2023

THE
CARTER CENTER

Waging Peace. Fighting Disease. Building Hope.

Summary

2023 Program Review

RIVER BLINDNESS ELIMINATION PROGRAM

Ethiopia, Nigeria, OEPA, Sudan, and Uganda

April 24-26, 2024

The Carter Center, Atlanta, GA

Printed: December 2024

Donors to The Carter Center River Blindness Elimination Program

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USAID's Act to End NTDs | East Program, led by RTI International

USAID's Achieve Onchocerciasis Elimination in the Americas Project

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And to many others, our sincere gratitude.

** The Reaching the Last Mile Fund, housed within The END Fund, is a multi-donor fund, initiated and led by His Highness Sheikh Mohamed bin Zayed Al Nahyan, President of United Arab Emirates.*

Table of Contents

ACRONYMS

APOC	African Program for Onchocerciasis Control
BMGF	Bill and Melinda Gates Foundation
CAR	Central African Republic
CDD	Community Directed Distributors
CDTI	Community Directed Treatment with Ivermectin
COVID-19	2019 novel coronavirus disease
CS	Community Supervisor
DBS	Dried Blood Spots
DEC	Diethylcarbamazine
DRC	Democratic Republic of the Congo
EOEEAC	Ethiopia Onchocerciasis Elimination Expert Advisory Committee
ELISA	Enzyme-linked immunosorbent assay
ESPEN	Expanded Special Project for Elimination of Neglected Tropical Diseases
FLHF	Frontline Health Facility
FMOH	Federal Ministry of Health
FTS	Filarial Test Strip
GIS	Geographical Information System
GONE	Global Onchocerciasis Network for Elimination
HDA	Health Development Army
HEW	Health Extension Worker
HQ	Headquarters
HW	Health Worker
IACO	InterAmerican Conference on Onchocerciasis
IHA	Indigenous Health Agent
IRB	Institutional Review Board
ITFDE	International Task Force for Disease Eradication
LF	Lymphatic Filariasis
LGA	Local Government Areas
LLIN	Long-lasting Insecticidal (Bed) Nets
MDA	Mass Drug Administration
MDP	Mectizan Donation Program
MMDP	Morbidity Management and Disability Prevention
MMN	Madi-Mid North
MOH	Ministry/Ministries of Health
NGDO	Non-Governmental Development Organization
NOEC	Nigeria Onchocerciasis Elimination Committee
NTD	Neglected Tropical Disease
OEM	Onchocerciasis Elimination Mapping

OEPA	Onchocerciasis Elimination Program for the Americas
OTS	Onchocerciasis Technical Subgroup/Subcommittee
PAHO	Pan American Health Organization
PCC	Program Coordinating Committee of OEPA
PCR	Polymerase Chain Reaction
PES	Post Elimination Surveillance
PHC	Primary Health Care
PTS	Post-Treatment Surveillance
RB	River Blindness
RBEP	River Blindness Elimination Program
RBF	River Blindness Foundation
REMO	Rapid Epidemiological Mapping of Onchocerciasis
RPRG	Regional Program Review Group
RoSS	Republic of South Sudan
RTI	Research Triangle Institute
S&C	Slash and Clear
SE/SS	South East/South South
SCH	Schistosomiasis
SIZ	Special Intervention Zone
SNNPR	Southern Nations, Nationalities and People's Region
STH	Soil-Transmitted Helminths
TAS	Transmission Assessment Survey
TCC	The Carter Center
UOEEAC	Ugandan Onchocerciasis Elimination Expert Advisory Committee
USAID	United States Agency for International Development
USF	University of South Florida
UTG	Ultimate Treatment Goal
WER	Weekly Epidemiological Record
WHO	World Health Organization
YFA	Yanomami Focus Area

GLOSSARY

Definitions of Eradication, Elimination and Control for Neglected Tropical Diseases (NTDs)[1]

Eradication: The permanent reduction to zero of a specific pathogen, as a result of deliberate efforts, with no more risk of reintroduction. The WHO process of documenting eradication is called ***certification***.

Elimination of transmission: The reduction to zero of the incidence of infection caused by a specific pathogen in a defined geographical area, with minimal risk of reintroduction, as a result of deliberate efforts; continued actions to prevent re-establishment of transmission may be required. The WHO process of documenting country-wide elimination of transmission is called ***verification***.

Elimination as a public health problem: Reduction of disease incidence, prevalence, morbidity and/or mortality defined by achievement of measurable global targets set by WHO in relation to a specific disease or pathogen. When reached, continued actions are required to maintain the targets, and additional interventions or assessments are required (if an infectious agent) to achieve zero transmission. The WHO process of documenting country-wide elimination as a public health problem is called ***validation***.

Control: Reduction of disease incidence, prevalence, morbidity, and/or mortality to a locally acceptable level as a result of deliberate efforts; continued intervention measures are required to maintain the reduction. Control may or may not be related to global targets set by WHO.

Phases of Onchocerciasis Transmission[2]

Transmission Suppressed: The absence of infective larvae (L3s) in the *Simulium* vector population. Infectivity can be suppressed through drug (ivermectin) pressure, despite the potential for re-initiation of transmission through the presence of a population of adult worms capable of producing microfilariae if the drug pressure is removed.

Transmission Interrupted: The permanent reduction of transmission in a defined geographical area after all the adult worms (and microfilariae) in the human population in that area have died, been exterminated by some other intervention, or become sterile and infertile. At this point, ivermectin drug pressure may be removed.

Transmission Eliminated: The demonstration through 3-5 years of post (ivermectin) treatment surveillance that onchocerciasis transmission remains interrupted. Continued (post elimination) surveillance is required.

[1] World Health Organization (2016). Generic Framework for Control, Elimination and Eradication of Neglected Tropical Diseases.

[2] World Health Organization (2016). Guidelines for Stopping Mass Drug Administration and Verifying Elimination of Human Onchocerciasis.

EXECUTIVE SUMMARY

The 28th Annual Review Meeting of the Carter Center's (TCC) River Blindness Elimination Program (RBEP) was held April 24-26, 2024 at the Cecil B. Day Chapel at the Carter Center in Atlanta, Georgia. This was the first in-person program review meeting since the COVID-19 pandemic began. The RBEP Atlanta and country-based staff, Ministry of Health (MOH) officials, partners, and donors discussed achievements, challenges, and operational research conducted in 2023, and made recommendations for 2024 activities.

The RBEP currently assists the ministries of health in six countries[3] to eliminate RB transmission. The strategy for elimination is mass drug administration (MDA) with ivermectin (Mectizan®, donated by Merck & Co, Inc. [known as MSD outside the United States of America and Canada]) generally given twice per year, although in certain areas, it is given annually or four times per year. This strategy has been highly successful in the Americas, resulting in the elimination of onchocerciasis transmission from Colombia (2013), Ecuador (2014), Mexico (2015), and Guatemala (2016) as verified by the World Health Organization (WHO)—the first and so far only countries to achieve this goal. The approach to RB elimination follow the three programmatic phases as defined by WHO guidelines (Figure 1): 1) **treatment** phase; after epidemiological and entomological surveys demonstrate *transmission interruption* is achieved, MDA can be stopped; 2) **post-treatment surveillance (PTS)** phase consisting of 3-5 years of surveillance to demonstrate *transmission elimination*; 3) **post-elimination surveillance (PES)** phase then continues until all transmission zones in a country complete PTS and the country requests WHO verification of transmission elimination.

The meeting was chaired by Dr. Gregory Noland, Director of the Carter Center's River Blindness, Lymphatic Filariasis, Schistosomiasis, and Malaria programs. The meeting opened with welcoming remarks from Paige Alexander, Chief Executive Officer of the Carter Center, Dr. Kashef Ijaz, Vice President of the Center's Health Programs, and a goodwill message from Dr. Tedros Adhanom Ghebreyesus, Director General of the WHO. Tributes were given for the passing in 2023 of Carter Center Co-Founder and former First Lady Rosalynn Carter, Mr Aryc Mosher, former member of Carter Center health programs, and Mr Christopher Ogoshi, of Christian Blind Mission (CBM), Nigeria.

Noland provided an introductory overview for the meeting, titled "Then and Now" to highlight significant changes since the last in-person meeting held March 2019 (which reviewed 2018 data). The first notable change is the volume of treatments distributed and treatments halted in RBEP-assisted areas. In the five complete calendar years 2019 through 2023, RBEP assisted with the distribution of 181.5 million Mectizan treatments for river blindness (RB) and 73.4 million treatments for lymphatic filariasis (LF). This represents around one-third (32% and 36%) of all treatments distributed for RB and LF, respectively, since the RBEP began in 1996. Also in the five-year period 2019—2023, treatments were halted for 25.3 million people for RB and 20.5 million people for LF, accounting for 79% and 72%, respectively, of all treatments halted in the program's 28 year history. The second significant change is the formal targeting of RB elimination in Africa. Under the 2012

[3] Brazil, Ethiopia, Nigeria, Sudan, Uganda, and Venezuela.

WHO NTD Roadmap [4], RB elimination was only targeted in the Americas region, Yemen and selected countries in Africa. In the 2021-2030 Roadmap [5], the disease-specific target for RB is elevated to "targeted for elimination (interruption of transmission)" without geographic restriction. This change is paralleled by new enthusiasm and resources for elimination. In December 2023 at the Reaching the Last Mile Forum held on the first World Health Day of the United Nations Climate Change Conference (COP28) in Dubai, United Arab Emirates, donors and countries pledged $777 million to fight neglected tropical diseases (NTDs). In addition, a new global partnership, called the Global Onchocerciasis Network for Elimination (GONE) held an inaugural meeting in Saly, Senegal in November 2023. The fourth change highlighted was to announce that Dr. Frank Richards, Jr., founding Director of the RBEP, and Dr. Mauricio Saurbrey, Director of the Onchocerciasis Program for the Americas (OEPA) plan to fully retire in 2024.

In 2023, TCC assisted with 33,694,088 Mectizan treatments for RB in the Americas, Ethiopia, Nigeria, Sudan, and Uganda (Figures 2). This represents 82% of the 2023 treatment target of 41 million. Country-specific coverage ranged from 0% in Sudan to 94% in Uganda (Figure 3). RBEP aims to exceed 90% treatment coverage of the eligible population (which excludes children under five years of age and pregnant women) in each treatment round, except in the Americas, where the goal is at least 85% coverage. RBEP's cumulative treatments since 1996 now total 565 million (Figure 4). Figures 5 and 6 show TCC-assisted treatments and annual coverage by country. A goal of 44 million treatments has been set for 2024. In 2023, more than 1.1 million people qualified to stop MDA for onchocerciasis in Uganda – marking the largest population to stop treatments in any Uganda onchocerciasis endemic focus to date (Figures 7 and 8). Cumulatively, 31.8 million people no longer need treatment for RB in Carter Center-assisted areas (Figure 9). In 2023, The Galabat focus in Sudan and Nyagak-Bondo focus in Uganda were declared transmission eliminated in 2023 by the respective ministries of health after completing PTS surveys.

RBEP is an integrated program that includes LF elimination in Ethiopia, Nigeria, and Sudan, and schistosomiasis (SCH) and soil-transmitted helminthiasis (STH) control in Nigeria. In 2023, TCC assisted with the distribution of 9,252,176 Mectizan and albendazole (donated by GSK) treatments for LF (50% of the treatment target), 2,296,735 praziquantel (donated by Merck KGaA, Darmstadt, Germany) treatments for SCH (65% of the treatment target) and 5,473,048 albendazole or mebendazole (donated by Johnson & Johnson) treatments for STH (62% of the treatment target) (Figure 10). Cumulatively, TCC has assisted in 204,558,507 LF treatments, 32,249,092 SCH treatments, and 69,453,433 STH treatments (Figure 4). In 2023, more than 4.2 million people qualified to stop MDA for LF: 3.7 million in Nigeria and 460,290 in Ethiopia (Figures 7 and 11). Cumulatively, 28 million people in Ethiopia and Nigeria no longer need treatment for LF (Figure 12). This includes 11.7 million people in 44 districts of Nigeria and 70,425 people in one district of Ethiopia who qualified to stop treatment in 2022. RB treatments represented 54% of the 92 million MDA treatments for RB, LF, SCH, STH, and trachoma assisted by TCC in 2022 (Figure 1).

Our work would not be possible without ministry partnership at all levels and a grassroots network of community-directed drug distributors (CDDs) who provide treatments and health education. A combined 392,621 CDDs were trained in 2023 – a 26% increase from 2022 owing to an increased number of workers trained in Ethiopia (Figure 13).

[4] World Health Organization (2012). Accelerating work to overcome the global impact of neglected tropical diseases – A roadmap for implementation. Geneva.
[5] World Health Organization (2020). Ending the neglect to attain the Sustainable Development Goals – A road map for neglected tropical diseases 2021–2030. Geneva.

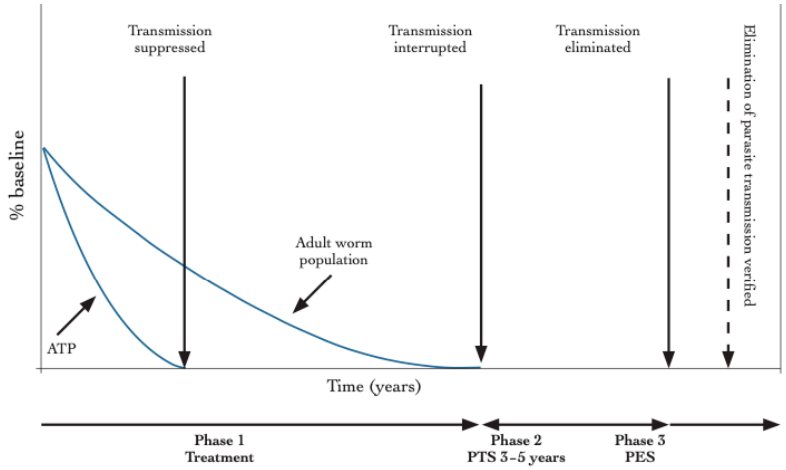
2023 Treatment Performance:

	2023 Treatment Targets	2023 Treatments	%
RB	41,048,141	33,694,088	82%
LF	18,579,457	9,252,176	50%
SCH	3,559,892	2,296,735	65%
STH	8,761,757	5,473,048	62%

FIGURES

Figure 1

Phases of Onchocerciasis Elimination



ATP, annual transmission potential; PES, post-elimination surveillance; PTS, post-treatment surveillance

WHO (2016). Guidelines for stopping mass drug administration and verifying elimination of human onchocerciasis: criteria and procedures (document WHO/HTM/NTD/PCT/2016.1). Geneva, World Health Organization. http://www.who.int/onchocerciasis/resources/9789241510011/en/

Figure 2

Carter Center-Assisted River Blindness Treatments and Targets 1996 – 2023 and 2024 Target

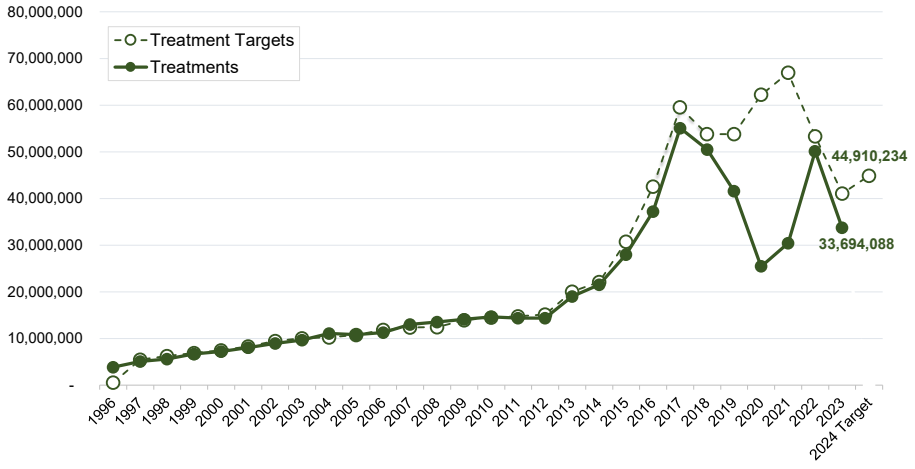
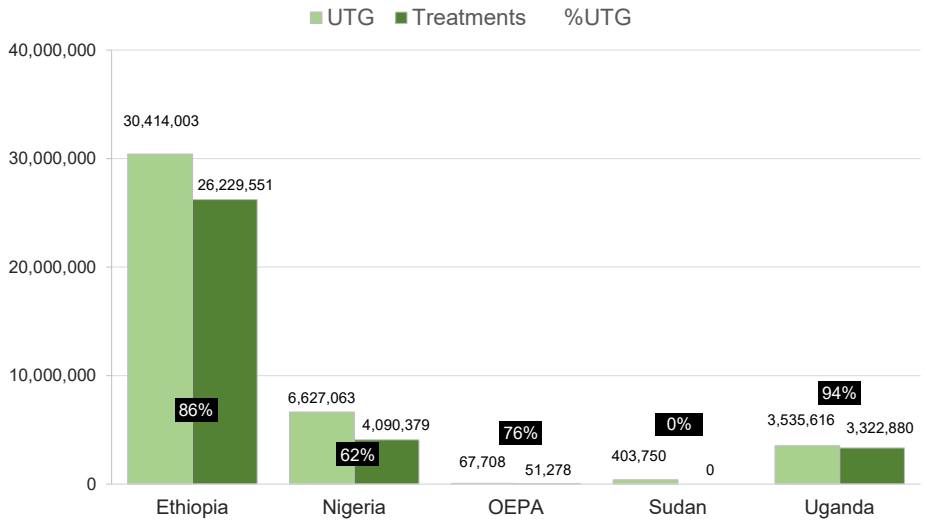


Figure 3

2023 Mectizan® Ultimate Treatment Goals (UTG) and Treatments for River Blindness in TCC-assisted Areas



OEPA: Represents Brazil, Colombia, Ecuador, Guatemala, Mexico, and Venezuela.
Uganda: Treatment totals include passive (173,277) and refugee (191,882) treatments.

Figure 4

Carter Center River Blindness, Lymphatic Filariasis, Schistosomiasis and Soil-transmitted Helminth Programs Cumulative Treatments 1996-2023

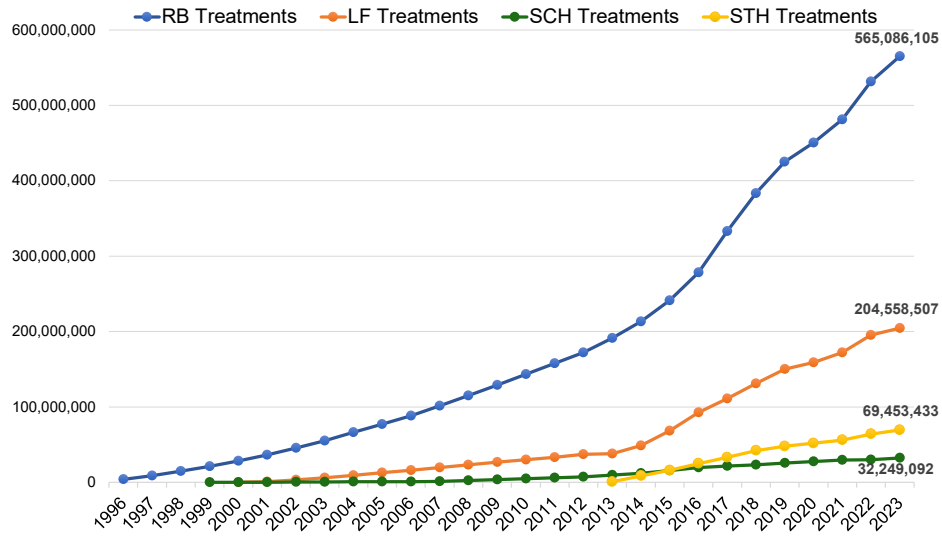


Figure 5

Carter Center-Assisted Mectizan® Treatments for River Blindness by Country/Program 1996 – 2023

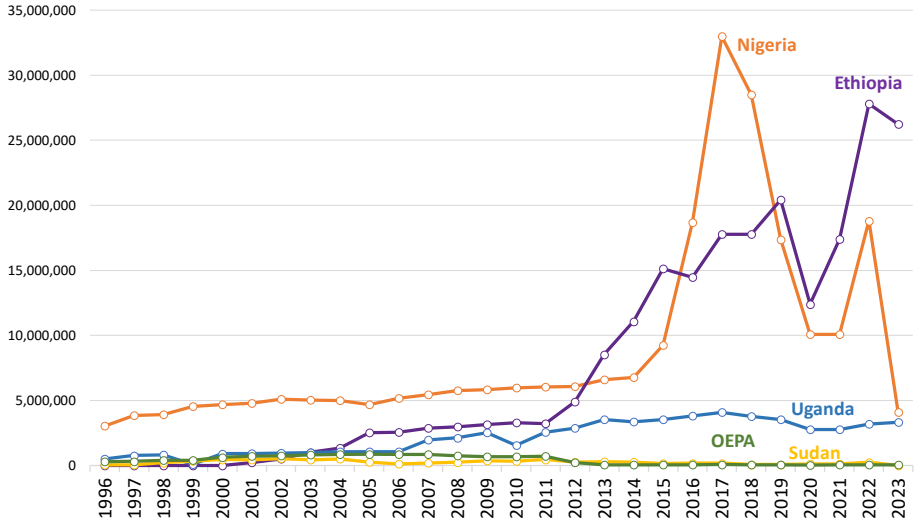
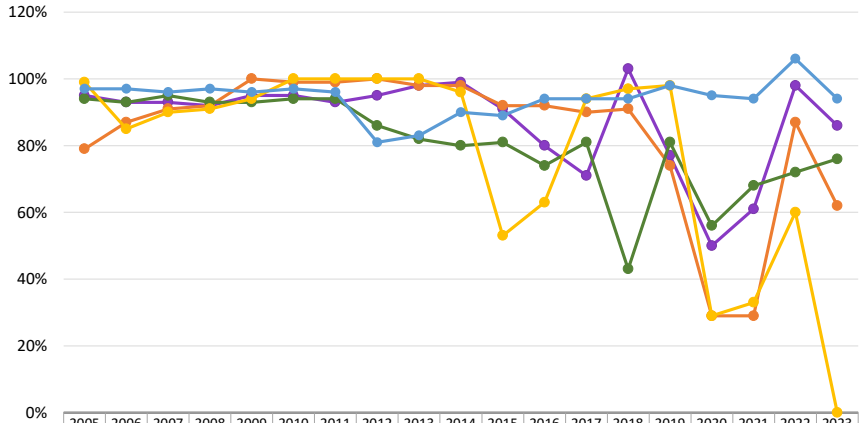


Figure 6

Reported Mectizan® Treatment Coverage (of Eligible Pop.) for River Blindness by Country/Program 2005 – 2023



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Ethiopia	95%	93%	93%	92%	95%	95%	93%	95%	98%	99%	91%	80%	71%	103%	77%	50%	61%	98%	86%
Nigeria	79%	87%	91%	92%	100%	99%	99%	100%	98%	98%	92%	92%	90%	91%	74%	29%	29%	87%	62%
OEPA	94%	93%	95%	93%	93%	94%	94%	86%	82%	80%	81%	74%	81%	43%	81%	56%	68%	72%	76%
Sudan	99%	85%	90%	91%	94%	100%	100%	100%	100%	96%	53%	63%	94%	97%	98%	29%	33%	60%	0%
Uganda	97%	97%	96%	97%	96%	97%	96%	81%	83%	90%	89%	94%	94%	94%	98%	95%	94%	106%	94%

Figure 7

Inventory of 'Stop MDA' for River Blindness and Lymphatic Filariasis in Carter Center-Assisted Areas

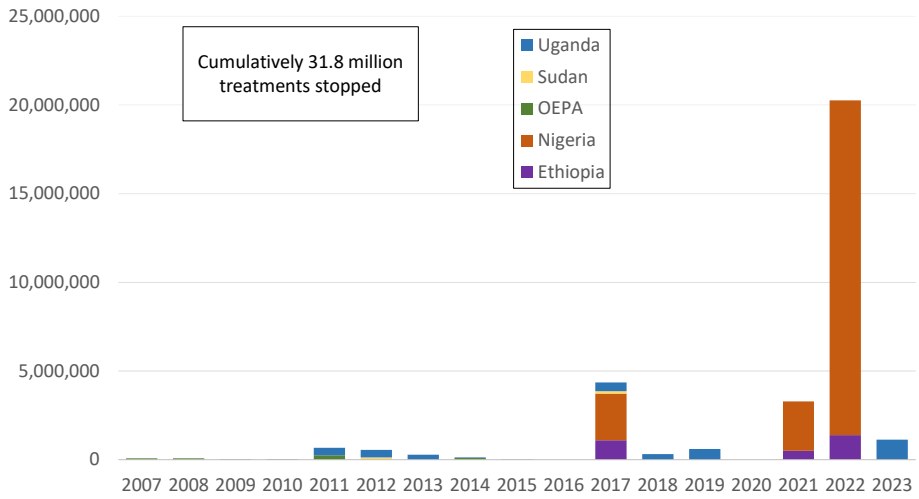
RIVER BLINDNESS		
Country	Total Population residing in areas where MDA stopped 2007-2023	Stopped MDA in 2023
ETHIOPIA	2,986,558	0
NIGERIA	24,286,356	0
OEPA[1]	538,517	0
SUDAN	264,811	0
UGANDA[2]	3,742,747	1,121,520
TOTAL	**31,818,989**	**1,121,520**

[1]Representing Brazil, Colombia, Ecuador, Guatemala, Mexico, and Venezuela.
[2]Excludes the eliminated Victoria focus (not TCC-assisted, eliminated in the 1970s), population 2.9 million.

LYMPHATIC FILARIASIS		
Country	Total Population residing in areas where MDA stopped 2016-2023	Stopped MDA in 2023
ETHIOPIA	1,962,748	460,290
NIGERIA	26,226,884	3,749,308
TOTAL	**28,189,632**	**4,209,598**

Figure 8

River Blindness Stopped Treatments in Carter Center-assisted Areas by Country and Year, 2007-2023

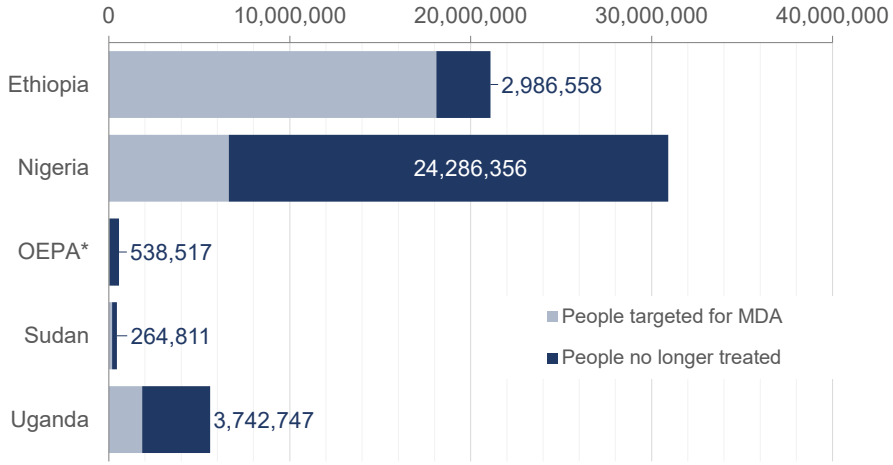


OEPA: Represents Brazil, Colombia, Ecuador, Guatemala, Mexico, and Venezuela.
UGANDA: Excludes the eliminated Victoria focus (not TCC-assisted, eliminated in the 1970s), population 2.8 million.

Figure 9

Population Currently and Previously Targeted for River Blindness Treatment with Mectizan®, 2023

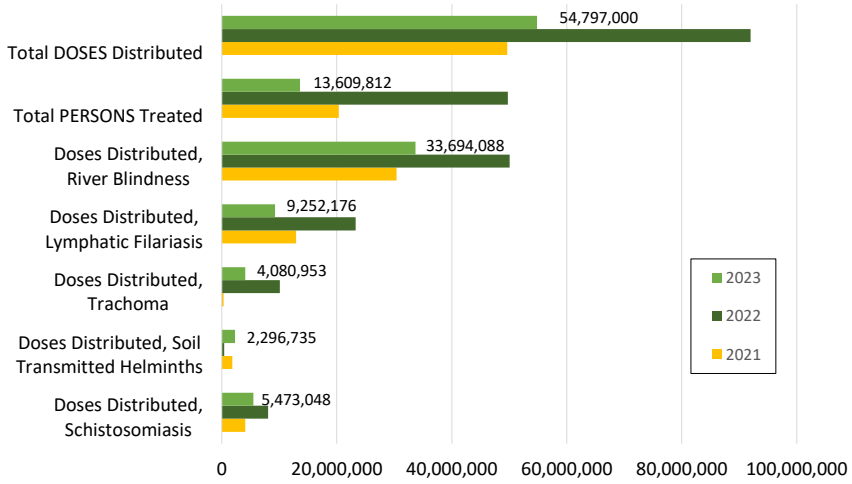
31.8 million people in nine Carter Center-assisted countries no longer need treatment as a result of our river blindness elimination partnership



**OEPA: Representing Brazil, Colombia, Ecuador, Guatemala, Mexico, and Venezuela*
Approximately 35,000 persons are still being treated in the Yanomami Focus Area on the border with Brazil and Venezuela

Figure 10

Carter Center-Assisted Treatment Doses and Persons Treated for Neglected Tropical Diseases, 2021 – 2023



The Carter Center is grateful for our Ministry of Health partners and the many donors and pharmaceutical companies who have made financial and in-kind contributions to make these treatments possible.

Figure 11

Lymphatic Filariasis Stopped Treatments in Carter Center-assisted areas, by Country and Year, 2016-2023

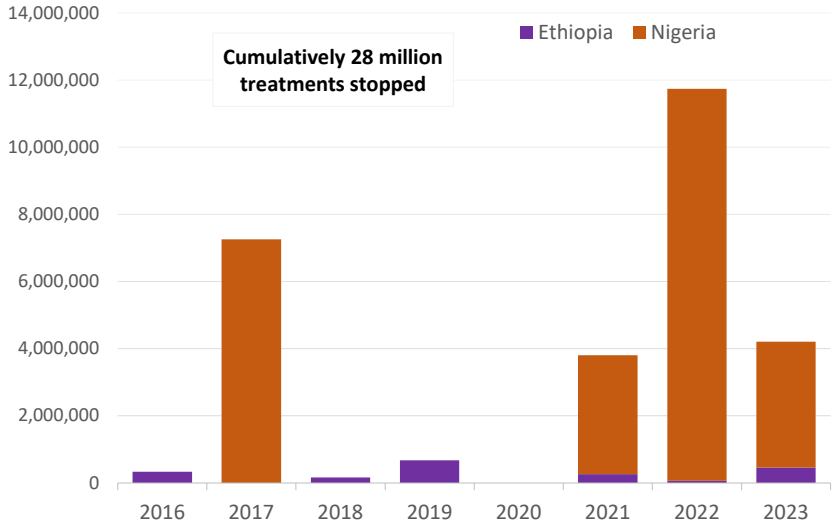


Figure 12

Population Currently and Previously Targeted for Lymphatic Filariasis Treatment, 2023

28 million people in two TCC-assisted countries no longer need treatment as a result of our elimination partnership

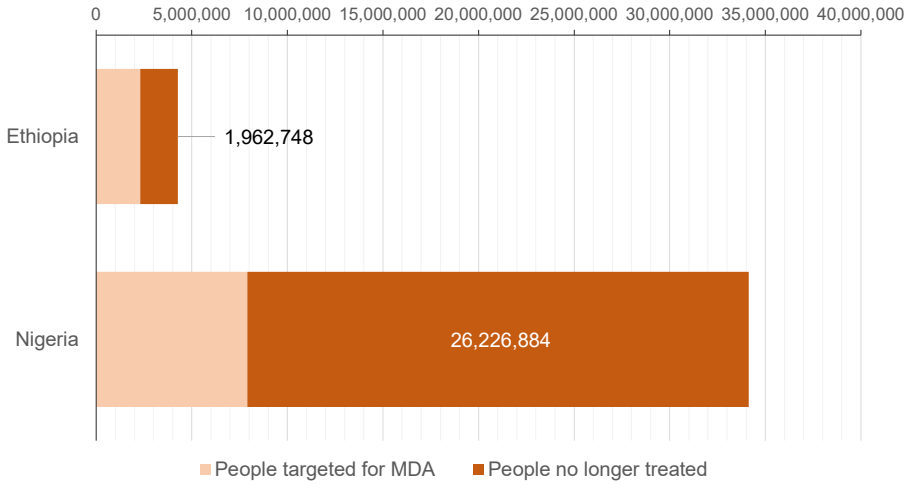


Figure 13

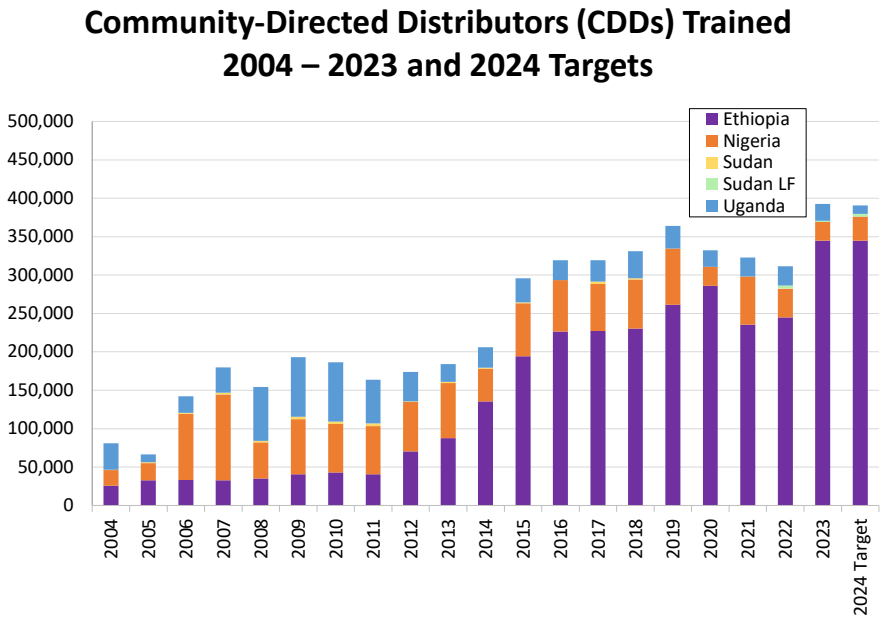
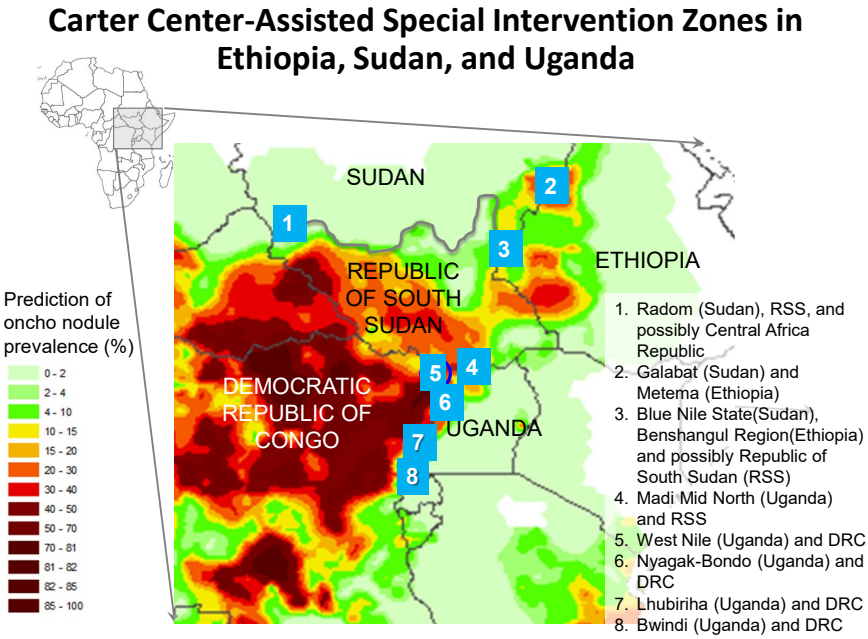


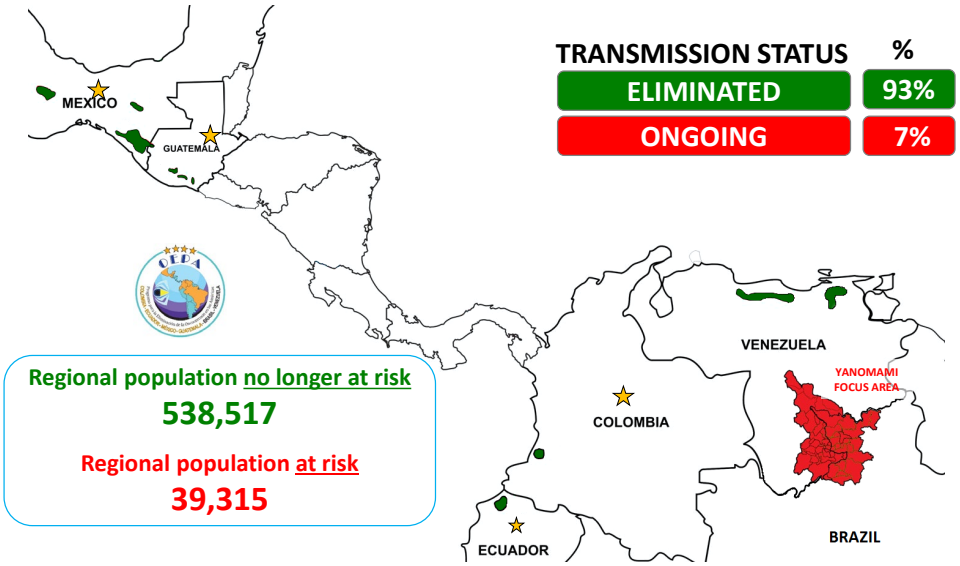
Figure 14



Map source: APOC

Figure 15

OEPA Geographic distribution and transmission status of Onchocerciasis in the Americas in 2023



☆ WHO has verified the elimination of onchocerciasis in this country

Figure 16

OEPA: Mectizan® Treatment for Onchocerciasis in the Americas 1989 – 2023 and 2024 target

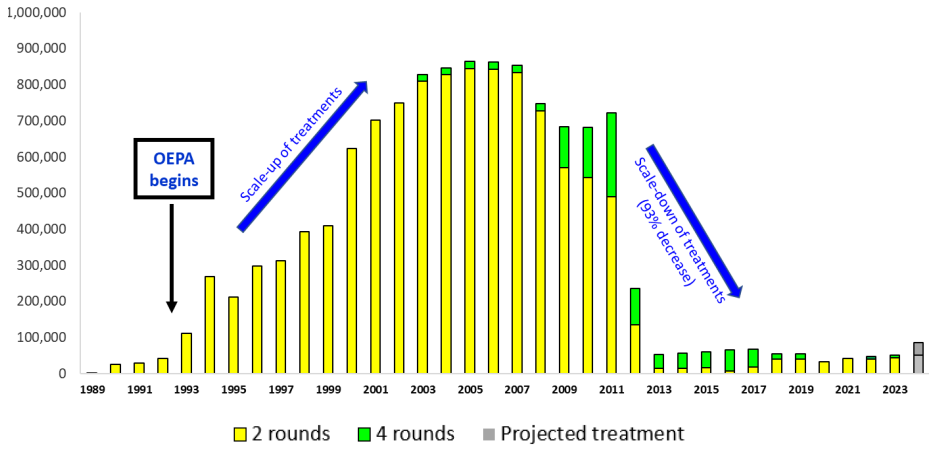


Figure 17

OEPA: Regional Population at Risk, No Longer at Risk and Eligible for Treatment in 2023

Country	Focus	Number of communities	Population at risk	Population out of risk	Transmission Eliminated	WHO Verification
Colombia	Lopez de Micay	1		1,366	2010	2013 ★
Ecuador	Esmeraldas	119		25,863	2012	2014 ★
Mexico	North Chiapas	13		7,125	2010	
Mexico	Oaxaca	98		44,919	2011	2015 ★
Mexico	South Chiapas	559		117,825	2014	
Guatemala	Escuintla	117		62,590	2010	
Guatemala	Santa Rosa	37		12,208	2010	2016 ★
Guatemala	Huehuetenango	43		30,239	2011	
Guatemala	Central	321		126,430	2014	
Venezuela	Northcentral	45		14,385	2013	
Venezuela	Northeast	465		95,567	2017	
Venezuela	South	428	18,741		ONGOING	
Brazil	Amazonas	273	20,574		ONGOING	
		2,519	39,315	538,517		

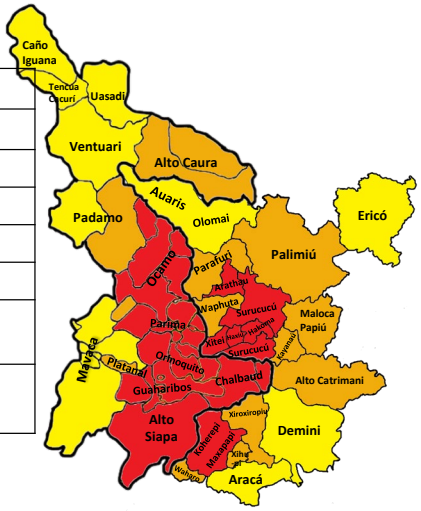
★ WHO has verified elimination in the country.

Figure 18

OEPA: Subareas of the Yanomami Focus Area (YFA) in 2024

Venezuela

428 communities	
Hyper	275
Meso	47
Hypo	106
Pop. at risk	18,741
Pop. eligible	16,071
UTG2: 27,264	
UTG4: 9,756	



Brazil

273 communities	
Hyper	122
Meso	75
Hypo	76
Pop. at risk	20,574
Pop. eligible	16,842
UTG2: 33,684	

UTG2 & UTG 4 for the YFA in 2024: 70,704 in 701 communities

Figure 19

OEPA: Scorecard Method of Community Prioritization

	Score Range	Color	Priority	2023 communities		2022 communities		Change in number of commun-ities *
				Number	% in range	Number	% in range	
Brazil	<= 10		Low	140	51%	153	56%	-13
	11 - 15		Medium	114	42%	103	38%	11
	>= 16		High	18	7%	16	6%	2
TOTAL				272	100%	272	100%	
Venezuela	<= 4		Low	117	30%	258	66%	-141
	5 - 8		Medium	236	60%	83	21%	153
	>= 11		High	41	10%	52	13%	-11
TOTAL				394	100%	393	100%	

Note: Total community numbers each year vary due to splitting and merging of communities.

Figure 20

Treatments distributed in 2023, twice-per-year approach

Focus	Commu-nities	Pop. At Risk	Eligible for treat-ment	Treated 1st Rd and coverage	Treated 2nd Rd and coverage	Treat-ment goal	Annual Treated UTG2 and coverage	Treatments by gender (percentage)			
								Female ♀		Male ♂	
								1st Round	2nd Round	1st Round	2nd Round
Amazonas-BRA	273	19,593	15,650	9,873	10,418	31,300	20,291	4,819	5,143	5,054	5,275
				63%	67%		65%	49%	49%	51%	51%
South- VEN	327	15,805	13,630	11,701	11,375	27,260	23,076	5,581	5,416	6,120	5,959
				86%	83%		85%	48%	48%	52%	52%
Total				21,574	21,793	58,560	43,367	10,400	10,559	11,174	11,234
				74%	74%		74%	48%	48%	52%	52%

Source: OEPA Country Programs

Figure 21

Treatments distributed in 2023, four-times-per-year approach
Venezuela South Focus Program

Communities	Pop at risk	Eligible for treatment (UTG)	UTG(4) Treatment Goal	Total treated	% Coverage of UTG(4)
67	2,647	2,287	9,148	7,911	86%

	1st Quarter	2nd Quarter	3th Quarter	4th Quarter
Population treated	1,844	2,067	2,095	1,905
Coverage	81%	90%	92%	83%
Communities Reached	63	64	64	62

Source: OEPA Country Programs

Figure 22

Ethiopia: Status of River Blindness Elimination, by District (Woreda), 2023

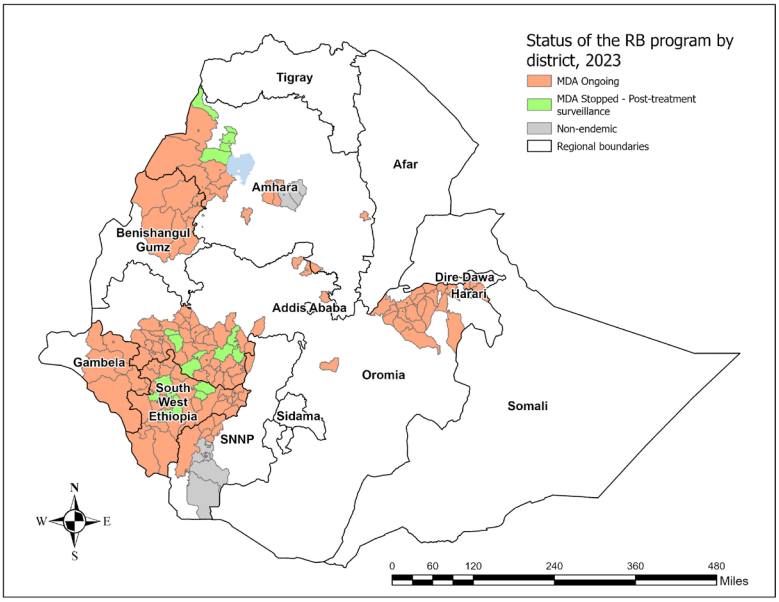


Figure 23

Ethiopia: Status of Lymphatic Filariasis Elimination, by District (Woreda), 2023

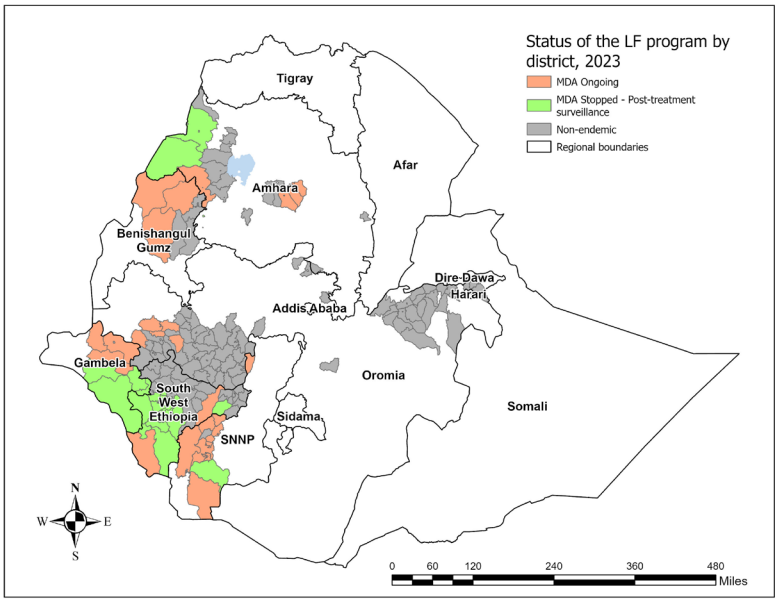


Figure 24

Ethiopia: Carter Center Assisted River Blindness (RB) and Lymphatic Filariasis (LF) Treatments and Targets

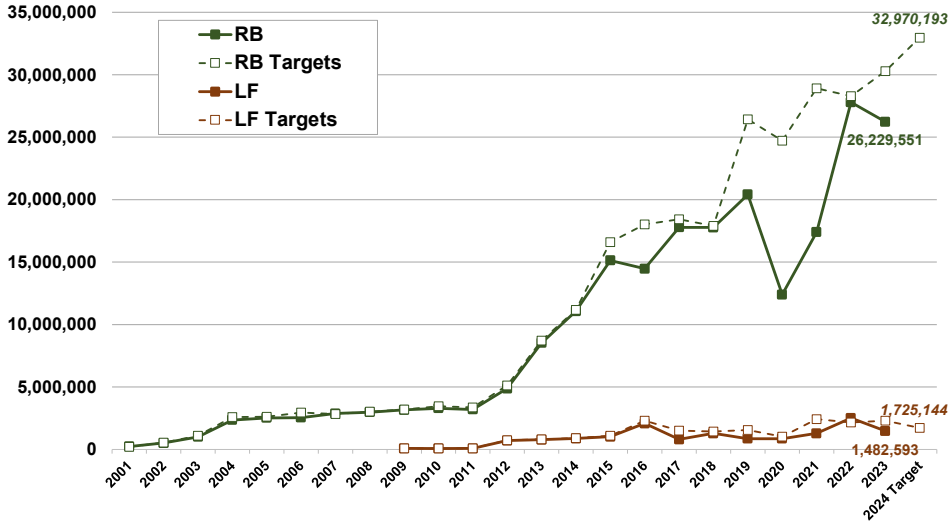


Figure 25

Ethiopia: Annual, Semiannual, and Quarterly Mectizan® Treatments for Onchocerciasis in RBEP-Assisted Areas

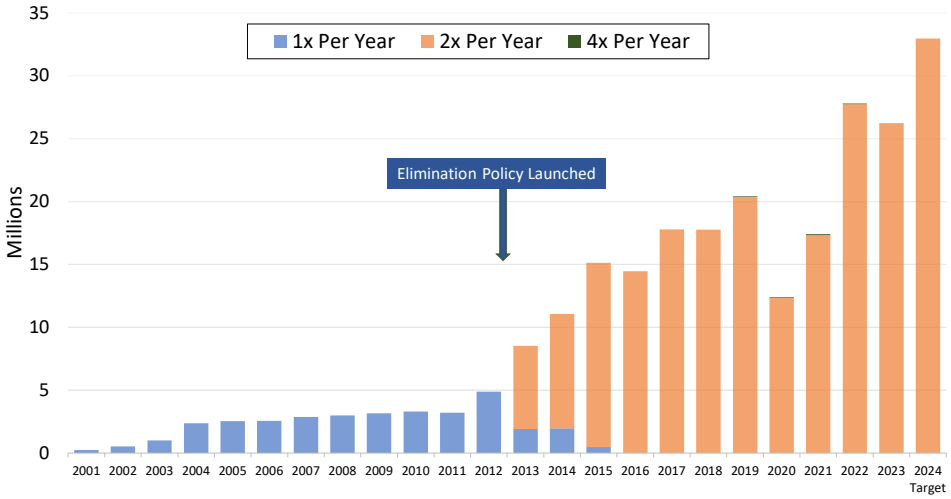
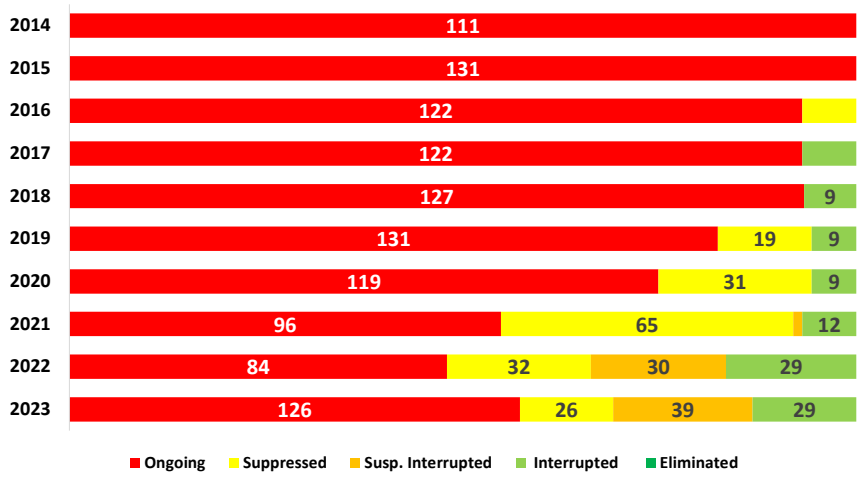


Figure 26

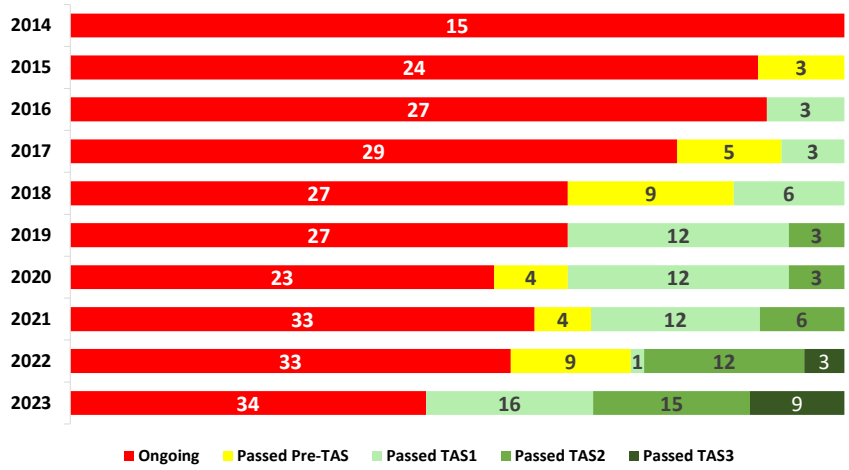
Ethiopia: Progress in Onchocerciasis Elimination, Transmission Status by Woreda (District) in Carter Center-assisted areas, 2014-2022



Note: The increase in total woredas over time reflects administrative splitting and expansion of program areas.

Figure 27

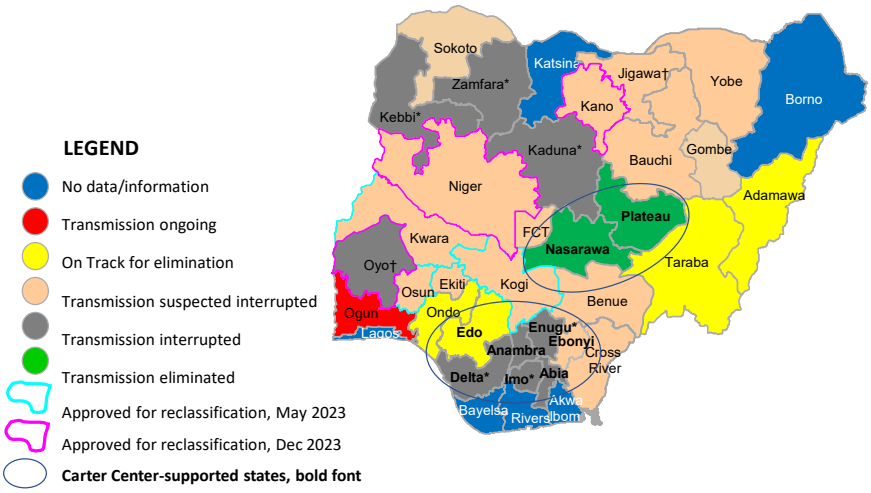
Ethiopia: Progress in Lymphatic Filariasis Elimination, Transmission Status by Woreda (District) in Carter Center-assisted areas, 2014-2023



Note: The increase in total woredas over time reflects administrative splitting and expansion of program areas.

Figure 28

Nigeria: Status of Onchocerciasis Elimination, 2023



* These states are unable to initiate PTS due to ongoing LF treatment
† Oyo status provisional pending updated serological assessments

Figure 29

Nigeria: Progress in National Onchocerciasis Elimination: Transmission Status by State and Federal Capital Territory, 2015 - 2023

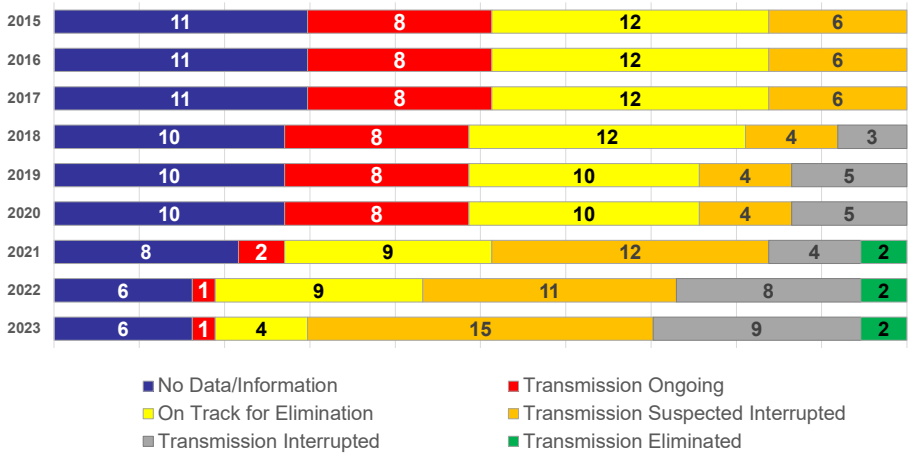
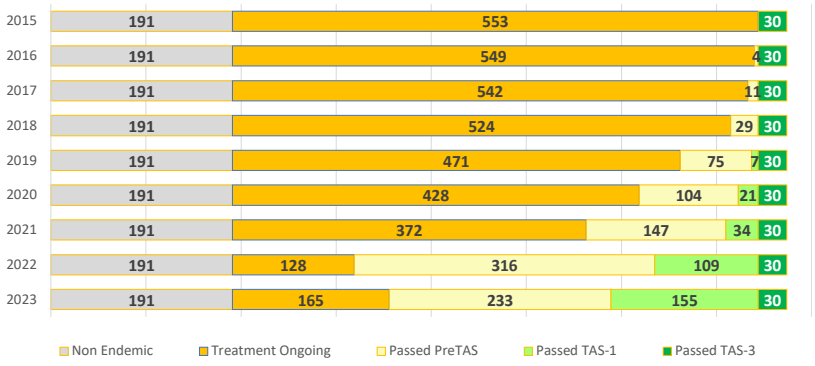


Figure 30

Nigeria: Progress in National Lymphatic Filariasis Elimination: Transmission Status by Local Government Area, 2015 - 2023

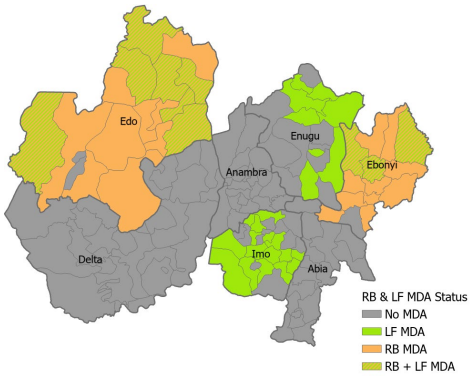


Data Source: FMOH and Partners

Figure 31

Nigeria: Treatment Status of NTD Programs in TCC-assisted Southeast/South South States

RB/LF MDA Status SE/SS States



SCH/STH MDA Status SE/SS States

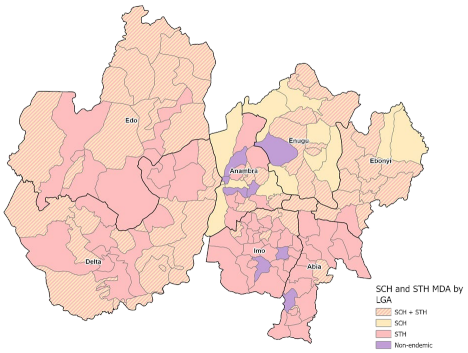
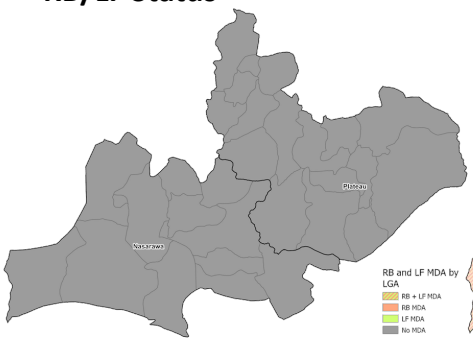


Figure 32

Nigeria: Treatment status of NTD programs in TCC-assisted Plateau/Nasarawa States

RB/LF Status



All LGAs in Plateau and Nasarawa have stopped MDA for both RB and LF.

SCH/STH MDA

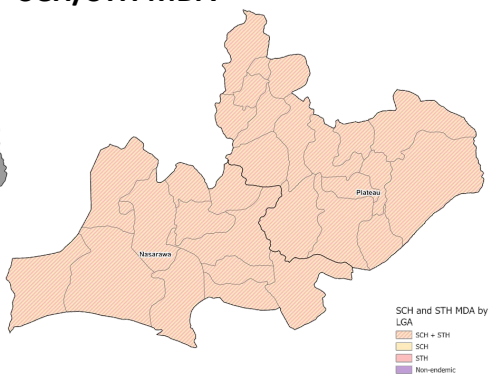


Figure 33

Nigeria: Carter Center Assisted River Blindness (RB) and Lymphatic Filariasis (LF) annual treatments and targets

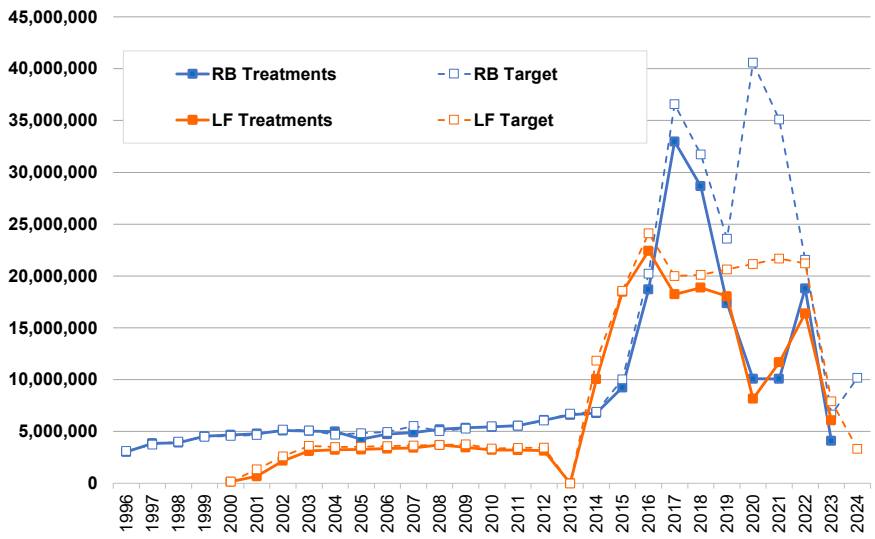
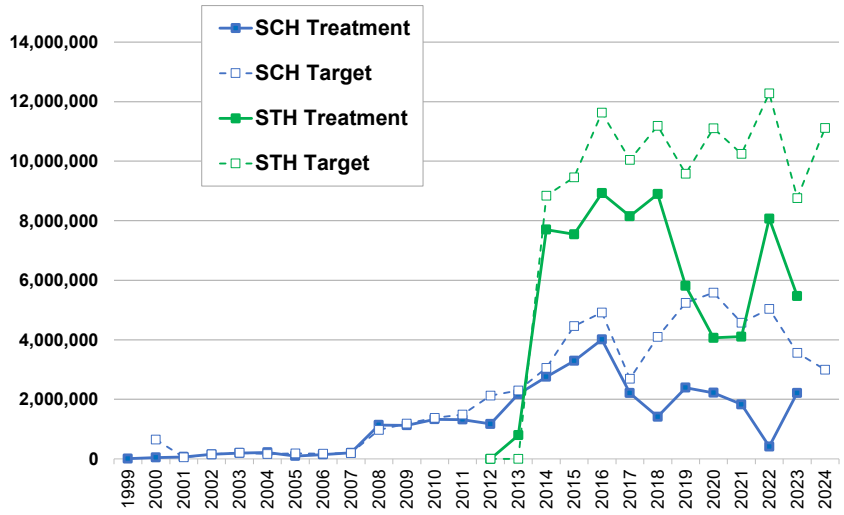


Figure 34

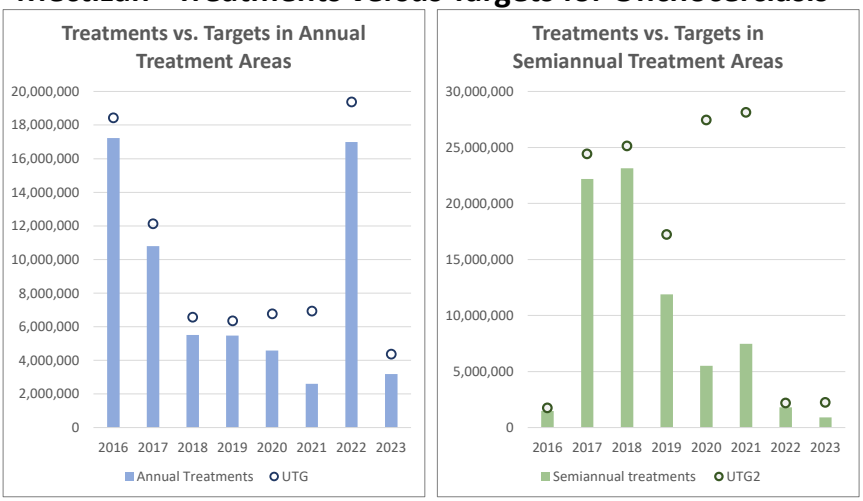
Nigeria: Carter Center-assisted annual treatments and 2024 targets for Soil Transmitted Helminths (STH) and Schistosomiasis (SCH)*



*treatment targets vary by year based on updates in WHO and national guidelines.

Figure 35

Nigeria: Carter Center-assisted Annual and Semiannual Mectizan® Treatments versus Targets for Onchocerciasis*



** Graphs begins at onset of semiannual treatments for RBEP. The decrease in annual treatment in 2018 is due to Plateau and Nasarawa halting treatment due to transmission interruption. Decrease in 2019 is due to delayed arrival of Mectizan, in 2020 is due to COVID-19 pandemic, and in 2021 due to drug delays and COVID-19 pandemic. Decrease in 2023 is due to insufficient and late drug supply.*

Figure 36

Sudan: Progression of Onchocerciasis Elimination

2007 **2023**

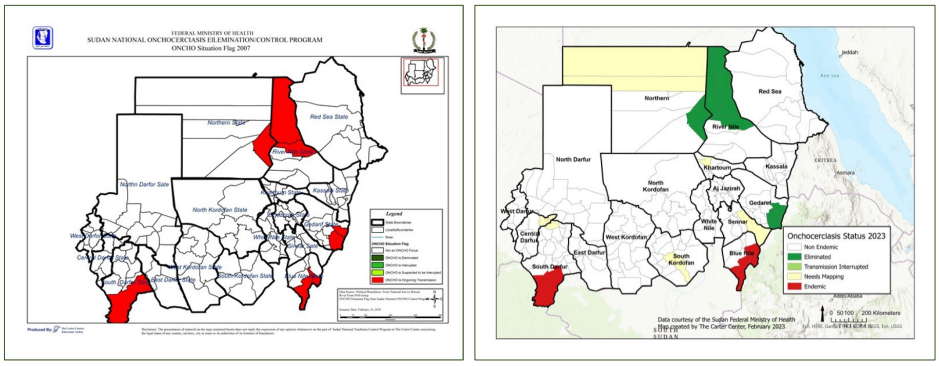


Figure 37

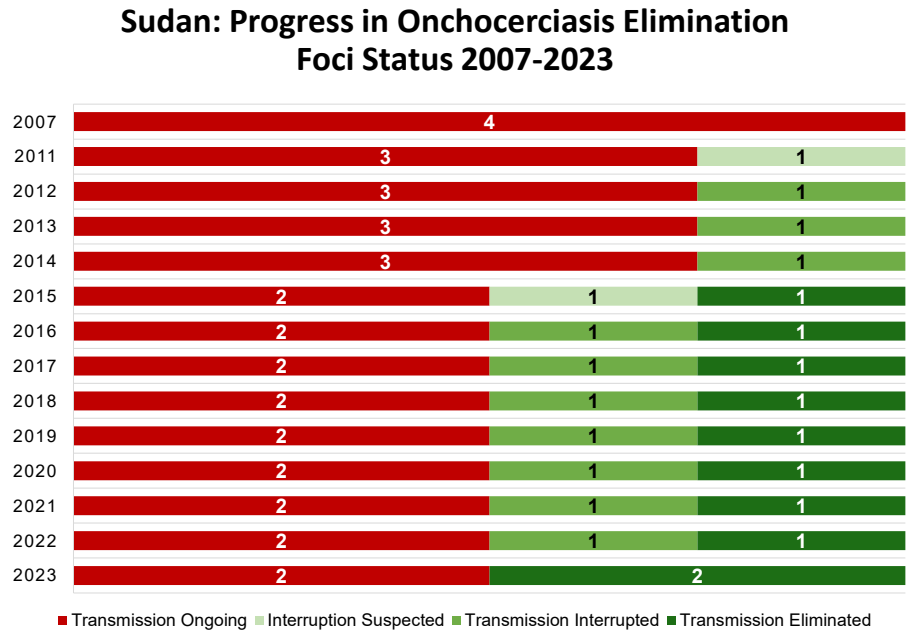


Figure 38

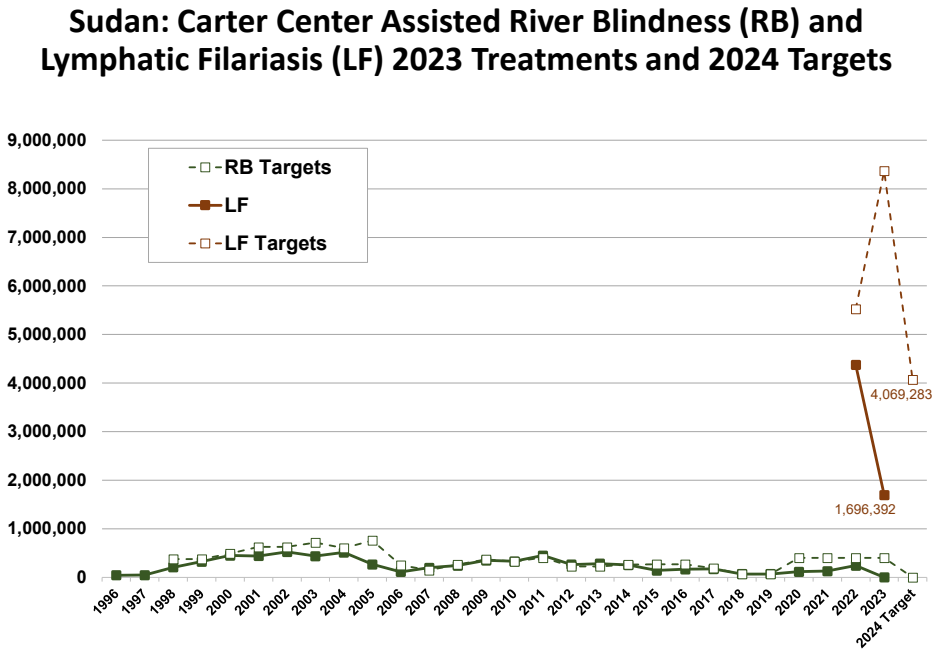


Figure 39

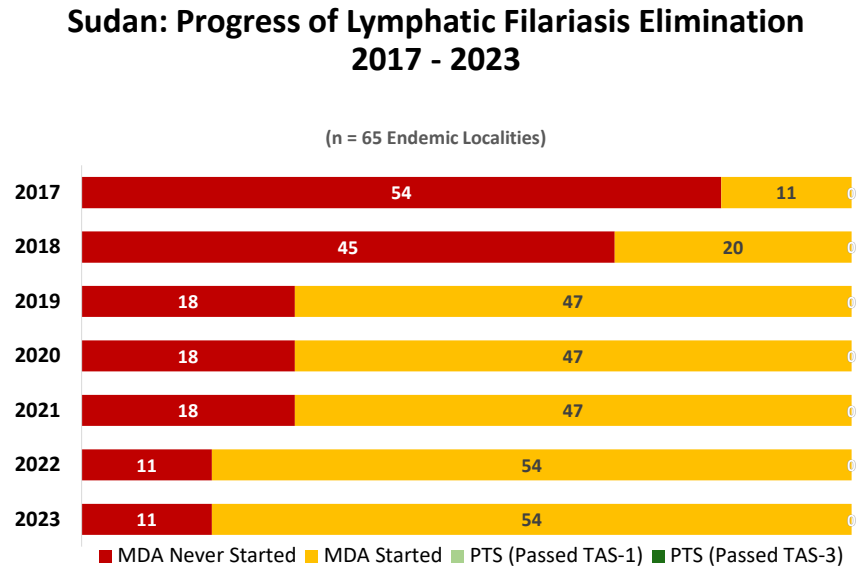
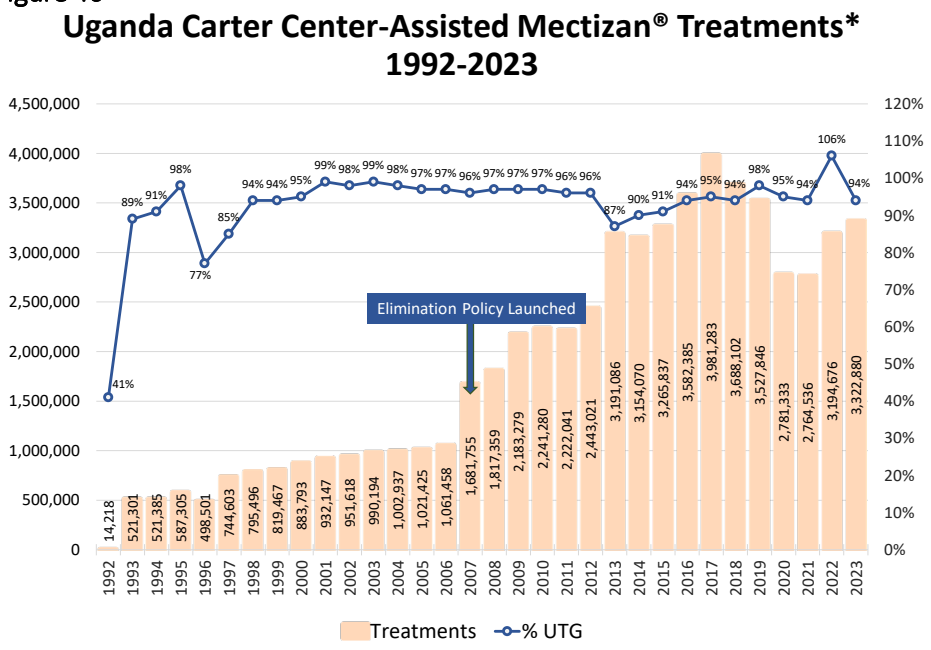


Figure 40



*2022-23 Includes passive and refugee treatments

Figure 41

Uganda: Progress of River Blindness Elimination
Foci Status 2007-2023

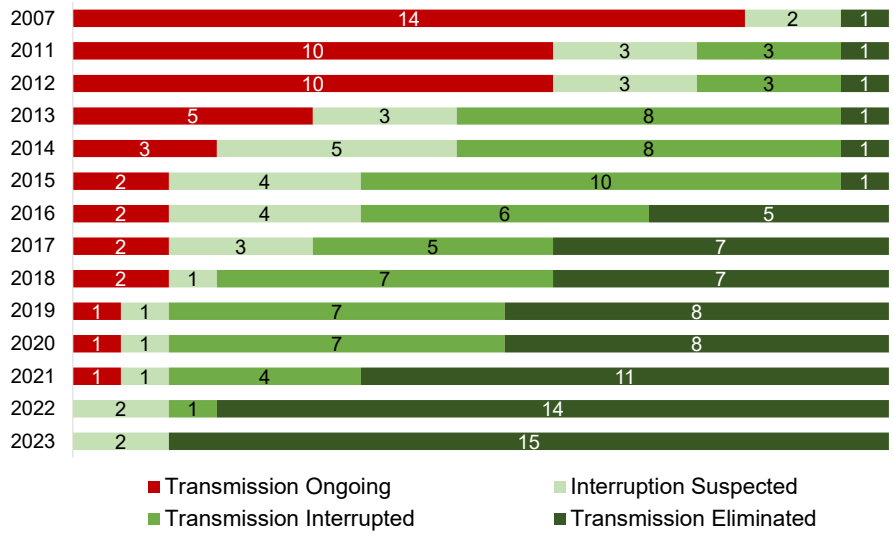
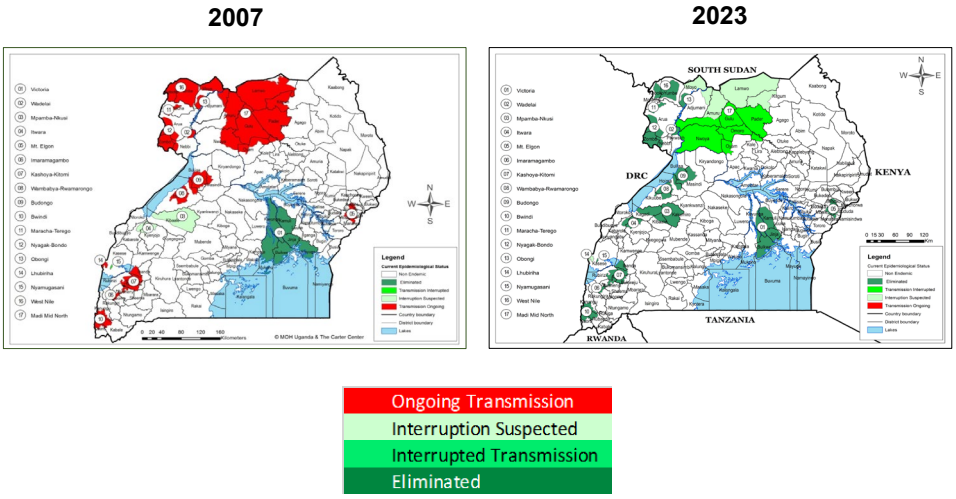


Figure 42

Uganda: Progress of River Blindness Elimination



GENERAL RECOMMENDATIONS 2024
RIVER BLINDNESS ELIMINATION PROGRAMS

Overview of the RBEP mission: In collaboration with the host governments, RBEP aims to eliminate onchocerciasis transmission in TCC-assisted areas in Africa and the Americas. RBEP work includes:

- Helping to empower national onchocerciasis elimination committees to review their data and inform national decisions that demonstrate progress toward elimination, such as: enhancing interventions, expanding treatment, stopping interventions, and conducting PTS/PES. Decisions should be guided by (but not restricted to) the WHO guidelines.
- Conducting new assessments to help delimit the precise borders of African onchocerciasis transmission zones ('foci') and buffer zones between transmission zones that can assist our elimination agenda in RBEP-assisted areas.
- Defining areas of active onchocerciasis transmission, including within the so-called 'hypoendemic' onchocerciasis areas that have traditionally not been targeted for Mectizan treatment under previous WHO/African Program for Onchocerciasis Control (APOC) disease control policy.
- Enhancing interventions (two- or four-times-per-year Mectizan treatment, vector control, etc.) where transmission persists or in new foci where treatments have never been given.
- Where active onchocerciasis transmission spans borders, working with authorities on both sides of internal or international boundaries to establish 'Special Intervention Zones' (SIZs) (Figure 14) to encourage collaboration and coordination on both sides to stop transmission.
- Monitoring the impact of interventions using sensitive and specific tools. Consider integrated monitoring especially in RB-LF overlap areas when "stop-MDA" or other impact evaluations are needed.

- Work with Reaching the Last Mile Fund Expansion project to plan for expanded RB/LF elimination activities in Africa.
- RBEP program staff across at all levels are encouraged to develop innovative solutions to local problems. Stay informed of pilot funding opportunities through TCC Innovation Hub. Engage program managers and TCC/Atlanta early to ensure support.
- RBEP encourages the MOH to submit drug applications to WHO and the Mectizan Donation Program (MDP) as early as possible; timely receipt of drugs is critical, particularly for twice-per-year treatment areas. TCC/RBEP in African countries should actively pursue collaboration with the MOH on application preparation, and submission by April 30. Drug inventories must be submitted with applications.
- RBEP country offices should actively seek inclusion in the drug application process and updates from the MOH on drug supply, keep RBEP staff informed throughout the drug application process, and promptly flag concerns on drug supply for Atlanta's attention.
- RBEP encourages improved collaboration and transparency among stakeholders and advocates for strengthening national supply chain management to reduce drug supply delays and supply inaccuracies.

- Any adverse event associated with MDA must be reported to the Atlanta office within 24 hours.
- Programs should investigate and address reasons for persistent low treatment coverage where applicable.
- TCC field offices should conduct treatment coverage surveys in at least two districts in two subregions/states/zones annually, in consultation with Headquarters (HQ) and Ministries of Health (MOH).
- Include details on MDA activities among refugees, internally displaced persons, and migrants, as well as by gender, in annual reports and presentations.
- Seek to increase training, supervision, involvement of kinship groups, and gender balance among CDDs and CSs. In those areas where MDA has stopped, strong consideration should be given to developing other public health uses for this network in partnership with the Ministry of Health.
- TCC website should house key public domain documents from national onchocerciasis elimination committees of Ethiopia, Nigeria, Sudan, and Uganda.
- TCC/RBEP will maintain laboratories for Ov16 serology, entomology, and parasitology (including O-150 polymerase chain reaction [PCR] testing in vectors and skin snips), with technical support by Tom Unnasch's team at the University of South Florida (USF). In consultation with USF, field laboratories should send samples and/or requested data to USF for quality control purposes. Reagent and supply orders from these labs must be reviewed promptly by USF staff so that TCC HQ can purchase and ship supplies in a timely manner. TCC will continue to use the 'OEPA' Ov16 enzyme-linked immunosorbent assay (ELISA) and standard (qualitative) PCR for Ov16 and O-150 testing, respectively.
- In accordance with USF recommendation, maintain a pool size of 100 flies maximum per pool for O-150 PCR testing in the Americas context.
- Review and consider, internally and with NOECs, the frequent changes in WHO's recommendations, particularly as these relate to Onchocerciasis Elimination Mapping (OEM) 'phase 2' sampling in unmapped areas, thresholds for launching MDA, and new diagnostic and entomological approaches. The changing recommendations are causing considerable confusion for the programs and imply resource expenditures that TCC and donors are unlikely to support at this time. Given its expense, TCC RBEP will leave OEM second-stage random sampling mapping to FMOH, WHO/AFRO, GONE or other partners.
- Through national mechanisms, RBEP offices should monitor government financial contributions for elimination efforts in RBEP-assisted areas.
- RBEP program staff must complete or renew their Emory Institutional Review Board (IRB) certification if they are to be involved with work that is considered human subjects research. Coordinate with HQ staff regarding all IRB determinations and compliance.
- In fulfillment of the second pillar of the Global Programme to Eliminate LF, ensure that CDDs collect and report LF morbidity data in LF-endemic areas of Ethiopia, Nigeria, and Sudan as part of annual program reports.

2024 Treatments and Training Objectives:

UTG = Ultimate (annual) Treatment Goal
UTG2 = Twice-per-year Treatment Goal
UTG4 = Four-times-per-year Treatment Goal

	RB	LF	SCH	STH
Annual (UTG)	3,742,942	9,520,292	2,991,689	6,423,711
Biannual (UTG2)	41,157,536	-	-	4,689,533
Quarterly (UTG4)	9,756	-	-	-
Total	**44,910,234**	**9,520,292**	**2,991,689**	**11,113,244**

2024 Training Objectives	
CDDs	**390,604**
CSs	**147,044**
HWs	**18,433**
Teachers	**5,439**

THE AMERICAS

Presenters: Dr. Mauricio Sauerbrey and Silvia Sagastume (The Carter Center), Dr. Oscar Noya (consultant, South Focus Venezuela) and Mr. Heriberto Schuertz (Ministry of Health, Brazil).

Summary:

OEPA is a coalition led by TCC that includes the ministries of health of the affected countries in the Americas, the Pan American Health Organization (PAHO)/WHO, and other partners. The OEPA initiative has stopped treatments in 93 percent of the population once endemic for the onchocerciasis (Figure 15), and four countries have received WHO verification of elimination: Colombia (2013), Ecuador (2014), Mexico (2015), and Guatemala (2016). In 2017, PTS was completed in the Northeast Focus of Venezuela, once the third-largest transmission zone of the region in terms of population. The OEPA treatment history over two decades shows a scaling up of MDA treatments followed by a scaling down of treatments as elimination was achieved in an increasing number of areas (Figure 16).

The status of the original and current transmission zones of the Americas is shown in Figure 17. The last active transmission zone is in the Amazon rainforest bordering Brazil and Venezuela, called the 'Yanomami Focus Area' (YFA) after the indigenous people residing there (Figure 18). A population of 39,315 people living in 701 communities in 65 subareas are believed to be at risk of onchocerciasis in the YFA. Notable challenges include the remoteness of the YFA, its nomadic populations, the lack of high-level involvement of the governments of Brazil and Venezuela, and Venezuela's political, humanitarian, and health crises. Brazil and Venezuela have developed "scorecards" to help prioritize resources to communities with the most ground to cover to reach elimination. Scores are based on initial infection intensity, number of high coverage treatment rounds, recent assessment results, security, and several other indicators, some of which are unique to each country (Figure 19).

The annual IACO meeting was held in person (in hybrid format), preceded by a one-day Program Coordinating Committee (PCC) meeting November 7 – 9, 2023. A hybrid mid-year PCC meeting was also held July 19 – 20, 2023.

The OEPA program received financial support in 2023 from the United States Agency for International Development's (USAID) *Achieve Onchocerciasis Elimination in the Americas* and other donors.

Treatments:

In 2023, OEPA assisted Brazil and Venezuela with 51,278 Mectizan treatments, representing 76% of the 2023 treatment target of 67,708. Brazil achieved 65% of its goal, while Venezuela achieved 85% of its goal. Venezuela offered standalone semi-annual treatments and also resumed four times-per-year treatment in 67 priority communities. In Brazil, semi-annual Mectizan treatments were offered primarily alongside essential health services, as has been the case since the onset of the COVID-19 pandemic. In addition to resource prioritization for the pandemic, the program had challenges with fuel supply and available flight hours to visit many of its endemic communities, as well as insecurity due to illegal mining and conflict between communities. Figures 20 - 21 show detailed treatment information from 2023.

The 2024 treatment target for OEPA is 70,704 treatments and includes a four-times-per-year treatment approach in three priority sub-areas of Venezuela.

Training:

Some of the Yanomami people from endemic communities of both Brazil and Venezuela are trained to serve as Indigenous Health Agents (IHAs), who provide health services in the YFA. IHAs delivered 53% of treatments that occurred in Venezuela in 2023; there, 197 IHAs serve the program, and 24 (12%) of these are women. In Brazil, 146 Yanomami people assist with health efforts in the endemic area, and an estimated 95 (65%) of these assist with the onchocerciasis program, but the exact number and gender are not known. Both countries conducted training and retraining exercises for IHAs; in Brazil this was primarily done by MOH staff, while in Venezuela health staff conducted some training of IHAs directly and also continued work to train Yanomami Educators who in turn train Yanomami IHAs.

Special Topics:

Anthony Cirillo (MPH candidate, Emory University) presented OEPA team progress on an activity supported by a Carter Center Innovation Hub grant received by Alba Lucía Morales. The grant supported the provision of smart phones and tablets to health workers (HWs) in Venezuela to improve drug distribution and communication with the communities they serve. Field workers used the devices to facilitate community education and IHA training, document field work, and quickly access and update data. The study team interviewed the HWs before and after using tablets on treatment excursions, to learn the impact of the devices. Preliminary findings suggest that these devices are an effective tool for technicians to distribute health education in hard-to-reach communities in the YFA. Through video format, onchocerciasis health education was easily accessible for technicians and better transmitted to communities. Most communities accepted the video education format, and all technicians accepted the electronic device. Future health education initiatives should be participatory at every stage of development, especially concerning historically marginalized populations.

Country	2023 Treatment Targets	2023 Treatments (%)	2024 Treatment Targets
Brazil (UTG2)	31,300	20,291 (65%)	33,684
Venezuela (UTG2)	27,260	23,076 (85%)	27,264
Venezuela (UTG4)	9,148	7,911 (86%)	9,756
Total	**67,708**	**51,278**	**70,704**

THE AMERICAS RECOMMENDATIONS 2024

GENERAL:

- Deliver a minimum of two effective (≥85% coverage) rounds in all communities of the YFA, maintaining COVID-19 precautions as stipulated by the governments.
- Interrupt transmission and stop MDA in the YFA as soon as possible, followed by 3 – 5 years of PTS and pursuit of formal WHO verification.
- Continue work to increase involvement of IHAs, Yanomami Educators, and Yanomami women. The IHA experience in both countries should be published in a peer reviewed journal.
- Complete report on the Innovation Hub-funded project evaluating the impact of smart devices on health workers' performance in Venezuela, and prepare a publication on the results.
- Conduct epidemiological assessments (serology, entomology) in non-sentinel areas.
- Continue work to compile previous monitoring results (particularly time-stamped serology and entomology results) into subregion- or community-specific graphs and tables to better track progress over time.
- The community-level scoring system ("score card") has evolved into a strong tool that should be continually updated and refined. Seek a common scoring system that would allow a map of the YFA with community scores based on common data variables, such as effective (≥85%) treatment rounds, baseline endemicity, most recent assessment results, and prevailing vector species.
- Further develop the binational treatment registration of moving or migratory populations that reflects with more accuracy the movement patterns and possible ramifications of these movements with disease transmission.
- Hold two in-person PCC meetings: the standalone mid-year PCC meeting, as well as a PCC in tandem with the IACO meeting later in the year.
- Hold the IACO meeting in late 2024. Promote the highest level of political representation at IACO from PAHO, Venezuela and Brazil.

VENEZUELA:

- Continue four-times-per-year treatment in the 67 communities deemed highest priority due to low number of effective treatment rounds (<10).
- Seek increased involvement of Yanomami women as educators and IHAs who will take part in treatment activities. Track the number and gender of IHAs in each program and establish common indices to monitor their performance (such as IHAs per persons treated, IHAs per community, ancillary program benefits, etc.). Document the participation of each group and track the impact on program treatment coverage.
- Report any "new" communities that are unknown to the health system and have not yet had a site visit for skin snip assessments and OV16 serology. If the village is confirmed to be onchocerciasis endemic, quarterly Mectizan treatment should be started immediately.

BRAZIL:

- Conduct high-level advocacy meetings with Brazilian Ministry of Health and USG representatives in Brazil to further onchocerciasis elimination efforts there.
- Improve treatment coverage in 2024 with increased field supervision and advocacy.
- Continue work to compile historical community-level treatment data to assist in score card community prioritization.
- Complete the Ov-16 serology assessment in children aged 1-9 in all endemic communities and complete DBS processing within three months of having collected the samples.
- Complete the PCR analysis of 2022 – 2023 entomological collections and actively seek to complete processing of future fly collections within six months of having captured them. Follow USF's recommendation to limit the size of fly pools for PCR to maximum 100 fly heads per pool.

2024 Treatments and Training Objectives:

UTG2 = Twice-per-year Treatment Goal
UTG4 = Four-times-per-year Treatment Goal

Focus	Treatment approach	Communities	Population at risk	Population Eligible for Treatment	UTG(2)	UTG(4)
Brazil Amazonas Focus	semiannual treatment	273	20,574	16,842	33,684	-
Venezuela South Focus	semiannual treatment	360	15,917	13,632	27,264	
	quarterly treatment	68	2,824	2,439	-	9,756
	Total	**701**	**39,315**	**32,913**	**60,948**	**9,756**

ETHIOPIA

Presenters: Mr. Anley Haile, Mr. Aderajew Mohammed, Mr. Fetene Mihretu, and Mr. Yohannes Eshetu (The Carter Center)

Summary:

Since 2001, TCC has assisted the Ethiopian MOH in eliminating transmission of onchocerciasis in the country. Around 25 million people are at risk of the disease in at least 285 *woredas* (districts)—approximately one-quarter of the country (Figure 22). The RBEP currently supports activities in 162 woredas, around 57% of the nationwide burden, providing primarily twice-per-year treatments to aggressively reach the FMOH's goal of onchocerciasis elimination by 2030. RBEP first provided semi-annual treatment in 2013, supplemented with quarterly treatment in select areas since 2018. Ethiopia is home to the first cross-border focus to interrupt transmission of onchocerciasis—the Metema-Galabat focus in northwestern Ethiopia - eastern Sudan.

TCC has assisted the Ethiopian LF elimination program since 2009. Approximately 7.8 million people in at least 109 (~10%) woredas are at risk of LF nationwide (Figure 23). TCC supports 57 (53%) of these woredas, home to about 4.6 million people.

TCC's work in Ethiopia is based on a longstanding partnership with the FMOH and receives support from the Lions Clubs International Foundation, the Lions-Carter Center SightFirst Program, The Reaching the Last Mile Fund, housed within The END Fund, is a multi-donor fund, initiated and led by His Highness Sheikh Mohamed bin Zayed Al Nahyan, President of United Arab Emirates, and other donors.

Treatment:

In 2023, TCC assisted with the delivery of 26,229,551 Mectizan treatments for river blindness, representing 86% of the 2023 treatment target. This was a drop of about 1.5 million from the previous year, a portion of which was due to areas stopping MDA. The TCC-assisted LF program provided 1,482,593 annual treatments with Mectizan and albendazole representing 98% of the 2023 treatment target (Figures 24 and 25). More than 82,000 villages were reached. The program aims to deliver 32,979,429 semi-annual treatments for RB and 1,725,144 for LF in 2023 (Figure 24).

Training:

A total of 344,729 CDDs were trained in 2023, about 100,000 more than in 2022 and 90% of the annual goal. Additionally, 122,576 (69%) CSs and 12,302 (98%) health extension workers (HEWs) received training. The goals for 2024 are 344,964 CDDs, 139,719 CSs, and 11,670 HEWs. Most areas are successfully meeting target ratios of community-directed treatment with ivermectin (CDTI) volunteers per community.

Impact:

In 2023, 8 woredas encompassing 924,611 people in Oromia and Southwest Ethiopia (SWE) regions met WHO criteria to stop MDA for RB. This brings the total number of woredas in PTS to 29 (Figure 26) and the total number of people no longer treated to 2.9 million (Figure 7). In 2023, 9 woredas passed LF TAS-1 and can stop MDA, while 14 woredas successfully completed PTS TAS-2 and TAS-3 demonstrating that transmission remains interrupted in those areas (Figure 27).

Special Topics:

Mitiku Adugna (The Carter Center) presented results from PTS evaluations in the Metema sub- focus. PCR testing of black fly vectors from three distinct sites showed evidence of *O. volvulus* infectivity. This represents the first reported PTS failure in The Carter Center's supported programs. The program undertook a comprehensive evaluation of the area to determine if transmission has been reestablished, following WHO guidelines. This part of Ethiopia has seen significant migration due to conflict and for commercial agriculture. Serological results from children demonstrated that transmission has indeed restarted, but it is unclear if this is due to migration or whether MDA was stopped too soon.

The second special topic presenter attempted to address this question. Professor Warwick Grant of LaTrobe University in Australia shared the results of ongoing genomic studies in Ethiopia and beyond. By examining flies at the genetic level, Prof. Grant and his group – which includes Mr. Sindew Feleke of the Ethiopia Public Health Institute – demonstrated that there are two broad groups of flies in northwestern Ethiopia, but that there is some mixing of populations. This corroborated evidence presented in previous years by Prof. Rory Post of Liverpool John Moores University. Combined, these results mean that there may not be a clear delineation between the Metema focus and its neighbor to the south, the Metekel focus, where onchocerciasis transmission remains ongoing. Prof. Grant's group plans to examine additional flies and also look for genetic evidence from parasites.

Finally, Tewodros Seid (The Carter Center) gave a presentation about how the river blindness elimination program has approached operational transmission zones (OTZs) in Ethiopia. OTZs are used in proxy of true, biological transmission zones. While transmission zones are the ideal unit of implementation and evaluation, it may not be possible to validate their boundaries, especially over time and given limited resources. OTZs then become the practical way to handle epidemiological evaluations. Mr. Seid showed how implementation units could be grouped based on ecological and epidemiological factors. He also demonstrated how different decisions would affect different target populations.

River Blindness			
	2023 Treatment Targets	2023 Treatments (%)	2024 Treatment Targets
UTG2	30,414,003	26,229,551 (86%)	32,970,193
UTG4	-	-	-
Total	**30,414,003**	**26,229,551**	**32,970,193**

Lymphatic Filariasis			
	2023 Treatment Targets	2023 Treatments (%)	2024 Treatment Targets
UTG	2,306,884	1,482,593 (64%)	1,725,144

Training Objectives			
	2023 Training Targets	2023 Training (%)	2024 Training Targets
CDDs	233,496	344,729 (148%)	344,964
CSs	81,022	122,576 (151%)	139,719
HWs	9,639	12,302 (127%)	11,670

ETHIOPIA RECOMMENDATIONS 2024

GENERAL:

- Work toward a target ratio of at least 1 CDD:50 people, 1 CS:5 CDDs, and 1 CS per village nationwide.

ONCHOCERCIASIS

- Study results from PTS and stop MDA failure investigations to generate ideas for program improvements.
- Complete mapping in Ethiopia.
    - Do not undertake any second-stage random sampling mapping until further clarification (see General Recommendations) and input from all other partners. However, do consider integrated surveys or operational research to elucidate indeterminate results.
    - Continue to follow EOEEAC guidance for starting MDA that relies on a mean OV16 seroprevalence of ≥2% in adults across a *woreda*, in contrast to OTS guidance of ≥2% seroprevalence in any single village in the woreda, which considerably expands the number of districts requiring MDA.
    - Work with HQ to resolve issues among donors who are not willing to support district-level expansion under the EOEEAC guidelines.
- Provide financial and administrative support for the annual EOEEAC meeting.
- Review the current data from entomological investigations in East and West Hararghe, Oromia region, designed to characterize RB transmission. Consider whether the body of data we have collected is sufficient to publish the on the unexpected finding of RB in an area APOC deemed as ecologically unsuitable for onchocerciasis transmission. It was noted at the meeting that in Ethiopia some *S. damnosum* do not bite humans and so do not serve as vectors. In these cases, larval surveys may be positive but Human Landing Captures negative.
- Encourage EOEEAC to issue a press release following each meeting and the chair to brief the Minister of Health after each meeting.
- Follow up on cross-border meeting held after program review to promote coordinated activities (e.g., MDA) in cross-border areas of Beneshangul-Gumuz region and neighboring areas of Sudan (Blue Nile state) as the security situation allows. Invite Sudan representatives to EOEEAC meetings and seek invitation for Ethiopian staff to Sudan's new national RB/LF elimination committee meetings. Involve representatives from neighboring zones and implementing partners.
- Develop enhanced mobilization strategies for MDA in areas with consistently poor MDA coverage. Enhance interventions in areas failing impact assessments.
- Expand the number of entomologic surveillance sites in candidate stop MDA areas.
- Stop MDA and begin PTS in TCC-assisted areas that met stop-MDA criteria in 2023 and were approved by FMOH.
- Conduct stop MDA assessments in accordance with EOEEAC recommendations.

LYMPHATIC FILARIASIS

- Investigate MDA coverage, community perception, migration patterns, and long-lasting insecticidal bed net (LLIN) ownership in woredas that failed pre-TAS, especially in Gambella region. Use findings to develop recommendations to increase the impact of interventions on LF elimination.
- Propose investigations, focal MDA, or other responses to areas seeing consistent positives but still below the cutoff in TAS2 and TAS3 studies.
- In consultation with HQ and FMOH, conduct pre-TAS and TAS studies in eligible areas. Work with FMOH to coordinate the order and delivery of filarial test strip (FTS) test kits and positive control.
- Obtain DBS for OV16 testing during TAS-1 studies if the area is co-endemic with RB and a data gap exists.
- Await direction from FMOH (preferably after consultation with LF Regional Program Review Group [RPRG]) before conducting further LF remapping/reassessments.
- If the necessary funding can be secured, expand LF MDA to new zones in concert with RB support.
- Support the scale-up of MMDP services for LF.
    - Revise MDA household registers to collect information on LF morbidity.
    - Establish designated care facilities in endemic areas in line with WHO guidelines.
    - Train health care workers on MMDP.

NIGERIA

Presenters: Dr. Abel Eigege, Dr. Emmanuel Emukah, Dr. Cephas Ityonzughul, Dr. Adamu Sallau.

Summary:

Since 1996, TCC has assisted the Nigerian FMOH to eliminate onchocerciasis transmission in the country. In Nigeria, the RBEP is an integrated NTD program that also works towards LF elimination and control of SCH and STH. TCC assists nine (24%) of the 36 Nigerian states and Federal Capital Territory, comprised of 168 districts called local government areas (LGAs). After more than a decade of an onchocerciasis control approach, Nigeria launched a national onchocerciasis elimination policy in 2013, and the FMOH established the Nigeria Onchocerciasis Elimination Committee (NOEC) in 2015. Two hybrid NOEC meetings were held in 2023 (May 17 – 19 and December 6 – 8) with support from TCC; Figure 28 reflects the outcomes of each of the meetings with regard to state transmission status. No Carter Center-assisted states experienced a statewide change in status in 2023.

The Carter Center assisted RB treatments in 2023 in two southern states in Nigeria (Ebonyi and Edo), while the other seven stopped treatment in 2018 (Plateau and Nasarawa), 2021 (Delta) and 2023 (Abia, Anambra, Enugu, and Imo). Operational research conducted in 2023 revealed a potential reservoir of transmission in Enugu, resulting in resumed MDA in two of the state's districts. Figure 29 shows national RB progress since 2015.

The LF Program assisted treatments in 2023 in five states. For LF, the implementation unit (IU) is the LGA; 17 LGAs passed stop-MDA TAS-1 and stopped MDA in 2023, bringing the total that has done so to 106 (75%) of the original 141 LGAs under treatment in TCC-assisted areas. Five states have stopped treatment statewide due to all LGAs passing TAS, in 2013 (Plateau and Nasarawa), 2022 (Abia and Anambra) and 2023 (Delta). Figure 30 shows national progress since 2015.

All nine states still have active schistosomiasis and soil-transmitted helminth control programs, and the program has begun to transition to full government ownership when an RB and/or LF platform is no longer present. See Figures 31 – 32 for maps showing ongoing treatments by state for each of the four NTDs.

Plateau, Nasarawa, and Ebonyi states also work to strengthen the health care system to provide care for those suffering from chronic LF (lymphedema and hydrocele), which persists after LF transmission has been eliminated. Our objective is to meet or exceed WHO's required level of MMDP work that would support the states' claims to have 'eliminated LF as a public health problem.'

TCC's work in Nigeria is based on a longstanding partnership with the FMOH and receives support from USAID's Act to End NTD's | East project, led by RTI International; The Bill and Melinda Gates Foundation (BMGF); IZUMI Foundation; The Task Force for Global Health; Clarke Mosquito Control and the Clarke Cares Foundation; and other generous donors.

Treatments:

The program assisted 17,933,353 total treatments for RB (4,090,379), LF (6,073,191), SCH (2,216,914), and STH (5,473,048) in 2023, representing 62%, 77%, 65%, and 62% of the treatment targets, respectively. Figures 33 – 34 show annual treatments and targets by disease since 1996. Figure 35 shows RB annual and semiannual treatments versus targets since the program began semiannual treatments in 2016.

The primary reasons for low treatment were delays in receipt of drugs and insufficient provision of drugs, related to FMOH policy as well as inflated reverse supply chain reports that showed more existing inventory at the state and LGA level than was accurate. Drug delays have perennially affected treatment coverage in TCC- assisted areas in Nigeria, although treatments were, of course, also temporarily hindered by the COVID-19 pandemic, primarily in 2020 and 2021. Currently, the FMOH policy of allocating 80% medicine and only providing the final 20% when the first tranche has been exhausted has added a layer of reporting burden on states and LGAs that, combined with late arrival of the initial tranche of medicine, tends to render 85% or higher UTG coverage impossible. The TCC Nigeria office makes every effort to provide the FMOH with accurate drug inventory reports and drug orders for our assisted areas and to be available to support the drug supply chain process however possible. Drug availability is expected to become less of an issue as TCC-assisted areas rapidly advance toward transmission interruption and the halt of MDA, and The Carter Center is supporting a reverse supply chain exercise in Ebonyi and Edo states in 2024 to help strengthen reporting and thus improve accurate drug supply provision.

The 2024 targets for the four diseases total 27.6 million; this is roughly equal to targets of 2023, but each disease program has different changes to reflect. The RB target has increased as the NOEC recommended semiannual treatments in the two Enugu LGAs that demonstrated persisting signs of transmission despite the state meeting national criteria to stop treatment in 2022. The LF target has decreased due to successful TAS-1 in the past year, which allowed 17 LGAs to stop treatment. Finally, targets for SCH and STH both increased; these vary by year based on WHO guidelines that prescribe every-other-year treatment in areas of lower prevalence (see Annex 3 for more detail on these guidelines).

Training:

The Nigeria program trained 24,399 CDDs, 4,510 CSs, 2,311 HWs, and 4,872 teachers in 2023. Training targets in 2024 for CDDs, CSs, HWs and teachers are 31,187, 3,444, 6,447 and 5,439, respectively.

Impact:

Plateau and Nasarawa states in central Nigeria are in PES after stopping MDA for LF and RB in 2013 and 2018, respectively. Delta state stopped MDA for RB in 2021. Abia, Anambra, Enugu, and Imo did so in 2023, in response to 2022 assessment results endorsed by the NOEC. This brought the total to seven of nine Carter Center-assisted states that have met WHO criteria to stop Mectizan treatment for RB, protecting about 24 million people. Operational research conducted in 2023 revealed a potential reservoir of transmission in Enugu, resulting in resumed MDA in two of the state's districts, targeting about 340,000 people. Including those two districts, just 7 million remain under treatment in three RBEP-assisted states. Figure 29 shows national RB progress since 2015.

For LF, 3.7 million people in 17 LGAs in Anambra and Delta states passed TAS-1 and qualified to stop LF MDA in 2023. Of 13,596 children tested for LF antigen using FTS, only 6 children tested positive. Cumulatively, 26.2 million people in the nine TCC-assisted states of Nigeria no longer need MDA for LF (Figure 10). The country making considerable progress towards elimination (Figure 30).

Special Topics:

Dr. Emmanuel Emukah (The Carter Center) presented on 2023 RB impact surveys in Ebonyi and Edo states. Survey were conducted April – May, and 93 sites were visited in 27 LGAs of Edo and Ebonyi based on NOEC criteria, categorized as first-line or high-risk (within 5 km of a riverine black fly breeding site) or second-line (within 10 km of the river). Dry blood spots were obtained after assent/consent for children aged 5 – 9 years and tested via OV16 ELISA. Eighty-eight sites had been visited in 2019, and thus allowed for analysis of change over time. Results identified that, while OV16 positivity remains low in most areas, it exceeds the 1% threshold that indicates stop treatment, and there are some "hotspots" with higher OV16 prevalence, indicating the need for enhanced interventions in two LGAs in Edo, and three in Ebonyi. These five LGAs will thus move from annual to semiannual MDA. Results also confirmed the need for continued semi-annual MDA in six border LGAs with Ondo State.

Dr. Adamu Sallau (The Carter Center) presented the TCC operational research (OR) in Enugu that led to the resumption of treatment in two LGAs. Although Enugu state met the criteria in 2022 to stop treatment based on NOEC guidelines, and did so in 2023, a paper by Ekpo et al.[6] reported that 225 skin snips from 6 villages in 3 LGAs - Ezeagu, Nkanu East and Uzo-Uwani, collected Sept. 2020 - May 2021, showed microfilaria prevalence of 32% to 51%. The OR sought to verify these findings by returning to the same 6 villages and also 31 surrounding villages, sampling 1,539 adults for nodule palpation and skin snip, 1,434 children for OV16 serology, and 9,555 flies for pool screen O-150 PCR. This study found mf rates and intensities lower than those reported by Ekpo et al., and nodule rates similarly far lower. The mean OV16 rates in children were <1%, which under NOEC guidelines classifies this area as "transmission suspected interrupted." However, OV16 results in 2 LGAs are higher than the <0.1% required for stop-MDA (0.35% in 1434 children.) There was seemingly no evidence of persistent transmission in Ezeagu LGA, but reasons for concern in Nkanu East (0.39%) and Uzo-Uwani (0.42%). Entomology will be completed after 12 months of black fly collections; PCR testing will guide further action.

Dr. Cephas Ityonzughul (The Carter Center) presented the results of the TAS-1 conducted in 2023, discussed in the impact section above.

Dr. Abel Eigege presented LF MMDP work in Ebonyi, Nasarawa, and Plateau states, and related mental health work. In 2023, three new Hope Groups (support groups for persons with LF disease manifestations) were established in the Nasarawa and Plateau states, bringing the total to 37. Forty-eight health personnel were trained to lead existing and new Hope Groups, bringing total leader numbers to 237. There were 6 new Hope Group members in 2023, bringing total membership to 1,003. The program also supported 228 hydrocele surgeries in 2023 in Ebonyi, Nasarawa and Plateau, with 100 occurring in the new expansion state of Ebonyi state. Case search in Ebonyi identified 235 persons in 2023. Prior to establishing Hope Groups in Ebonyi, the program sought to quantify the baseline disability and mental health status of people living with LF in the state, to allow a measurement of changes in occurrence and severity of LF complications before and after participation in Hope Groups. Baseline findings reveal that the LF patients in Ebonyi State are highly stigmatized, socially isolated and experiencing common depressive symptoms. TCC's LF Program

[6] Ekpo UF, Eneanya OA, Nwankwo EN, Soneye IY, Weil GJ, Fischer PU, Nwaorgu OC. Persistence of onchocerciasis in villages in Enugu and Ogun states in Nigeria following many rounds of mass distribution of ivermectin. *BMC Infect Dis.* 2022 Nov 10;22(1):832.

is working with TCC's Mental Health Program to incorporate additional mental health treatment training for Hope Group leaders.

Dr. Emmanuel Emukah (The Carter Center) presented on SCH/STH status and strategy. The program is continuing to support a transition to full funding of SCH/STH by national programs in all areas where the RB or LF community-wide platform is being lost due to stop-MDA. Dr. Emukah shared Nigeria's timeline for mainstreaming LGAs by state, based on when LGAs are expected to lose both RB and LF platforms. Mainstreaming decisions vary by LGA and state; there are different platforms that may be appropriate in different areas to assume SCH/STH responsibilities. The strategy is to form transition committees in each state, help affected governments in planning and budgeting for SCH/STH, and to conduct a coverage survey before and after transition in 2 LGAs in each state.

Finally, Mr. Lungi Okoko (the Bill & Melinda Gates Foundation) and Ms. Sarah Andersson (JSI) presented on the new Nimble Supply Chain Technical Support Mechanism for NTD Programs Project. Okoko presented the background to the project including the ongoing challenges that led to the foundation prioritizing supply chain as an investment area for NTDs and the codesign process with pharmaceutical donation partners, WHO and USAID. Andersson presented the goals and objectives of the 5-year project (November 2023 to October 2028) that will provide technical support at global/regional level and in eight focus countries, including Nigeria, Democratic Republic of Congo, Ethiopia, Kenya, Uganda, Tanzania, Mozambique and Madagascar. At the global level the project aims to optimize allocation of donated PC medicines for the four targeted NTDs – onchocerciasis, lymphatic filariasis, soil transmitted helminths, schistosomiasis – through improved data visibility for medicine donors and funders. At the country level, the project aims to strengthen NTD supply chains by improving logistics data quality and use, using long term forecasting and inventory management, and integrating NTD supplies into national health supply chains where feasible.

River Blindness			
	2023 Treatment Targets	2023 Treatments (%)	2024 Treatment Targets
UTG	4,377,744	3,176,346 (73%)	3,742,942
UTG2	2,249,319	914,033 (41%)	6,449,294
Total	**6,627,063**	**4,090,379**	**10,192,236**

Lymphatic Filariasis			
	2023 Treatment Targets	2023 Treatments (%)	2024 Treatment Targets
UTG	7,905,059	6,073,191 (77%)	3,331,210
Total	**7,905,059**	**6,073,191**	**3,331,210**

Schistosomiasis			
	2023 Treatment Targets	2023 Treatments (%)	2024 Treatment Targets
UTG	3,559,892	2,296,735 (65%)	2,991,689
Total	**3,559,892**	**2,296,735**	**2,991,689**

Soil-Transmitted Helminths			
	2023 Treatment Targets	2023 Treatments (%)	2024 Treatment Targets
UTG	6,642,946	4,264,329 (68%)	6,423,711
UTG2	2,118,811	972,331 (46%)	4,689,533
Total	**8,761,757**	**2,296,735**	**11,113,244**

Training Objectives			
	2023 Training Targets	2023 Training (%)	2024 Training Targets
CDDs	25,065	24,399 (97%)	31,187
CSs	4,281	4,510 (105%)	3,444
HWs	6,191	2,311 (37%)	6,447
Teachers	7,479	4,872 (65%)	5,439

NIGERIA RECOMMENDATIONS 2024

GENERAL:

- Conduct a reverse supply chain exercise in Edo and Ebonyi states to strengthen the process of reporting and determine areas for improvement.
- Attend the drug application package preparation meeting held with partners by the FMOH, and work with the different levels of government to effectively track drug supply, including reverse supply logistics.
- Maintain strong focus on communication and security awareness with State MOH, local officials, and community leaders before commencement of community-based activities. Continue "hit and run" treatment strategy in communities with insecurity.
- Conduct coverage surveys in six LGAs in three states using FMOH protocol and use results to better understand missed and/or excluded populations, improve MDA implementation, and make programmatic decisions.
- Where MDA continues, target at least 1 CDD:250 people, 1 CS:5 CDDs and 1 CS per village. Track urban populations served by health workers separately.
- Complete the analysis of the pilot CDD attrition study (based on Kaplan-Meier survival methodology), which was delayed due to the COVID-19 pandemic. Review final analysis with HQ and then make plans to expand the study by establishing the number of CDDs that will be studied (with good gender representation). Explore the relationship of increasingly complicated registers and roll-up forms to CDD attrition rates, perhaps using focus groups of CDDs and their supervisors.
- Look for opportunities to transition from paper to electronic data reporting to ease work of HWs, CDDs, and others involved with report submission.
- Conduct study on potential new health system roles for CDDs in Plateau and Nasarawa States. Consider CDD visibility study in Delta and Anambra States.
- Conduct central-level and local-level cross-border meetings in Abia, Anambra, Ebonyi, Edo, Enugu, Nasarawa, and Plateau to synchronize activities on both sides of the border, maximize MDA impact where applicable, and ensure that any recrudescence is detected.
- Advocate for governments to utilize CDDs for other health activities, as the majority of RB states and LF LGAs have reached stop-MDA criteria.
- Continue to monitor, register and treat all migrant farmers and traders, and identify CDDs from among the migrant groups to better reach them.

ONCHOCERCIASIS:

- Prioritize reaching good MDA coverage in Ebonyi and Edo States, and newly-discovered "hot spots" in Enugu State (especially in border LGAs) to advance progress towards RB transmission elimination.
- Support a meeting of the Nigeria Onchocerciasis Elimination Committee (NOEC) in December and attend the NOEC in May (supported by USAID Act | East, led by RTI).
    - Continue work to identify residual hot spots where transmission may be limited to a

specific area.

  - Encourage the NOEC to expand sub-state (e.g. LGA-level) classification as has been done in Enugu, which is treating twice-per-year in the newly identified areas with OV-16 or PCR positives. Begin to show this on the NOEC map.

- Launch PES in Plateau and Nasarawa States. Continue PTS in Abia and Anambra, launch PTS in Delta now that all LF-endemic districts in the states have passed TAS1 and LF MDA is halted statewide. Commence PTS in Imo if ongoing TAS1 there are completed and all LGAs pass. Communicate program changes to CDDs and populations no longer being treated, and train CDDs to educate communities on these changes.
- Work with the BMGF to support the development of their entomological model for improving black fly collections. Advocate for this model to predict vector densities as well as vector presence. Use the model to assess potential hot spots in areas where MDA has halted.
- Provide lab support to non-TCC states as funding and lab priorities allow. Priority should be given to TCC samples or assessments conducted in states neighboring TCC-assisted states.

LYMPHATIC FILARIASIS/MALARIA:

- The 34 eligible LGAs in SE/SS should conduct TAS-1 as soon as possible. Where TAS-1 and RB surveys indicate all community-based MDA can cease, conduct health education to prepare the populations for MDA halt, and advise the state MOH that TCC support for SCH and STH will cease (see below).
- Prioritize Ebonyi State, particularly LGAs that failed pre-TAS in the past, for Clarke LLIN donations and work with State malaria programs to ensure usage and care for the nets.
- The program in Plateau and Nasarawa should ensure that WHO requirements for MMDP are met. With IZUMI support and in close consultation with TCC/Atlanta, continue MMDP activities in Ebonyi, Nasarawa and Plateau States including 1) burden assessment, 2) strengthening of primary care support for patients with lymphedema/elephantiasis/acute attacks and hydrocele, 3) increasing the number of and participation in Hope Clubs, and 4) hydrocele surgical camps that include referral systems for more severe cases to specialized centers. Continue and expand LF burden assessment in all TCC-supported states alongside MDA or post-MDA health education and increase items 2 – 4 as funding allows.

SCHISTOSOMIASIS (SCH) AND SOIL TRANSMITTED HELMINTHIASIS (STH):

- In LF-only LGAs where TAS1 shows MDA may stop and STH surveys show that MDA for school age children should continue for STH, conduct an all-age group stool survey for STH prevalence as a “baseline” measurement before the halt community-wide Mectizan-albendazole MDA. Plan to repeat the survey in 3 years to document changes in (especially hookworm) prevalence in adults post LF MDA. The hypothesis is that all age groups (but especially adults) will show STH levels have increased.
- Where the RB or LF community-wide platform is being lost due to stop-MDA determinations, the SCH/STH programs should be mainstreamed into a school-based or otherwise appropriately-platformed program fully supported by national/state funds.

SUDAN

Presenter: Dr. Sara Lavinia Brair (The Carter Center)

Summary:

Since 1997, TCC has assisted the Sudanese FMOH in eliminating onchocerciasis transmission in the country. In 2006, Sudan was the first African country to declare a national onchocerciasis elimination policy. There are four transmission foci (Figures 36 and 37): Abu Hamad (River Nile State), Galabat (Gedaref State), Khor Yabus (Blue Nile State), and Radom (South Darfur State). Transmission elimination was declared in Abu Hamad (2015) under WHO elimination guidelines—the first African focus to do so. The FMOH officially declared transmission elimination in the Galabat focus in February 2023 after reviewing results of PTS surveys that were completed in 2022.

Sudan is also endemic for LF, and the FMOH has targeted eliminating it as a public health problem since 2012. In 2016, mapping studies showed that LF is endemic in 65 (34%) of the country's 189 localities in 14 of its 18 states. Approximately 11 million Sudanese are at risk for LF. Our work in Sudan reflects partnerships with the Federal Ministry of Health and the United Arab Emirates' Reaching the Last Mile Fund, hosted by the END Fund. The Reaching the Last Mile Fund, housed within The END Fund, is a multi-donor fund, initiated and led by His Highness Sheikh Mohamed bin Zayed Al Nahyan, President of United Arab Emirates

In April 2023, armed conflict erupted in Khartoum, Sudan's capital, disrupting MDA activities. This conflict persisted throughout 2023, resulting in the suspension or significant reduction of all planned activities.

Treatments:

In 2023, the Sudan RB/LF program assisted with distributing 1,696,392 annual LF treatments in the South Darfur State (Figure 38), representing 19% of the treatment target. These were the only treatments distributed before the conflict erupted in Khartoum. As of 2023, 54 of the 65 LF-endemic districts (83.1%) have received at least one round of MDA (Figure 39). The 2024 treatment targets are provided in the data tables below. Due to the ongoing conflict, MDA activities are not feasible in certain states.

Training:

In 2023, the Sudan program trained 1,514 volunteers (1,330 CDDs, 148 CSs, and 36 HWs) for the LF program. 2024 training goals for RB and LF are in the data table below.

River Blindness Sudan			
	2023 Treatment Targets	2023 Treatments (%)	2024 Treatment Targets
UTG2	3,113,540	0	0
Total	**3,113,540**	**0**	**0**

Training Objectives Sudan RB			
	2023 Training Targets	2023 Training (%)	2024 Training Targets
CDDs	28,063	0	0
CSs	8,916	0	0
HWs	148	0	0

Lymphatic Filariasis Sudan			
	2023 Treatment Targets	2023 Treatments (%)	2024 Treatment Targets
UTG	8,771,264	1,696,392 (19%)	4,069,283

Training Objectives Sudan LF			
	2023 Training Targets	2023 Training (%)	2024 Training Targets
CDDs	9,380	1,330 (14%)	3,512
CSs	938	148 (16%)	289
HWs	180	36 (20%)	253

SUDAN RECOMMENDATIONS 2024

GENERAL:

- Work toward a target ratio of at least 1 CDD:100 people, 1 CS:5 CDDs, and 1 CS per village.
- Coordinate with the Republic of South Sudan (RSS), Ethiopia, and the Central African Republic (CAR) for cross-border issues. Resume cross-border managers meetings.
- Intensify sensitization and health education in parallel with MDA campaigns.
- Establish the National RB/LF Elimination Committee

ONCHOCERCIASIS

- Conduct entomological surveys in the Merowe Dam's spillway as a part of PES in the Abu Hamad focus.
- Develop a PES plan for Galabat.
- Evaluate the onchocerciasis transmission status in the Blue Nile State (Khor Yabous).
- Sudan FMOH and TCC encourage the Ethiopian MOH to conduct surveys in Assosa and Kamashi along the Sudanese border to determine current transmission.
- Publish a peer-reviewed article on the Galabat focus elimination.
- Develop RB National Guidelines with Sudan FMOH.

LYMPHATIC FILARIASIS

- Develop LF National Guidelines and conduct training with SMOH and FMOH staff.
- Complete Arabic translation of the WHO LF MMDP aide-mémoire Annexes B and 1-8.
- Collect lymphedema and hydrocele case counts and health facility capacity information during MDA activities.
- Continue LF MMDP situational assessments in six States.
- Training of MMDP FMOH staff.

UGANDA

Presenters: Dr. Edridah Muheki (The Carter Center-Uganda) and David Oguttu (Ministry of Health)

Summary:

Since 1996, TCC has assisted the Ugandan MOH in eliminating the transmission of onchocerciasis in the country. In 2007, Uganda declared a goal of RB transmission elimination in all 17 transmission foci nationwide, including the Victoria Nile focus, which achieved elimination in the early 1970s.

The Carter Center's work in Uganda is based on a longstanding partnership with the MOH and receives support from USAID's Act to End NTDs | East, led by RTI International, The ELMA Foundation, and other generous donors.

Treatments:

In 2023, TCC assisted with distributing 3,322,880 treatments (including passive and refugee treatments), reaching 94% of the treatment target of 3,535,616 (Figure 40). There were 201,870 passive treatments and 199,379 refugees from the RSS that received treatments. Refer to the 2024 treatment targets in the data tables below.

Vector control based on the "slash and clear" (S&C) method was conducted semi-annually in the Amuru district (3 sub-counties), Kitgum district (2 sub-counties), and Nwoya district (4 sub-counties) of the Madi Mid-North focus. The S&C approach relies on community-directed clearing of river vegetation at one to two kilometers up and downriver from affected communities. This approach works well when the river is narrow and shallow to avoid risk to the community members.

Training:

The Uganda program trained 31,122 Community-Directed Intervention workers in 2023. 22,163 CDDs (46% female), 8,959 CSs (31% female), and 146 HWs received training. In 2023, the current ratio of CDDs to the population served was 1 CDD to 82 persons. The ratio of CDDs per CS was 2:1, below the minimum requirement of 4 CDDs: 1 CS. An assessment is being conducted to identify the reasons for the decline in the number of CDDs participating in MDA activities. Refer to the data tables below for the 2024 training targets.

Impact:

In 2023, the Nyagak-Bondo focus completed post-treatment surveillance and was reclassified as transmission eliminated, bringing the total number of transmission eliminated foci to 15, covering approximately 6.1 million people. The large Madi Mid-North (MMN) focus (cross-border with South Sudan) was divided into Upper MMN (five districts) and Lower MMN (seven districts). The Lower MMN, with a population of 1,121,520, was reclassified as transmission interrupted, marking the largest population to stop treatments in any onchocerciasis endemic focus in Uganda (Figure 41). The Upper MMN five districts and the Lhubiriha foci remain under twice-per-year treatment with Mectizan, and both share cross-border transmission with the RSS and the Democratic Republic of Congo (DRC), respectively (Figure 42).

River Blindness Treatments Uganda			
	2023 Treatment Targets	2023 Treatments (%)	2024 Treatment Targets
UTG2	3,535,616	3,322,880 (94%)	1,677,101
Total	**3,535,616**	**3,322,880 (94%)**	**1,677,101**

Training Objectives Uganda			
	2023 Training Targets	2023 Trainings (%)	2024 Training Targets
CDDs	28,063	22,163 (79%)	10,941
CSs	8,916	8,959 (100%)	3,592
HWs	148	146 (97%)	63

UGANDA RECOMMENDATIONS 2024

GENERAL:

- In areas with active CDDs, work toward a target ratio of at least 1 CDD:74 people in all districts and 1 CS:4 CDDs.
- Provide financial and administrative support for the 2024 Ugandan Onchocerciasis Elimination Expert Advisory Committee (UOEEAC) meeting.
- Develop strategic approaches for post-elimination surveillance, which will be conducted after confirming elimination through post-treatment surveillance in a specific focus.
- Develop strategic approaches for post-verification surveillance following country-wide verification by the World Health Organization.
- Invite representatives from the Republic of South Sudan (RSS) and the Democratic Republic of Congo (DRC) to the UOEEAC meeting and seek an invitation for the FMOH to attend RSS and DRC national RB elimination committee meetings.
- Conduct a study to identify the reasons for low participation in CDDs during MDA.
- Provide laboratory support to Sudan.

MADI-MID NORTH (MMN) AND LHUBIRIHA

- Conduct a serological evaluation among nodding syndrome cases in MMN per UOEEAC recommendation.
- Conduct a serological evaluation in the Lhubiriha focus, currently classified as "transmission interrupted."
- Coordinate with RSS and DRC MOH programs in cross-border special intervention zones (SIZs).
    - Harmonize MDA campaigns on both sides of the SIZ to ensure staggered campaigns by each country do not miss mobile populations.
    - Advocate for semi-annual MDA in RSS and DRC cross-border areas.
    - Provide technical assistance for entomological surveillance in Magwi County, cross-border areas of MMN.
    - If the situation allows, collaborate with the MOH and DRC to conduct entomological and serological surveys on Mutwanga cross-border areas of Lhubiriha.
- Advocate districts to sustain community-directed Slash & Clear activities for *Simulium damnosum* vector control in the Upper and Lower MMN foci.

ANNEX 1: River Blindness Elimination Program

Human onchocerciasis, an infection caused by the parasitic worm *Onchocerca volvulus*, causes eye lesions that can progress to visual loss or complete blindness. In addition to severe eye disease, onchocerciasis causes papular or hypopigmented skin lesions and intense itching. The parasite is transmitted by certain species of *Simulium* black flies, with the most common vector being *Simulium damnosum sensu lato (s.l.)*. *Simulium* species black flies breed in rapidly flowing rivers and streams, thus leading to the common name for the disease, "river blindness."

In humans, the adult worms cluster in subcutaneous fibrous onchocercomas (commonly referred to as 'nodules') that are often visible and palpable. In these nodules, fertilized females release first-stage larvae (microfilariae [mf]) that migrate into the sub-dermis and eye, causing immune reactions that result in the major morbidities associated with the infection. Some mf are picked up when the vector flies take a blood meal. In the flies, the mf eventually develops into the third stage larvae (L3) infectious to humans on subsequent blood meals. In humans, the larvae develop into adult worms, continuing the life cycle. There are no known environmental or epidemiologically important animal reservoirs of *O. volvulus*.

The World Health Organization (WHO) estimated in 2023 that at least 246 million people in 29 countries required preventive chemotherapy against onchocerciasis, and in 2017 estimated that 1.15 million had vision loss. More than 99% of those at risk live in sub-Saharan Africa, with a small fraction in Brazil, Venezuela and Yemen. Globally, 19.5 million people live in areas that no longer require onchocerciasis MDA. Periodic mass drug administration (MDA) with oral Mectizan tablets prevents eye and skin disease caused by *O. volvulus*. Mectizan may also be used to reduce or interrupt disease transmission depending on the duration and frequency of treatment, the efficiency of the vector, the extent of the infected population, the vector, and MDA distribution programs. A WHO update on the global onchocerciasis initiative was provided in the Weekly Epidemiological *Record* on November 10, 2023 (WER No 45, 2023, 98, 572–582).

The Carter Center (TCC) River Blindness Elimination Program (RBEP) is dedicated to safe and sustainable mass distribution of Mectizan (together with health education) to eliminate onchocerciasis transmission. The distinction between control (of disease) and TCC's approach to elimination (of transmission) is important. In the control approach, Mectizan is distributed only once per year in areas where the eye and skin disease from the infection is greatest (the so-called "meso/hyperendemic" areas where nodule rates are ≥20%). In control programs, MDA will likely need to continue indefinitely because onchocerciasis transmission persists, and people continue to get new infections ('open system'); sustainability of control programs and indefinite effectiveness of the drug are vital in this scenario. In the elimination approach, Mectizan treatment is used more intensively to 'close the system' to break transmission eventually. Treatment is given twice per year and is included in areas where nodule rates are <20% (hypoendemic areas). When the residual parasites in the human population are compromised to be unable to recover their reproductive capacity, MDA can be stopped because there is no animal or environmental reservoir of infection. Before 2013, the elimination of onchocerciasis was the program goal in the Americas, Uganda, and Sudan, but not in Nigeria and Ethiopia. By 2013, national onchocerciasis transmission elimination had become the stated goal of all the governments where RBEP assists. At that time, RBEP set a new goal to stop transmission in all its assisted areas.

In some TCC-assisted areas in Nigeria, a historical barrier to treatment has been the coendemicity of the parasitic worm *Loa loa*. Mectizan treatment in a person with high *Loa loa* parasite loads (>20,000 *Loa loa* microfilaria per ml of blood) can result in severe central nervous system adverse reactions, with complications that can lead to coma or death. In partnership with Nigeria's federal and local governments, TCC conducted an extensive survey in Nigeria in 2016 using a recently developed technology called the "LoaScope." It determined that microfilaria levels of *Loa loa* were not sufficient in our supported areas to preclude treatment (of over 10,000 persons examined with the LoaScope, the highest count observed was under 12,000 mf per ml blood). Our results (published in 2018 by Emukah et al. in *AJTMH*) were reviewed by the Mectizan Expert Committee and the Federal Ministry of Health of Nigeria. Both gave their permission to use Mectizan MDA treatment in *Loa loa* areas in Nigeria that are Mectizan-naïve and hypoendemic for onchocerciasis.

A major focus of TCC is reaching the best possible treatment coverage, monitored through routine monthly reports by assisted programs, periodic coverage surveys, and impact on RB transmission indicators. A discussion of this reporting process and treatment indices used by the program and in this report is below. Important coverage terms include: the Ultimate Treatment Goal (UTG), which is the census-based calculation of treatment-eligible people living in a program area (persons >5 years of age); UTG(2), and UTG(4), which is the multiplication of the UTG by two or by four, respectively, and used by elimination programs in areas where semi-annual or quarterly treatments are required to break transmission; and full coverage, which is defined as >90% achievement of the UTG, UTG(2), or UTG(4) (85% for OEPA). It is important not to confuse coverage reported in this Program Review with coverage calculated based on the Total Population (often called "therapeutic coverage" or "epidemiologic coverage") that includes children. The difference in the denominators between these two calculations can amount to 10-20%.

Mectizan tablets are distributed in Africa at the community level by grassroots community volunteers known as Community Directed Distributors (CDDs) through a process known as Community Directed Treatment with Ivermectin (CDTI). CDTI was perfected by the Tropical Disease Research Program of WHO and was broadly introduced into the African Programme for Onchocerciasis Control's (APOC) supported project areas throughout Africa in the late 1990s. In some areas, TCC's RBEP focuses on "kinship/family/neighborhood-enhanced CDTI," an approach that seeks to train more CDDs than is done in classic CDTI and which TCC developed and pioneered in Uganda. In kinship-enhanced CDTI, CDDs serve within their kinships/family or neighborhoods, and decisions and treatment activities are provided at the sub-community level. A similar approach is used in Ethiopia, where the Health Development Army (HDA) system is based in communities' Health Development Units, with five households/families of about 30 people served by at least one CDD from the HDA. Historically, the ratio of CDDs per population that our programs have pursued has been at least 1 CDD per 100 persons to be treated. Using its Health Development Army, Ethiopia has moved towards supporting a ratio of 1 CDD: 50 people. Uganda is steadily increasing its concentration of CDDs with an ultimate goal of 1 CDD: 74 people.

CDDs are supervised by Community Supervisors (CSs). These are often district-level health personnel or they may be more senior CDDs. This grouping may be managed by frontline HWs, similar to Ethiopia, where distributors and supervisors are organized health extension workers (HEWs). The desired ratio is 1 CS:5 CDDs.

Our MDA strategy seeks to increase the active participation of members of affected communities by 1) training as many inhabitants of endemic villages as possible to serve as distributors; 2)

encouraging the involvement of women; 3) reducing the demand for financial or other "incentives"; 4) allowing community members to choose their distributors and the time and location of treatments.

Monitoring indices of the kinship approach include 1) community selection of CDDs in every kinship/neighborhood zone in the community; 2) sustained treatment coverage of at least 90% of treatment-eligible persons; 3) increasing involvement of women as CDDs, and 4) the presence of at least two community-selected supervisors in every community.

The CDDs and CSs are often highly engaged in other community-based health interventions, such as water provision and sanitation, malaria control, immunization, and integrated NTD control efforts.

River Blindness Elimination Program Reporting Processes

Treatment areas: An epidemiological mapping exercise is a prerequisite to identifying at-risk communities for mass Mectizan treatment programs. The assessment techniques used in the mapping exercise in Africa varies from those used in the Americas. An overview of the two approaches follows.

In much of Africa, a staged village sampling scheme called Rapid Epidemiological Mapping of Onchocerciasis (REMO) was executed with assistance from WHO to define endemic "zones" that should capture most or all villages having onchocercal nodule rates ≥ 20% in adults (which roughly corresponds to a prevalence of microfilariae (mf) in skin ≥ 40%) for mass treatment. The mapping strategy is based on studies that have shown that most ocular and dermal morbidity from onchocerciasis occurs in villages where the nodule prevalence exceeds 20%.

In the first stage of REMO, survey villages are selected based on a review of large-scale maps of areas that appear to be environmentally able to support black fly breeding and, therefore, transmission of O. volvulus. In the second stage, villages located closest to what appears on maps to be rapidly flowing rivers (rivers near compressed contour lines on topographical maps) are called 'first line villages' and are priority for visits by field teams. In the first line villages, a convenience sample of 30-50 adults are examined for characteristic onchocercal nodules. The mean nodule prevalence for each village sample is then mapped in geographic information systems (GIS), which is used to define endemic zones where all villages are to be treated by CDTI. As noted, CDTI treatment zones typically are defined to include all sample villages having nodule prevalence of ≥20%.

All villages within the CDTI treatment zone are offered mass Mectizan treatment annually. The approach of REMO excludes those endemic villages from CDTI where nodule rates are under 20% (the so-called "hypoendemic areas"). Here it is important to note again that not all persons infected with onchocerciasis (as defined by their having mf in their skin) have nodules. On average, nodule prevalence is 50% of mf prevalence, although this varies by geographical location. Villages in hypoendemic areas with nodule rates of <20% could still have 30% mf prevalence of onchocerciasis as determined by superficial skin biopsies ('skin snips') to identify *O. volvulus* mf by microscopic examination.

As the policy in Africa is now elimination, the role of hypoendemic areas in *O. volvulus* transmission is being critically re-examined. Any Mectizan-naïve areas are being reassessed based on new mapping guidelines set by that country's national onchocerciasis elimination committee, typically

using OV16 serology. The WHO Onchocerciasis Technical Subcommittee (OTS) has suggested that OV16 testing be conducted in samples of adult residents with a proposed serological threshold of 2% for launching mass drug administration, though exact procedures for onchocerciasis elimination mapping (OEM) are being refined.

In the Americas, the goal from early on has been to eliminate *O. volvulus* transmission. As a result, all endemic villages are offered mass Mectizan treatment activities every three or six months. The Onchocerciasis Elimination Program for the Americas (OEPA) casts a much broader net for mass treatment, and the African concept of excluding hypoendemic villages has never been accepted. For the Americas, where the endemic foci are characteristically smaller and more defined than in Africa, every village in known or suspected endemic areas has a rapid epidemiological assessment of 50 adults, who have both nodule examinations and skin snip microscopy to identify *O. volvulus* microfilaria in skin. Villages in which one or more persons are positive (sample prevalence ≥2%) are considered "at risk" and are recommended for the twice per year (or four times per year) mass drug administration (MDA) program. Thus, the cutoff prevalence for treatment was much lower for the Americas compared to the original threshold in Africa—until elimination of transmission of onchocerciasis in Africa became the focus.

Data Reporting: TCC country program offices report monthly to TCC headquarters in Atlanta. These reports include: 1) number of at-risk communities and persons treated during the previous month (treatment reports are updated quarterly for the Americas); 2) the status of the Mectizan tablet supply; 3) training and health education activities; 4) epidemiological assessment, research, and program monitoring activities; and 5) administrative issues. Standardized tables and graphs are used across programs. The reported treatment data are recorded by hand in village-level registers during census and directly observed treatment activities by community drug distributors (CDDs) or national Ministry of Health (MOH) personnel. It is important to emphasize that these are MOH programs and MOH data.

The accuracy of these reports is routinely confirmed with random spot checks performed primarily by TCC and MOH personnel, supplemented by treatment coverage surveys, which are based on statistical sampling methods with household questionnaires administered by TCC and MOH staff. Recently, these data have been collected on smart phones or tablets so that results can be rapidly compiled.

Summary reports of numbers of villages and persons treated are compiled from the village registers by the CDDs and their CSs, then forwarded to the district level. District-level summary reports are forwarded (whenever possible through MOH surveillance and reporting channels) to both the state MOH headquarters and the national TCC offices, which forward the data monthly to RBEP in Atlanta. In the Americas, the MOHs of Venezuela and Brazil report their treatments semiannually or quarterly to the OEPA office in Guatemala City, which then provides a combined regional report to TCC and to the Program Coordination Committee (PCC), InterAmerican Conference on Onchocerciasis (IACO) and the Pan American Health Organization (PAHO)/WHO in its regular meetings; OEPA updates are provided annually in WHO's WER articles (See Annex 5 for references to these publications). African MOHs report their annual results directly to WHO, which produces annual summaries of African programs' onchocerciasis treatments.

The data from monthly reports are supplemented with additional information at the annual TCC RBEP Review held during the first quarter of the following year. At these reviews, TCC program

directors and partners convene to finalize treatment figures for the previous year, establish new treatment objectives for the coming year, and discuss results from monitoring and research initiatives. TCC reports its final treatment figures to the Mectizan Donation Program (MDP), Merck & Co, Inc. (known as MSD outside the United States of America and Canada), and the non-governmental development organization (NGDO) Onchocerciasis Coordination Group.

RBEP Treatment Indices: Treatments are reported as number of persons and number of communities treated for the month by district, focus, region, state, or zone, depending on the MOH's administrative structure of the country program. Cumulative treatment figures for the year are compared to UTGs, i.e., the eligible at-risk population that is targeted for MDA. Treatment coverage is calculated with treatments as the numerator and UTG as the denominator. UTG figures assume full geographic coverage of the targeted area, and typically increase by about five percent annually to account for normal population growth.

The eligible populations of at-risk communities targeted for mass distribution receive community-wide Mectizan treatment. The eligible at-risk population includes all persons living in at-risk communities who are eligible to receive Mectizan (i.e., those who are either ≥5 years of age, ≥15 kg in weight, or ≥90 cm in height, and who are in good health). Although RBEP mass treatment activities exclude pregnant women, these women should be treated later during the treatment year, as soon as one week or more after parturition; therefore, all adult women are included in the UTG calculation. In practice, the UTG should be established by census, adjusting from the most recent treatment rounds. The UTG is expected to be the same figure used in the annual request for tablets submitted to the Mectizan Donation Program. RBEP differs from the usual WHO approach which uses total population as their treatment denominator; therefore, for standardization requirements RBEP also routinely reports both coverage of eligible population (UTG) and coverage of total population ("therapeutic coverage") in its tables to satisfy those programs' needs. The rationale for RBEP's focus on the UTG denominator has been published (Richards et al., *AJTMH* 2001; 65:108-14). In general, total population coverage is 16-20% less than UTG (eligible) population coverage, in accord with population pyramids in areas being served, where up to 20% of the population is under 5 years of age and thus ineligible for Mectizan treatment.

The UTG(2) and UTG(4) denominators are used by elimination programs where six-monthly ('semiannual') or quarterly treatments are delivered, respectively. The values are twice or four times the UTG and represent treatments targeted for the year, not persons. Full coverage in once-per-year treatment areas is defined as 90% achievement of the UTG. Full coverage for elimination programs is 90% of the UTG(2) in African projects, and 85% of the UTG(2) or UTG(4) for OEPA. The differences in full coverage thresholds result from varying recommendations by the African and American expert committees.

In post-treatment scenarios, passive treatments with Mectizan are provided when patients present themselves in clinics within towns of endemic districts, or where large sections of the population are highly mobile and are often from non-endemic areas.

ANNEX 2: Lymphatic Filariasis Elimination Program

LF in Africa is caused by *Wuchereria bancrofti*, a filarial worm that is transmitted in rural and urban areas by *Anopheline* and *Culex* sp. mosquitoes, respectively. The adult worms live in the lymphatic vessels and cause vessel dysfunction, often leading to poor drainage of lymphatic fluid. Clinical consequences include a collection of lymph (lymphatic fluid) that results in swelling of limbs and genital organs (lymphoedema, "elephantiasis" and hydrocele), and painful recurrent bacterial infections (“attacks” of acute adenolymphangitis). The female worms release mf, which are tiny embryonic worms that circulate in blood at night when the mosquito vectors bite. Mosquitoes pick up Mf, develop over several days into infective larvae, and are then able to be transmitted to another person when the mosquitoes bite again. Mf are killed by annual single-dose combination therapy, with either Mectizan and albendazole or diethylcarbamazine and albendazole (in areas where there is no onchocerciasis and/or *Loa loa* infection). Annual MDA prevents mosquitoes from becoming infected and, when given for a period (estimated to be five to six years), can interrupt transmission of *W. bancrofti* (which has no animal reservoir). In 2013, WHO issued a provisional strategy for *Loa loa* areas that includes the dual approach of albendazole monotherapy via MDA twice per year, together with LLIN. Because of RBEP-sponsored research, as of 2017, Nigeria has been excluded from this *Loa loa* policy, and a combination of MDA with Mectizan/albendazole can be used there (see below).

Nigerians suffer in disproportionate numbers from LF. Nigeria is second globally (behind India) in human suffering from this parasite.

LF and Malaria in Nigeria: In Plateau and Nasarawa States, TCC, working with the FMOH of Nigeria and with state and local government ministries, assisted in establishing TCC’s first LF elimination program. The current effort is based on a strategy of two pillars: 1) annual MDA combination therapy consisting of albendazole and Mectizan to interrupt transmission of LF and 2) MMDP programs for those suffering from lymphoedema, elephantiasis, hydrocele, and adenolymphangitis. GSK and Merck donations in Nigeria allow pillar 1 MDA activities, which were the focus of the program's early years. The MDA program was launched in 2000 following disease mapping in 1998-99. After years of high treatment coverage and LLIN distribution by the malaria program, LF transmission was broken in the two states in 2012. Subsequent TAS surveys (TAS-2 and TAS-3) confirmed that children were not becoming reinfected during the PTS period. Additional entomology studies showing no infected mosquitos and LF antigen studies in adults showed that LF transmission had been eliminated. Seven million people are no longer at risk of LF due to a successful pillar 1 MDA program. PES continues in the two states, together with ongoing LLIN distribution, which will hopefully prevent reintroduction of the infection since the two states are surrounded by LF-endemic areas.

LF treatments in Nigeria expanded to the seven states we assist in southern Nigeria as part of USAID’s ENVISION project led by RTI International. Treatments started in 2014 in areas with an existing river blindness program and, in 2015, expanded to address all LF-endemic areas in the nine states. After two years of the provisional six-monthly albendazole-alone monotherapy (together with LLIN) due to *Loa loa* concerns, TCC, in partnership with Nigeria’s federal and local governments, conducted a large survey in 2016. The study determined that *Loa loa* levels were insufficient in TCC-supported areas to preclude treatment (Emukah et al., *AJTMH* 2018). Our results were favorably reviewed by the Mectizan Expert Committee; the program now supports annual Mectizan and

albendazole MDA where needed in the seven states, rather than the less efficient and more costly twice-per-year albendazole-only approach.

The Nigeria LF Program also addresses the second pillar of eliminating LF: clinical services to those suffering from LF morbidity. In 2019 RBEP began work with its MOH partners to quantify the burden of morbidity and to help Plateau and Nasarawa strengthen primary care support and referral networks for the management of lymphedema and hydrocele surgery, as well as mental health needs (in 'Hope Club' support groups). Ebonyi state began similar efforts in 2022, and case searches have begun in all of our assisted states. These activities are ethically sensible, as well as necessary to complete elements of the national dossier for WHO. Current support for LF MMDP comes from USAID's Act to End NTD's | East project, led by RTI International, and the Izumi Foundation.

Through a previous grant from the Bill & Melinda Gates Foundation, TCC also conducted field research on the use of LLINs alone to combat LF in Imo and Ebonyi States, areas where LF MDA with Mectizan was at that time not possible due to the presence of Loa loa. Results showed that the LLINs significantly impacted mosquito infection (Richards et al., *Am J T Med Hyg* 2013). Thanks to The Global Fund Round 8 in the early 2010s, LLINs were distributed at a rate of two per household throughout the majority of Nigeria for malaria prevention; LLINs were shown to be synergistic with the MDA program in Plateau and Nasarawa states. The national malaria and LF programs remain actively involved in TCC-assisted programs, and TCC has assisted (in differing degrees) in the mass distribution of LLINs in all nine states where we work. Due in part to strong TCC advocacy, Nigeria launched its FMOH Guidelines for Malaria-Lymphatic Filariasis Co-implementation in Nigeria in June 2013. We continue to work on this important synergy in TCC-assisted states, although much less so after TCC's Malaria Program closed in 2014.

LF in Ethiopia: Ethiopia's much smaller LF program was launched in 2008 in tandem with TCC's Malaria Program, which assisted the MOH in distributing LLINs. The Ethiopian Malaria Program completed the mass distribution of LLINs throughout the malaria-endemic areas of Ethiopia just before the LF program (the first such program in Ethiopia) was launched. These LLINs undoubtedly have impacted LF transmission, and the 'killing two birds with one stone' strategy of fighting malaria and LF with LLINs were the primary reason the MOH launched the LF MDA effort. With GSK support, TCC assisted the MOH in launching an LF elimination pilot program in 2009. LF interventions have since expanded across all regions assisted by TCC. The Ethiopia LF program receives support from the United Arab Emirates' Reaching the Last Mile Fund, hosted by the END Fund. The Reaching the Last Mile Fund, housed within The END Fund, is a multi-donor fund, initiated and led by His Highness Sheikh Mohamed bin Zayed Al Nahyan, President of United Arab Emirates.

LF in Sudan: Since 2022, through a grant from the Reaching the Last Mile Fund, hosted by the END Fund, The Carter Center enhanced assistance for RB and expanded support to the Ministry of Health for LF elimination. The Reaching the Last Mile Fund, housed within The END Fund, is a multi-donor fund, initiated and led by His Highness Sheikh Mohamed bin Zayed Al Nahyan, President of United Arab Emirates. LF mapping in 2016 revealed that 65 (34%) of the country's 189 districts, distributed in 14 of its 18 states, were endemic. Around 11 million people are at risk for LF, with 9.3 million eligible for treatment.

ANNEX 3: The Schistosomiasis/Soil-Transmitted Helminthiasis Control Program

SCHISTOSOMIASIS

Schistosomiasis (SCH) is a parasitic disease acquired from skin contact with fresh-water bodies where snails infected with the parasite are present. The cercarial stages of the parasite leave the snails and swim in the water until they find an exposed person. The cercaria then penetrates the skin and migrates through the body as 'schistosomula' parasitic forms. They develop into adult male and female worms when they reach the venules of the intestines (intestinal schistosomiasis caused by *Schistosoma mansoni*) or bladder and genitals (urinary schistosomiasis caused by *S. haematobium*). It is important to note that in Africa, where TCC works, SCH exists as these two different infections have different (and often overlapping) geographical distributions, epidemiology, and disease patterns (morbidity). In both conditions, female worms lay thousands of eggs that exit the body in feces (in the intestinal form) or urine (in the urinary form). If the eggs gain access to fresh water, they hatch and release miracidiae, which swim in search of a specific type of snail (*S. mansoni* infects snails of the *Biomphalaria* species; *S. haematobium* infects *Bulinus* species). The miracidia penetrate and infect the snails and transform and multiply, resulting in a single snail releasing thousands of cercaria, thus continuing the lifecycle.

Eggs deposited into human tissues by adult female worms cause inflammation, organ damage, bleeding, and anemia. Although all age groups are infected, persons with the greatest number of adult worms have the greatest number of eggs in their tissues, urine, and feces. Adults most commonly suffer from liver fibrosis and esophageal bleeding (intestinal schistosomiasis) or bladder and cervical cancer (urinary schistosomiasis). School-aged children (ages 5 to 14) may have abdominal pain, anemia, and (in urinary schistosomiasis) bloody urine. They act as the main disseminators by contaminating water with excreta. Mass Drug Administration (MDA) with the safe and effective oral medicine praziquantel can significantly reduce schistosomiasis morbidity. Praziquantel kills the adult worms, reduces the number of eggs that accumulate in tissues and, as a result, reduces the disease (morbidity) associated with schistosomiasis. The Merck KGaA, Darmstadt, Germany/World Health Organization (WHO) donation of praziquantel is given only for MDA in school-aged children, although adults and preschool-aged children would also benefit from treatment in endemic areas.

TCC's SCH program in Nigeria is seeking to adopt WHO's 2022 guidelines on control and elimination[7]. As with the 2011 guidelines, these call for different frequency of praziquantel preventive chemotherapy depending on parasite prevalence in a district. Thus, treatment numbers in the same state can vary from year to year, and training and logistics become more complicated. Programs anticipate WHO manuals that operationalize the 2022 guidelines.

Transmission is unlikely to be interrupted by the paradigm of MDA targeted at school-aged children because: 1) transmission occurs in all age groups; 2) praziquantel does not kill the migrating schistosomula forms, thus single dose treatment in children in highly endemic areas is unlikely to be curative; and 3) until open defecation and urination (or reduction of release of raw sewage into

[7] World Health Organization (2022). WHO guideline on control and elimination of human schistosomiasis. Geneva.

fresh water) are halted through construction and use of sanitation systems, MDA will have little to no impact on infected snails (which live for many months) and infected water. In other words, persons treated are either not cured of their schistosomula (developing) infections, and/or they become reinfected when they reenter the contaminated water.

SOIL-TRANSMITTED HELMINTHS

Soil-Transmitted Helminthiasis (STH) is caused by a group of four different intestinal worms that infect humans: *Ascaris lumbricoides* (roundworm), *Trichuris trichiura* (whipworm), *Ancylostoma duodenale*, and *Necator americanus* (hookworms). STH are among the most common infections worldwide, and heavy infections lead to developmental delay, malnutrition, intestinal obstruction, and anemia (depending on the infecting species). As with SCH, school-aged children are usually the most heavily infected with these worms, with the exception of hookworms, which have their heaviest infections in adults.

Transmission of soil-transmitted helminths occurs through feces. Eggs from the adult females are passed into the environment in feces, where they become infective within days (hookworm and whipworm) or weeks (roundworm). Once in the environment, infective whipworm and roundworm eggs reach their next human host via human ingestion of fecally-contaminated food or water. Hookworm eggs hatch in soil and the resultant larvae infect humans by penetration of the skin (often entering via bare feet).

Once in the human, hookworm larvae migrate through the circulatory system until they reach the lungs. From there, they pass through the trachea and mouth where they are ingested, traveling next to the intestines. They mature, mate, and release eggs within 6-8 weeks. Whipworm and roundworm eggs hatch into larvae in the intestine and remain there through adulthood.

Heavy worm infections result in blood loss which can lead to anemia and hypoproteinemia. In children, this can lead to poor physical and developmental growth, stunting, and decreased mental acuity. In adults, hookworm-associated anemia reduces productivity and can be especially dangerous in reproductive-aged (menstruating) women. Pulmonary complications can occur due to migration of roundworm or hookworm larvae through the lungs and, in the case of ascaris , bowel obstructions can occasionally lead to death.

The 2017 WHO guidelines for STH focus on providing treatment to school-aged children. STH MDA programs are for morbidity control; transmission will not be interrupted until open defecation is halted through deployment and the use of sanitary systems. As with SCH treatment frequency differs based on a district's endemicity level; the result is that STH treatment numbers in the same state can vary greatly from district to district and from year-to-year.

Notably, the different worms species have different sensitivities and cure rates from the MDA regimens provided. Albendazole is superior to mebendazole. Roundworm is most sensitive to treatment, while whipworm is least sensitive. The Mectizan/albendazole combinations given for LF improve whipworm cure rates.

The challenges for TCC Nigeria in implementing schistosomiasis and STH programs include: 1) complex WHO guidelines that result in different regimens tailored to district epidemiology; 2) a focus since 2011 on a Ministry of Education (school-based) approach rather than the traditional Ministry

of Health (community- based) platform, which is more experienced at MDA activities; 3) a focus on teachers (in schools) rather than community distributors (house to house); 4) exclusion of potentially infected persons, including preschool children, unenrolled school-aged children (especially girls), and adults; 5) algorithms with thresholds statistically indistinguishable from one another; 6) mapping based on averages resulting in exclusion of communities that need interventions; 7) difficult calculations of coverage due to challenges with denominator determinations; 8) loss of high-quality STH control resulting from community-wide LF MDA with the most potent STH treatment (Mectizan and albendazole) when LF programs that pass Transmission Assessment Surveys (TAS) assessments cease treatment; 9) as LF and RB programs succeed and cease treatments, elements of these platforms that supported SCH/STH programs are lost; and 10) donor fatigue related to indefinite SCH/STH programs.

The Carter Center's SCH/STH work focuses on "mainstreaming" the two diseases into the large healthcare delivery system, abandoning the vertical MDA approach to control. In Local Government Areas (LGAs) where the River Blindness (RB) or Lymphatic Filariasis (LF) platform does not exist, we are implementing plans to transfer support of MDA fully to the Ministries of Health (MOH) and Education.

ANNEX 4: Timeline of the River Blindness Campaign at The Carter Center

- **2023:** The Galabat focus in Sudan and Nyagak-Bondo focus in Uganda were declared transmission eliminated. More than 1.1 million people in the lower part of Madi Mid-North focus qualified to stop MDA for RB and 4.2 million people in Nigeria (3.7 million) and Ethiopia (460,290) qualified to stop MDA for LF.
- **2022:** RBEP surpassed the distribution of 500 million Mectizan treatments for onchocerciasis. Three foci in Uganda completed PTS for RB and were reclassified as transmission eliminated. More than 20 million people qualified to stop treatment for RB:18.9 million in four states of Nigeria and 1.3 million in Ethiopia. For LF, 11.7 million people in Nigeria and around 70,000 in Ethiopia qualified to stop MDA. Building on long-term support for RB elimination in Sudan, TCC expanded support for LF elimination in the country.
- **2021:** Two states in Nigeria and three foci in Uganda completed PTS for onchocerciasis and achieved transmission elimination status. Nigeria also qualified to stop RB treatments in Delta State for 2.8 million people and LF treatments for 3.4 million people. Ethiopia qualified to halt 508,000 RB treatments and 260,923 LF treatments. In the Americas, the OEPA program broadened its access to remote Yanomami communities by building a new airstrip in Siapa Valley, Venezuela.
- **2020:** NTD programs worldwide suspended community-based activities in compliance with WHO recommendations to prevent the spread of COVID-19. As a result, most countries only achieved one round of MDA within the calendar year. RBEP-assisted MDA for onchocerciasis in Uganda was one of the first large-scale campaigns to resume globally. Program review and national committee meetings were held virtually (IACO, EOEEAC, UOEEAC) or postponed (PCC, NOEC).
- **2019:** Problems with the importation of Mectizan into Nigeria in 2019 resulted in an inability of RBEP-assisted programs to provide twice-per-year MDA for onchocerciasis; all RBEP- assisted Nigeria programs provided a single round of treatments. Just over 600,000 treatments were halted in Uganda after successful stop MDA assessments were conducted. The large MMN focus bordering the Republic of South Sudan was reclassified as 'transmission suspected interrupted.' However, the DRC Ebola outbreak halted cross-border activities between Uganda and the DRC. Onchocerciasis Elimination Mapping in Ethiopia provided data that led the national committee to recommend treatment be launched in several new areas of the country. The LF elimination program in Ethiopia stopped about 117,000 treatments after successful TAS surveys. The OEPA program held the 29th IACO conference in Brasilia with the theme "Brazil approaching the elimination of onchocerciasis." The conference praised the IHAs involved in both the Brazil and Venezuela elimination programs. In 2019, RBEP authors published papers on S&C vegetation clearance as non-chemical- based vector control in Uganda, the role of OEPA as a model for Africa RB elimination programs, MDA coverage surveys in Uganda and Cameroon, and use of doxycycline treatment as an endgame strategy in the Americas.
- **2018:** Three papers (on topics of Uganda, OEPA, and National Onchocerciasis Elimination Committees) are published by RBEP authors in a special supplement on Onchocerciasis Elimination in the journal International Health. In Nigeria, an SCH and STH impact evaluation was conducted among 9,660 children; a reduction in the prevalence of infection compared to a 2013 baseline was demonstrated in many areas. In eastern Ethiopia's East and West Harage zones, a new onchocerciasis focus was identified in OV16 surveys in an area previously believed to be non-endemic. In Uganda, MDA for onchocerciasis was recommended to be halted among more than

335,000 persons with declaration of transmission interruption in two foci. The OEPA program celebrated its 25th anniversary as it struggled to operate in Venezuela amidst political and financial turmoil.

- **2017:** The most successful year ever for numbers of RBEP-assisted Mectizan treatments (over 55 million) delivered. Decisions to stop treatments at the end of 2017 in 3.8 million persons resident in RBEP-assisted areas in three African countries (Ethiopia, Nigeria, and Sudan), believed to be the largest number of persons for whom RB MDA has been stopped in a given year. Sudan and Ethiopia jointly declare a stop Mectizan MDA decision for 1.2 million persons in the cross-border Galabat/Metema onchocerciasis transmission zone. Nigeria halts MDA for onchocerciasis among 2.2 million persons in Plateau and Nasarawa States. Uganda halts MDA among 421,000 persons in two foci. Venezuela completes PTS in its largest focus (the Northeast focus) and transmission there is declared eliminated.
- **2016:** WHO verifies that Guatemala has eliminated onchocerciasis transmission. Uganda declares river blindness transmission eliminated in four foci. TCC celebrates its ½ billionth treatment for NTDs. NOEC releases a plan of action to eliminate river blindness in Nigeria. TCC is selected as a semi-finalist in the MacArthur Foundation's 100&Change grant competition with a proposal to support the NOEC plan but is not ultimately the grant recipient.
- **2015:** WHO verifies that Mexico has eliminated onchocerciasis, and Guatemala requests verification. TCC provides technical and financial assistance to help establish a national onchocerciasis expert advisory committee in Nigeria. Sudan announces that transmission has been eliminated in Abu Hamad Focus.
- **2014:** WHO verifies that Ecuador has eliminated onchocerciasis. The International Task Force for Disease Eradication (ITFDE) reviews RB/LF in Africa again (*WER* 2014). TCC provides technical and financial assistance to help establish a national onchocerciasis expert advisory committee in Ethiopia.
- **2013:** The name of TCC's River Blindness Program changes to TCC's River Blindness Elimination Program to reflect the paradigm shift to focusing efforts on eliminating RB transmission everywhere we work. Colombia is the first country in the world verified by WHO to be free of onchocerciasis. Ecuador applies to WHO for verification of elimination.
- 2012: Sudan announces interruption of onchocerciasis transmission in Abu Hamad Focus (Higazi, 2013). TCC's River Blindness Program obtains our Board of Trustees' approval for an eight-year plan to interrupt RB transmission everywhere we assist by 2020. WHO sends a verification team to Colombia to determine if the country has eliminated onchocerciasis. Plateau and Nasarawa states in Nigeria qualify to halt MDA for LF.
- **2011:** TCC's ITFDE reviews the RB and LF elimination efforts in Africa, applauds the move by APOC from RB control to elimination, and calls for better coordination of RB and LF interventions as well as with malaria bed net distribution efforts (WER 2011). An expert committee (with Frank Richards, the TCC RBP Director, as a member), meeting under the auspices of the World Bank, recommends an elimination goal for ten African countries by 2020, including Nigeria, Uganda, and Ethiopia. In late 2012, the World Bank/APOC governing board recommends onchocerciasis elimination now be APOC's goal.
- **2010:** TCC reports considerable success in RB elimination efforts in the Americas (series of WER articles) and parts of Africa. However, Katabarwa (TCC/RBP) notes a need to expand treatment into the so-called hypoendemic areas excluded by APOC's treatment strategies. He also challenges the

Diawara report by noting failures of once-per-year treatment with Mectizan alone for 17 years in TCC-assisted North Province, Cameroon; TCC calls for twice- per-year treatment in these areas (Katabarwa, 2011). At an international conference, TCC reports an analysis of the impact of annual Mectizan and albendazole (for lymphatic filariasis) on onchocerciasis transmission elimination in many areas of Plateau and Nasarawa States of Nigeria.

- **2009:** A key Gates Foundation-supported WHO/TDR study by Diawara (2009) conducted in Senegal and Mali (derived as an outcome of the 2002 Conference on Eradicability) proves RB elimination is possible with 17 years of Mectizan alone under some conditions in Africa. Gates, MDP, TCC, and APOC all call for "Shrinking the Map" in Africa (WHO 2009). Rakers (TCC/RBP) reports that RB programs in Nigeria would collapse without external support, questioning the 'sustainability' theory (*Lancet*, 2009).
- **2008:** TCC provides technical and financial assistance to help establish a national onchocerciasis expert advisory committee in Uganda with seed support from Mr. John Moores.
- **2007:** TCC's International Task Force for Disease Eradication reviews RB eradicability and notes evidence that Mectizan alone may interrupt transmission in Africa, but that the challenge of Loa loa needs to be resolved. (WHO 2007). TCC/RBP agrees to assist Uganda in its new goal of national RB elimination.
- **2006:** TCC agrees to assist Sudan's declaration of national elimination, starting with enhanced efforts in the Abu Hamad focus on the River Nile (Higazi 2011, 2013).
- **2005:** A paper published by Hopkins, Richards, and Katabarwa ("Whither Onchocerciasis Control in Africa?") challenges the feasibility of indefinite RB control in Africa without continued external support, calls for governments to do more to fund their programs; and calls for further research into RB elimination in Africa (Hopkins, 2005).
- **2003:** Richards co-authors a paper on mass treatment decision-making in Loa loa areas where onchocerciasis occurs (Addis, 2003).
- **2002:** TCC and WHO (with Gates Foundation support) co-host the Conference on RB Eradicability that concludes RB can be eliminated in the Americas but not yet throughout Africa with current tools (Mectizan alone). The challenge is noted of the parasite Loa loa, which occurs in some areas with RB: Mectizan given to a person with Loa loa infection can result in severe nervous system reactions, including coma. The conference calls for further study in Africa and for implementers to 'go for transmission elimination' in Africa where feasible (Dadzie, 2003). The Gates Foundation, in part due to the findings of the conference, shortly thereafter provide major grants to TCC in support the OEPA program and TDR to study using Mectizan alone to eliminate onchocerciasis transmission in Mali and Senegal.
- **2000:** OEPA needs a 'definition of success' endorsed by WHO; with a push from President Carter to WHO DG H Gro Brundland, WHO agreed to hold an important meeting to establish certification criteria for onchocerciasis elimination (WHO, 2001), which had great utility for programs in the Americas and Uganda. Richards, writing in The Lancet, notes the importance of the LF program in advancing the RB elimination agenda and challenges the African program to move toward onchocerciasis transmission elimination in a model similar to that in the Americas.
- **1998:** Richards, with other TCC authors (Miri and Sauerbrey), writes about opportunities for RB elimination in a special edition of the Bulletin of WHO entitled "Global Disease Elimination and Eradication as Public Health Strategies". He also writes about the history of launching the OEPA initiative (*Bull PAHO*).

- **1997:** TCC Vice President of Health Programs, Dr. Donald Hopkins, and Richards publish "Visionary Campaign: Eliminating River Blindness" in the 1997 Encyclopedia Britannica Medical and Health Annual.
- **1996:** TCC assumed country program activities of RBF in the Americas, Nigeria, Cameroon, Sudan, and Uganda. (Ethiopia started in 2001.) Dr. Frank Richards is seconded from CDC to TCC as its RB technical director. RBF formally closes, and program funding in Africa becomes the responsibility of the newly launched APOC, which was jointly developed by NGOs (including RBF and TCC), WHO, and the World Bank with bilateral and multilateral donors.
- **1991:** The River Blindness Foundation (RBF) is launched by philanthropists John and Rebecca Moores of Houston, Texas. RBF quickly becomes the largest source of support for Mectizan distribution activities, funding NGOs such as Sightsavers, Helen Keller International, the International Eye Foundation, CBM, and others. It also launches the OEPA initiative in the Americas and supports the WHO-NGO coordination office for onchocerciasis in Geneva.

ANNEX 5: Publications Authored or Coauthored by RBEP Personnel

*2023 Publications shown in **bold**.*

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ANNEX 6: Program Review Agenda

28th Annual
River Blindness, Lymphatic Filariasis, and Schistosomiasis Program Review

Wednesday, April 24, 2024

Start	End	Title	Speaker
8:00 AM	8:30 AM	*Shuttle Pickup at Hampton Inn/Courtyard by Marriott*	
8:30 AM	9:00 AM	*Continental Breakfast*	
9:00 AM	9:10 AM	Day 1 Welcome and Introduction	Dr. Gregory Noland
9:10 AM	9:15 AM	Video Tribute: Mrs. Rosalynn Carter	
9:15 AM	9:20 AM	Welcome Remarks	Ms. Paige Alexander
9:20 AM	9:25 AM	Video: A Global Health Legacy	
9:25 AM	9:30 AM	Opening Remarks	Dr. Kashef Ijaz
9:30 AM	9:35 AM	Goodwill Message	Dr. Tedros Ghebreyesus
9:35 AM	10:00 AM	RBEP Overview	Dr. Gregory Noland
Morning Session Chair:		**Dr. Zerihun Tadesse**	
10:00 AM	10:15 AM	OEPA Overview	Dr. Mauricio Sauerbrey
10:15 AM	10:25 AM	*Discussion*	Ms. Silvia Sagastume
10:25 AM	10:40 AM	Brazil Amazonas Focus	Mr. Heriberto Schuertz
10:40 AM	10:50 AM	*Discussion*	
10:50 AM	**11:20 AM**	**Break**	
11:20 AM	11:35 AM	Venezuela South Focus	Dr. Oscar Noya Alarcon
11:35 AM	11:40 AM	5-minute video	
11:40 AM	11:50 AM	*Discussion*	
11:50 AM	12:05 PM	OEPA: Results from Electronic Device Intervention	Mr. Anthony Cirilo
12:05 PM	12:15 PM	*Discussion*	
12:15 PM	**1:45 PM**	**LUNCH**	
Afternoon Session Chair: Dr. Abel Eigege			
1:45 PM	2:10 PM	Uganda: Treatments and Impact	Mr. David Oguttu
2:10 PM	2:25 PM	*Discussion*	
2:25 PM	2:40 PM	Uganda: Training, Integration, and Community Ownership	Dr. Edridah Muheki
2:40 PM	2:55 PM	*Discussion*	
2:55 PM	3:10 PM	Uganda: CDD Study Results	Ms. Annet Khainza
3:10 PM	3:20 PM	*Discussion*	
3:20 PM	3:25 PM	Day 1 Closure	Dr. Gregory Noland
3:25 PM		*Shuttle Departs to Hotel*	
4:30 PM	8:30 PM	*Edgewood Mall Shopping Trip - Pick up from Hampton Inn*	

28th Annual
River Blindness, Lymphatic Filariasis, and Schistosomiasis Program Review
Thursday, April 25, 2024

Start	End	Title	Speaker
8:00 AM	8:30 AM	*Shuttle Pickup at Hampton Inn/Courtyard by Marriott*	
8:30 AM	9:00 AM	*Continental Breakfast*	
9:00 AM	9:05 AM	Day 2 Introduction	Dr. Gregory Noland
Morning Session Chair:		**Dr. Mauricio Sauerbrey**	
9:05 AM	9:20 AM	Nigeria: National Onchocerciasis Elimination Status	Mr. Fatai Oyediran
9:20 AM	9:30 AM	*Discussion*	
9:30 AM	9:50 AM	Nigeria: Treatments and Impact	Dr. Abel Eigege
9:50 AM	10:00 AM	*Discussion*	
10:00 AM	10:20 AM	Nigeria: Training, Integration and Community Ownership/Lessons Learned	Dr. Adamu Sallau
10:20 AM	10:30 AM	*Discussion*	
10:30 AM	**11:00 AM**	**BREAK**	
11:00 AM	11:25 AM	Nigeria: RB Impact Surveys in Edo and Ebonyi	Dr. Emmanuel Emukah
11:25 AM	11:40 AM	*Discussion*	
11:40 AM	12:00 PM	Nigeria: Enugu Operational Research	Dr. Adamu Sallau
12:00 PM	12:10 PM	*Discussion*	
12:10 PM	12:25 PM	Nigeria: LF TAS Results	Dr. Cephas Ityonzughul
12:25 PM	12:35 PM	*Discussion*	
12:35 PM	**2:00 PM**	**LUNCH**	
Afternoon Session Chair:		**Dr. Sara Lavinia**	
2:00 PM	2:15 PM	Nigeria: LF MMDP & Mental Health Results	Dr. Abel Eigege
2:15 PM	2:25 PM	*Discussion*	
2:25 PM	2:40 PM	Nigeria: SCH/STH Status and Strategy	Dr. Emmanuel Emukah
2:40 PM	2:50 PM	*Discussion*	
2:50 PM	3:10 PM	Nigeria: BMGF Supply Chain Project	Dr. Lungi Okoko
3:10 PM	3:20 PM	*Discussion*	Ms. Sarah Andersson
3:20 PM	3:30 PM	Day 2 Closure	Dr. Gregory Noland
3:30 PM	**6:30 PM**	***Reception***	
6:30 PM		*Shuttle Departs to Hotel*	

28th Annual
River Blindness, Lymphatic Filariasis, and Schistosomiasis Program Review
Friday, April 26, 2024

Start	End	Title	Speaker
8:00 AM	8:30 AM	*Shuttle Pickup at Hampton Inn/Courtyard by Marriott*	
8:30 AM	9:00 AM	Continental Breakfast	
9:00 AM	9:05 AM	Day 3 Introduction	Dr. Gregory Noland
Morning Session Chair:		**Dr. Edridah Muheki**	
9:05 AM	9:30 AM	Ethiopia: RB Treatments and Impact	Mr. Aderajew Mohammed
9:30 AM	9:45 AM	*Discussion*	
9:45 AM	10:10 AM	Ethiopia: LF Treatments and Impact	Dr. Yohannes Eshetu
10:10 AM	10:25 AM	*Discussion*	
10:25 AM	**10:55 AM**	**BREAK**	
10:55 AM	11:15 AM	Ethiopia: Metema PTS Investigation	Mr. Mitiku Adugna
11:15 AM	11:25 AM	*Discussion*	
11:25 AM	11:50 AM	Ethiopia: Vector Genomics Studies	Dr. Warwick Grant
11:50 AM	12:05 PM	*Discussion*	
12:05 PM	12:20 PM	Ethiopia: Practical approaches to "mapping" OTZs	Mr. Tewodros Seid
12:20 PM	12:30 PM	*Discussion*	
12:30 PM	**2:00 PM**	**LUNCH**	
Afternoon Session Chair:		**Dr. Gregory Noland**	
2:00 PM	2:15 PM	Ethiopia: MITRE Remote sensing of entomology	Mr. Matt Boyas
2:15 PM	2:25 PM	*Discussion*	
2:25 PM	2:45 PM	Sudan: Country Update	Dr. Sara Lavinia
2:45 PM	2:55 PM	*Discussion*	
2:55 PM	3:05 PM	Data Review	Ms. Lauri Bernard
3:05 PM	3:35 PM	Meeting Closure	Dr. Gregory Noland
3:55 PM		*Shuttle Departs to Hotel*	

ANNEX 7: Program Review Participants

(V) indicates virtual participation

The Carter Center Atlanta

Ms. Paige Alexander
Ms. Paige Baum
Ms. Achiek Abiel (v)
Ms. Valery Beiriger Valdez (v)
Ms. Nina Benard
Ms. Lauri Bernard
Ms. Kelly Callahan
Ms. Jenna Coalson
Mr. Yohannes Dawd
Mr. Yasir Deafalla
Dr. Obiora Eneanya
Ms. Cassandra Grant
Ms. Emily Griswold
Dr. Karen Hamre
Ms. Madelle Hatch
Dr. Kashef Ijaz
Ms. Molly Ison
Ms. Monica Johnson
Mr. Curtis Kohlhaas
Ms. Victoria Krauss
Ms. Nicole Kruse
Mr. Terry Lewis II
Ms. Emalee Martin
Ms. Amiah Matthews
Ms. Marquita McMichael
Ms. Savanna Murphy
Dr. Scott Nash
Ms. Mindze Nkanga (v)
Dr. Gregory Noland
Ms. Chika Okala
Ms. Lindsay Rakers
Dr. Frank Richards
Ms. Emily Staub
Ms. Shandal Sullivan
Dr. Anyess Travers
Mr. Adam Weiss
Mr. Craig Withers

The Americas

Ms. Alba Lucia Morales (The Carter Center)
Dr. Oscar Noya-Alcaron (SACAICET, Venezuela)
Mr. Joao Luiz Pereira (MOH, Brazil)
Ms. Dalila Rios (The Carter Center)
Ms. Silvia Sagastume (The Carter Center)
Dr. Mauricio Sauerbrey (The Carter Center)
Mr. Heriberto Schuertz (v) (MOH, Brazil)
Ms. Maria Solis (The Carter Center)
Mrs. Sofia Villatoro (The Carter Center)

Ethiopia

Mr. Mitiku Adugna (The Carter Center)
Mr. Abdo Aliyi (The Carter Center)
Mr. Yohannes Eshetu (The Carter Center)
Mr. Anley Haile (The Carter Center)
Mr. Fetene Mihretu (The Carter Center)
Mr. Aderajew Mohammed (The Carter Center)
Mr. Birhanu Reta (The Carter Center)
Mr. Tewodros Seid (The Carter Center)
Mr. Fikre Seife (FMOH)
Dr. Zerihun Tadesse (The Carter Center)

Nigeria

Dr. Abel Eigege (The Carter Center)
Dr. Emmanuel Emukah (The Carter Center)
Dr. Cephas Ityonzughul (The Carter Center)
Dr. Emmanuel Miri (v) (The Carter Center)
Mr. Lazarus Nweke (v) (The Carter Center)
Prof. B.E.B Nwoke (v) (Imo State University Owerri)
Dr. Francisca Olamiju (MITOSATH)
Mr. Fatai Oyediran (FMOH)
Dr. Adamu Sallau (The Carter Center)

Sudan

Dr. Heitham Mohammed Ibrahim (FMOH)
Dr. Talal Hassan (FMOH)
Dr. Sara Lavinia (The Carter Center)
Mr. Mazin Mohamed (The Carter Center)
Dr. Moutaz Omer (The Carter Center)
Dr. Isam Zarroug (The Carter Center)

Uganda

Hon. Dr. Jane Ruth Aceng (MOH)
Mr. Elisa Byamukama (The Carter Center)
Ms. Annet Khainza (The Carter Center)
Dr. Alfred Mubangizi (MOH)
Dr. Edridah Muheki (MOH)

Mr. David Oguttu (MOH)
Mr. George Ssewamala (MOH)

Other Observer Countries
Dr. Ader Macar Aciek Ader (MOH, South Sudan)
Dr. Maria Cecilia C. Almeida (MOH, Angola)
Mr. Bior Bol Bior (MOH, South Sudan)
Dr. Yak Yak Bol (MOH, South Sudan)
Dr. Luccene Desir (The Carter Center, Hispaniola)
Hon. Mohamed Idris (MOH, South Sudan)
Dr. Abdella Meftuh (The Carter Center, Chad)
Mr. Jim Niquette (The Carter Center, South Sudan)
Dr. Tony Ukety (v) (CRMT, DRC)

Bill & Melinda Gates Foundation
Dr. Rachel Bronzan
Dr. Arielle Dolegui (v)
Ms. Kathryn Malhotra (v)
Dr. Lungi Okoko (v)
Dr. Jordan Tappero

Centers for Disease Control and Prevention
Dr. Andrew Abbott (v)
Dr. Vitaliano Cama
Dr. Paul Cantey (v)
Dr. Diana Martin (v)
Dr. Andreas Nshala (v)
Dr. Kimberly Won

Crosscut
Mr. Coite Manuel (v)

Christian Blind Mission
Dr. Girija Sankar

ELMA Philanthropies
Dr. Nebiyu Ayele

Emory University
Dr. David Civitello (v)

Erasmus University Medical Center Rotterdam
Dr. Wilma Stolk

Foreign, Commonwealth & Development Office, UK
Dr. Hannah Barton
Dr. Nat Brittain (v)

GLIDE
Mr. Simon Bland
Dr. Aissatou Diawara (v)

Independent Attendees
Dr. Moses Katabarwa
Dr. Adrian Hopkins (v)

International Public Health Advisors
Ms. Jessica Rockwood (v)

IZUMI Foundation
Dr. Gretchen Stoddard (v)
Ms. Yuko Yoshida (v)

JSI
Dr. Sarah Andersson (v)

Judge Baker Children's Center
Ms. Kathryn Cade (v)

Latrobe University
Dr. Warwick Grant

Lions Clubs International Foundation
Ms. Sarah Buki (v)

Liverpool John Moores University
Prof. Rory Post

Merck & Co, Inc. (known as MSD outside the United States of America and Canada)
Ms. Marilyn Mainardi
Dr. Johannes Waltz (v)

Mectizan Donation Program
Ms. Joni Lawrence
Dr. Yao Sodahlon (v)

Noor Dubai Foundation
Dr. M. Mansur Rabiu

PAHO
Dr. Ruben Santiago Nicholls

PATH
Dr. Abdel Direny

P.D. Merrill Charitable Trust
Mr. John Achatz

RTI International
Ms. Stella Agunyo
Ms. Katie Crowley (v)
Ms. Danielle Epps
Ms. Sabrina Eyob
Dr. Michael French
Mr. Belete Mammo
Dr. Upendo Mwingira

Sightsavers
Mr. Simon Bush
Dr. Philip Downs
Dr. Louise Hamill
Mr. Thomas Millar

Task Force for Global Health
Dr. Katherine Gass (v)
Dr. Teshome Gebre
Dr. Kristin Saarlas (v)

The END Fund
Dr. Daniel Boakye
Ms. Anne Heggen
Dr. Kimberly Kamara (v)
Ms. Kendra Palmer

The MITRE Corporation
Dr. Matt Boyas
Dr. Victoria Gammino

University of Florida
Dr. Madsen Beau De Rochars

University of South Florida
Dr. Edwin Michael
Dr. Thomas Unnasch

University of Central Venezuela
Dr. Maria-Eugenia Grillet (v)

WHO
Dr. Jonathan King (v)

ANNEX 8: Acknowledgments

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Ms. Valery Beiriger Valdez, Ms. Nina Benard, Ms. Antonette Benford, Ms. Lauri Bernard, Dr. Jenna Coalson, Mr. Asmerom Gettu, Ms. Cassandra Grant, Ms. Tynesha Green, Ms. Emily Griswold, Ms. Madelle Hatch, Dr. Kashef Ijaz, Ms. Molly Ison, Ms. Victoria Krauss, Mr. Terry Lewis, Ms. Amiah Matthews, Dr. Gregory Noland, Ms. Lindsay Rakers, Dr. Frank Richards, Ms. Emily Staub, Ms. Shandal Sullivan, Mr. Marc Tewari, and Mr. Craig Withers.

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