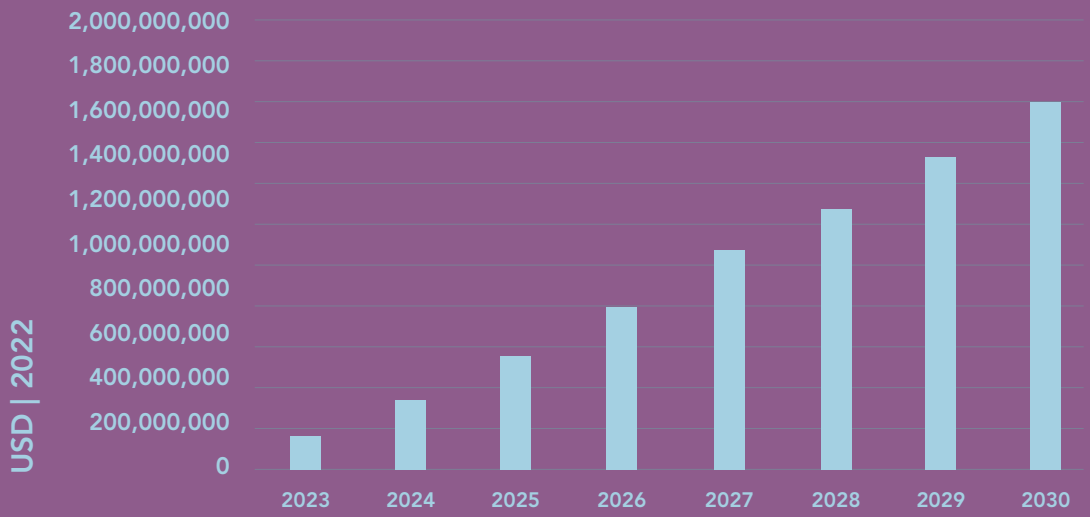
YEARLY GAINS:

$146Mill 2023 | **$1.63Bill** 2030

TOTAL GAINS:

$6.84Bill 2023-2030

Figure 16. Yearly productivity gains associated with eliminating LF under the Elimination scenario, 2023-2030 (non-cumulative, discounted to 2022)



Source: Own calculation based on the approach described in Section 4.1.2.

Note that these are yearly, non-cumulative figures. They increase yearly due to the rising number of cases eliminated annually.

Schistosomiasis

Eliminating Schistosomiasis by 2030 in Nigeria is estimated to yield the highest productivity gains among the diseases studied because of its high prevalence in Nigeria. The yearly gains in 2023 are estimated to be USD 181.7 million in 2023 and USD 1.96 billion in 2030. The total gains for 2023-2030 are estimated at USD 8.32 billion. The yearly gains for 2023-2030 are shown in Figure 17.

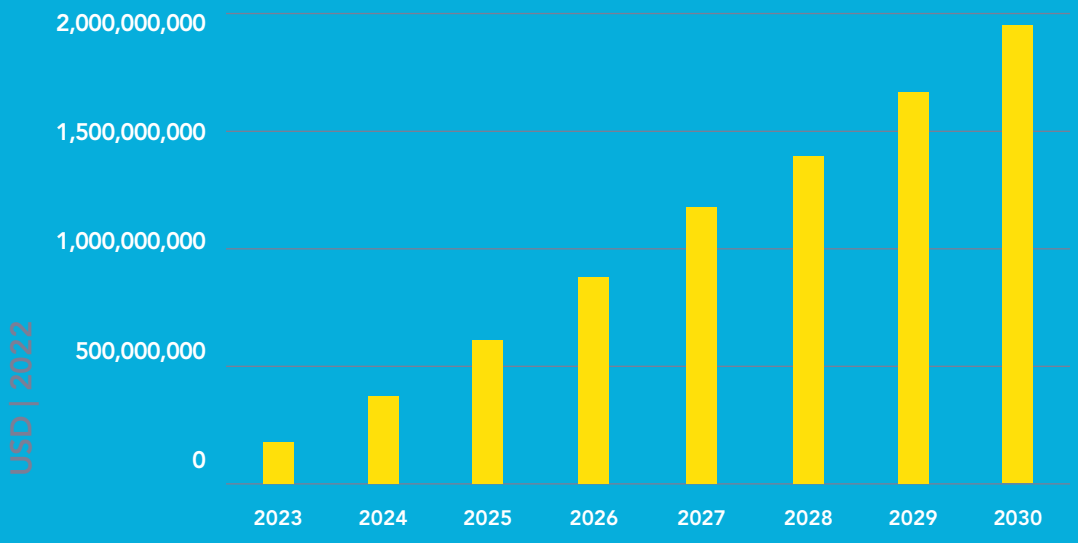
YEARLY GAINS:

$181.7Mill 2023 | **$1.96Bill** 2030

TOTAL GAINS:

$8.32Bill 2023-2030

Figure 17. Yearly productivity gains associated with eliminating LF under the Elimination scenario, 2023-2030 (non-cumulative, discounted to 2022)



Source: Note that these are yearly, non-cumulative figures, which increase yearly due to the rising number of cases eliminated annually.

COSTS ANALYSIS

As described in Section 4.1.3, this study takes a conservative approach to analyze the costs of scaling up MAM programs for each disease separately. These are determined by multiplying the individual treatment costs (with the tool developed by Fitzpatrick et al., as described in Section 4.1.3) by the number of additional persons requiring treatment under the elimination scenario compared to the baseline scenario. The resulting cost estimates are shown in Table 9 below and described in more detail in Appendix D.

Table 9. Total cost of scaling up treatment to meet elimination scenario assumptions in Nigeria until 2030, 2022 USD, discounted

Disease	Financial Cost	Economic Cost	Economic Cost + Cost Of Medicines
Lymphatic filariasis	-9.07m	-11.34m	-32.36m
Onchocerciasis	41.8m	49.8m	69.3m
Schistosomiasis	66.3m	80.5m	313.1m
STH	230.7m	280.0m	2.03bn
Trachoma	3.6m	4.3m	8.0m

Source: Own calculation

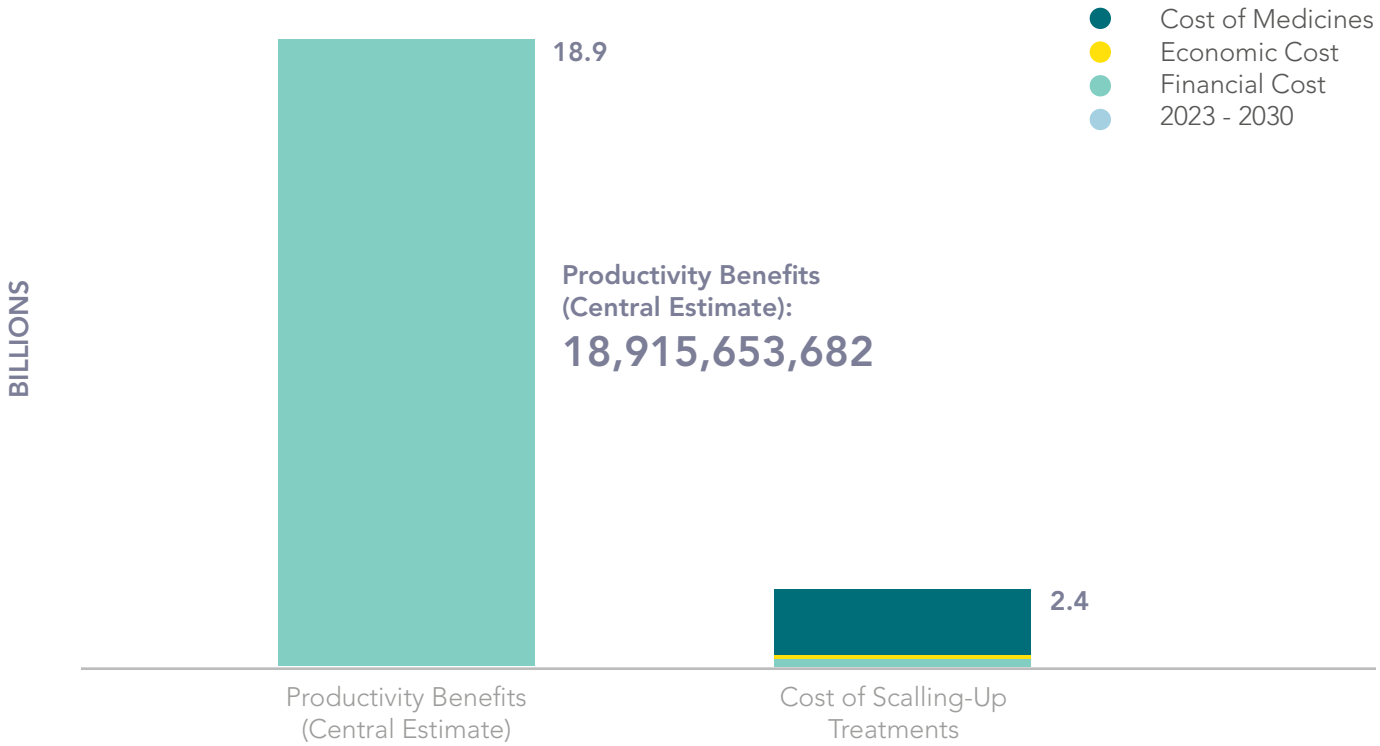
COST-BENEFIT ANALYSIS

Summary Of Cost-Benefit Analysis Results

The benefits associated with productivity gains stemming from eliminating the five studied NTDs by 2030 are estimated at $18.9 billion, and the economic cost (including the cost of medicines) of scaling-up treatments is estimated at $2.4 billion.

Therefore, the productivity gains for cured and avoided NTD cases are much higher than their treatment costs. Even under the most conservative approach (where it is assumed that drugs are not donated but fully paid for, which is often not the case). The costs and benefits resulting from the primary cost-benefit analysis are shown in Figure 18. The cost of medicines is sourced from MSH International Medical Products Price Guide 2015, as outlined in Table 8. The financial cost is the extension of economic cost, as summarized in Table 5)

Figure 18. Cost-benefit analysis of productivity gains (central estimate) and total costs 2023-2030 discounted to 2022



Source: Own calculation

Detailed Cost-benefit Analysis Results

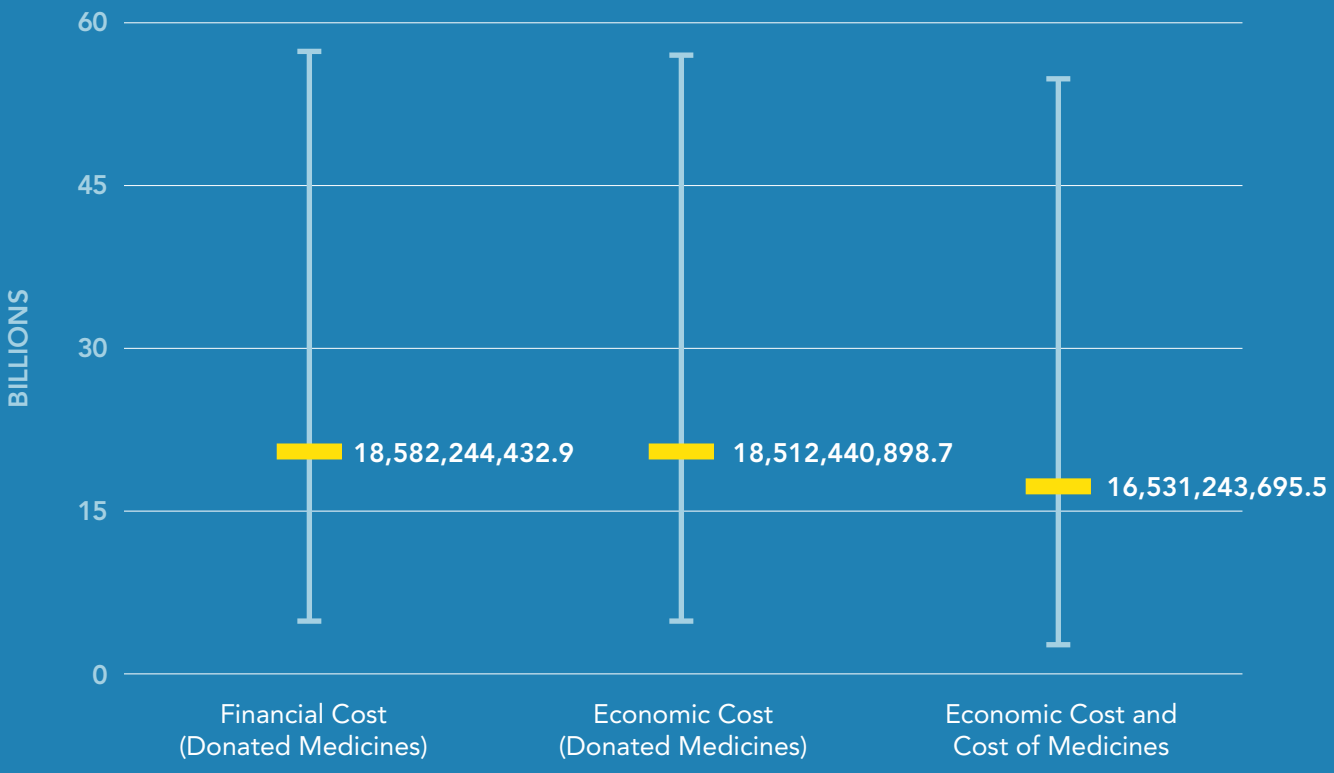
The benefits stemming from eliminating the five studied NTDs were calculated while accounting for three types of costs:

- Financial Cost Assuming That The Drugs Are Donated
- Economic Cost Assuming That The Drugs Are Donated
- Economic Cost Assuming That The Drugs Have To Be Paid For

The cost of the elimination scenario increases significantly when it is assumed that medicines must be purchased; however, even under these assumptions, the expected benefits hugely outweigh the expected costs.

The results of the cost-benefit analysis with confidence intervals are presented in Figure 19, where it can be seen that these intervals point to a much higher net-benefit upside than the downside. Furthermore, cost-effectiveness holds even when the lowest estimates of individual productivity gains are used.

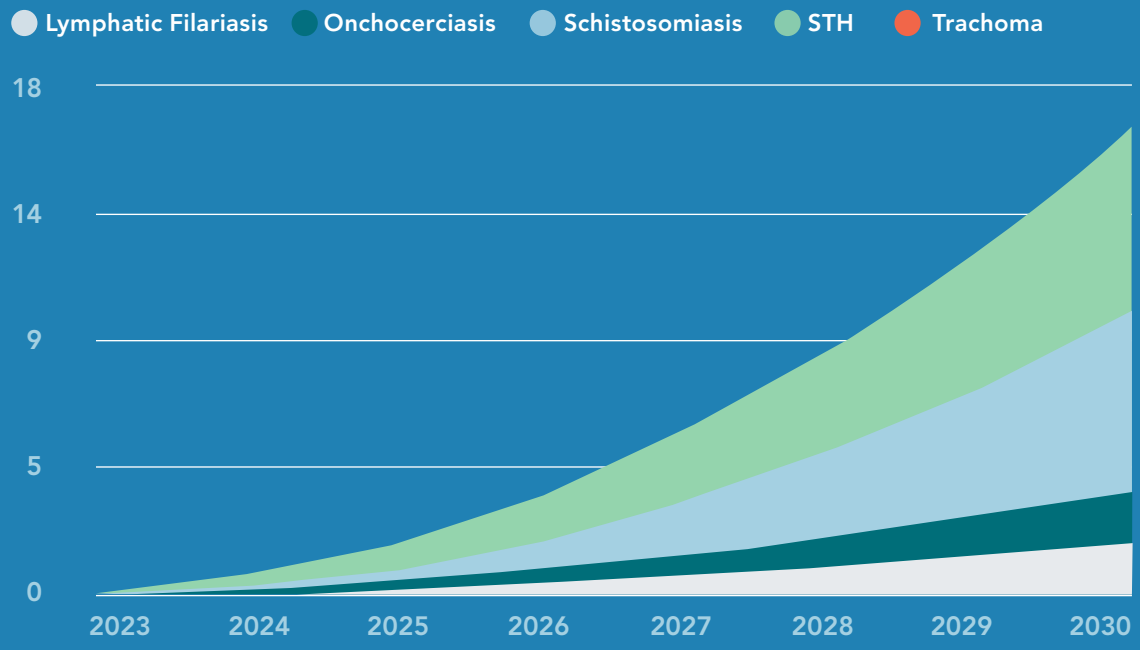
Table 9. Total cost of scaling up treatment to meet elimination scenario assumptions in Nigeria until 2030, 2022 USD, discounted



Source: Own calculation

The cumulative net benefits are presented in Figure 20, with most gains coming from eliminating Schistosomiasis and STH due to their high prevalence. Comparatively, the gains from eliminating Trachoma are low because although this disease induces very high productivity costs to individuals, there were far fewer cases among the Nigerian population.

Figure 20. Cost-benefit analysis (cumulative), 2023-2030 discounted to 2022



Source: Own calculation

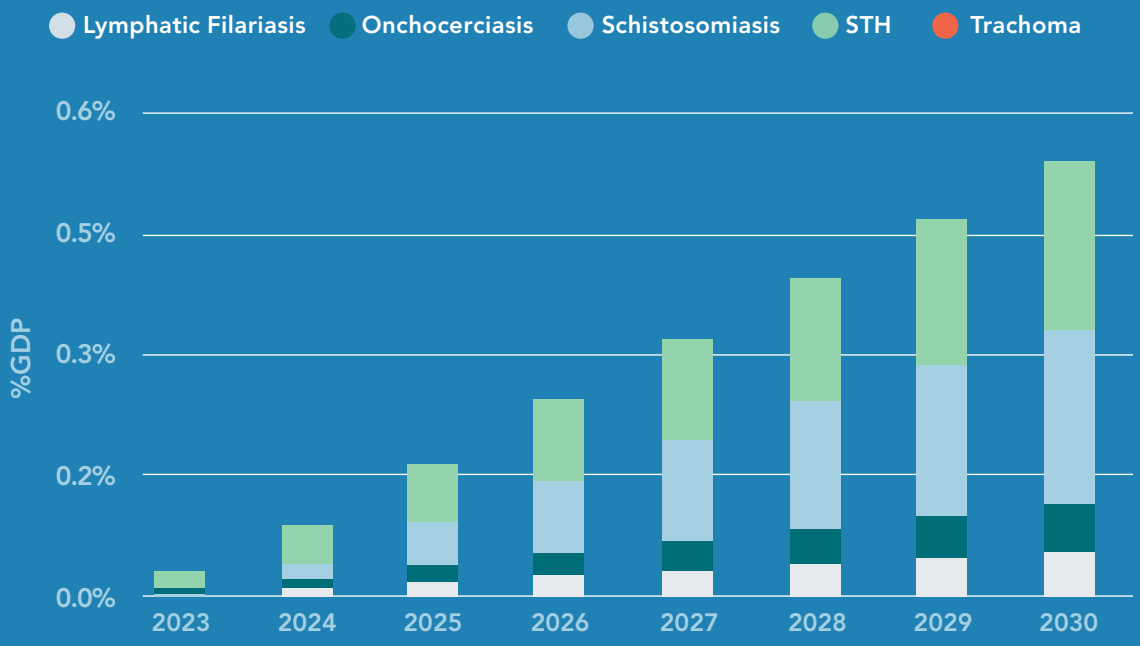
The yearly net benefits relative to annual GDP forecasts are shown in Figure 21. These benefits increase yearly not because they are cumulative but because the number of avoided new infections increases under the elimination scenario. In 2023, it is estimated that the net benefits associated with eliminating these five NTDs will equal 0.03% of GDP and 0.54% of GDP in 2030.

NET BENEFITS ASSOCIATED WITH ELIMINATING THESE FIVE NTDS WILL EQUAL:

0.03% OF GDP

0.054% OF GDP

BY 2030



ADDITIONAL BENEFITS

5.

OBJECTIVES

In the principal cost-benefit analysis, the only benefit results from the freed-up productivity of those who are cured or avoid infection under the Elimination scenario. This is, as explained previously because these gains are most broadly covered in the literature and backed by Nigeria-specific, reliable data. Notwithstanding, the benefits of eliminating NTDs are not limited to this, with various other favorable effects stemming from eliminating these diseases. However, as they are generally not described in any detail in the scientific literature, this study adopts the conservative approach of presenting them as "additional benefits."

These additional benefits include:

- **Avoided out-of-pocket expenses related to treatment (calculated only for Lymphatic Filariasis, as described below)**
- **Freed-up productivity of caregivers, i.e., the people who, under the Elimination scenario, no longer need to dedicate their time to caring for those suffering from the diseases**
- **Benefits of increased school attendance for those who are currently unable to participate in the educational system due to illness**

The approach and results of the estimations of these benefits are described in Sections 5.2, 5.3, and 5.4, respectively. While the results of the principal cost-benefit analysis (covered in Section 4.2.3), combined with the estimates of the additional benefits, are covered in Section 5.5.

OUT-OF-POCKET EXPENSES

This study follows the approach of Redekop et al. and calculates the out-of-pocket expenses (OPPs) only for Lymphatic filariasis owing to a lack of data for other diseases. What is more, as Redekop et al. (2017) explain:

- **Blindness or low vision resulting from onchocerciasis or trachoma are assumed not to incur significant OPPs as there is no drug-based treatment for blindness**

- **Treatment for skin disease due to onchocerciasis is rarely sought by the infected**

- **Soil-Transmitted Helminthiasis and Schistosomiasis can be cured with antiparasitic medication, resulting in minimal chronic sequelae and costs.**

Due to the above, this study assumes that the OPP for diseases other than LF is zero, meaning that none would be avoided under our elimination scenario.

Lymphatic Filariasis

This study combines data available in the following studies:

1. Treatment-seeking parameters and treatment costs for Lymphatic Filariasis presented by Mathew et al. (2020). They are shown in Table 10.

2. Eze et al. (2021) surveyed NTD morbidity management in Anambra State, Nigeria, which included LF treatment. The costs reported in this survey are presented in Table 11.

Table 10. Treatment seeking parameters for Lymphatic Filariasis

TREATMENT SEEKING PARAMETERS			
Parameter	**Point estimate**	**Min**	**Max**
Percentage Seeking Treatment			
Seeking treatment with hydrocoele	30%	20%	80%
Seeking treatment with lymphoedema	35%	30%	100%
Percentage Seeking Treatment			
Frequency for adenolymphangitis (per year per infected)	0.43	0.39	1.56
Frequency for hydrocoele (per year)	2	1	4
Frequency for lymphoedema (per year)	3	1	6
Treatment Preferences	**Public**	**Private**	**Self-Treat**
For patients experiencing adenolymphangitis episodes	25%	5%	70%
For hydrocoele/lymphoedema patients	15%	5%	80%
OUT-OF-POCKET TREATMENT COSTS			
Type of cost	**Cost**		
Doctors' fees and other costs associated with utilizing healthcare	60% of medication costs		
Medication costs	International Medical Products Price Guide (prepared by Management Sciences for Health)		
Medication used	Conservative use of three medications: amoxicillin (500mg three times a day), paracetamol (500mg three times a day), and ibuprofen (400mg twice a day)		
Treatment length	Seven (7) days		

Source: Mathew, C. G., Bettis, A. A., Chu, B. K., English, M., Ottesen, E. A., Bradley, M. H., & Turner, H. C. (2020). The health and economic burdens of lymphatic filariasis before mass drug administration programs. Clinical Infectious Diseases, 70(12), 2561

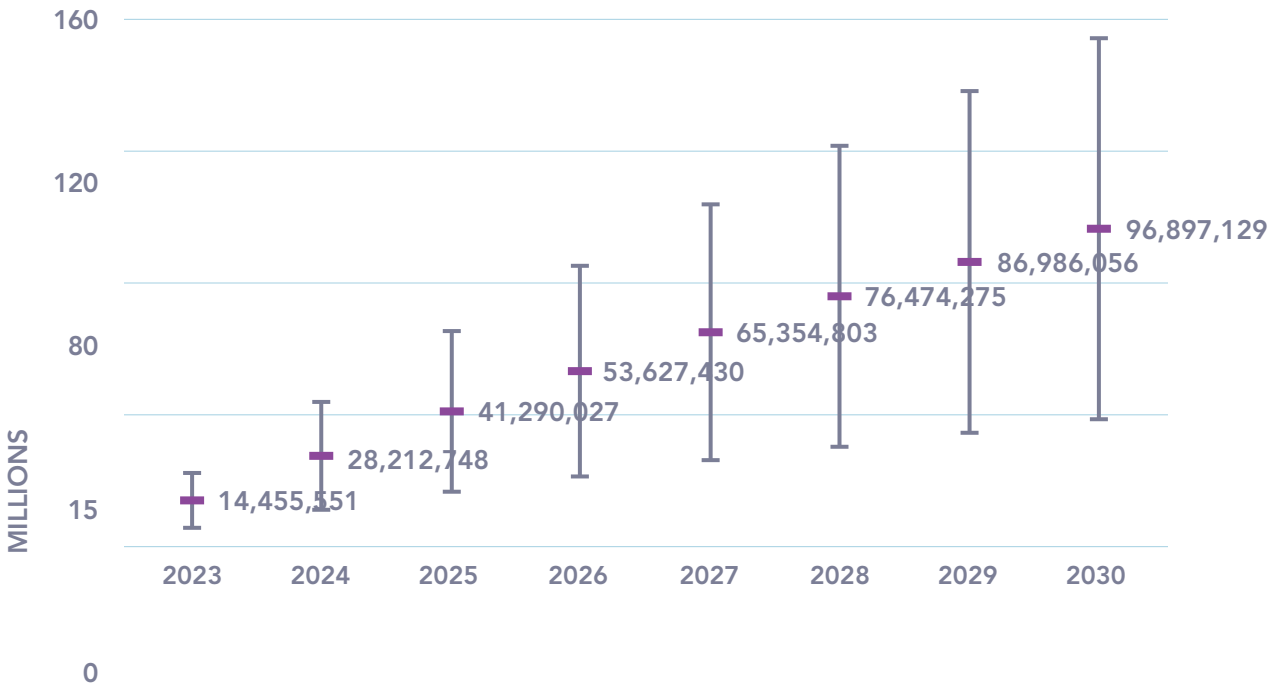
Table 11. Reported out-of-pocket treatment costs associated with NTDs (including LF) in Anambra state, Nigeria

Type of cost	Participants reporting expenditure N (%)	Mean (SD) costs in USD	Cost (% of total)
Out-of-Pocket Costs			
Fetching Clean Water For Chores And Self-Care	14 (29.2)	2.71 (4.88)	3.1
Persons To Assist With Your Work	8 (16.7)	3.02 (8.82)	3.5
Getting Persons To Care For Your Children	0 (0)	0 (0)	0
Transportation To Clinic/Doctor/Traditional Healer	32 (66.7)	7.36 (11.24)	8.5
Transportation Costs To Work/School	5 (10.4)	0.41 (1.94)	0.5
Transportation Costs To/From Market	7 (14.6)	0.99 (3.32)	1.1
Transportation Costs To/From Social Events	12 (25)	1.37 (2.94)	1.6
Self-Care Materials (Soap, Clean Clothing, Etc.)	30 (62.5)	3.19 (7.23)	3.7
Wound Care Materials	28 (58.3)	6.56 (9.33)	7.6
Traditional Healers	18 (37.5)	44.74 (124.0)	51.7
Caregiver/Helper	10 (20.8)	2.94 (6.65)	3.4
Painkillers (Or Analgesics)	34 (70.8)	9.72 (17.02)	11.2
Antibiotics	13 (27.1)	2.34 (5.70)	2.7
Antifungal	3 (6.3)	0.10 (0.45)	0.1
Special Footwear/Clothing	2 (4.2)	0.22 (1.08)	0.3
Mobility Assistance/Devices	3 (6.3)	0.87 (3.75)	1.0
Mean Out-Of-Pocket Costs		**86.54 (134.22)**	

Source: Eze et al. (2021)

Avoided out-of-pocket expenses are calculated based on reduced case numbers under the elimination scenario and the two approaches described above. As they yielded different results, their average was calculated, marked in green, and labeled. The results of these calculations are presented in Figure 22, where it can be seen that the average yearly avoided out-of-pocket expenses are estimated at USD 14 million in 2023 and USD 97 million in 2030. The increase in these estimates is not due to their cumulative nature (these figures are per year) but rather due to the increasing number of cases eliminated under the Elimination scenario.

Figure 22. Yearly avoided out-of-pocket expenses associated with Lymphatic Filariasis treatment (discounted to 2022)



Source: Own calculations

FREED-UP PRODUCTIVITY OF CAREGIVERS

Approach

NTDs impact the productivity of those who are infected with them, but also of those who care for them. However, a lack of peer-reviewed analyses estimating gains for caregivers associated with NTD elimination makes it impossible to source methodology from reliable research. In light of this, in this study, the freed-up productivity of caregivers is calculated based on the following:

The productivity of caregivers is the GDP per capita of the bottom 20% of the population for those infected with NTDs

Caregiving activities reduce productivity by 10% (based on working two (2) days in a 20-day month from the 2021 study by Eze et al. in Anambra State, Nigeria)

The number of caregivers is assumed to be analogous to the maximum productivity loss from a particular NTD (i.e., more severe cases more often require the assistance of caregivers).

Results

The resulting estimates of the yearly freed-up productivity of caregivers under the elimination scenario between 2023 and 2030 are shown in Figure 23. The most significant gains stem from eliminating Schistosomiasis, followed by STH, owing to its prevalence among the Nigerian population. These benefits are estimated at USD 125.7 million in 2023, increasing yearly to USD 1.37 billion in 2030. The total productivity gains for 2023-2030 are estimated at USD 5.79 billion.

The figures shown are yearly figures; therefore, their increase is not due to the cumulation of the gains but rather due to the increasing number of cases eliminated each year (those who avoid infection under the Elimination scenario).

GAINS FROM ELIMINATING SCHISTOSOMIASIS :

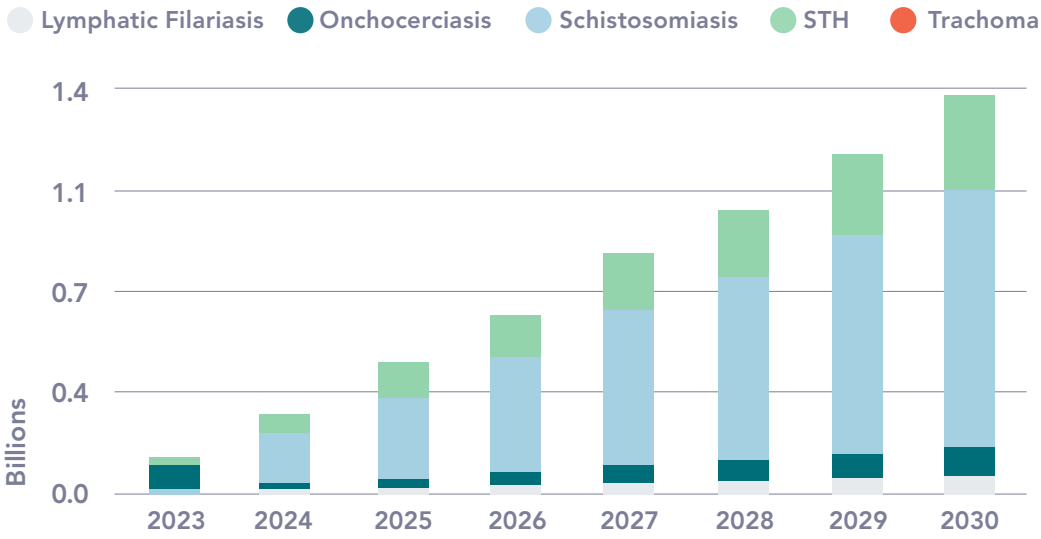
$125.7Mill
2023

$1.37Bill
2030

TOTAL GAINS:

$5.79Bill
2023-2030

Figure 23. Yearly freed-up productivity of caregivers under Elimination scenario, 2023-2030 (non-cumulative, discounted figures, in 2022 USD)



Source: Note that these are yearly, non-cumulative figures, which increase yearly due to the rising number of cases eliminated annually.

BENEFITS OF INCREASED SCHOOL ATTENDANCE

The symptoms caused by NTDs among school-age children negatively impact their academic performance, and severe cases may impede them from attending school altogether. The treatment of NTDs among school-age children results in increased school attendance, which produces benefits associated with applied skills and performance later in life. This study leveraged De Neve et al. to assess the benefits of increased school attendance. It used data regarding case numbers among school-age children, estimates of lost school years caused by NTDs, the increase of lifetime earnings related to additional years of schooling, average earnings, and the employment rate. These are used to calculate the benefits associated with increased school attendance stemming from eliminating NTDs.

23Million
SCHOOL-AGE CHILDREN

Had one of the 5 NTDs In 2019

Table 12. Input data for the calculation of benefits stemming from increased school attendance due to the elimination of the five studied NTDs in Nigeria by 2030

Input data	Source	Note
23 million school-age children had one of the 5 NTDs in 2019	Global Burden of Disease database (2019)	
0.15 years of education is gained by treating an NTD child	Baird et al., 2016	Estimate for Kenya
One additional year of education increases lifetime earnings by 10.1% in Nigeria	Montenegro & Patrinos, 2014	
Average yearly earnings in Nigeria in 2019: USD 1,680	ILO database	
The employment rate in Nigeria in 2019 was 52.6%	ILO Database	
Working life: 40 years (conservative estimate based on the expected remaining years of life at the age of 15 equal to 47.6 years)	UN World Population Prospects – Life Expectancy at Age 15	

Source: Own elaboration

As a result of this analysis, we may see that Nigerian school-age children infected with NTDs in 2019 could lose USD 7.2bn in discounted earnings over 40 years. For a single child, this is equal to 20% of their average yearly earnings.

The lack of valid data prevented us from estimating the number of people suffering from multiple NTDs. Therefore, this calculation assumes that all school-age children affected by NTDs are bearers of only one disease, which may translate into overestimating the calculated benefits. Additionally, it should be noted that these benefits are not included in the final cost-benefit analysis described in Section 5.5 because they are private, not social, returns to education.

SUMMARY OF RESULTS

This summary presents the results of the primary cost-benefit analysis (described in 4.2.3), combined with the additional benefits (described in Sections 5.2, 5.3, and 5.4). These results are presented in Figure 24. Results of primary cost-benefit analysis combined with the additional benefits under the elimination scenario, 2022 USD, discounted.

This study estimates that, under the elimination scenario, the total benefits from:

Increased productivity of cured or avoided NTD cases

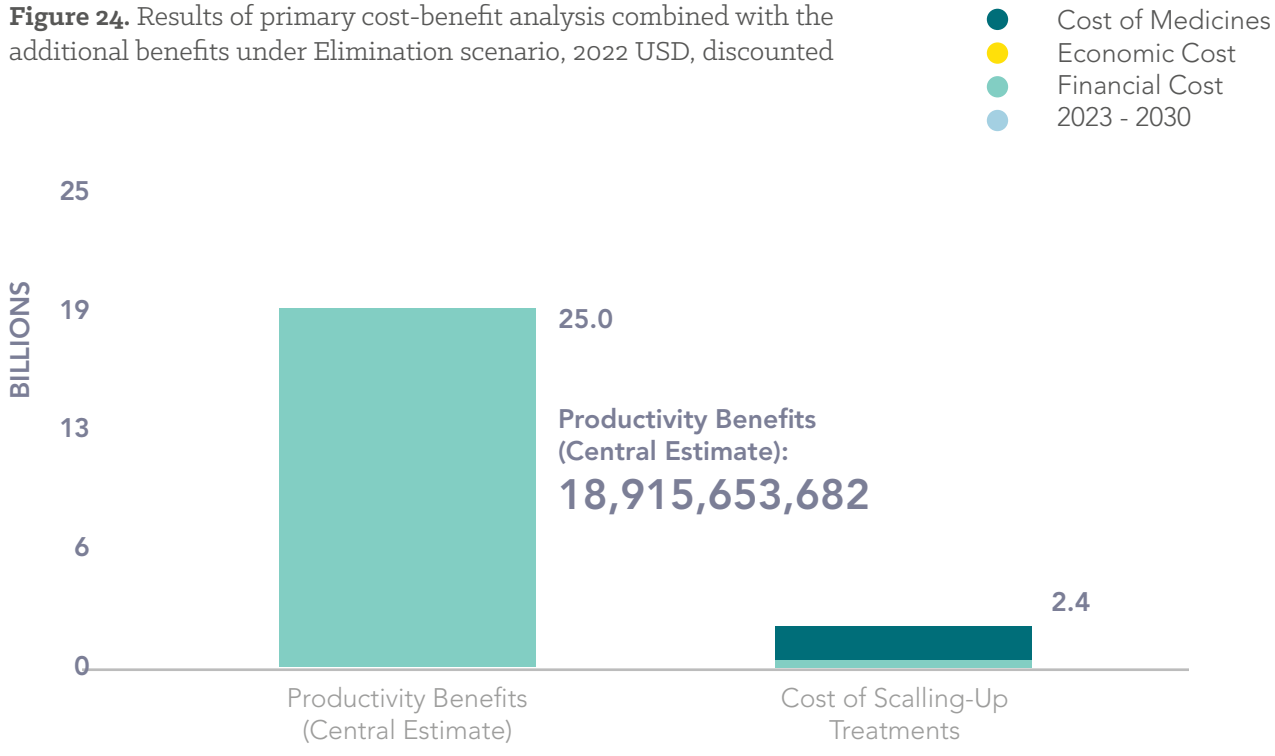
Avoided out-of-pocket treatment expenses for Lymphatic Filariasis

Freed-up productivity of caregivers

Will add up to $25 billion to the Nigerian economy from 2023 to 2030. This figure is more than ten times higher than the total costs of scaling up treatment under the elimination scenario (Including the cost of drugs), equaling $2.4 billion. **The net gains, including these additional benefits, are therefore equal to $22.6 billion**

The above calculation does not include the lifetime benefits to school children from increased school attendance since these are individual, unquantifiable returns (not social or direct economic returns) and, therefore, cannot be included. While the estimates of social returns relating to education are not available for Nigeria, these would likely be lower than those from individual returns. These will likely still be significant, owing to the large numbers of people suffering from NTDs, and the fact that these gains are spread across their whole working lives.

Figure 24. Results of primary cost-benefit analysis combined with the additional benefits under Elimination scenario, 2022 USD, discounted



Source: Own elaboration

CONCLUSIONS & RECOMMENDATIONS

6.

NTD elimination requires considerable initial investment – therefore, the people who bear the financial burden of elimination efforts should be aware of all the benefits for society and the economy and that the benefits vastly outweigh the costs.

This report offers robust evidence that gains from increased productivity alone significantly exceed the costs, even if a very conservative approach is taken and the cost of medicine is included. The most conservative estimate of net productivity gains is USD 16.5 billion. However, the total net benefits are likely to be significantly higher because these extend beyond productivity gains (e.g., avoided out-of-pocket expenses and increased school attendance).

Moreover, drugs are usually donated, which reduces elimination costs (as drugs account for more than 80% of the total cost). Regardless, efforts to scale up local production and secure the rights to produce medicines should still be pursued, as donating necessary medication can never be taken for granted. This is also important from the perspective of full country ownership and accountability of NTD program delivery.

THIS STUDY **PRIMARILY FOCUSED** ON QUANTITATIVE ANALYSIS TO ALLOW VARIOUS STAKEHOLDERS TO UNDERSTAND THE ECONOMIC IMPACT OF NTD ELIMINATION **IN THE SHORT AND LONG TERM.**

In addition to the economic impact, there is also the social impact that cannot be easily expressed in monetary terms, with many unquantifiable benefits (e.g., reduction in anxiety and pain) but of equal importance. There is a literature gap, presenting a significant opportunity for further study.

In light of the results of this study, there is no doubt that every effort should be made to combat NTDs in Nigeria as quickly as possible. Eliminating NTDs in the shortest possible time results in increased benefits and reduced costs compared with tackling the problem in small steps; therefore, a front-loading of public health investment to eliminate NTDs should be considered. Elimination efforts should be guided by the rich experience of Nigerian experts from various backgrounds (e.g., government, private sector, NGOs), as well as global solutions which have proved successful in other countries.

These international experiences and the opinions of experts consulted in this study reveal the key factors contributing to the success of elimination programs. These include effective mapping of areas with active transmission, the continuous administering of treatment according to WHO guidelines, engagement and cooperation of various stakeholders, and educational activities.

The effective mapping of areas of effective transmission is accomplished by surveying, and it is essential to achieve a coverage rate that effectively eliminates diseases. Simultaneously, continuous treatment (which requires uninterrupted funding) perpetuates the suppression of the diseases – as can be seen in the example of LF, not achieving the decisive levels of treatment increases costs in the long term, as the emergence of new cases counteracts the effect of previous treatment.

The effective cooperation of various stakeholders is also crucial. This includes the close collaboration of regional (e.g., state government), national (e.g., health ministry), international (e.g., WHO), and non-governmental (e.g., Sightsavers) stakeholders. Combining the expertise and capabilities of these actors is crucial for achieving higher efficiency in treatment delivery.

Another important factor related to NTD elimination is education, and raising awareness about how infection can be avoided can significantly stop transmission. This includes hygienic practices such as hand-washing or boiling water before consumption. These can be implemented even where water and sanitation facilities are limited, thus limiting exposure until more decisive steps, such as MAM or the construction of clean water sources, are available.

The programs associated with COVID-19, despite drawing funds previously allocated to NTD elimination, do present an opportunity. The delivery of treatment for tropical diseases could piggyback on the vaccination scheme for COVID-19, which could cut costs while allowing for a wide delivery.

The net benefits of eliminating the five studied NTDs in Nigeria by 2030 will be high. Assuming sufficient coverage, assured funding, and the active involvement of stakeholders, there is an opportunity to leverage the current pandemic to increase the scale of treatment for the studied diseases, thus ending an era of neglect.

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APPENDICES

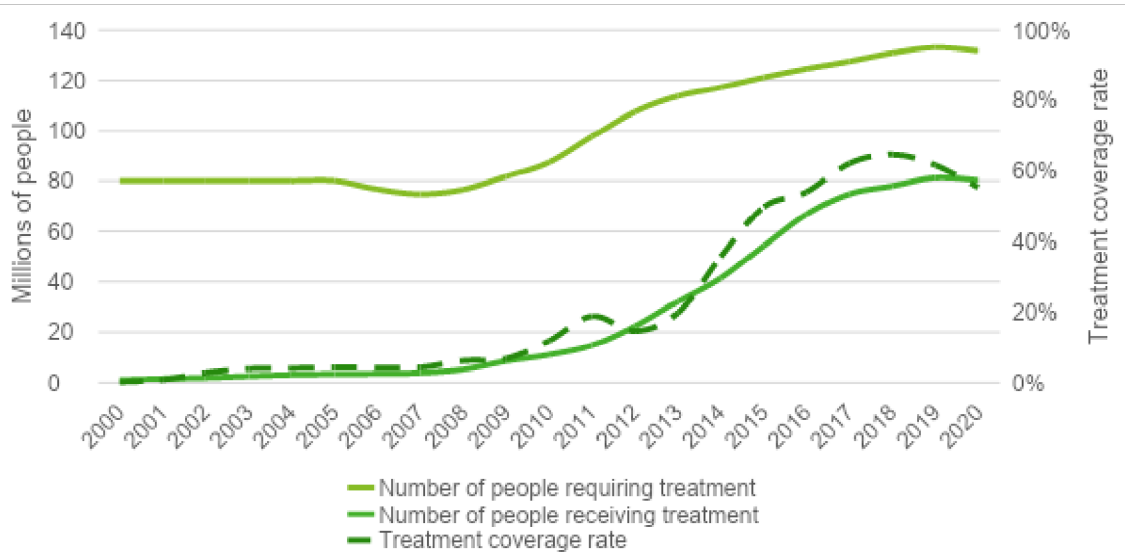
APPENDIX A – DISEASE-SPECIFIC PREVALENCE

Lymphatic Filariasis

In 2019 there were 5 million cases of LF in Nigeria, according to the Global Burden of Disease 2019 estimates. However, many more Nigerians lived at risk of contracting the disease, and WHO estimated the number of people requiring treatment at 133 million.

Over the last 20 years, significant efforts have been made to scale-up preventive chemotherapy treatments for LF. While the coverage rates for the at-risk population remained below 10% in the first decade, better mapping of endemic areas and better tracing of the development of cases in the second decade have been matched by increased efforts to combat LF. AS a result, coverage rates have risen above 50%. As coverage rates only briefly achieved 65% in 2018 (and dropped back to 55% in 2020), further effort is needed to speed-up elimination, as the WHO-established minimum coverage threshold is 65% over at least five years. Figure 25 shows the number of people requiring treatment for LF and those who received it (in absolute numbers, shown on the left vertical axis). Also displayed is the coverage rate of the treatment schemes (i.e., the share of those requiring treatment who did obtain it, shown in % on the right vertical axis).

Figure 25. Lymphatic Filariasis in Nigeria: Population requiring treatment vs. population treated, and the national coverage rate of treatment, 2000-2020



The cases were calculated using GBD (2019) prevalence rates for sex-specific 5-year age groups and UN WPP (2019) population data.

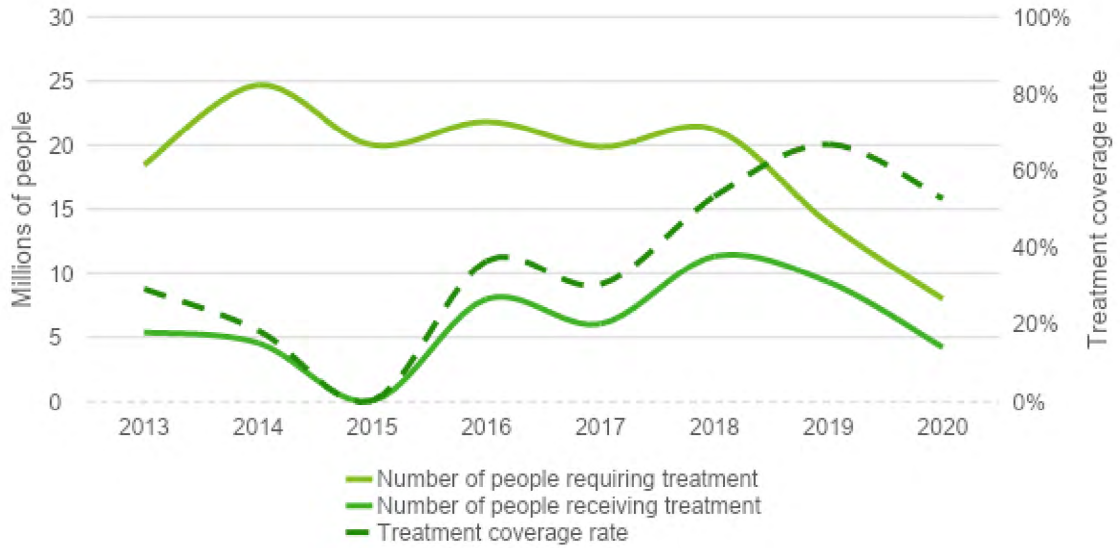
Source: Own elaboration based on WHO ESPEN, GBD (2019), and UN WPP (2019) data

APPENDIX A – DISEASE-SPECIFIC PREVALENCE

Trachoma

The number of Trachoma cases in Nigeria in 2019 has been estimated at 141,000 (as shown in Figure 7). At the same time, the number of people requiring treatment was estimated at 13.9 million, with this figure falling to 7.9 million in 2020. The number of people covered by MAM schemes varied between 5 and 10 million between 2013 and 2020, but the coverage rate has increased due to the decreasing number of individuals requiring treatment. The evolution of these numbers is shown in Figure 26.

Figure 26. Figure 26 Trachoma in Nigeria: Population requiring treatment vs. population treated, and the national coverage rate of treatment, 2000-2020



The cases were calculated using GBD (2019) prevalence rates for sex-specific 5-year age groups and UN WPP (2019) population data.

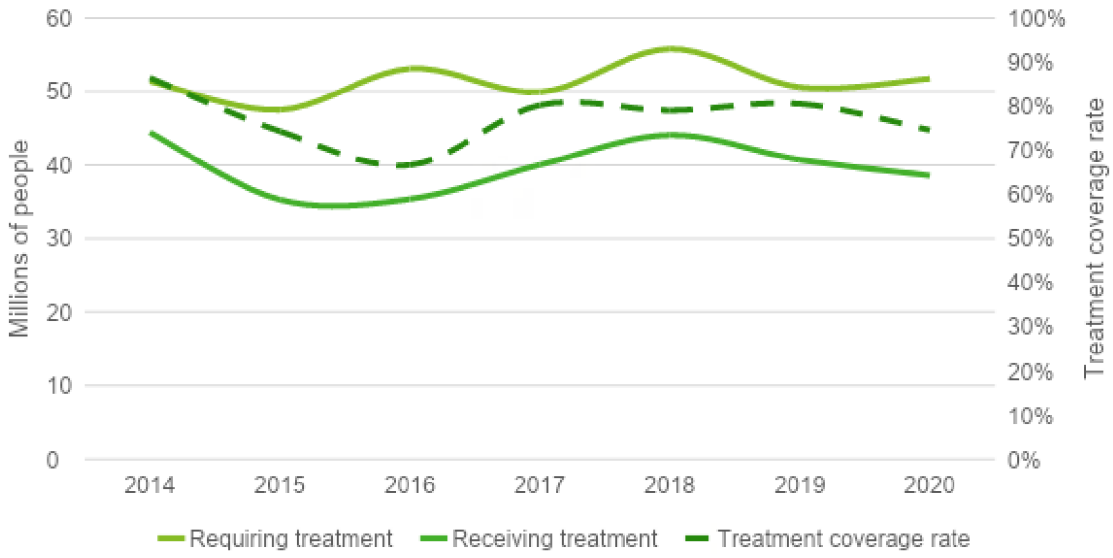
Source: Own elaboration based on WHO ESPEN, GBD (2019), and UN WPP (2019) data

APPENDIX A – DISEASE-SPECIFIC PREVALENCE

Onchocerciasis

In 2019, an estimated 2.4 million cases were present in Nigeria (Figure 7). However, the number of people requiring treatment was estimated at 50.6 million (i.e., around a quarter of the Nigerian population). This figure has been relatively stable since 2014 (the earliest year for which WHO data is available), and the number of people that received treatment over this period was also relatively constant, hovering at around 40 million per year. This translates into a continuous treatment coverage rate between 70% and 80%. Although this seems to be a relatively high figure, it requires more effort, as this range falls below the minimum effective coverage rate of 80% recommended by the WHO. Moreover, the WHO advises that coverage above this rate must be maintained over 12-15 years.

Figure 27. Onchocerciasis in Nigeria: Population requiring treatment vs. population treated, and the national coverage rate of treatment, 2000-2020



The cases were calculated using GBD (2019) prevalence rates for sex-specific 5-year age groups and UN WPP (2019) population data.

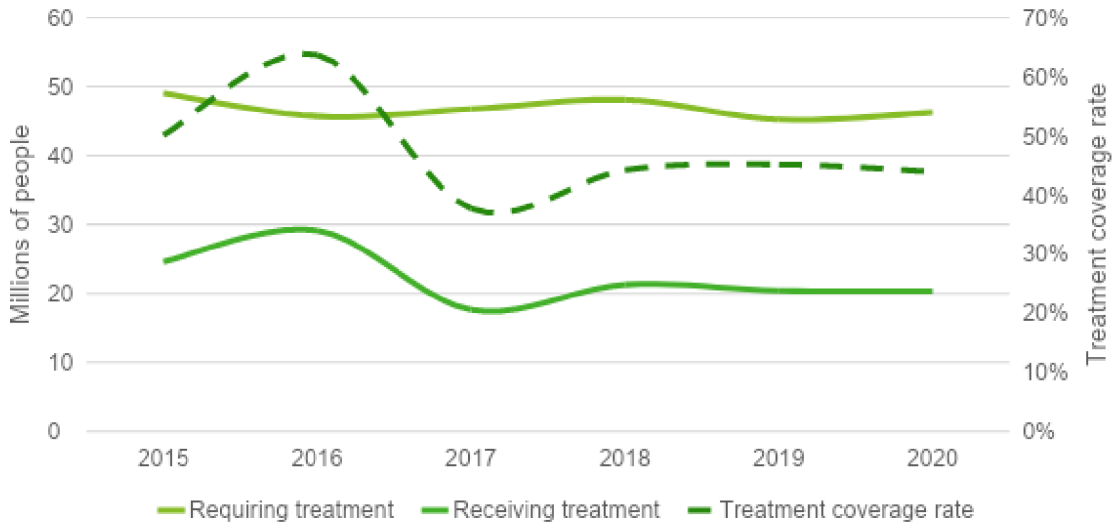
Source: Own elaboration based on WHO ESPEN, GBD (2019), and UN WPP (2019) data

APPENDIX A – DISEASE-SPECIFIC PREVALENCE

Soil-Transmitted Helminths (STH)

The number of cases of STH in Nigeria was estimated at 32.9 million in 2019 (as shown in Figure 7). The WHO recommends that treatment be targeted at preschool and school-age children, women of reproductive age, and adults in high-risk occupations (such as tea pickers or miners). As only specific groups are targeted for treatment, the number of people requiring treatment in a given year may be lower than the number of disease cases, and this was not the case between 2015 and 2020. According to WHO, the number of people requiring treatment has been between 45 and 50 million since 2015. Meanwhile, the number of people receiving treatment fell from nearly 30 million in 2016 to around 20 million between 2017 and 2020, which has caused the treatment coverage rate to decrease from almost 65% in 2017 to about 45-50% presently.

Figure 28. Soil-transmitted helminths in Nigeria: Population requiring treatment vs. population treated, and the national coverage rate of treatment, 2000-2020



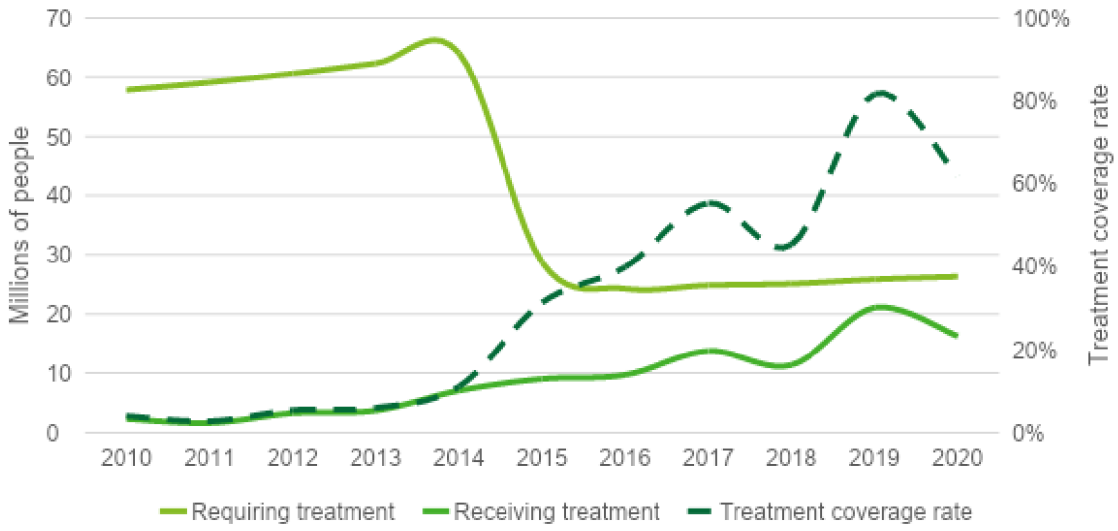
The cases were calculated using GBD (2019) prevalence rates for sex-specific 5-year age groups and UN WPP (2019) population data.

Source: Own elaboration based on WHO ESPEN, GBD (2019), and UN WPP (2019) data

APPENDIX A – DISEASE-SPECIFIC PREVALENCE

Schistosomiasis

The number of cases of Schistosomiasis in 2019 in Nigeria was estimated at 34.2 million (GBD database data for prevalence rates, UN WPP data for population, as shown in Figure 7). WHO recommends that treatment for Schistosomiasis be delivered to all school-age children living in endemic areas and adults considered "at risk" (i.e., those at risk of being in contact with infested water, such as fishermen, farmers, irrigation workers, and women doing domestic tasks). For STH, because of the specific groups being targeted for treatment, the number of those requiring treatment can be lower than the number of cases, as was the case in 2019. During the last decade, the number of people requiring treatment for Schistosomiasis halved, decreasing very quickly between 2014 and 2016. The number of people receiving treatment has been steadily increasing over the 2010-2020 period, from 1.8 million in 2010 to 12.6 million in 2020. The significant drop in those requiring treatment has substantially increased the treatment coverage rate from less than 10% in 2014 to above 80% in 2019. 2020 saw a decrease in the coverage rate below 60%, likely caused by the COVID-19 pandemic.



The cases were calculated using GBD (2019) prevalence rates for sex-specific 5-year age groups and UN WPP (2019) population data.

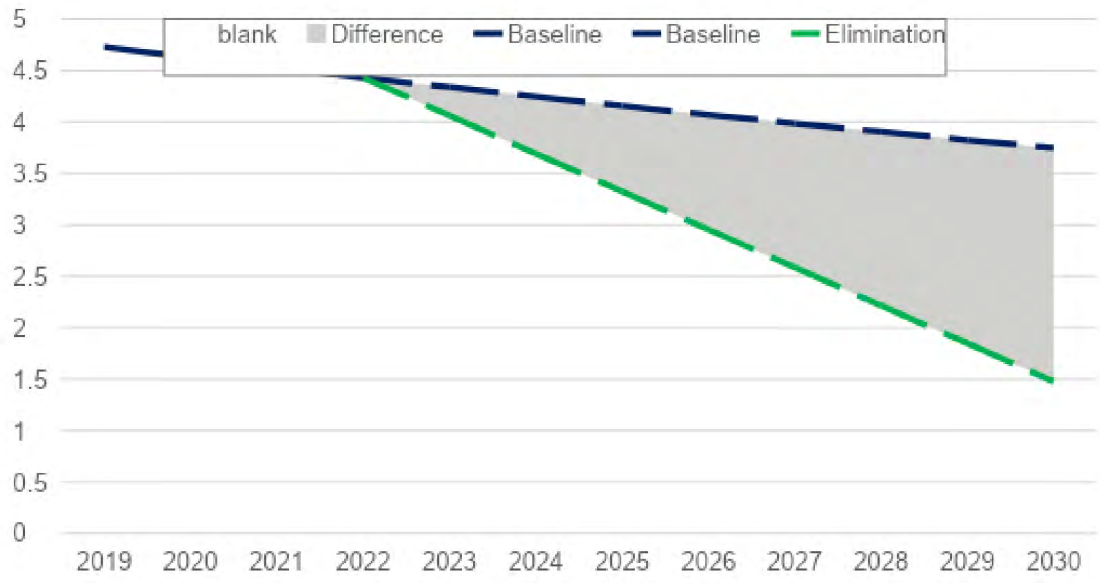
Source: Own elaboration based on WHO ESPEN, GBD (2019), and UN WPP (2019) data

APPENDIX B –
CASE NUMBER ESTIMATES FOR 2023-2030

Lymphatic Filariasis

Under the Baseline scenario, it is assumed that LF case numbers will fall at a moderate rate, and their number will be equal to 3.7 million in 2030. Under the Elimination scenario, it is assumed that 33% of LF cases are irreversible. Therefore, the number of LF cases would be at 33% of 2019 levels in 2030 (i.e., at 1.6 million). The evolution of LF cases under both scenarios for 2023-2030 is in Figure 29.

Figure 29. Lymphatic Filariasis cases in Nigeria from 1990 until 2030 under Baseline and Elimination scenarios



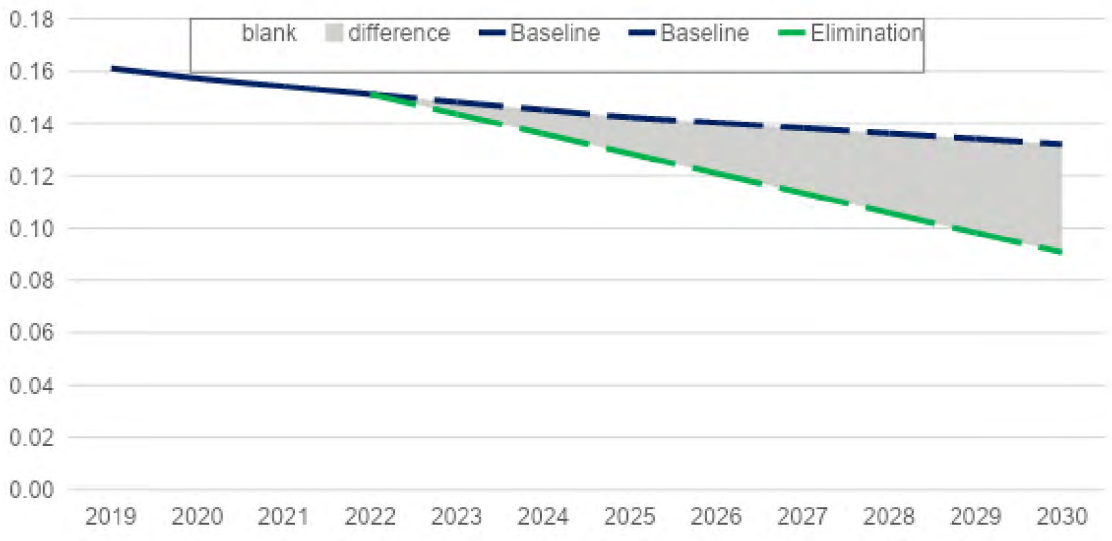
Source: For 2019-2022: WHO projections adjusted for population numbers (no hard data available post-2019); for the 2022-2030 Baseline scenario: it is assumed that sex- and age-specific prevalence rates follow the 2010-2019 trend and use population projections from the UN WPP (2019); for the 2022-2030 Elimination scenario, the number of irreversible cases in 2019 is assumed, forming the minimal value in 2030.

APPENDIX B – CASE NUMBER ESTIMATES FOR 2023-2030

Trachoma

The number of cases in 2022 is estimated at 151 thousand. The evolution of cases beyond this year is shown in Figure 30, with the baseline scenario being based on the downward 2010-2019 trend. Therefore, it is assumed that cases will continue to decrease at the same rate, falling to 132 thousand in 2030. Meanwhile, under the elimination scenario (with the share of irreversible cases at 60%, based on de Vlas et al., 2016), it is assumed that the number of Trachoma cases will decrease more rapidly to reach 96 thousand in 2030.

Figure 30. Trachoma cases in Nigeria from 2019 until 2030 under Baseline and Elimination scenarios



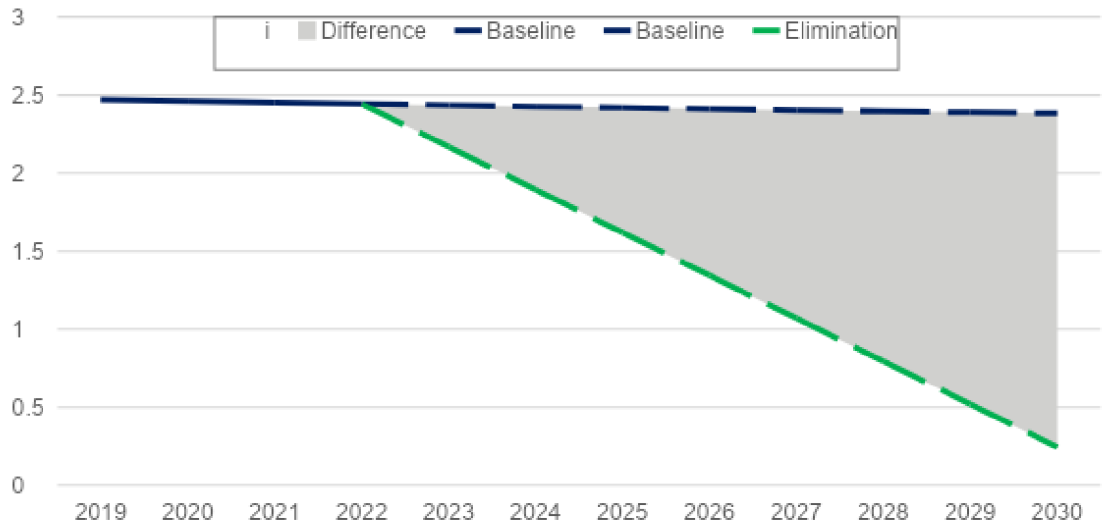
Source: For 2019-2022: WHO projections adjusted for population numbers (no hard data available post-2019); for the 2022-2030 Baseline scenario: it is assumed that sex- and age-specific prevalence rates follow the 2010-2019 trend and use population projections from the UN WPP (2019); for the 2022-2030 Elimination scenario, the number of irreversible cases in 2019 is assumed, forming the minimal value in 2030.

APPENDIX B – CASE NUMBER ESTIMATES FOR 2023-2030

Onchocerciasis

Under the Baseline scenario, it is assumed that after 2022, the number of Onchocerciasis cases in Nigeria will be constant at 2.4 million (following the trend from the previous years). Under the Elimination scenario, it is assumed that the number of cases in 2030 will equal 244 thousand (i.e., 10% of that in 2022), as this is the rate of irreversible Onchocerciasis. The evolution of Onchocerciasis case numbers under both scenarios in 2022-2030 is shown in Figure 31.

Figure 31. Trachoma cases in Nigeria from 2019 until 2030 under Baseline and Elimination scenarios



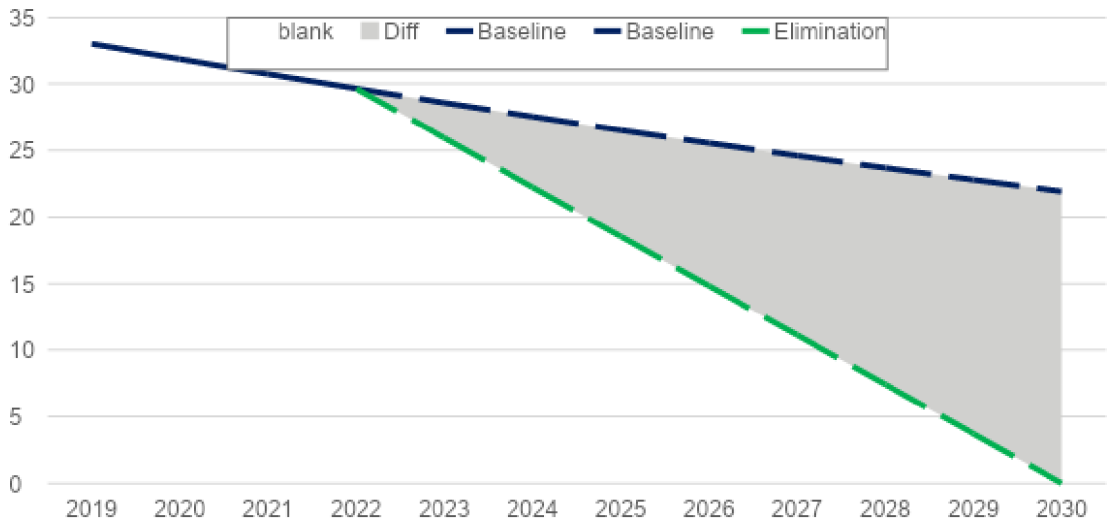
Source: For 2019-2022: WHO projections adjusted for population numbers (no hard data available post-2019); for the 2022-2030 Baseline scenario: it is assumed that sex- and age-specific prevalence rates follow the 2010-2019 trend and use population projections from the UN WPP (2019); for the 2022-2030 Elimination scenario, the number of irreversible cases in 2019 is assumed, forming the minimal value in 2030.

APPENDIX B – CASE NUMBER ESTIMATES FOR 2023-2030

Soil-Transmitted Helminths (STH)

This study estimates the number of STH cases in Nigeria in 2022 at 29.6 million. Under the Baseline scenario, it is assumed that the downward trend from last year will result in 22 million cases in 2030. However, as STH is the only studied disease where no cases are assumed to be irreversible, under the Elimination scenario, it is assumed that complete disease elimination will be achieved in Nigeria by 2030.

Figure 32. Soil-transmitted helminths cases in Nigeria from 1990 until 2030 under Baseline and Elimination scenarios



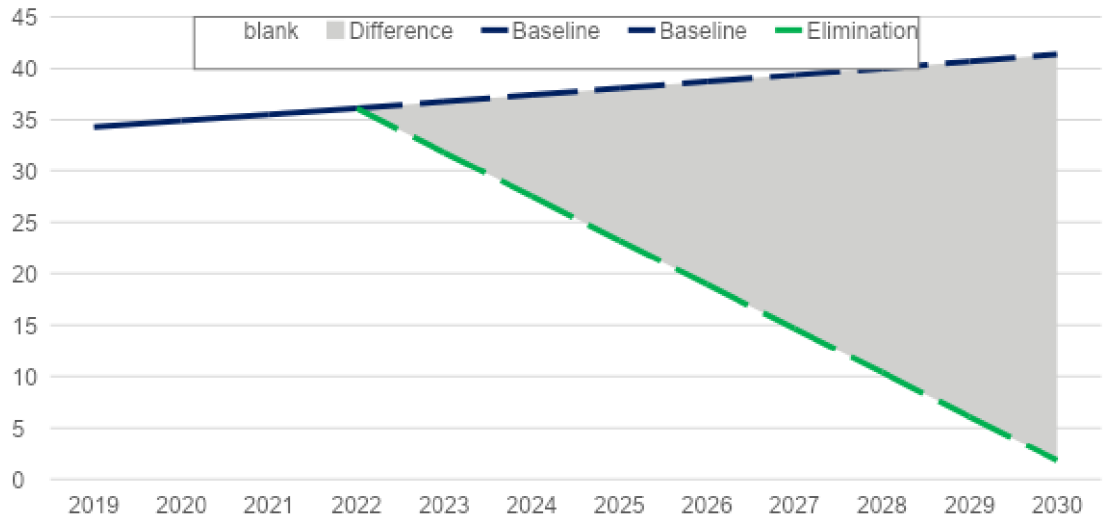
Source: For 2019-2022: WHO projections adjusted for population numbers (no hard data available post-2019); for the 2022-2030 Baseline scenario: it is assumed that sex- and age-specific prevalence rates follow the 2010-2019 trend and use population projections from the UN WPP (2019); for the 2022-2030 Elimination scenario, the number of irreversible cases in 2019 is assumed, forming the minimal value in 2030.

APPENDIX B – CASE NUMBER ESTIMATES FOR 2023-2030

Schistosomiasis

The estimated number of Schistosomiasis cases in Nigeria in 2022 equals 36.1 million. For 2022-2030, under the Baseline scenario, it is assumed that the upward trend from previous years will continue, with the number of cases reaching 41 million in 2030. The Elimination scenario, on the other hand, assumes a very different trajectory due to the low 5% share of irreversible cases. Under this scenario, it is assumed that cases will decrease rapidly to 1.8 million in 2030.

Figure 33. Schistosomiasis cases in Nigeria from 2019 until 2030 under Baseline and Elimination scenarios



Source: For 2019-2022: WHO projections adjusted for population numbers (no hard data available post-2019); for the 2022-2030 Baseline scenario: it is assumed that sex- and age-specific prevalence rates follow the 2010-2019 trend and use population projections from the UN WPP (2019); for the 2022-2030 Elimination scenario, the number of irreversible cases in 2019 is assumed, forming the minimal value in 2030.

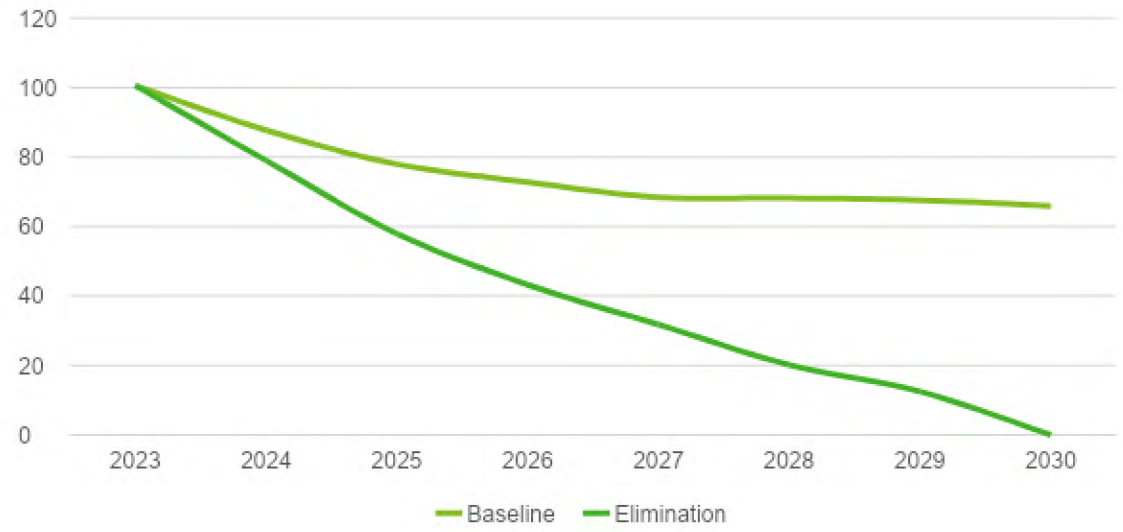
APPENDIX C – ADDITIONAL POPULATION RECEIVING TREATMENT UNDER THE ELIMINATION SCENARIO

Lymphatic Filariasis

In the case of LF, the WHO assumes that by 2028 no one in Nigeria will require treatment. However, in 2020, only 55% of the population was thought by the WHO to require treatment received care. Therefore, in this study, it is assumed that the number of endemic areas in the Baseline Scenario will drop 50% slower than the WHO assumes. Consequentially, the number of people requiring treatment will go down more slowly.

For 2023-2030, this study assumes a 55% coverage rate for the baseline scenario and a 100% for the elimination scenario – the 100% coverage rate is achieved in 2025 as it is assumed that two years is a realistic timeframe for scaling up the MAM. The population requiring treatment under both scenarios for these years is shown below. A clear distinction between the evolution of these numbers is visible, resulting from the difference in assumed coverage rates. Due to the coverage rate falling short of the WHO's guidelines (minimum coverage of 65% over at least five years), under the Baseline scenario, the number of people requiring treatment will stabilize in 2027 at around 70 million people. This significantly limits the effects of targeted treatment. On the other hand, under the Elimination scenario, the number of people requiring treatment decreases substantially faster and reaches zero in 2030. The evolution in the number of people requiring treatment for LF in Nigeria under the Baseline and Elimination scenarios is shown below.

Figure 34. Number of people requiring treatment for LF in Nigeria under Baseline and Elimination scenarios in 2023-2030, 5-year moving average

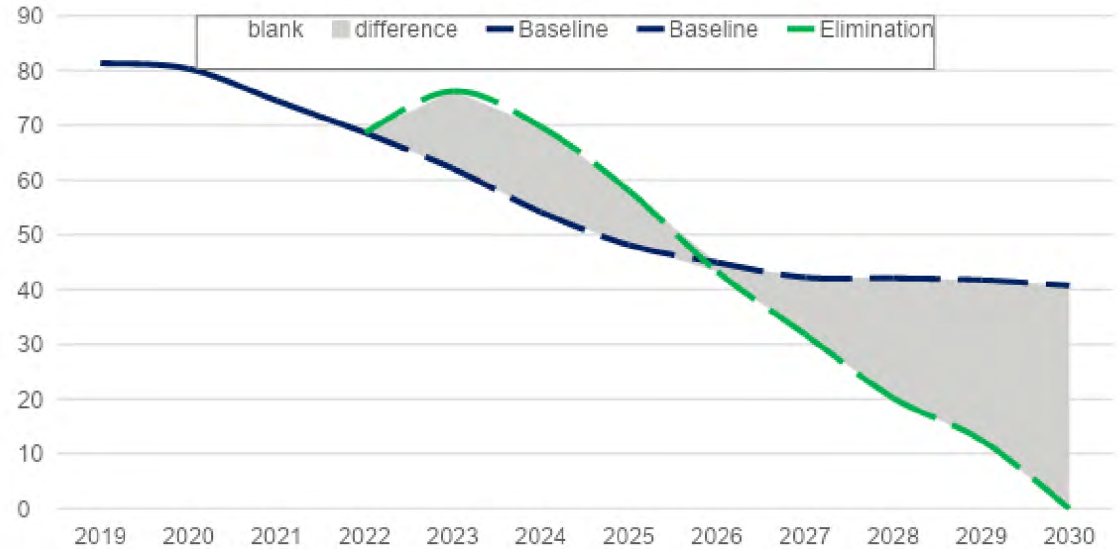


Source: Own calculation

APPENDIX C – ADDITIONAL POPULATION RECEIVING TREATMENT UNDER THE ELIMINATION SCENARIO

Per the coverage rates mentioned, the number of people receiving treatment for LF under both scenarios between 2023 and 2030, together with the other population to be treated under the elimination scenario, are shown in Figure 35. The number of people receiving treatment under the baseline scenario (i.e., with a coverage rate of 55%) falls from more than 60 million in 2023 to slightly above 40 million in 2027, remaining relatively stable later. Under the elimination scenario, however, the number of people receiving treatment is increased to 76 million in 2023, with the coverage rate hitting 100% in 2025 (equal to 58 million). This number later decreases together with the number of people requiring treatment, and in 2026 these figures (under the elimination scenario) fall below those under the Baseline scenario due to scaling up treatment. Under the elimination scenario, the number of people requiring and receiving treatment will reach zero in 2030. The only remaining cases of LF were those that were irreversible in 2023 (the assumed share of irreversible LF cases was 33%, as described in Section 4.1.1).

Figure 35. Number of people receiving treatment for LF in Nigeria under Baseline and Elimination scenarios between 2023 and 2030, and the additional population to be treated under Elimination scenario, 5-year moving average



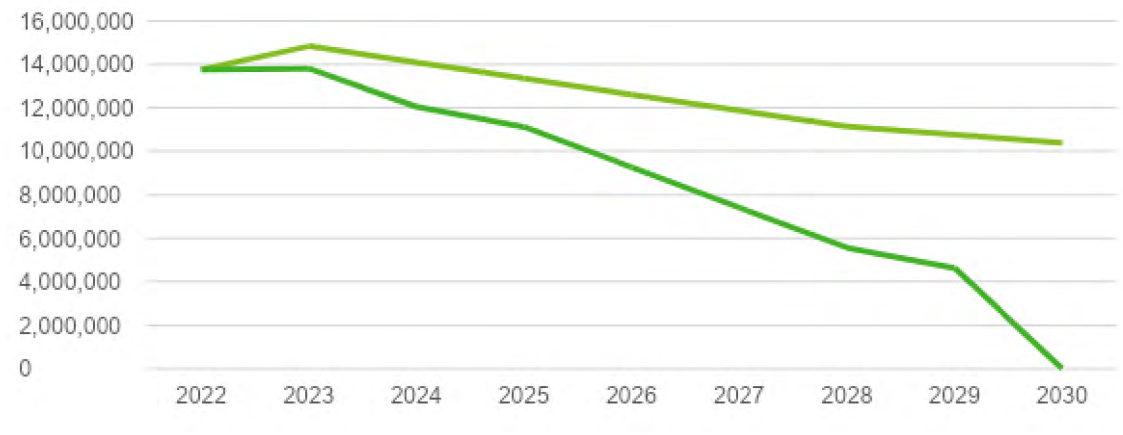
Source: Own calculation

APPENDIX C – ADDITIONAL POPULATION RECEIVING TREATMENT UNDER THE ELIMINATION SCENARIO

Trachoma

The evolution in people requiring treatment for Trachoma under Baseline and Elimination scenarios for 2023-2030 is shown in Figure 36. Under the Baseline scenario, this number decreases at a moderate rate from 13.8 million in 2023 to 10.3 million in 2030. In contrast, under the elimination scenario, it decreases significantly faster, achieving zero in 2030 when the only remaining cases of Trachoma are those that were irreversible in 2023 (the assumed share of irreversible Trachoma cases is assumed at 60%, as described in Section 4.1.1).

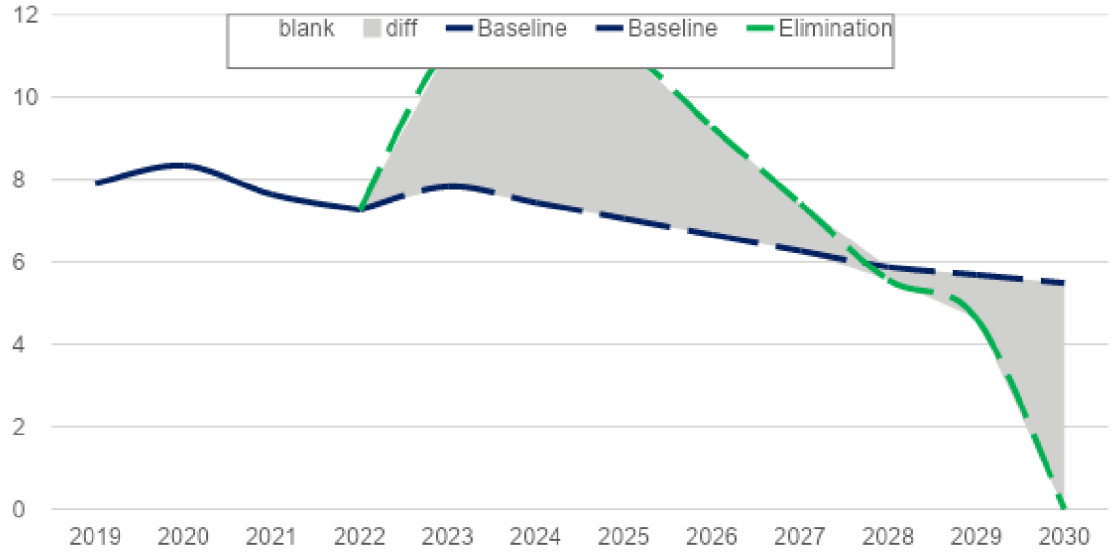
Figure 36. Number of people requiring treatment for Trachoma in Nigeria under Baseline and Elimination scenarios in 2023-2030, 5-year moving average



Source: Own calculation

The evolution in the number of people receiving treatment for Trachoma for 2023-2030 under both scenarios is shown in Figure 37. The baseline scenario is based on the continuation of the linear 2013-2019 trend of the population requiring treatment (due to a lack of WHO projections) and 2016-2020 coverage rates. Under the elimination scenario, it is assumed that the MAMs will be scaled up to 100%, allowing the number of people requiring treatment to decrease to zero by 2030.

Figure 37. Number of people receiving treatment for Trachoma in Nigeria under the Baseline and Elimination scenarios between 2023 and 2030, and the additional population to be treated under the Elimination scenario, 5-year moving average



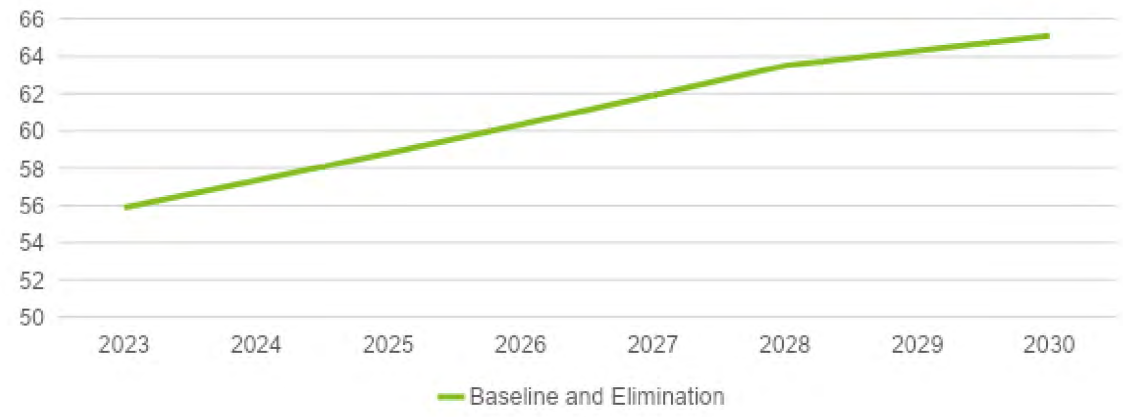
Source: Own calculation

APPENDIX C – ADDITIONAL POPULATION RECEIVING TREATMENT UNDER THE ELIMINATION SCENARIO

Onchocerciasis

In the case of Onchocerciasis, it is impossible to impact the number of people requiring treatment by scaling up MAMs during the 2023-2030 period. This is primarily because proper water and sanitation are crucial to stopping this particular disease's spread. Therefore, continuous treatment is needed. The number of people requiring treatment under the baseline and elimination scenarios is the same.

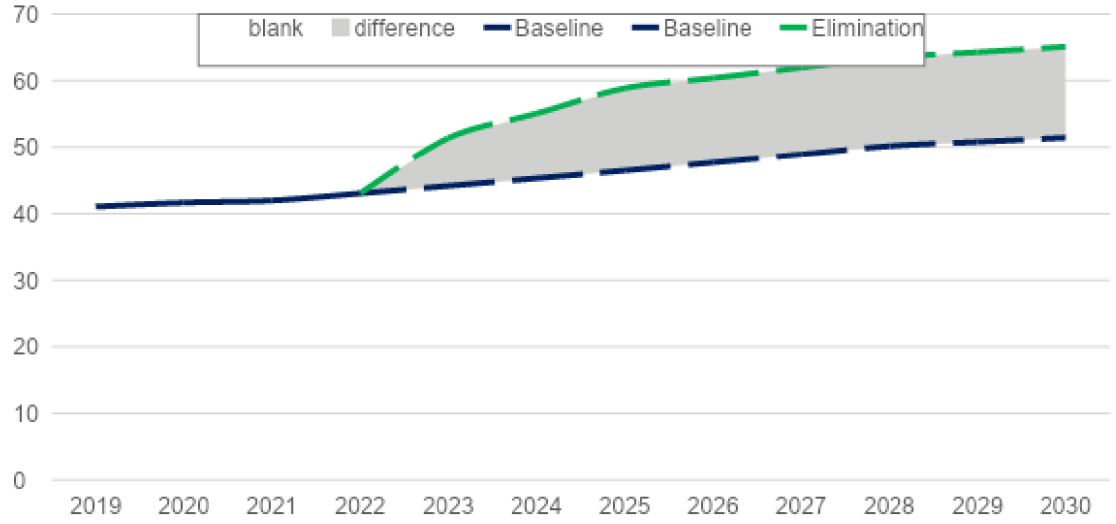
Figure 38. Number of people requiring treatment for Onchocerciasis in Nigeria under Baseline and Elimination scenarios between 2023 and 2030, 5-year moving average



Source: Own calculation

The evolution in the number of people receiving treatment for Onchocerciasis in 2023-2030 under both scenarios is shown in Figure 39. Under the baseline scenario, this number is based on WHO projections of the proportion of the population requiring treatment and the 2016-2020 coverage rates. Under the elimination scenario, it is assumed that MAMs are scaled up to WHO projections of the above proportion, with a 100% coverage rate. The additional persons receiving treatment increased from 7.2 million in 2023 to 13.6 million in 2030.

Figure 39. Number of people receiving treatment for Onchocerciasis in Nigeria under the Baseline and Elimination scenarios between 2023 and 2030, and the additional population to be treated under the Elimination scenario, 5-year moving average



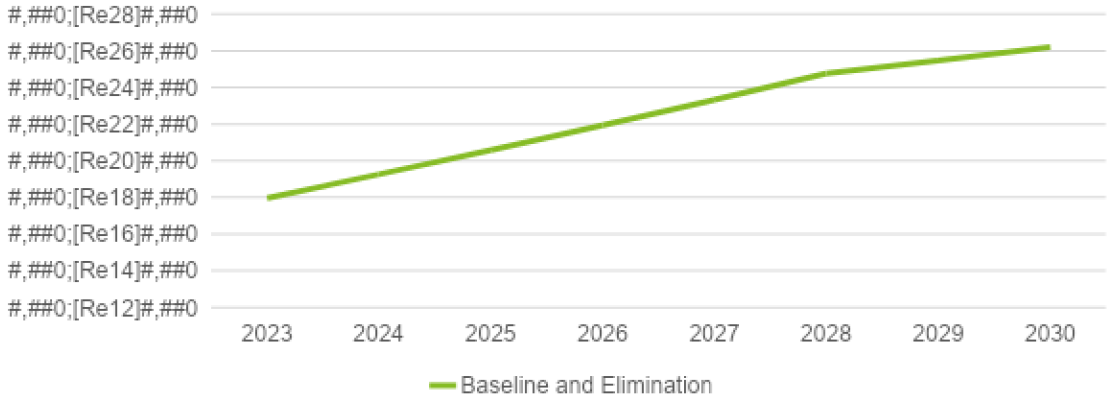
Source: Own calculation

APPENDIX C – ADDITIONAL POPULATION RECEIVING TREATMENT UNDER THE ELIMINATION SCENARIO

Soil-Transmitted Helminths (STH)

In the case of STH, similar to Onchocerciasis, scaling up MAMs under the elimination scenario does not allow for the driving down of the number of people requiring treatment, making continuous treatment necessary during the 2023-2030 period. Therefore, the number of people requiring treatment in 2023-2030 is expected to be equal in both scenarios, increasing from 50 million in 2023 to 58.2 million in 2030, as shown below.

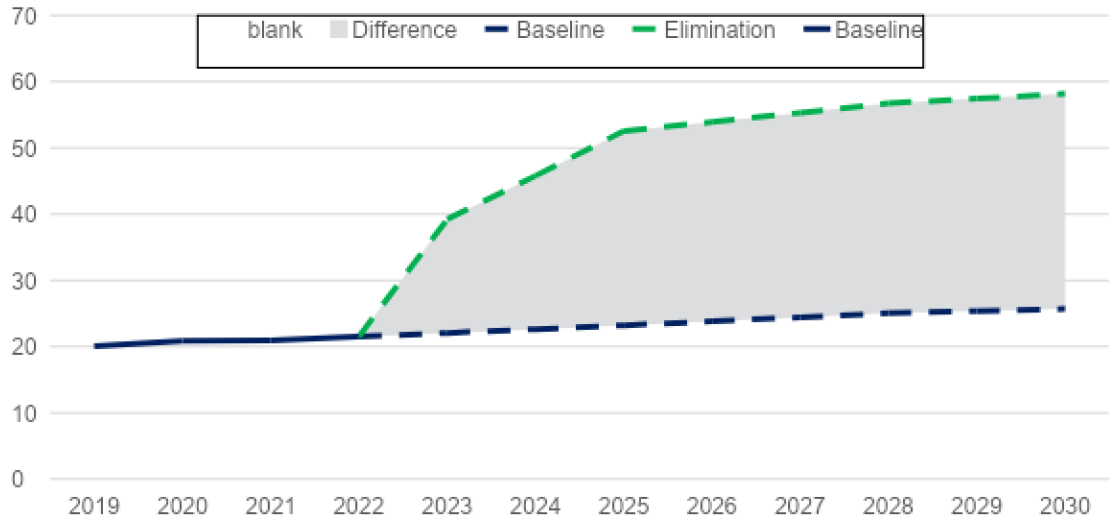
Figure 40. Number of people requiring treatment for Onchocerciasis in Nigeria under the Baseline and Elimination scenarios between 2023 and 2030, 5-year moving average



Source: Own calculation

The number of people receiving treatment for STH under both scenarios is shown in Figure 41. Under the baseline scenario, this number increases at a very moderate rate, while the elimination scenario assumes a significant increase in the number of people receiving treatment from 2022 to 2025. This is projected to continue increasing, albeit at a more modest rate.

Figure 41. Number of people receiving treatment for STH in Nigeria under the Baseline and Elimination scenarios between 2023 and 2030 and the additional population to be treated under the Elimination scenario, 5-year moving average



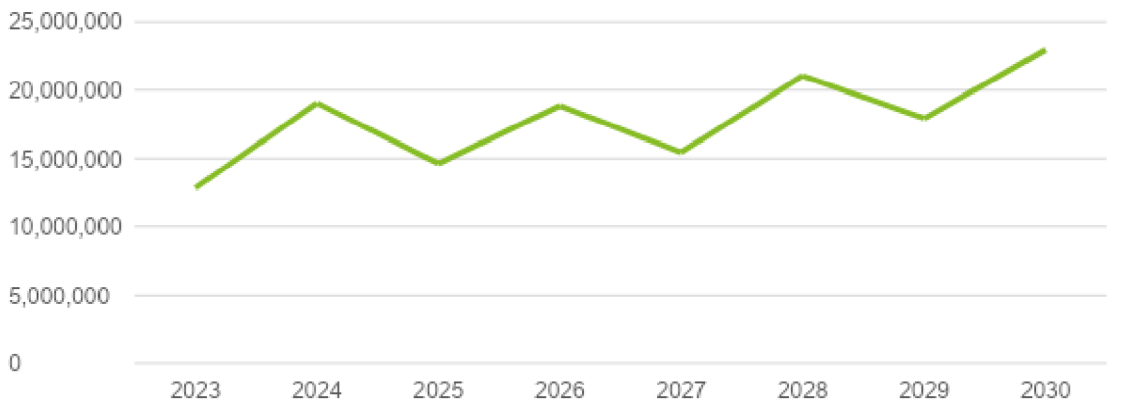
Source: Own calculation

APPENDIX C – ADDITIONAL POPULATION RECEIVING TREATMENT UNDER THE ELIMINATION SCENARIO

Schistosomiasis

The number of people requiring treatment for Schistosomiasis cannot be driven down solely by scaling up treatment under the Elimination scenario, much as in the cases of Onchocerciasis and STH. Therefore, the number of people requiring treatment for Schistosomiasis in 2023-2030 in Nigeria follows the same pattern in both the Baseline and Elimination scenarios. This pattern is based on the 2016-2020 trend and assumes an increase in the number of patients from 12.8 million in 2023 to 23.0 million in 2030, as shown in Figure 42. These figures increase and decrease alternately, as this was the case for the 2016-2020 figures, on which the current projection is based.

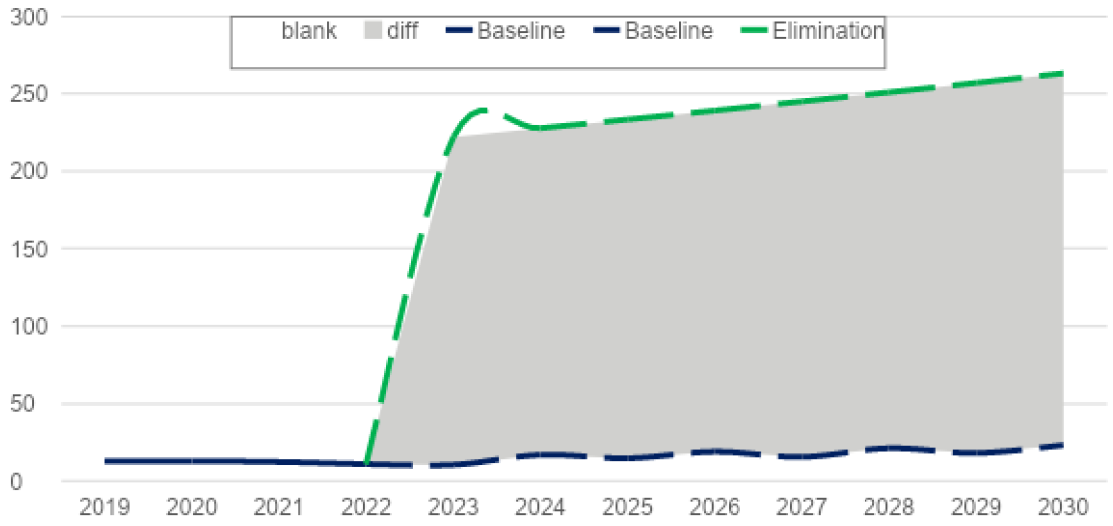
Figure 42. Number of people requiring treatment for Schistosomiasis in Nigeria under the Baseline and Elimination scenarios in 2023-2030, 5-year moving average



Source: Own calculation

As for the population receiving Schistosomiasis treatment in 2023-2030, the baseline scenario is based on WHO projections and 2016-2020 coverage rates. Under the elimination scenario, it is assumed that the MAMs are scaled up to cover the whole of the Nigerian population. As outlined in Section 4.2.2, WHO projections appear unreasonably low because they do not cover everyone living in endemic zones, only children and adolescents. As a result, these case projections are lower than the GBD 2019 estimates. Furthermore, Abdulkadir et al. estimate that the Schistosomiasis prevalence rate in Nigeria is 35%, and as this figure is substantial, treating the whole Nigerian population is not unreasonable. This risks driving up costs, but any further analysis should be performed in light of the cost-benefit analysis presented in this report. The evolution in the number of people receiving treatment in 2023-2030 under Baseline and Elimination Scenarios is shown in Figure 43.

Figure 43. Number of people receiving treatment for Schistosomiasis in Nigeria under the Baseline and Elimination scenarios between 2023 and 2030 and the additional population to be treated under the Elimination scenario, 5-year moving average



Source: Own calculation

APPENDIX D – PER TREATMENT DELIVERY AND MEDICINE COSTS

Lymphatic Filariasis

Per-person treatment costs of LF are estimated using a benchmarking tool developed by Fitzpatrick et al. (as described in Section 4.1.3) and are shown in Table 13.

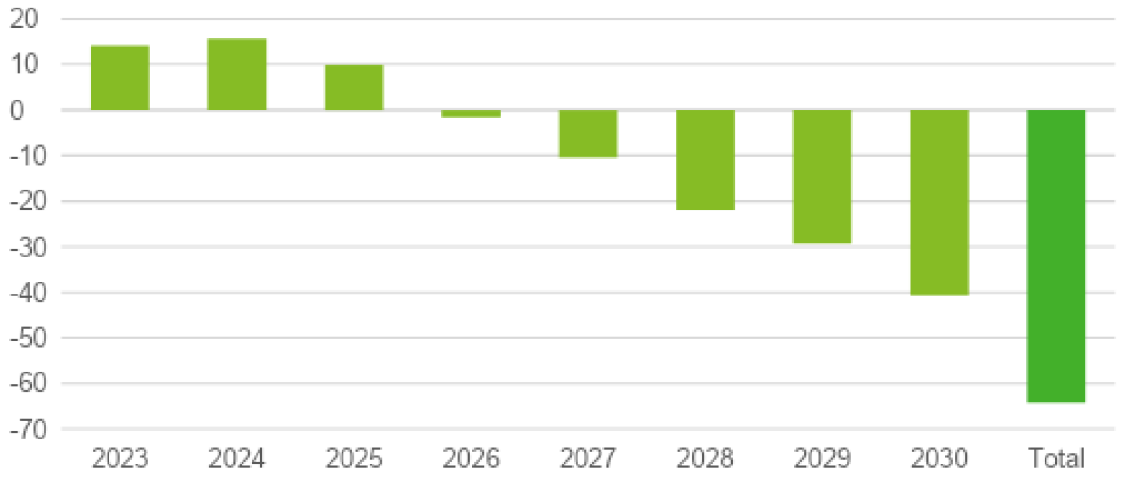
Table 13. Individual LF treatment costs, USD per person per year

Financial cost	Economic cost	Economic cost + cost of medicines
0.19	0.24	0.69

Source: **Tool** developed by Fitzpatrick et al. (2016), DOI:10.1371/journal.pntd.0005037. Input data developed by Deloitte

The additional number of persons to be treated under the elimination scenario in 2023-2030 is shown in Figure 44. This number exceeds that assumed under the baseline scenario only in 2022-2025, as due to the effectiveness of scaling up the program, fewer and fewer people need treatment. Therefore, from 2026 onwards, more people need treatment under the Baseline scenario, while the elimination scenario is significantly more effective, eliminating all reversible cases and new cases from 2022 onwards. **This exemplifies the high economic and health effects of scaling up treatment. In the long run, ending NTDs in a short period results in increased benefits and reduced costs compared to tackling the problem in small steps.**

Figure 44. Additional number of people to be treated for LF under elimination scenario compared to the Baseline scenario



Source: Own calculation

The total cost of eliminating LF under the Elimination scenario, taking into account the additional number of people to treat (as well as the individual costs), is shown in Table 14. This cost is negative, meaning that in the time horizon up to 2030, it will be cheaper to eliminate LF under the elimination scenario than to continue ad-hoc activities.

Table 14. Total cost of scaling up treatment to meet elimination scenario assumptions for LF in Nigeria until 2030, 2022 USD, discounted

Financial cost	Economic cost	Economic cost + cost of medicines
-9.07m	-11.34m	-32.36m

Source: Own calculation

APPENDIX D – PER TREATMENT DELIVERY AND MEDICINE COSTS

Trachoma

Per-person treatment costs of Trachoma are estimated using a benchmarking tool developed by Fitzpatrick et al. (as described in Section 4.1.3) and are shown in Table 15.

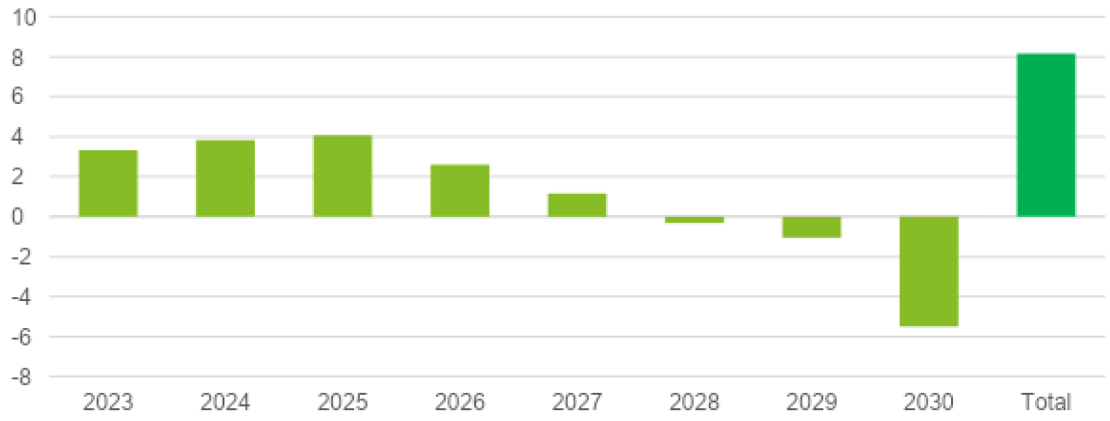
Table 15. Individual Trachoma treatment costs, USD per person per year

Financial cost	Economic cost	Economic cost + cost of medicines
0.42	0.50	0.95

Source: **Tool** developed by Fitzpatrick et al. (2016), DOI:10.1371/journal.pntd.0005037. Input data developed by Deloitte

The additional number of persons to be treated under the elimination scenario in 2023-2030 is shown in Figure 45. This number, as in the case of LF, becomes negative from 2028 onwards, meaning that fewer people need treatment for Trachoma from that point on due to the effectiveness in driving down cases. Contrary to the case of LF, however, the total number of people requiring treatment for Trachoma under the elimination scenario up to 2030 is still higher than that under the baseline scenario. This does not mean that scaling up MAM for Trachoma treatment is not economically viable, only that it implies incurring a higher cost explicitly related to treatment. This being said, an Elimination program remains a very profitable investment (as described in sections 4.2.3 and 5.5) owing to the magnitude of the benefits that it is projected to bring about.

Figure 45. Additional number of people to be treated for Trachoma under elimination scenario compared to the Baseline scenario



Source: Own elaboration

The total costs of scaling up treatment for Trachoma under the elimination scenario are shown in Table 16.

Table 16. Total cost of scaling up treatment to meet elimination scenario assumptions for Trachoma in Nigeria until 2030, 2022 USD, discounted

Financial cost	Economic cost	Economic cost + cost of medicines
3.6m	4.3m	8.0m

Source: Own elaboration

APPENDIX D – PER TREATMENT DELIVERY AND MEDICINE COSTS

Onchocerciasis

The individual treatment costs of Onchocerciasis are estimated using a benchmarking tool developed by Fitzpatrick et al. (as described in Section 4.1.3) and are shown in Table 17.

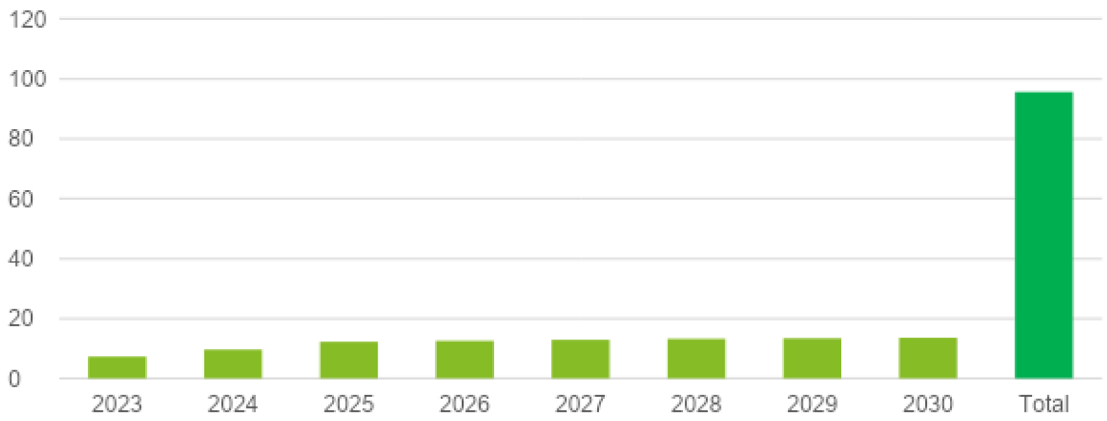
Table 17. Individual Onchocerciasis treatment costs

Financial cost	Economic cost	Economic cost + cost of medicines
0.50	0.60	0.84

Source: **Tool** developed by Fitzpatrick et al. (2016), DOI:10.1371/journal.pntd.0005037. Input data developed by Deloitte

The additional number of people receiving treatment for Onchocerciasis under the elimination scenario is shown in Figure 46. This number exceeds those requiring treatment under the baseline scenario every year until 2030. However (as in the case of Trachoma), this by no means discredits the economic (not to mention social) viability of scaling up treatment.

Figure 46. Additional number of people to be treated for Onchocerciasis under an elimination scenario compared to the baseline scenario



Source: Own elaboration

The total cost of scaling up treatment for Onchocerciasis under the Elimination scenario, taking into account the individual cost and the additional number of people requiring treatment under the Elimination scenario, is shown in Table 18.

Table 18. Total cost of scaling up treatment to meet elimination scenario assumptions for Onchocerciasis in Nigeria until 2030, 2022 USD, discounted

Financial cost	Economic cost	Economic cost + cost of medicines
41.8m	49.8m	69.3m

Source: Own elaboration

APPENDIX D – PER TREATMENT DELIVERY AND MEDICINE COSTS

Soil-Transmitted Helminths (STH)

The individual treatment costs of STH are estimated using a benchmarking tool developed by Fitzpatrick et al. (as described in Section 4.1.3) and are shown in Table 19.

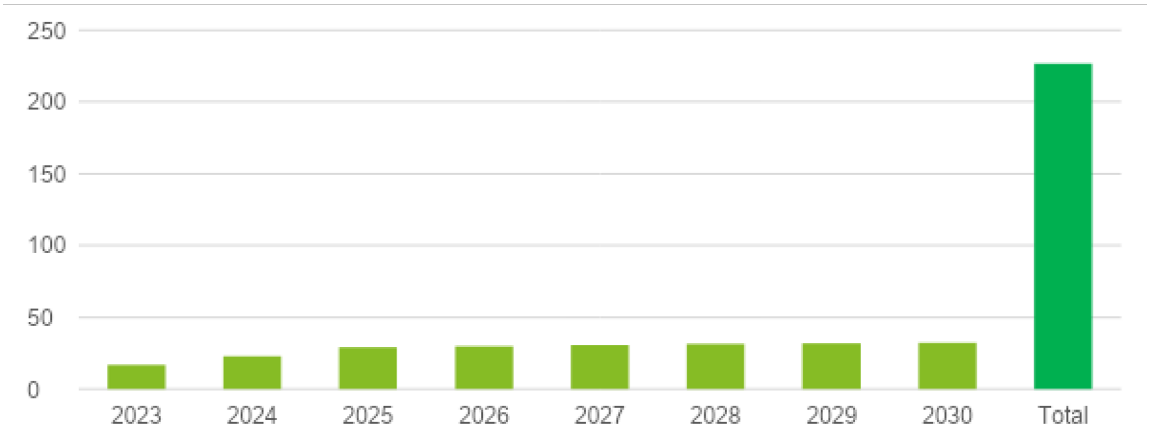
Table 17. Individual Onchocerciasis treatment costs

Financial cost	Economic cost	Economic cost + cost of medicines
0.34	0.41	1.59

Source: Own elaboration

The additional number of people receiving treatment for STH under the elimination scenario is shown in Figure 47. These numbers are relatively high, as STH is prevalent among the Nigerian population.

Figure 47. Additional number of people to be treated for STH under an elimination scenario compared to the Baseline scenario



Source: Own elaboration

The total costs of scaling up treatment for STH under the baseline scenario are shown in Table 15.

Table 20. Total cost of scaling up treatment to meet elimination scenario assumptions for Soil-transmitted helminths in Nigeria until 2030, 2022 USD, discounted

Financial cost	Economic cost	Economic cost + cost of medicines
66.3m	80.5m	313.1m

Source: Own elaboration

APPENDIX D – PER TREATMENT DELIVERY AND MEDICINE COSTS

Schistosomiasis

The costs of individual treatment for Schistosomiasis are shown in Table 21.

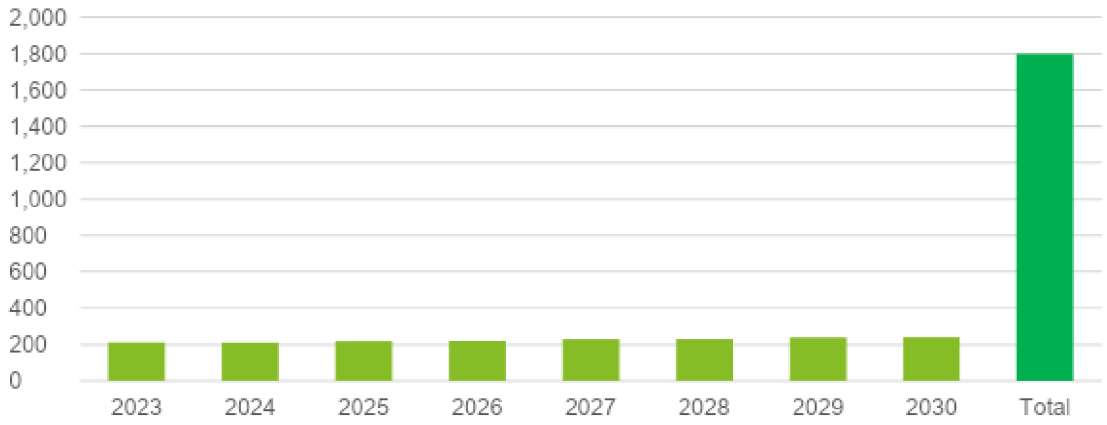
Table 21. Individual Schistosomiasis treatment costs

Financial cost	Economic cost	Economic cost + cost of medicines
0.15	0.18	1.29

Source: Own elaboration

The additional population requiring treatment for Schistosomiasis under the elimination scenario is shown in Figure 48. These numbers are high as this study assumes that under the Elimination scenario, the whole of Nigeria's population would be covered by treatment. This is because the WHO projections of the proportion of the population requiring treatment appear unreasonably low (as they do not cover everyone living in endemic zones, but only children and adolescents). As a result, these projections are lower than the GBD 2019 estimates of the number of cases. Moreover, Abdulkadir et al. estimate that the Schistosomiasis prevalence rate in Nigeria is 35%. As this figure is substantial, this study assumes that the whole Nigerian population would be treated in the Elimination scenario. This approach is conservative from the perspective of cost estimates as it risks overestimating them. Although costly, the 'blanket' approach ensures achieving the expected outcomes of the elimination scenario (i.e., eliminating all reversible cases from 2022 and preventing the emergence of new ones) and directly pursues the cost-benefit analysis results. Likely, the costs associated with scaling up MAM will be lower than estimated.

Figure 48. Additional number of people to be treated for Schistosomiasis under elimination scenario compared to the baseline scenario



Source: Own Calculation

The total costs of scaling up MAM for Schistosomiasis to cover the whole Nigerian population are shown in Table 22.

Table 22. Total cost of scaling up treatment to meet the elimination scenario assumptions for Schistosomiasis in Nigeria until 2030, 2022 USD, discounted

Financial cost	Economic cost	Economic cost + cost of medicines
230.7m	280.0m	2.03bn

Source: Own Calculation

Deloitte.