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CARTER CENTER

Waging Peace. Fighting Disease. Building Hope.

SUMMARY
2022 VIRTUAL PROGRAM REVIEW
RIVER BLINDNESS ELIMINATION PROGRAM
ETHIOPIA, NIGERIA, OEPA, SUDAN, AND UGANDA
MARCH 8 – 10, 2023
THE CARTER CENTER, ATLANTA, GA

December 2023

Donors to The Carter Center River Blindness Elimination Program

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Clarke Mosquito Control

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United States Agency for International Development (USAID)

USAID's Achieve Onchocerciasis Elimination in the Americas Project

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

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 the United Arab Emirates.*

FRONTISPIECE A

Commemorative pin celebrates 500 million Mectizan treatments distributed for river blindness with Carter Center assistance. Designed by Dr. Zerihun Tadesse and Mr. Anley Haile of The Carter Center Ethiopia.

FRONTISPIECE B

Participants, including Carter Center CEO Paige Alexander (center), celebrate the expansion of Carter Center assistance for river blindness and lymphatic filariasis elimination in Sudan, January 2023, Khartoum, Sudan.

Table of Contents

ACRONYMS

APOC	African Program for Onchocerciasis Control
ARV	At-Risk Village
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

ACRONYMS *Continued*

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
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 27th Annual Review Meeting of the Carter Center (TCC) River Blindness Elimination Program (RBEP) was held virtually from March 8 – 10, 2023. The RBEP Atlanta- and country-based staff, Ministry of Health (MOH) officials, partners, and donors discussed the 2022 achievements, challenges, operational research, and recommendations for 2023 activities.

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 Dr. Kashef Ijaz, Vice President of Carter Center Health Programs, and a goodwill message from Dr. Tedros Adhanom Ghebreyesus, Director General of the World Health Organization (WHO). Noland provided an introductory overview for the meeting and highlighted multiple areas of success from 2022: the RBEP surpassed 500 million ivermectin (Mectizan®, donated by Merck & Co., Inc., Rahway, New Jersey [known as Merck Sharp & Dohme outside the United States and Canada]) treatments distributed for river blindness (RB) with Carter Center assistance—a milestone celebrated with a commemorative pin designed by Dr. Zerihun Tadesse and Mr. Anley Haile of The Carter Center Ethiopia (Frontispiece A); a program record 20 million people live in areas that qualified to stop mass drug administration (MDA) for RB while 11.8 million people qualified to stop MDA for lymphatic filariasis (LF); the Carter Center expanded support for RB and LF elimination in Sudan in 2022—celebrated in January 2023 with a ceremony attended by Carter Center Chief Executive Officer Paige Alexander (Frontispiece B); and The Carter Center welcomed Dr. Sara Lavinia Brair and Dr. Edridah Muheki Tukahebwa as Senior Country Representative, Sudan and Country Representative, Uganda, respectively.

The RBEP assists the MOH in six countries[3] to eliminate RB transmission. The strategy for elimination in RBEP programs is MDA with Mectizan, 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 WHO-verified national elimination of onchocerciasis from Colombia (2013), Ecuador (2014), Mexico (2015), and Guatemala (2016). The approach to RB elimination is defined by WHO guidelines, which provide three milestones (shown by the vertical lines in Figure 1): 1) **transmission suppressed**; 2) **transmission interrupted,** and MDA halted; 3) **transmission eliminated** after three to five years of post-treatment surveillance (PTS). After transmission elimination, post-elimination surveillance (PES) occurs, during which time elimination of parasite transmission is verified at the country level by WHO. The Abu Hamad Focus in Sudan was the first focus in Africa to eliminate onchocerciasis transmission in 2015 under WHO elimination guidelines.

In 2022, TCC assisted with 50,079,803 Mectizan treatments for RB in the Americas, Ethiopia, Nigeria, Sudan, and Uganda (Figures 2 and 3). This represents 94% of the 2022 treatment target of 53.4 million. 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 531 million, surpassing 500 million in 2022 (Figure 4). Figures 5 and 6 show TCC-assisted treatments and annual coverage by country. A goal of 42 million treatments has been set for 2023.

In 2022, more than 20 million people qualified to stop MDA for onchocerciasis in TCC-assisted areas: 1.3 million people in Ethiopia and 18.9 million people in Nigeria—a global record to date.

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

As a result of our RB elimination partnership, 30.7 million people no longer need Mectizan treatment in TCC-assisted areas of ten countries (Figures 7-9). Three foci in Uganda (encompassing 566,871 people) achieved RB transmission elimination status after completing PTS.

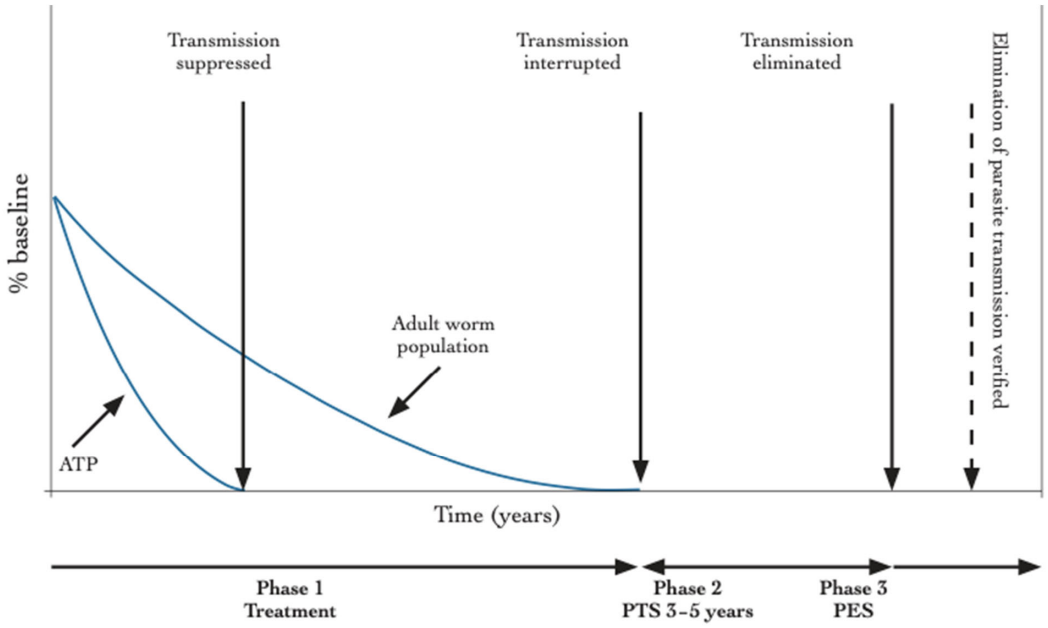
RBEP is an integrated program that includes LF elimination in Ethiopia, Nigeria, and Sudan, and schistosomiasis (SCH) and soil-transmitted helminthiasis (STH) control in Nigeria. As a result of our LF elimination partnership, 24 million people in Ethiopia and Nigeria no longer need treatment (Figures 10 and 11). 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. In 2022, TCC assisted with the distribution of 23,274,376 Mectizan and albendazole (donated by GSK) treatments for LF (81% of the 2022 treatment target), 415,999 praziquantel (donated by Merck KGaA, Darmstadt, Germany) treatments for SCH (8% of the treatment target) and 8,069,550 albendazole or mebendazole (donated by Johnson & Johnson) treatments for STH (66% of the treatment target). Cumulatively, TCC has assisted in 195,306,331 LF treatments, 29,952,357 SCH treatments, and 63,980,385 STH treatments (Figure 4). RB treatments represented 54% of the 92 million MDA treatments for RB, LF, SCH, STH, and trachoma assisted by TCC in 2022 (Figure 12).

Our work would not be possible without a grassroots network of community-directed drug distributors (CDDs) who provide treatments and health education. A combined 311,457 CDDs were trained in 2022, all of whom were trained and mentored by MOH personnel working in affected districts assisted by TCC (Figure 13).

FIGURES

Figure 1

Phases of Onchocerciasis Elimination

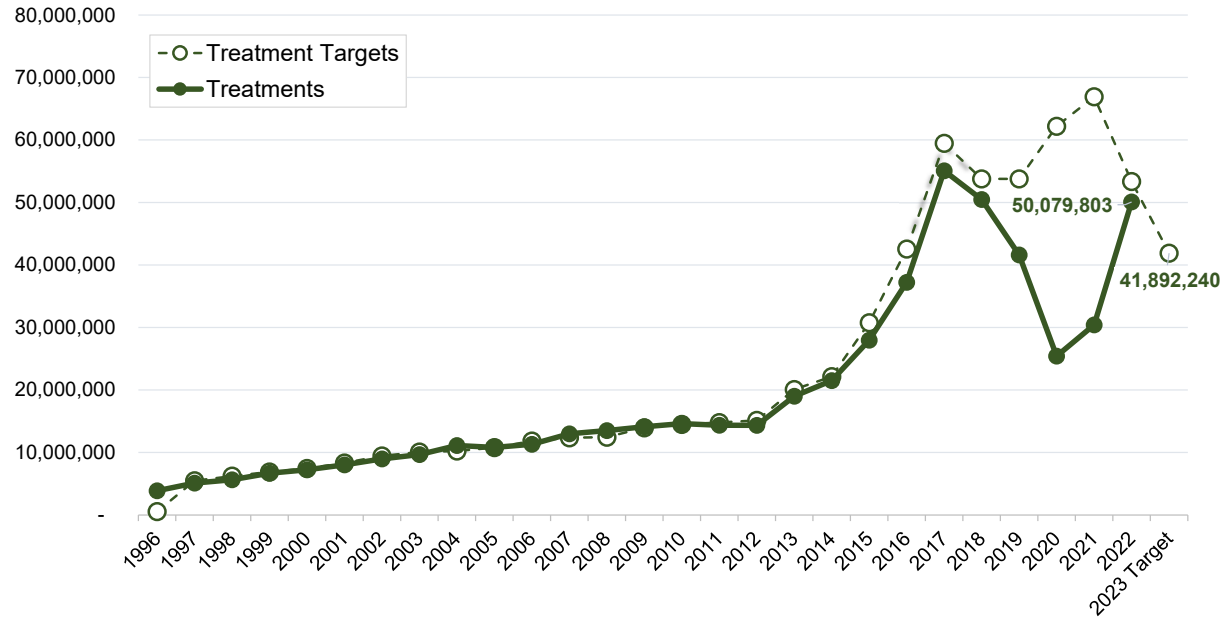


ATP, annual transmission potential; PES, post-elimination surveillance; PTS, post-treatment surveillance

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

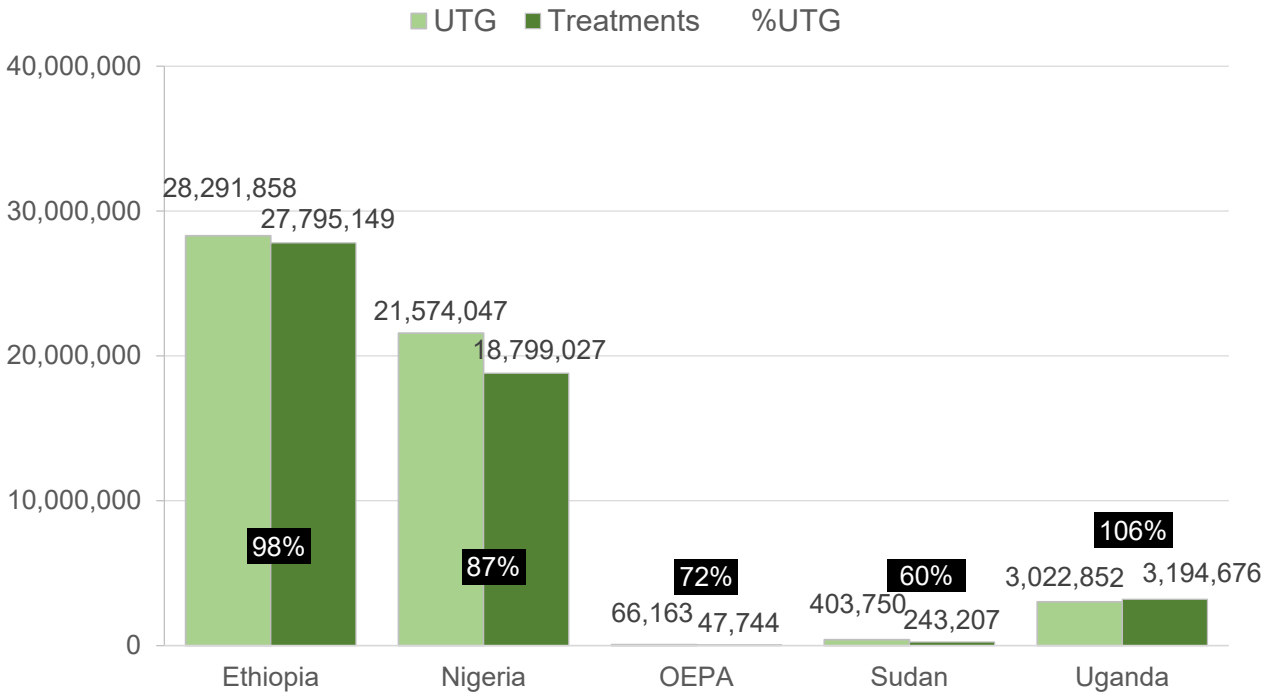
RBEP-Assisted Programs: Mectizan® Treatments/Targets 1996 – 2022 and 2023 Target



- *The decrease in treatment between 2019 and 2020 is due to the COVID-19 pandemic.*
- *The decrease in treatment between 2018 and 2019 is attributable to a Mectizan delay in Ethiopia and Nigeria.*
- *The 2022 treatments total include Uganda's passive (173,277) and refugee (191,882) treatments.*

Figure 3

2022 Mectizan® Ultimate Treatment Goals (UTG) and Treatments for 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 1996-2022

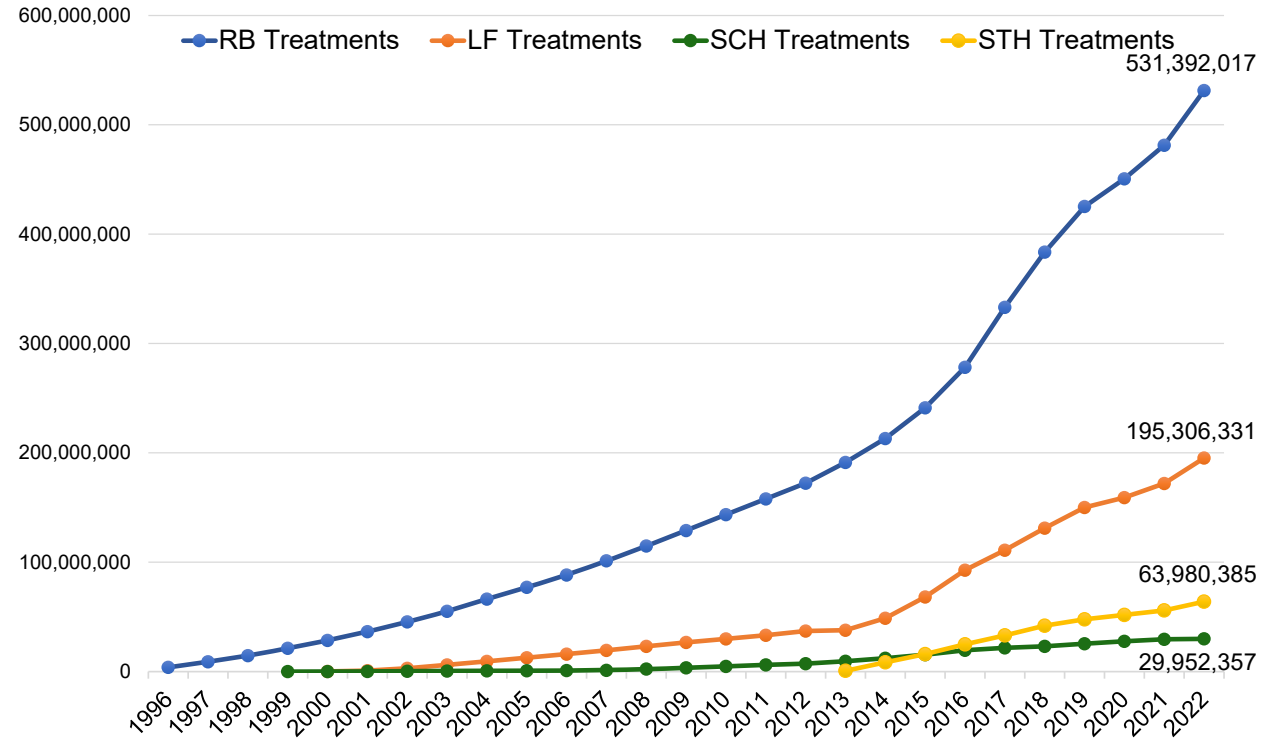


Figure 5

Carter Center-Assisted River Blindness Elimination Program: Mectizan® Treatments by Country/Program 1996 – 2022

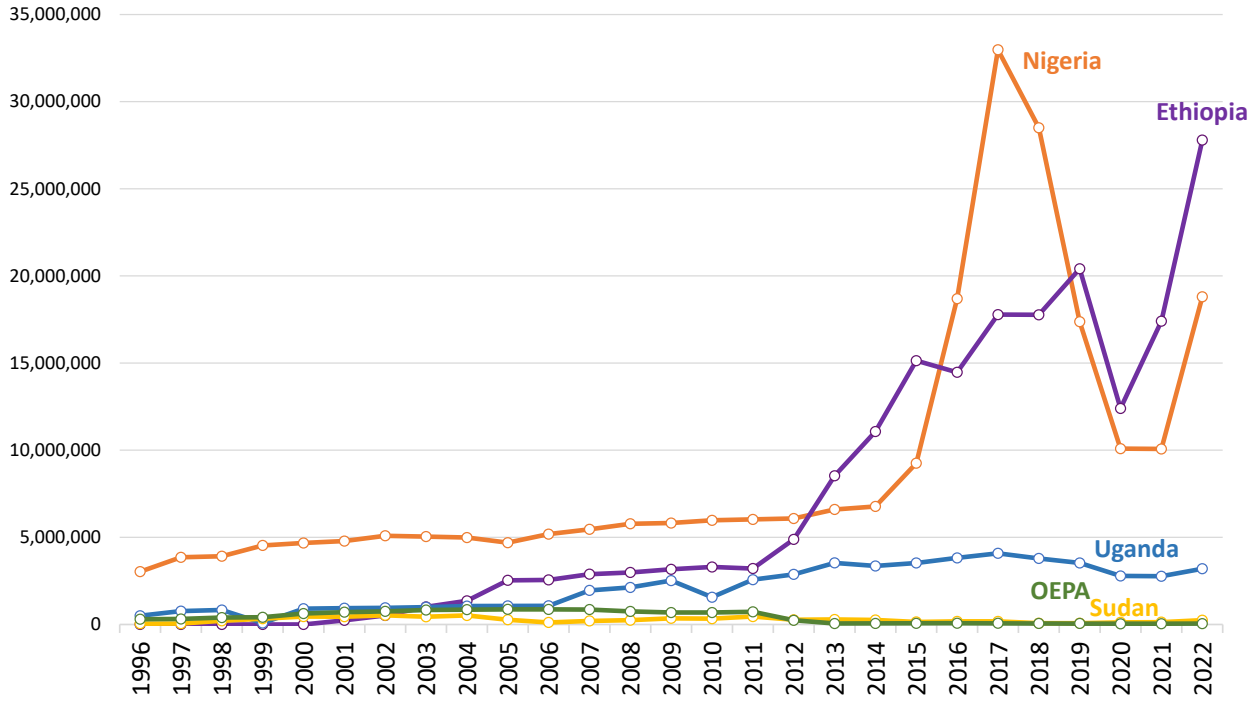
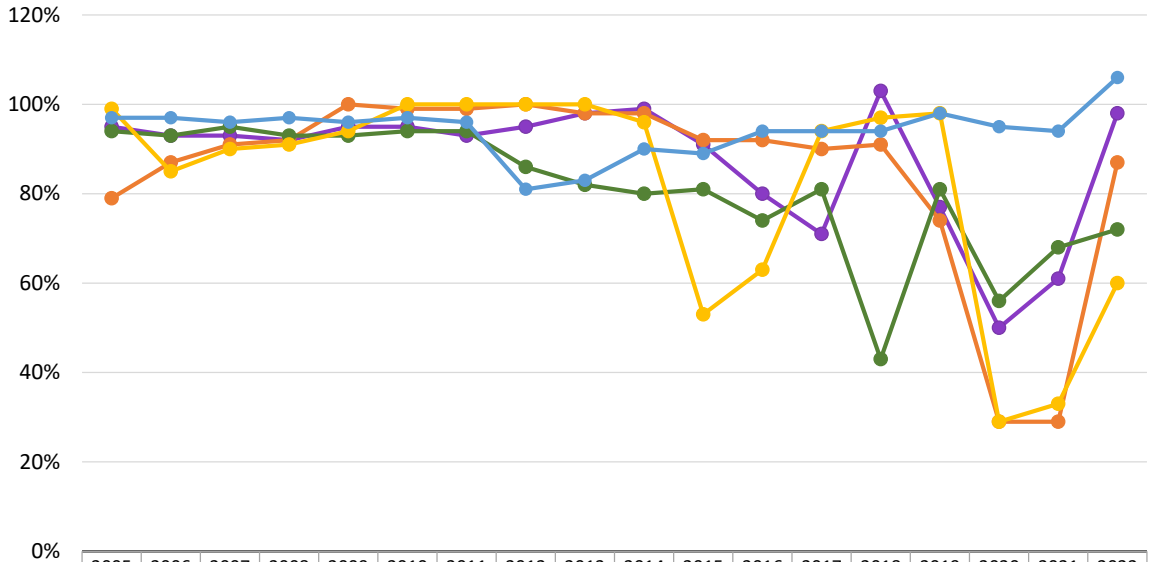


Figure 6

River Blindness Program: Reported Treatment Coverage (Eligible Population) by Country/Program, 2005 – 2022



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

Uganda: Treatment coverage percentage includes passive and refugee treatments.

Figure 7

Inventory of 'Stop MDA' for River Blindness (RB) and Lymphatic Filariasis (LF) in Carter Center-Assisted Programs 2022

RIVER BLINDNESS		
Country	Total Population residing in areas where MDA stopped 2007-2022	Stopped MDA in 2022
ETHIOPIA	2,986,558	1,378,558
NIGERIA	24,286,356	18,885,772
OEPA[1]	538,517	0
SUDAN	264,811	0
UGANDA[2,3]	2,621,227	0
TOTAL	**30,697,469**	**20,264,330**

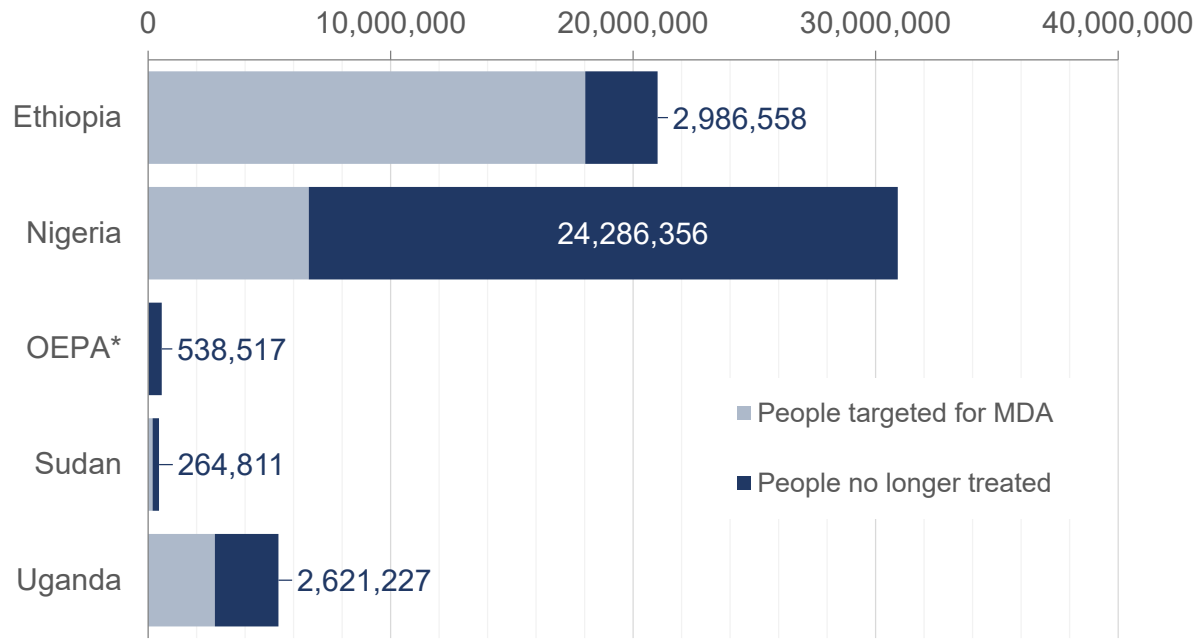
[1]Representing Brazil, Colombia, Ecuador, Guatemala, Mexico, and Venezuela.
[2]Excludes the eliminated Victoria focus (not TCC-assisted, eliminated in the 1970s), population 2.9 million.
[3] 225,087 is pending further investigation

LYMPHATIC FILARIASIS		
Country	Total Population residing in areas where MDA stopped 2016-2022	Stopped MDA in 2022
ETHIOPIA	1,502,458	70,425
NIGERIA	22,477,576	11,671,751
TOTAL	**23,980,034**	**11,742,176**

Figure 8

Population Currently and Previously Targeted for River Blindness Treatment with Mectizan®, 2022

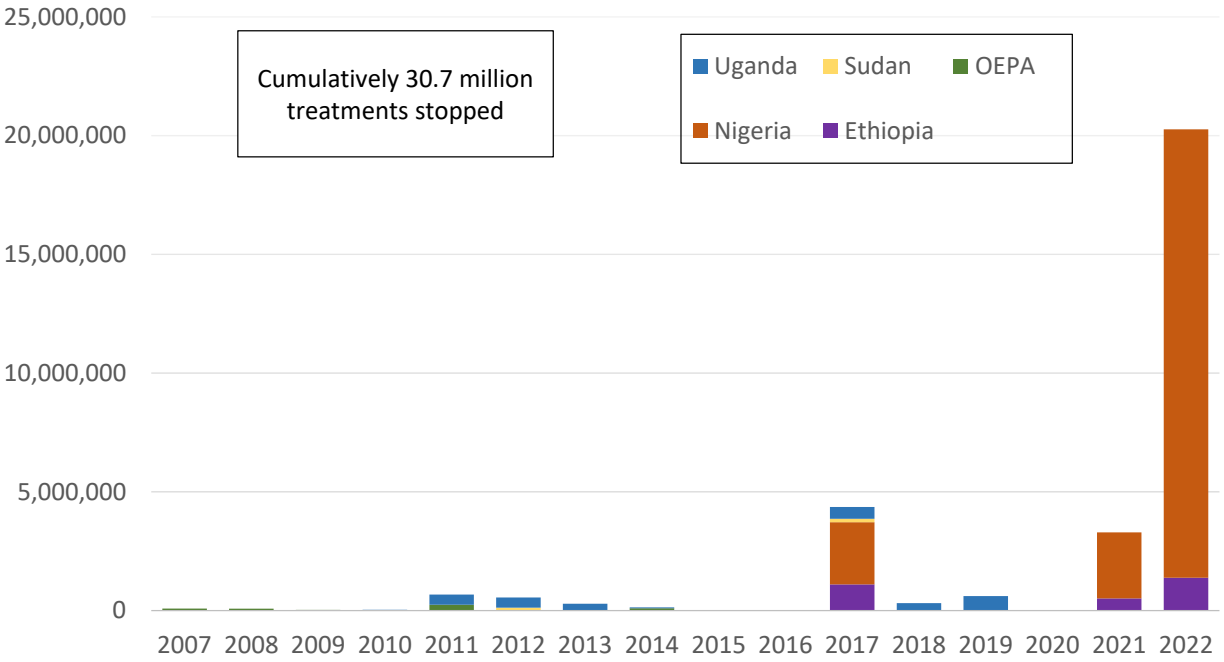
30.7 million people in nine Carter Center-assisted countries no longer need treatment as a result of our river blindness elimination partnership



**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 9

Onchocerciasis Stopped Treatments in Carter Center-assisted Areas by Country and Year, 2007-2022



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 10

Population Currently and Previously Targeted for Lymphatic Filariasis Treatment 2022

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

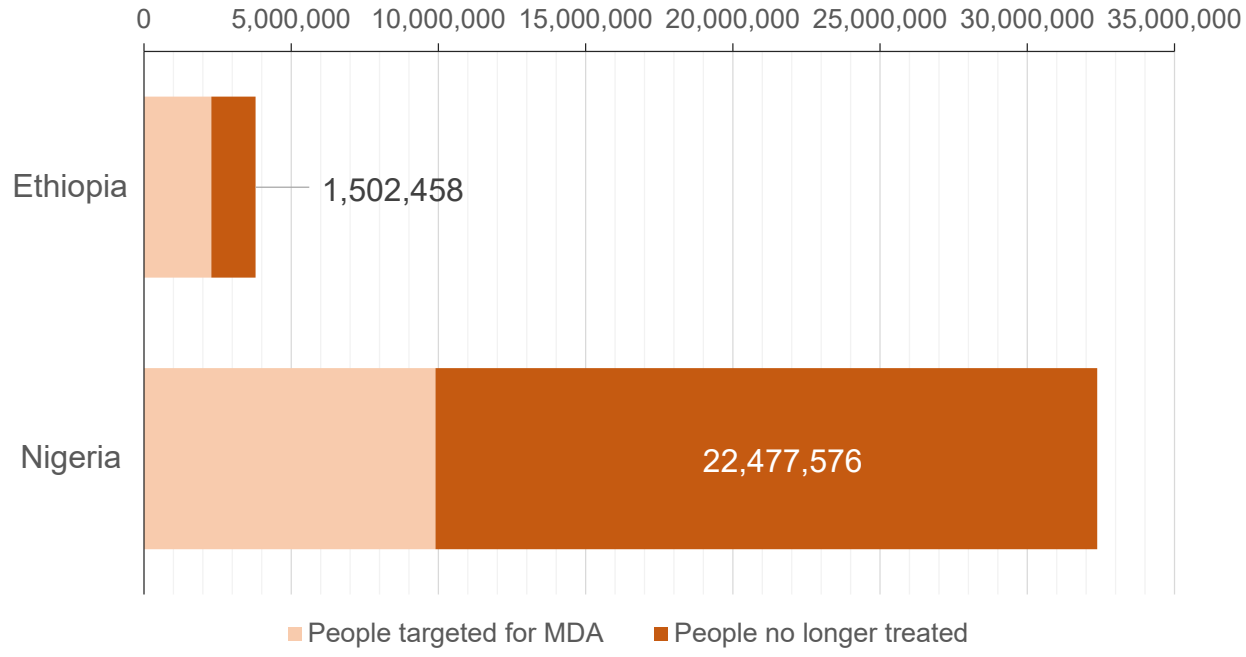


Figure 11

Lymphatic Filariasis Stopped Treatments in Carter Center-assisted areas, by Country and Year, 2016-2022

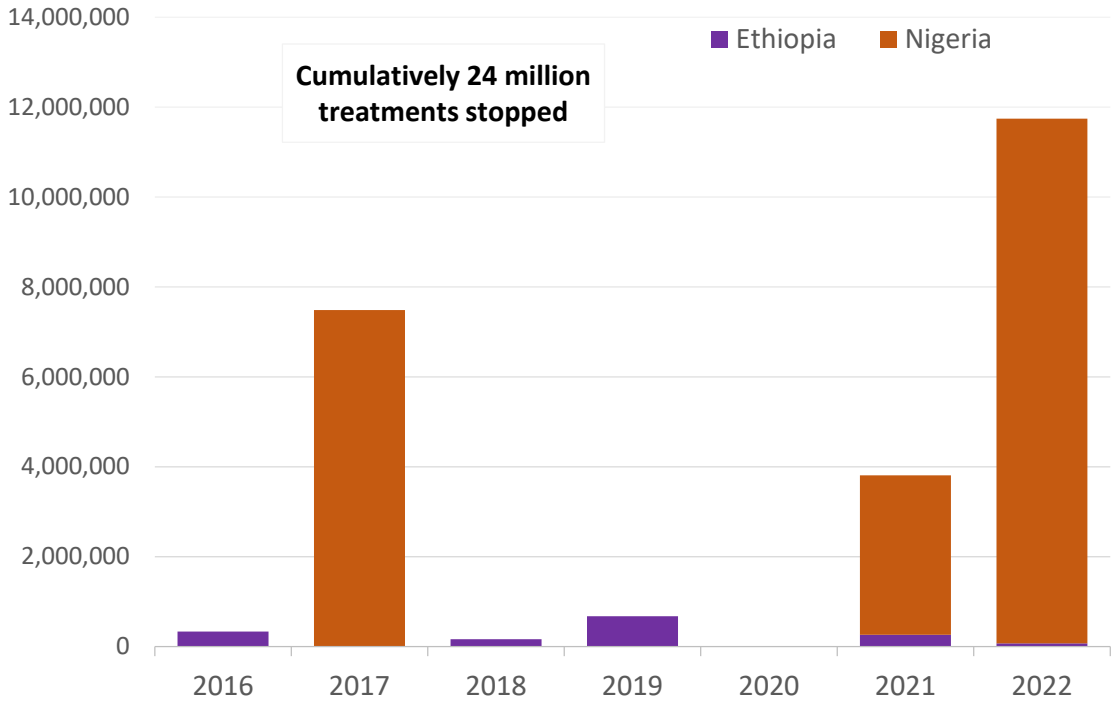
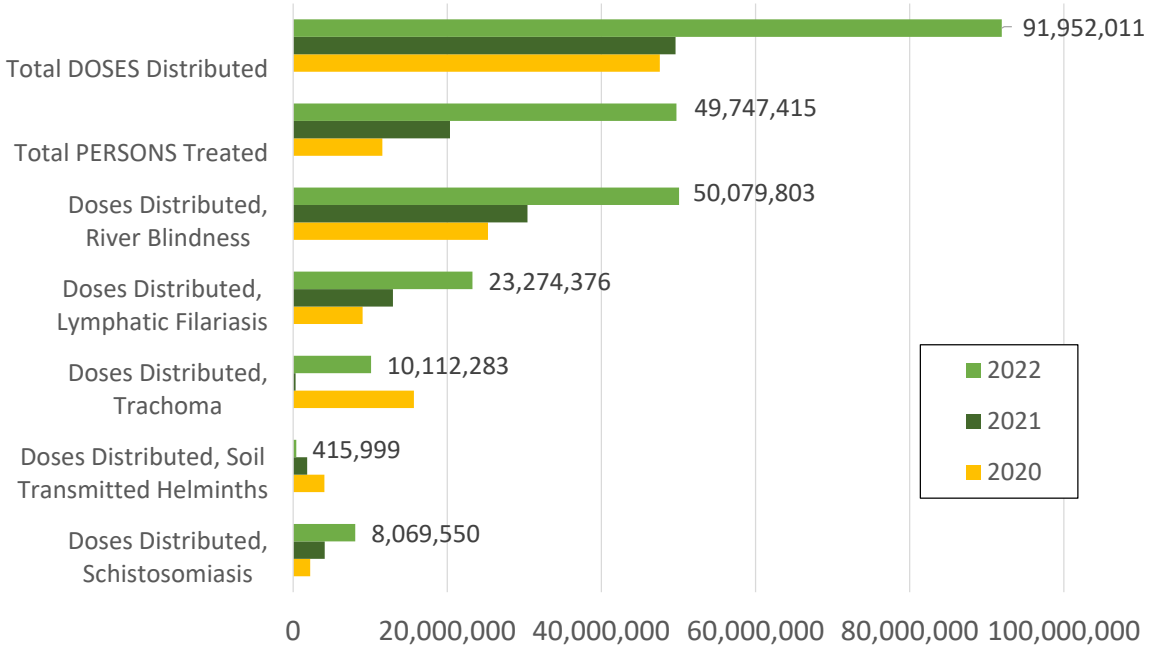


Figure 12

Carter Center-Supported Treatment Doses and Persons Treated for Neglected Tropical Diseases, 2020 – 2022



- *RB total includes 365,159 passive and refugee treatments.*
- *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 13

Community-Directed Distributors (CDDs) Trained 2004 – 2022 and 2023 Targets

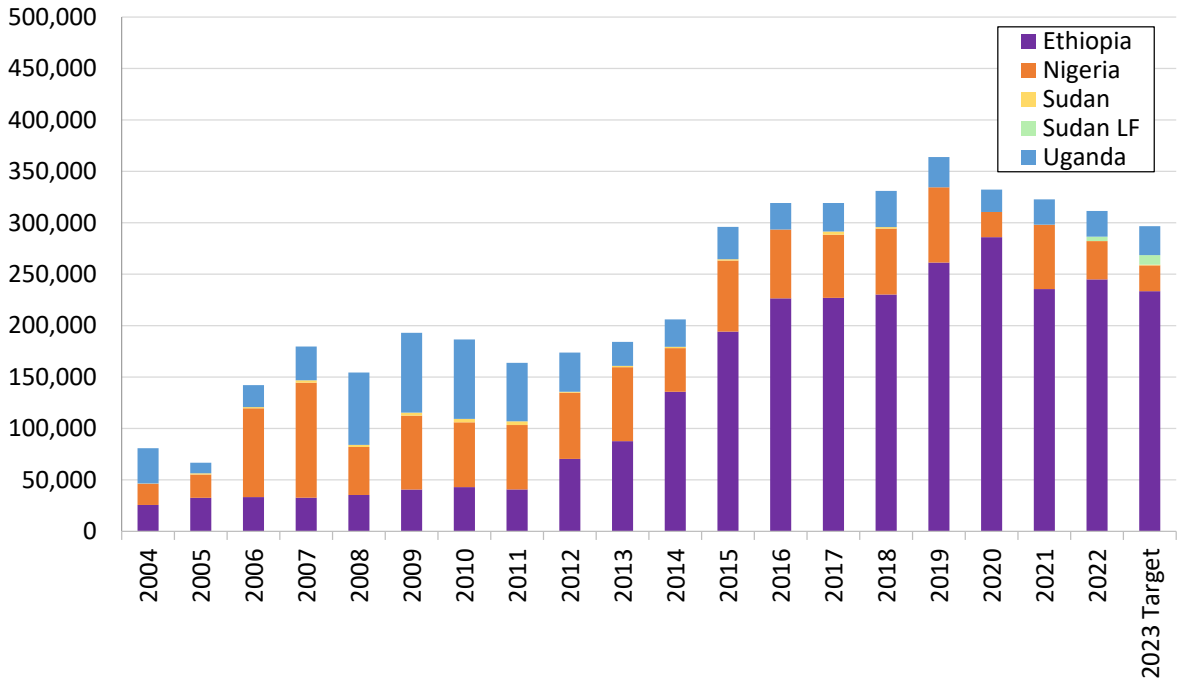
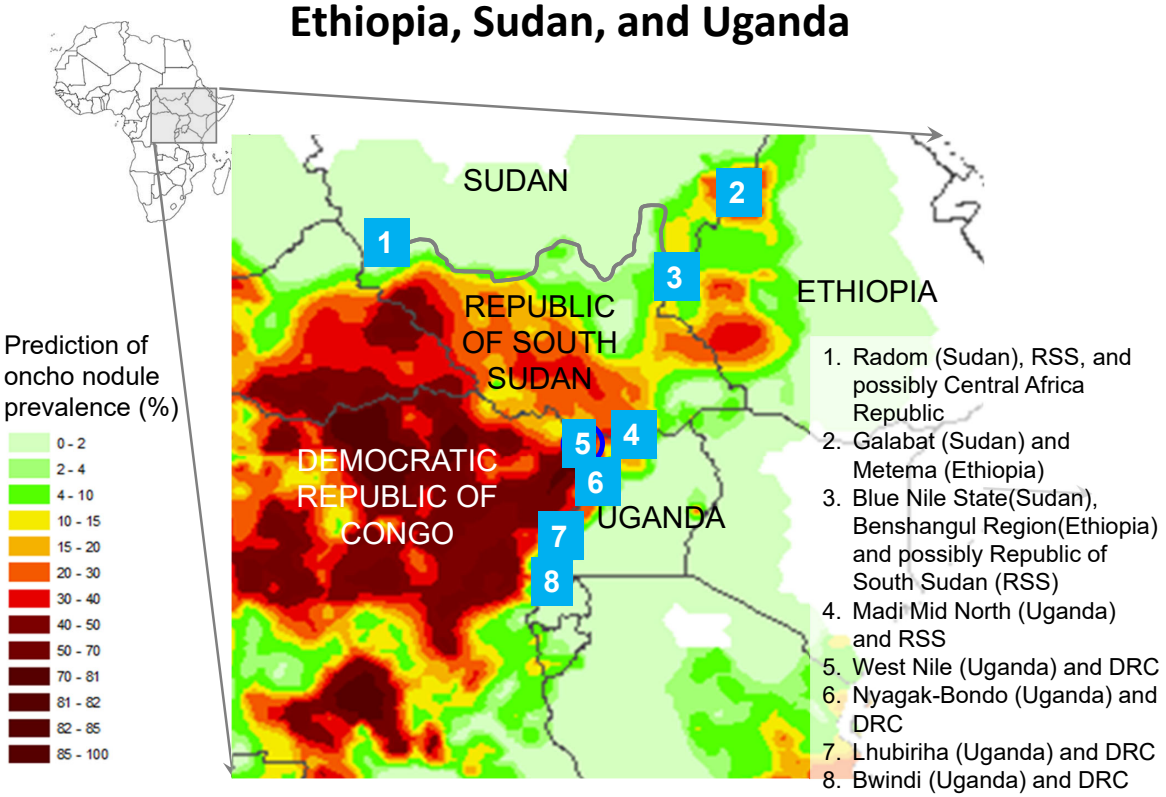


Figure 14

Carter Center-Assisted Special Intervention Zones in Ethiopia, Sudan, and Uganda



Map source: APOC

Figure 15

OEPA Geographic distribution and transmission status of Onchocerciasis in the Americas in 2022

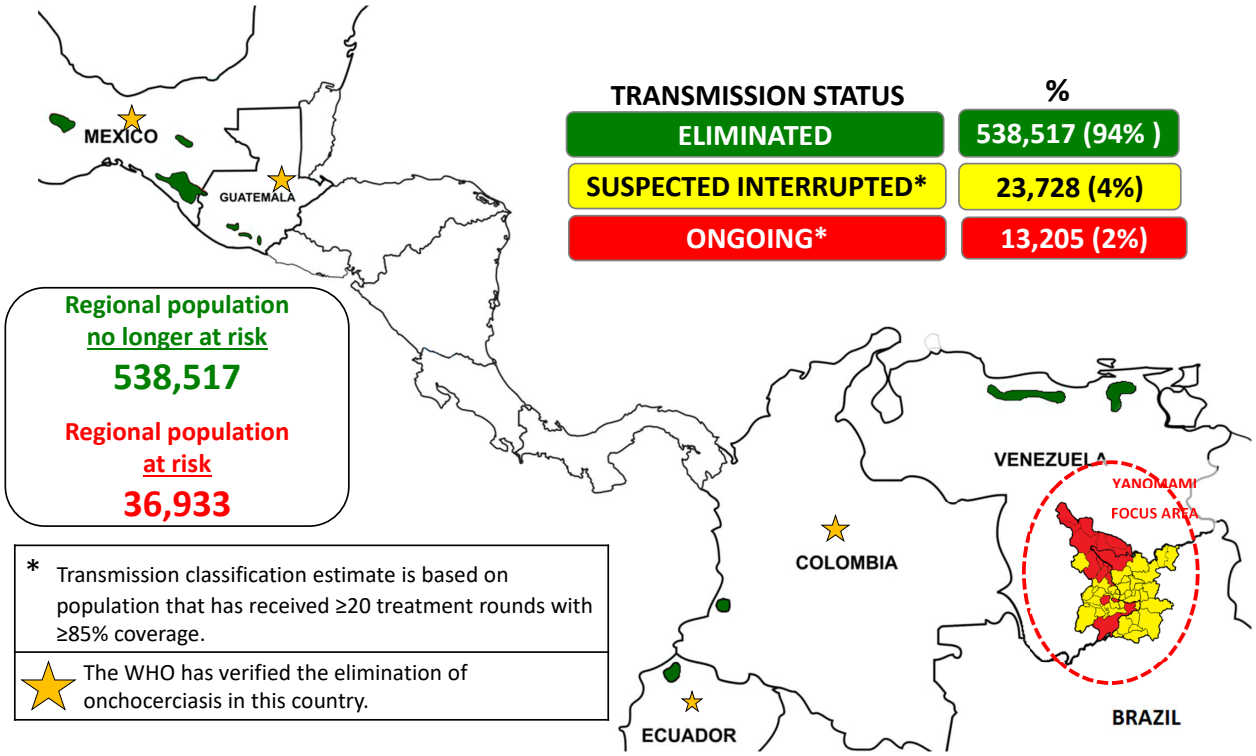


Figure 16

OEPA: Mectizan® Treatment for Onchocerciasis in the Americas 1989 – 2022 and 2023 target

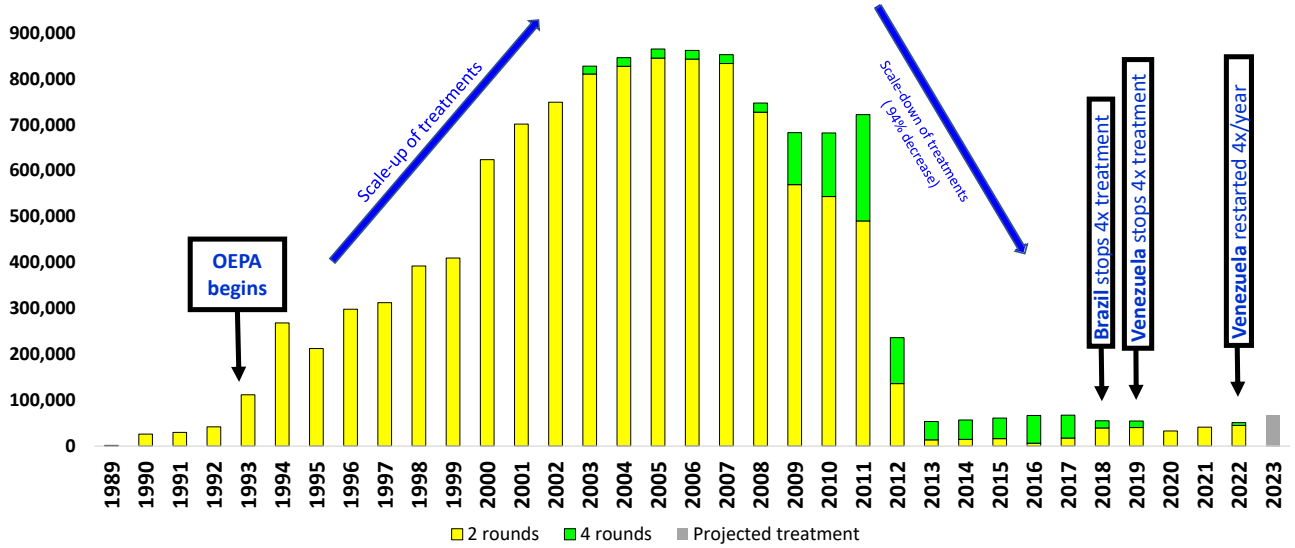


Figure 17

OEPA: Regional Population at Risk, No Longer at Risk and Eligible for Treatment in 2022

Focus	Number of Communities	Population at Risk	Population Out of Risk	Transmission Status
Lopez de Micay-COL	1		1,366	Eliminated in 2010 Verified in 2013 ★
Esmeraldas-ECU	119		25,863	Eliminated in 2012 Verified in 2014 ★
North Chiapas-MEX	13		7,125	Eliminated in 2010, 2011, 2014 Verified in 2015 ★
Oaxaca-MEX	98		44,919	
South Chiapas-MEX	559		117,825	
Escuintla-GUA	117		62,590	Eliminated in 2010, 2010, 2011, 2014 Verified in 2016 ★
Santa Rosa-GUA	37		12,208	
Huehuetenango-GUA	43		30,239	
Central-GUA	321		126,430	
Northcentral -VEN	45		14,385	Eliminated in 2013
Northeast -VEN	465		95,567	Eliminated in 2017
South-VEN	261	12,530		**Suspected Interrupted***
	132	5,588		**Ongoing***
Amazonas-BRA	160	11,198		**Suspected Interrupted***
	112	7,617		**Ongoing***
Regional total	**2,483**	**36,933**	**538,517**	

★ WHO has verified elimination in the country.

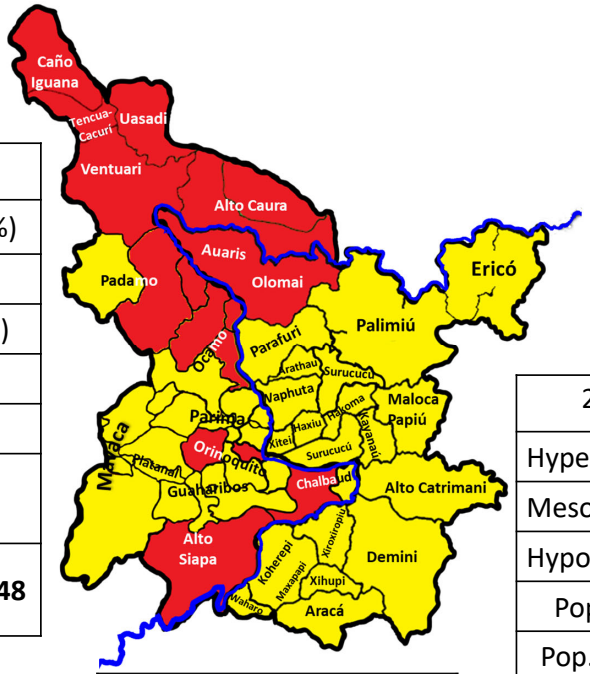
* Transmission classification estimate is based on population that received ≥20 treatment rounds with ≥85% coverage

Figure 18

OEPA: Subareas of the Yanomami Focus Area (YFA) in 2023

Venezuela

394 Communities	
Hyper	270 (68.5%)
Meso	47 (12%)
Hypo	77 (19.5%)
Pop. at risk	18,452
Pop. eligible	15,917
327 Communities UTG2: **27,260**	
67 communities UTG4: **9,148**	



Based on number of effective treatment rounds received

Brazil

273 Communities	
Hyper	124 (45%)
Meso	76 (28%)
Hypo	73 (27%)
Pop. at risk	19,593
Pop. eligible	15,650
UTG2 31,300	

UTG2 & UTG 4 for the YFA in 2023: **67,708**

Figure 19

OEPA: Scorecard Method of Community Prioritization

	Score Range Established	Color	Priority	2022 communities		2021 communities		Change – Number of communities*
				Number	% in category	Number	% in category	
Brazil	<=10		Low	153	56%	142	52%	11
	11 - 15		Medium	103	38%	110	40%	-7
	>=16		High	16	6%	21	8%	-5
	TOTAL			**272**	**100%**	**273**	**100%**	
Venezuela	<=4		Low	284	72%	260	68%	24
	5 - 8		Medium	47	12%	33	9%	14
	>=9		High	62	16%	88	23%	-26
	TOTAL			**393**	**100%**	**381**	**100%**	

*total community numbers each year vary due to splitting and merging of communities. 12 communities in Brazil and 26 in Venezuela improved their scores in 2022.

Figure 20

OEPA: Twice-per-year Mectizan® Treatments Distributed in Brazil and Venezuela in 2022

Focus	Pop at Risk	Eligible for Treatment	Treated 1st Rd (Coverage %)	Treated 2nd Rd (Coverage %)	Treatment Goal*	Annual Treated UTG(2) (Coverage)	Treatments by Sex (Percentage)	
							Female	Male
Amazonas-BRA	18,815	15,482	8,247 (53%)	9,774 (63%)	30,964	18,021 (58%)	8,789 (49%)	9,232 (51%)
South- VEN, 1st semester (356 communities)	16,409	14,326	11,850 (83%)		27,871	23,467 (84%)	5,656 (48%)	6,194 (52%)
South- VEN, 2nd semester (326 communities)	15,480	13,545		11,617 (86%)			5,576 (48%)	6,041 (52%)
Total			**20,097 (67%)**	**21,391 (74%)**	**58,835**	**41,488 (71%)**	**20,021 (48%)**	**21,467 (52%)**

*Treatment goal for the Venezuela South Focus differs for the two semesters, as 30 communities moved to the quarterly approach during the second half of 2022.

Source: Onchocerciasis Country Programs

Figure 21

OEPA: Four-times-per-year Mectizan® Treatments Distributed in Venezuela in 2022

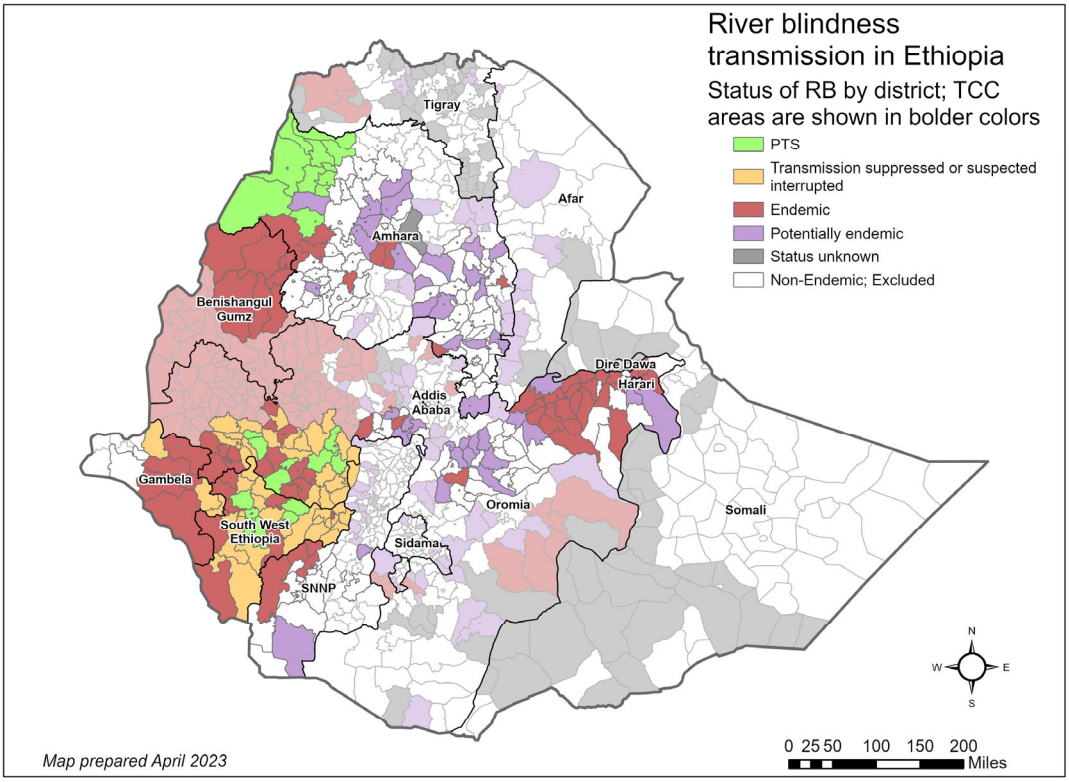
Communities	Pop at Risk	Eligible for Treatment	First Semester		Second Semester		Treatment Goal	Total Treated	% Coverage of Goal
			Treated 1st Rd	Treated 2nd Rd	Treated 3rd Rd	Treated 4th Rd			
Phase 1* (37 communities)	1,709	1,463	1,386 (95%)	1,255 (86%)	1,321 (90%)	1,226 (84%)	5,852	5,188	89%
Phase 2 (30 communities)**	929	781			548 (70%)	520 (67%)	1,562	1,068	68%
Totals	**2,638**	**2,244**	**1,386 (95%)**	**1,255 (86%)**	**1,869 (83%)**	**1,746 (78%)**	**7,414**	**6,256**	**84%**

* Phase 1 communities conducted quarterly treatments for the whole of 2022.
** Phase 2 communities treated once in first semester (which appears in previous slide) and moved to quarterly in the second semester.

Source: Onchocerciasis Country Programs

Figure 22

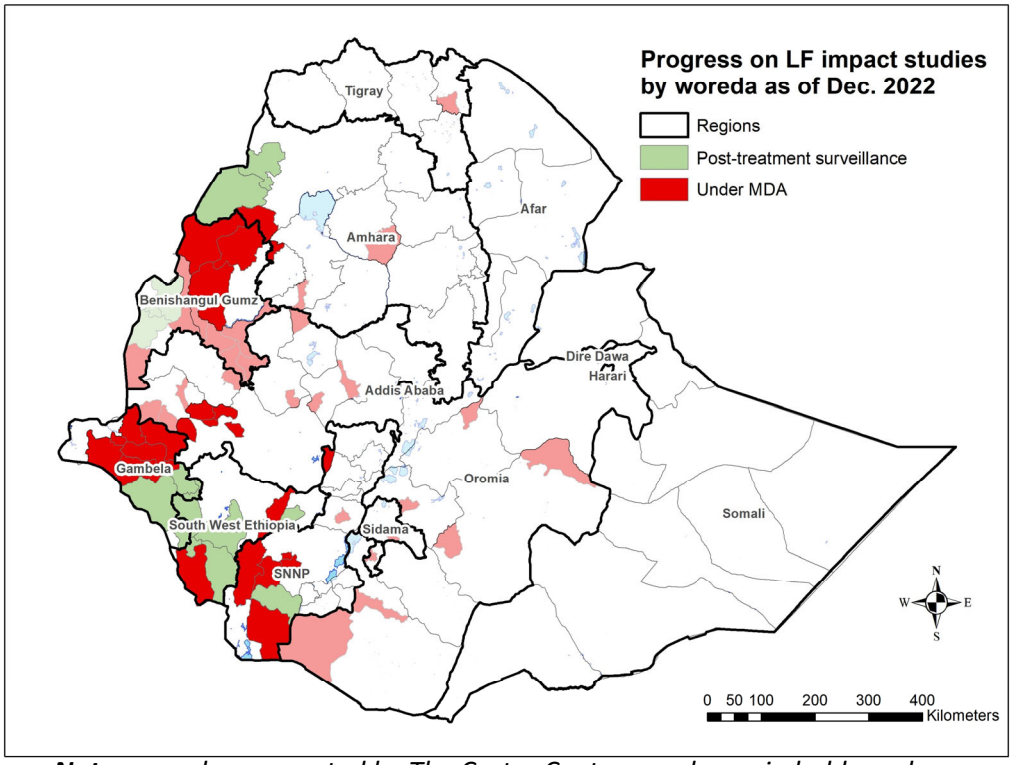
Ethiopia: Status of River Blindness Elimination, by District (Woreda), 2022



***Note**: woredas supported by The Carter Center are shown in bolder colors.*

Figure 23

Ethiopia: Status of Lymphatic Filariasis Elimination, by District (Woreda), 2022



***Note**: woredas supported by The Carter Center are shown in bolder colors.*

Figure 24

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

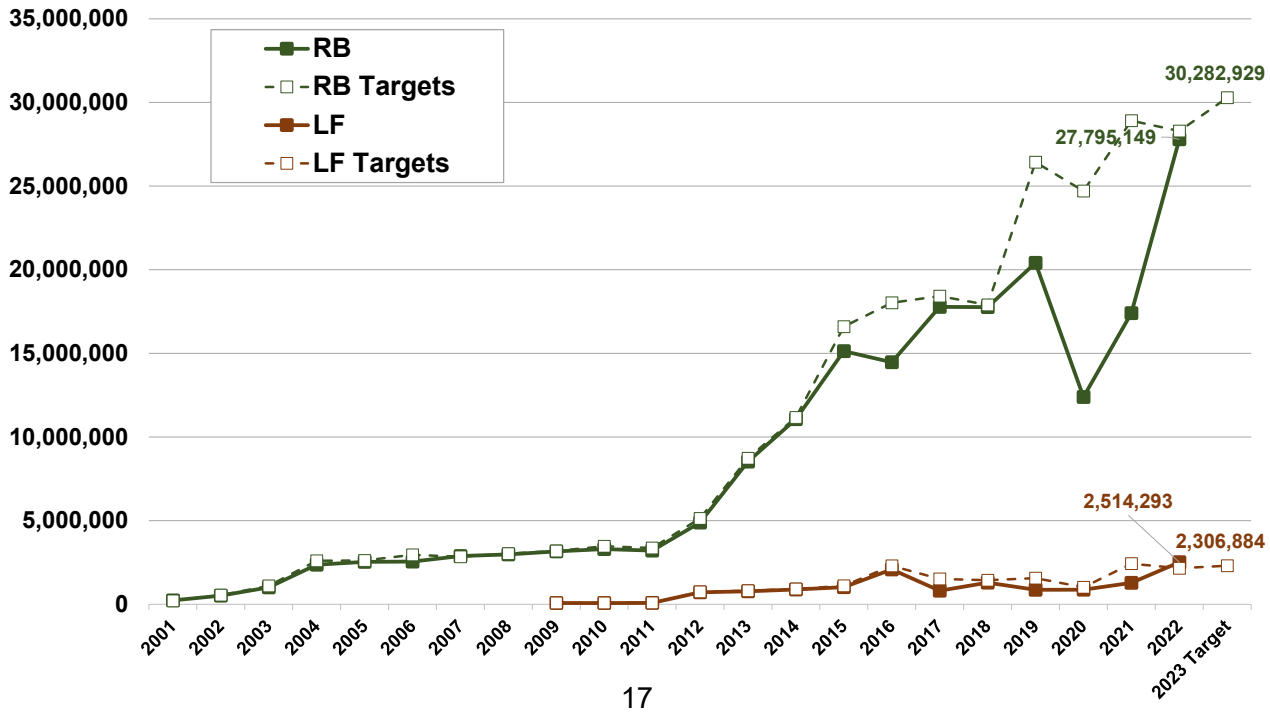


Figure 25

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

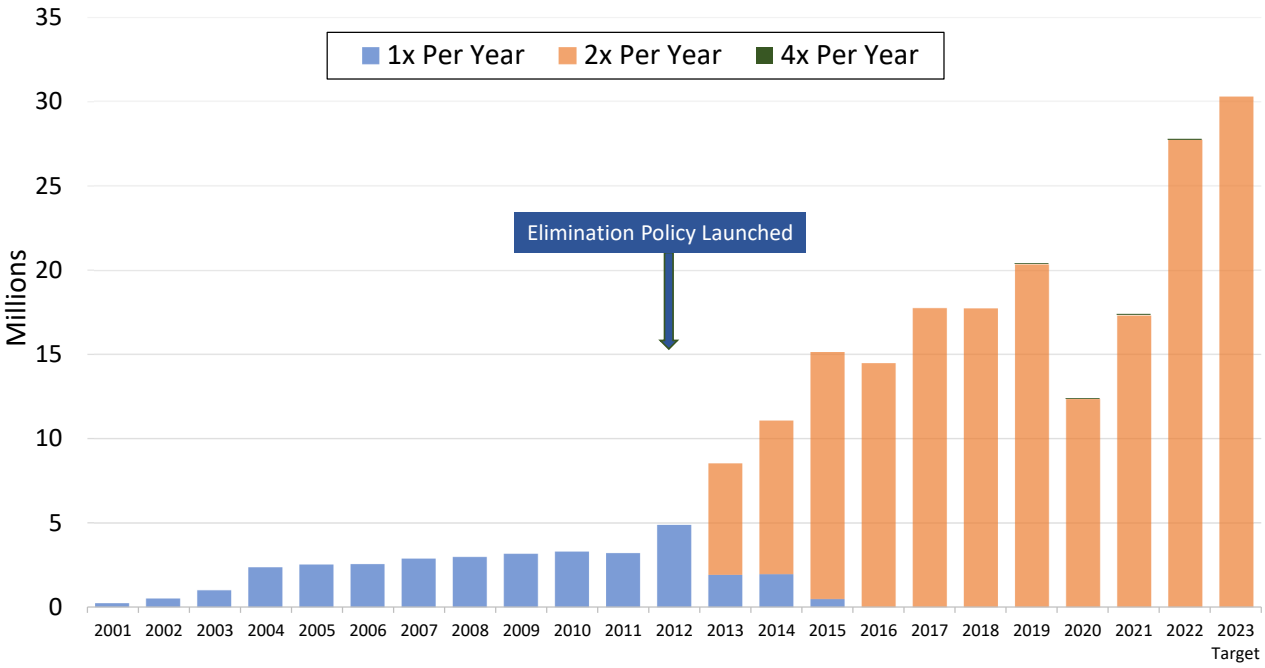
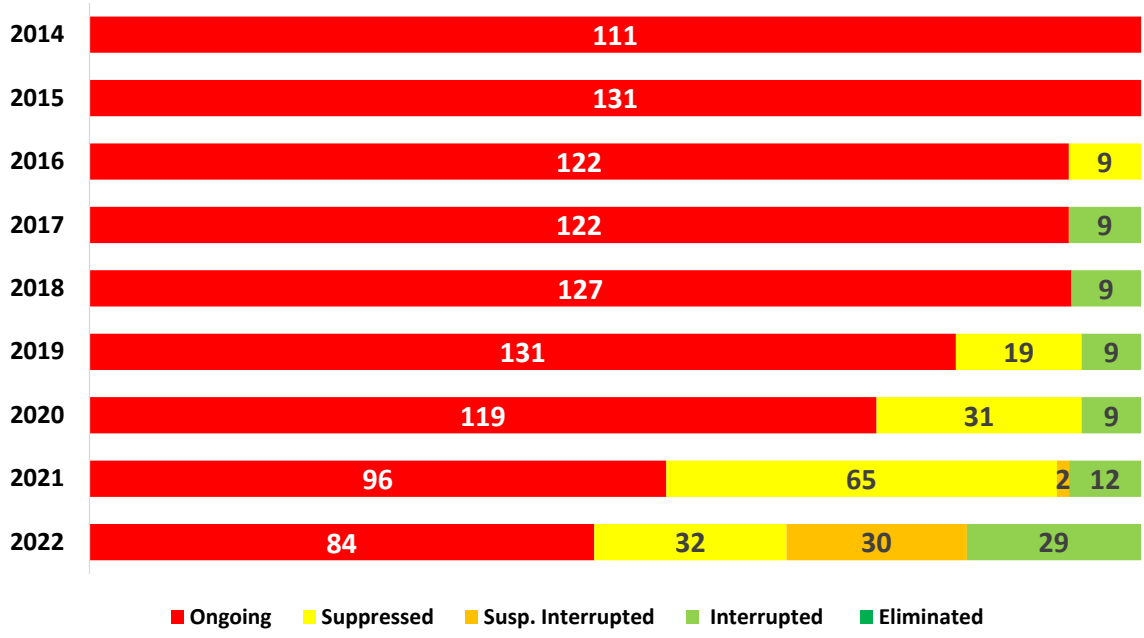


Figure 26

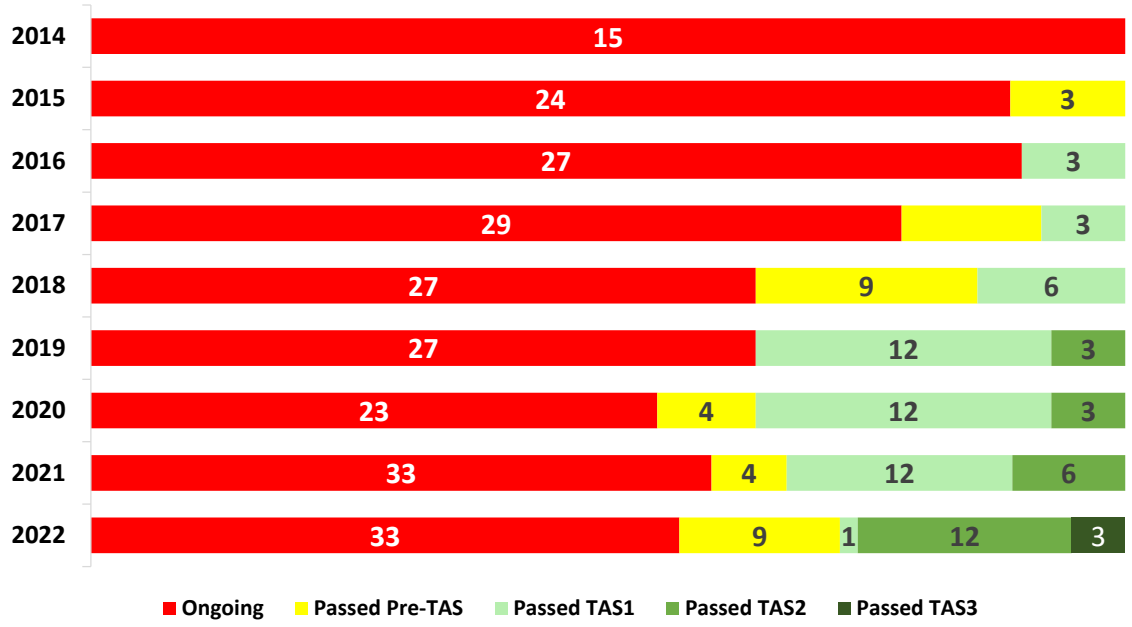
Ethiopia: Progress in Onchocerciasis Elimination, Transmission Status by Woreda (District) in Carter Center-assisted areas, 2014-2022



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, 2014-2022



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

Figure 28

Nigeria: Status of Onchocerciasis Elimination, 2022

2022 NOEC RECOMMENDATIONS

1. Enugu/Anambra/Imo/Abia move from "suspected interrupted" to "transmission interrupted" (Tan to Ash) and stop-MDA
2. Sokoto and Gombe move from "no data" to "suspected interrupted" (Blue to Tan). Benue moved from Red to Tan.
3. FMoH to prioritize conducting LF assessment in LF/Oncho co-endemic LGAs especially where stop-MAM for Onchocerciasis have been achieved.
4. A 7-person committee was constituted to develop PTS and OEM procedures in Onchocerciasis and LF co-endemic areas.

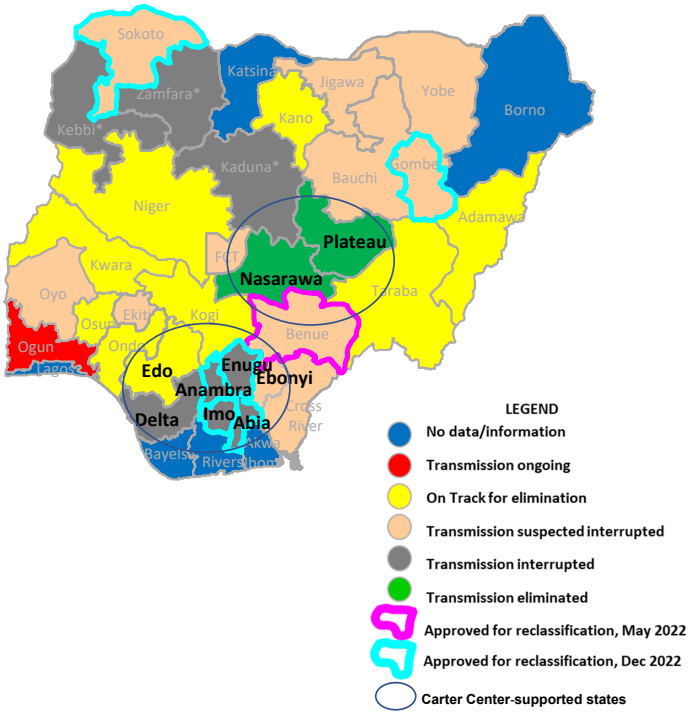


Figure 29

Nigeria: Progress in National Onchocerciasis Elimination: Transmission Status by State and Federal Capital Territory, 2015 - 2022

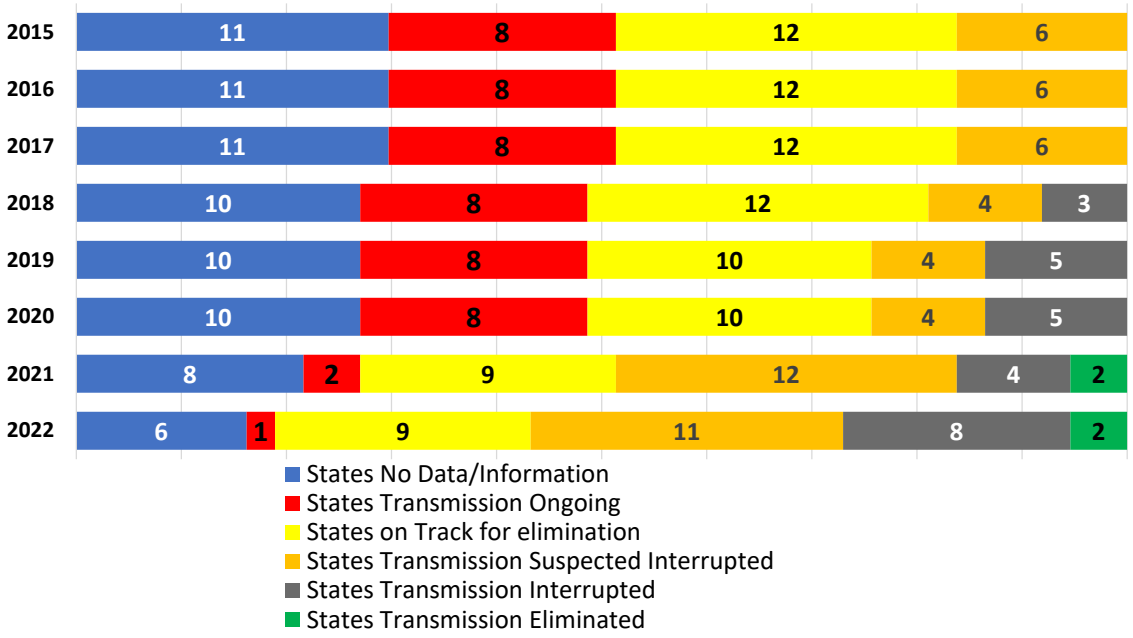
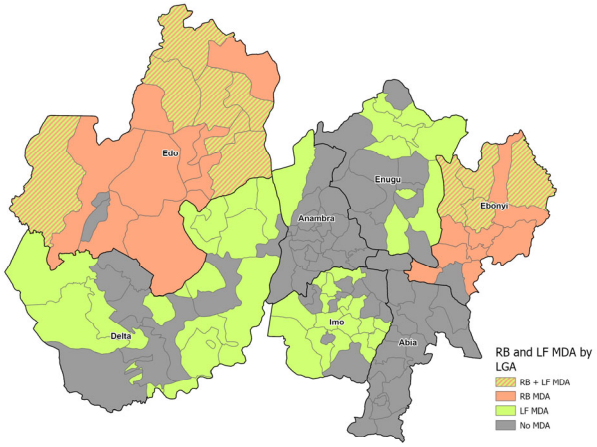


Figure 30

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

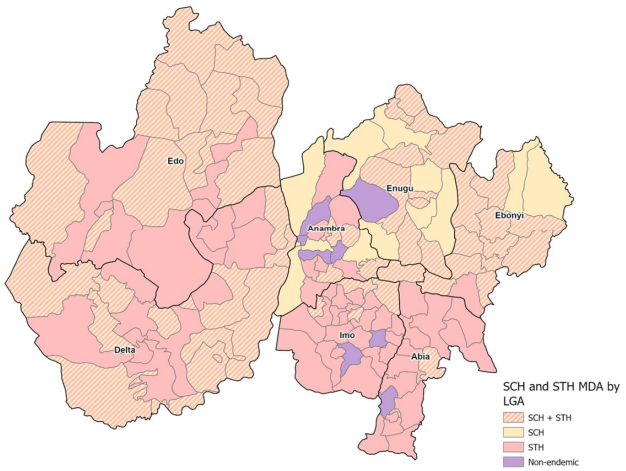
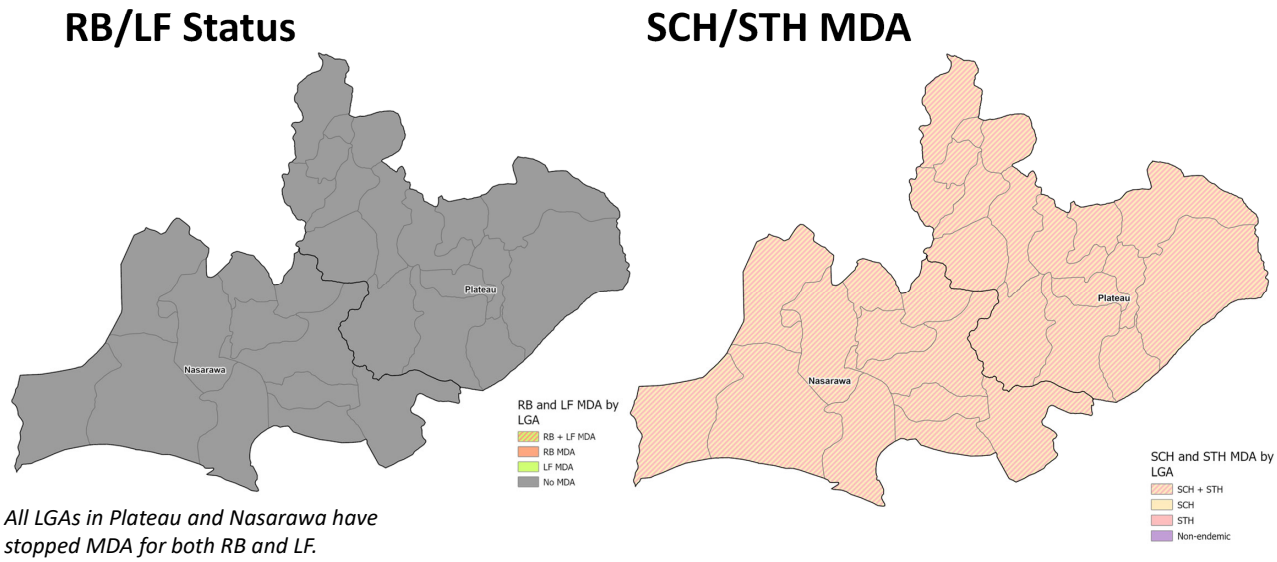


Figure 31

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



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

Figure 32

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

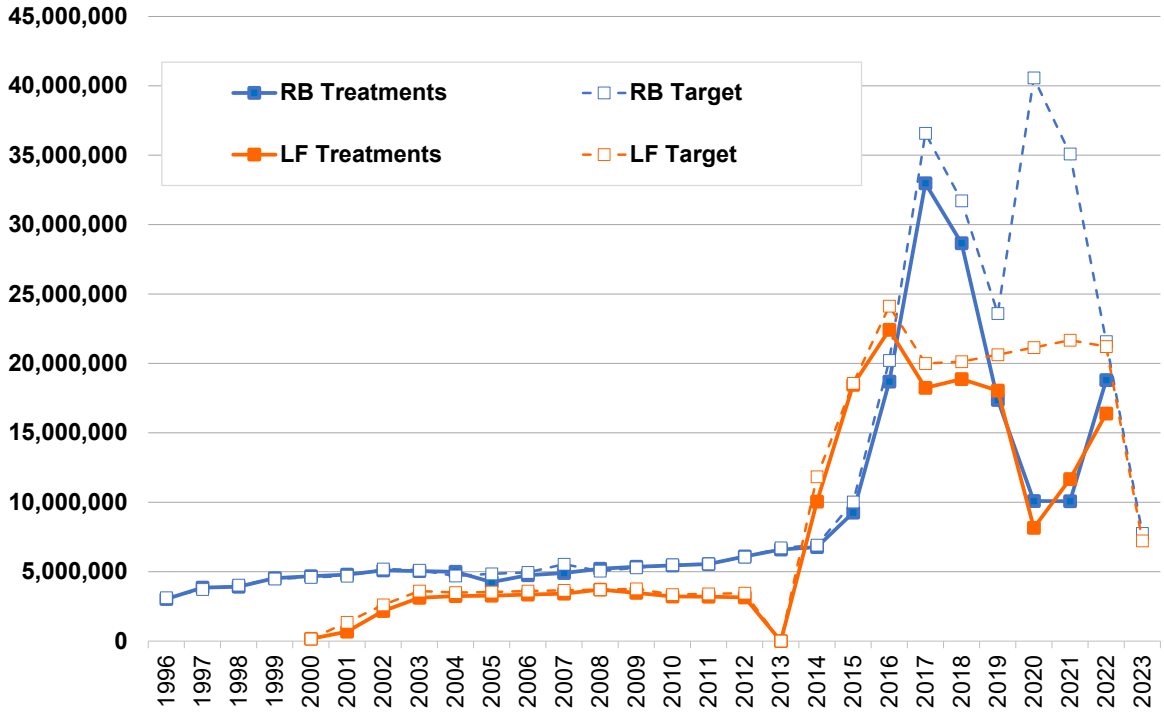
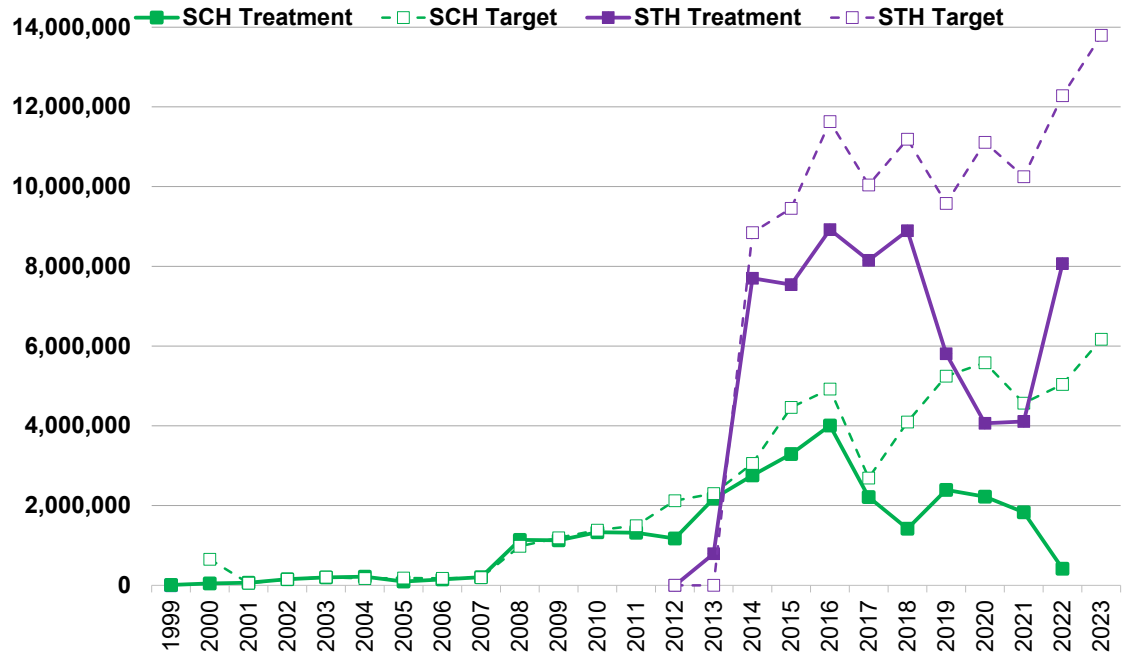


Figure 33

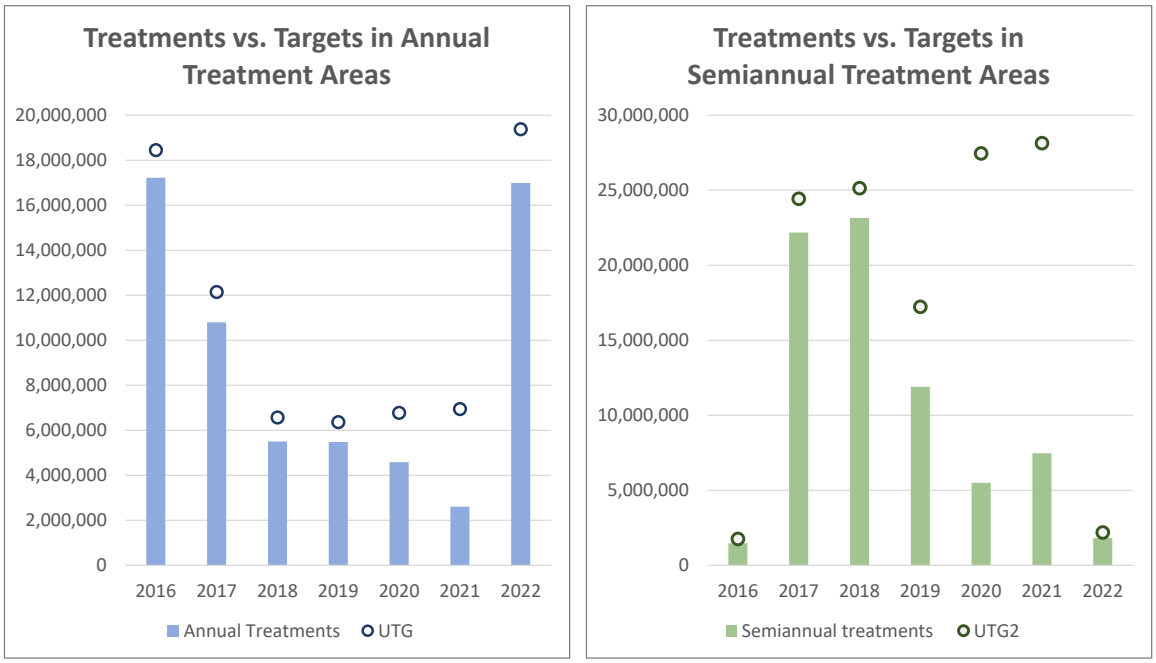
Nigeria: Carter Center-assisted annual treatments and 2023 targets for Soil Transmitted Helminths (STH) and Schistosomiasis (SCH)*



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

Figure 34

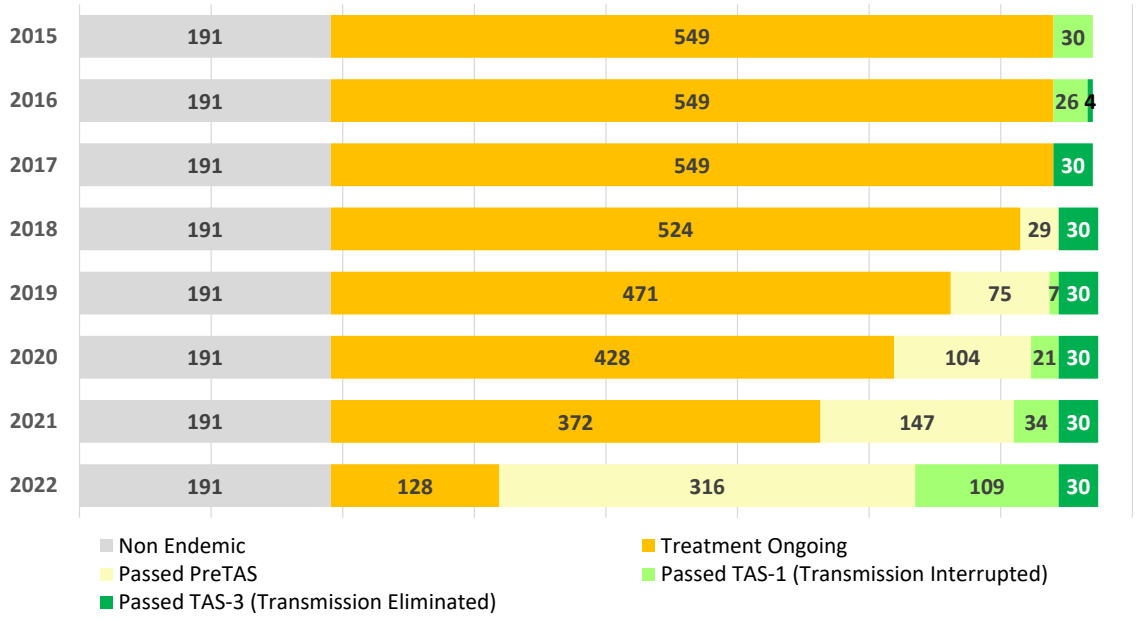
Nigeria: Carter Center-assisted Annual and Semiannual Mectizan® Treatments versus Targets for Onchocerciasis*



** 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. 2022 saw a return to high treatment coverage.*

Figure 35

Nigeria: Progress in National Lymphatic Filariasis Elimination: Transmission Status by Local Government Area, 2015 - 2022

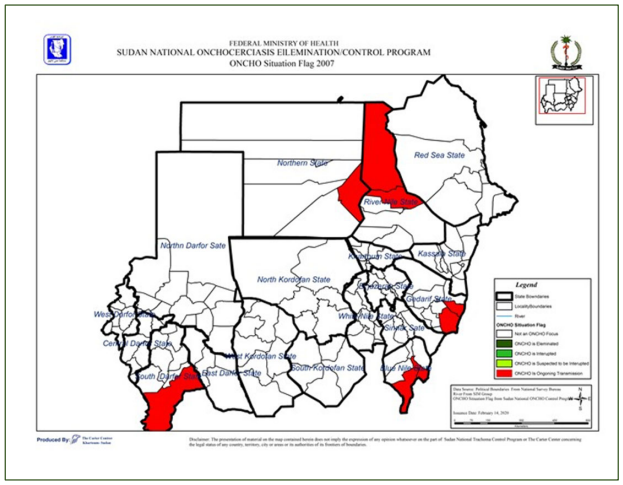


Data Source: FMOH and Partners

Figure 36

Sudan: Progression of Onchocerciasis Elimination

2007



2022

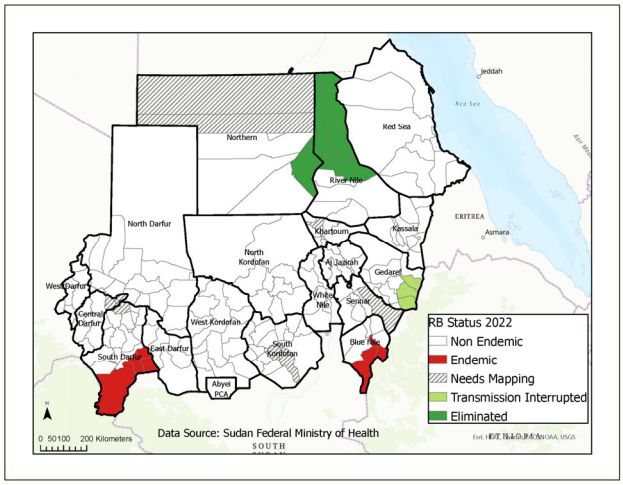


Figure 37

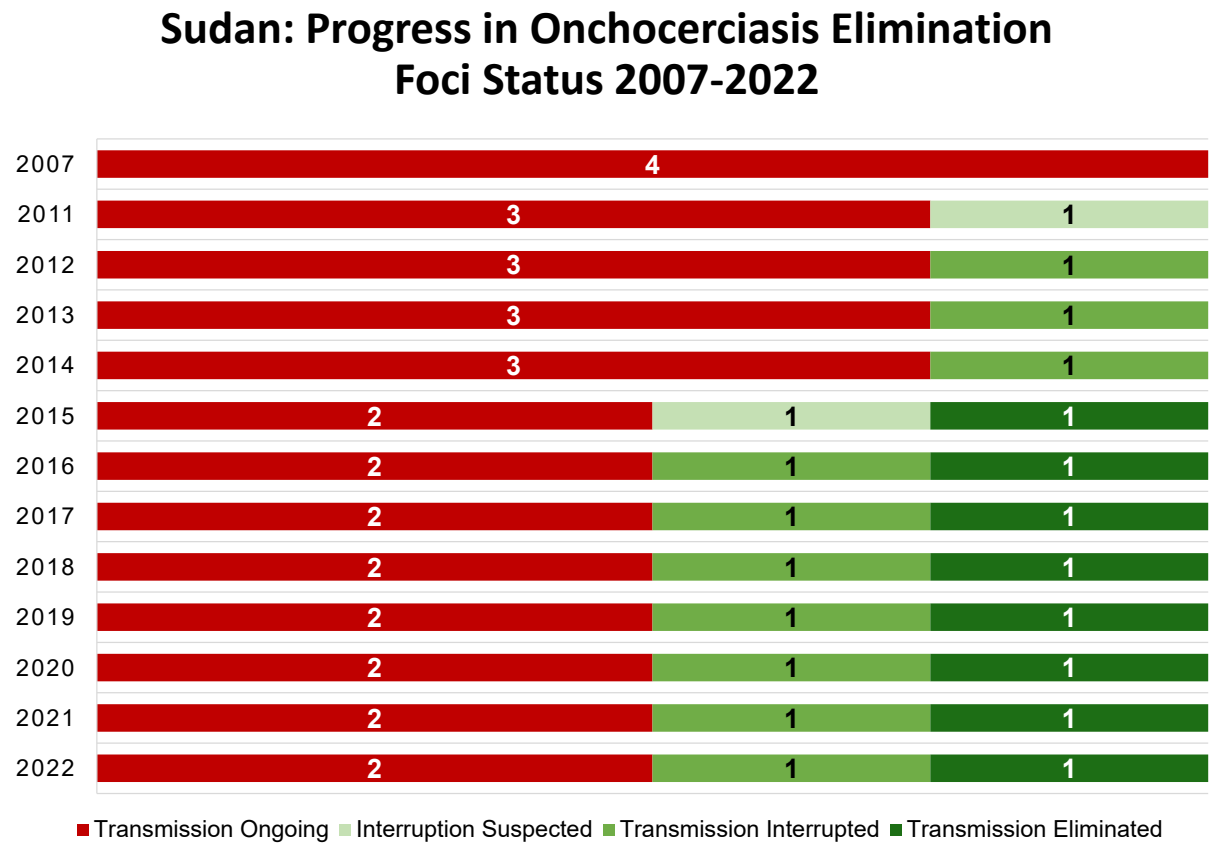


Figure 38

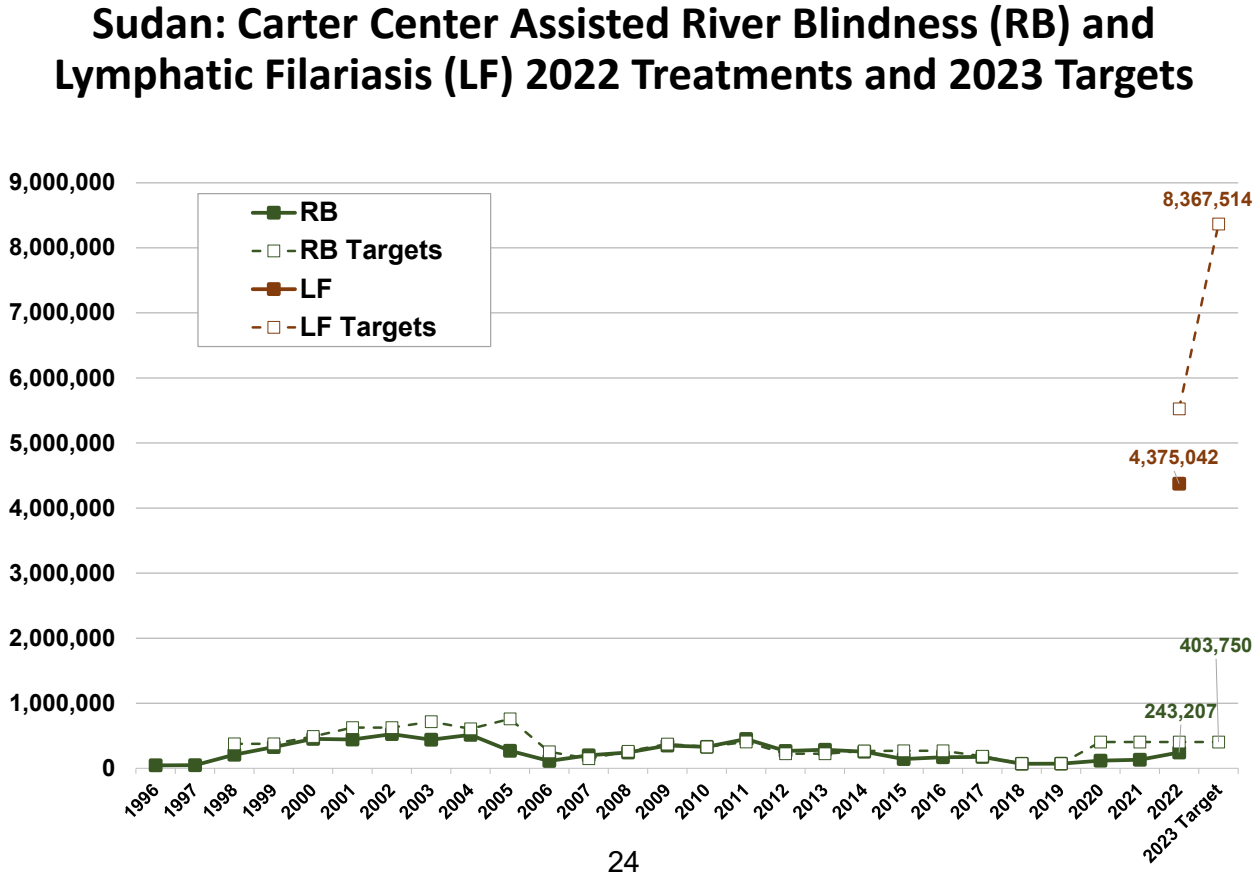


Figure 39

Sudan: Progress of Lymphatic Filariasis Elimination 2017 - 2022

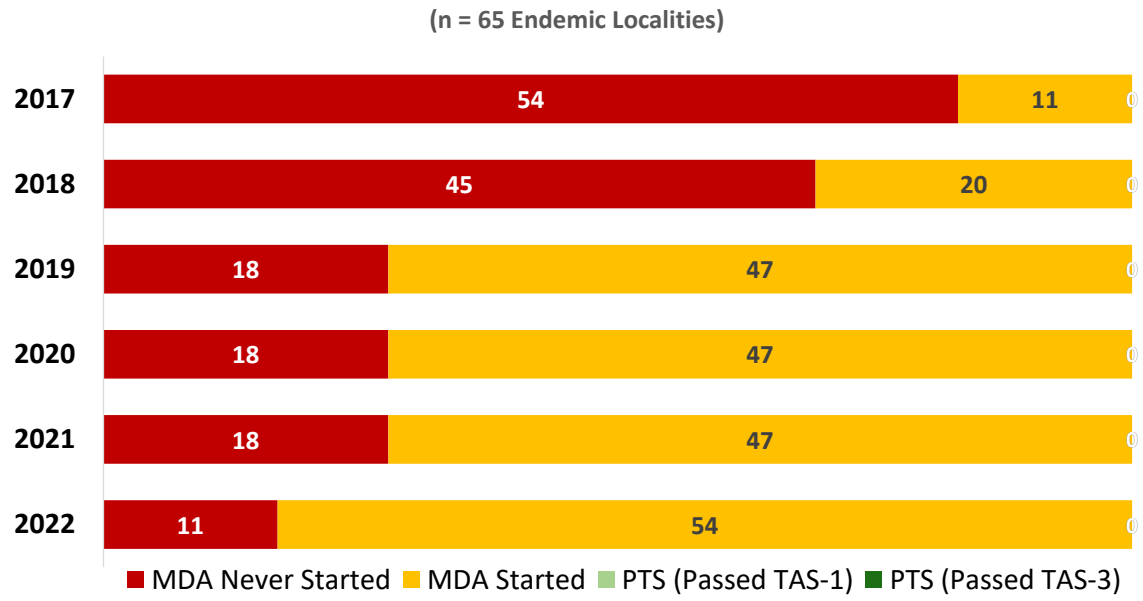
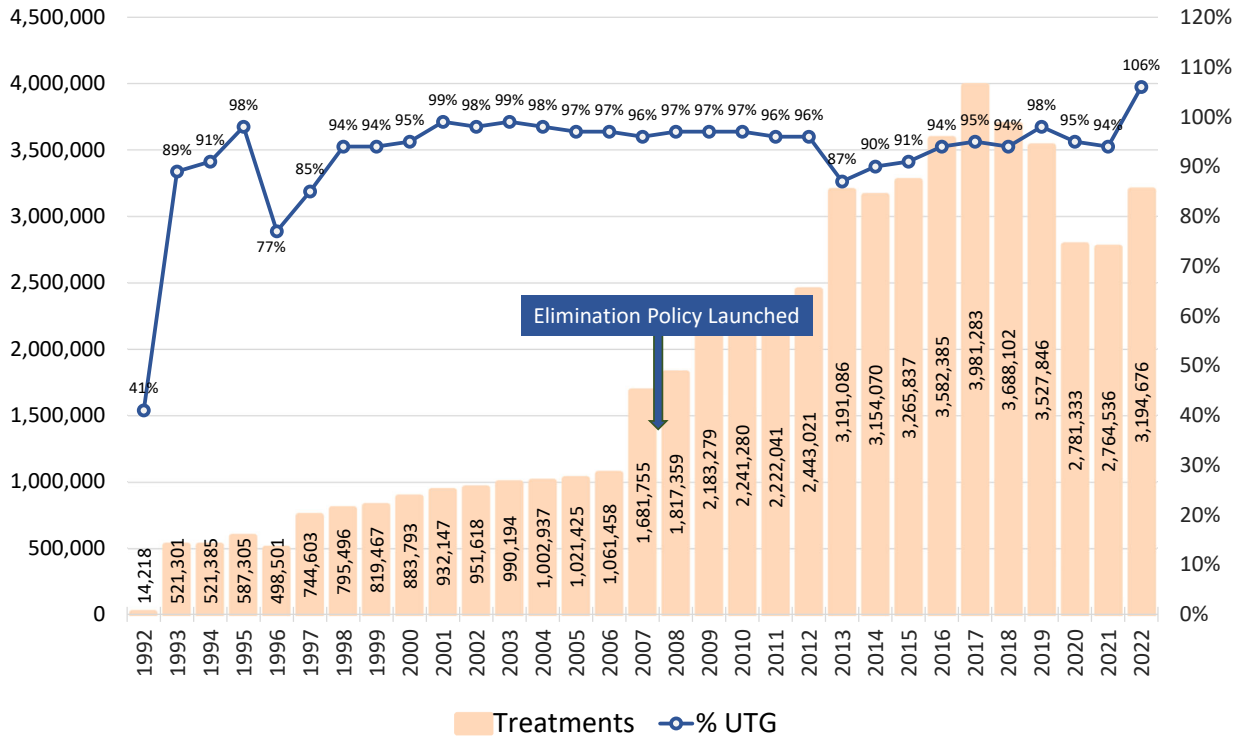


Figure 40

Uganda Carter Center-Assisted Mectizan® Treatments* 1992-2022



*Includes passive and refugee treatments

Figure 41

Uganda: Progress of River Blindness Elimination
Foci Status 2007-2022

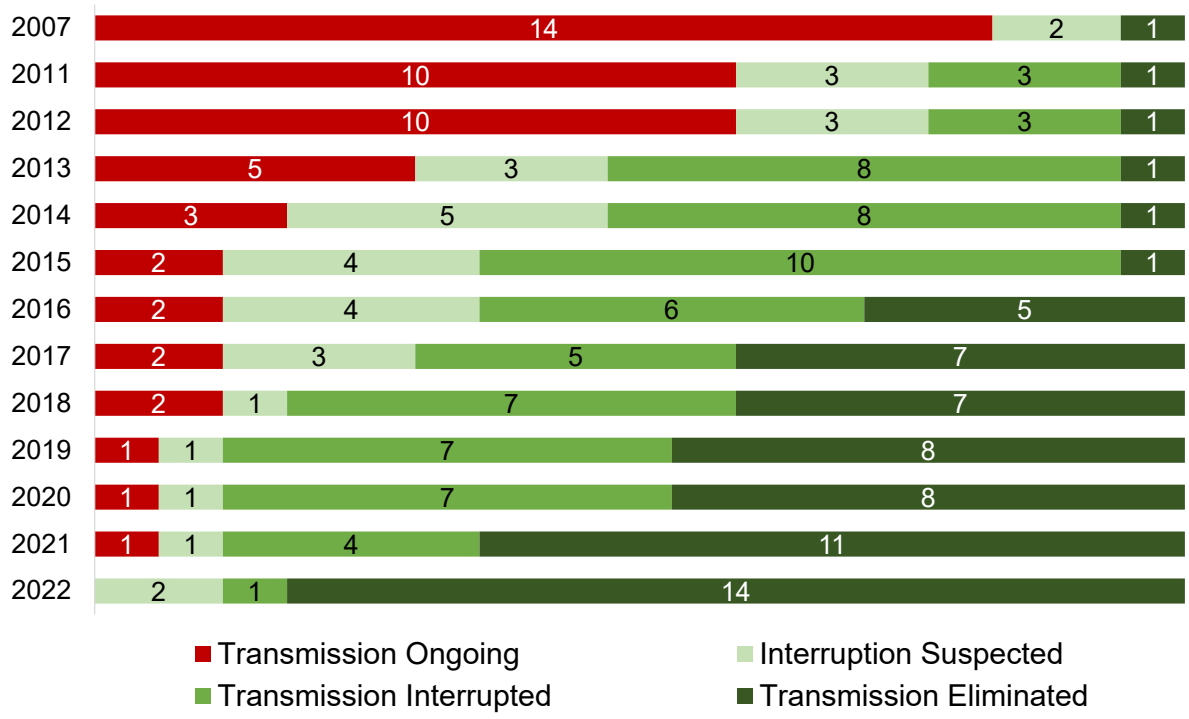
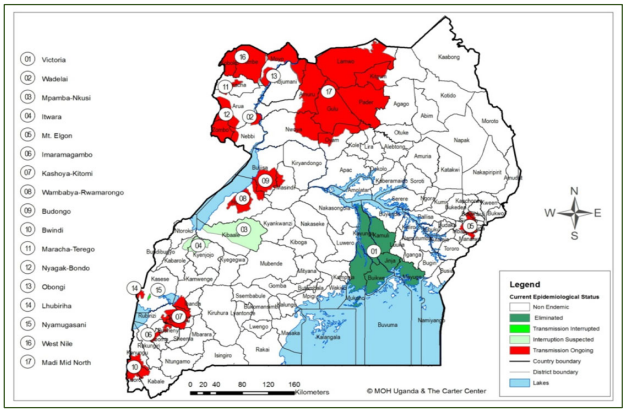


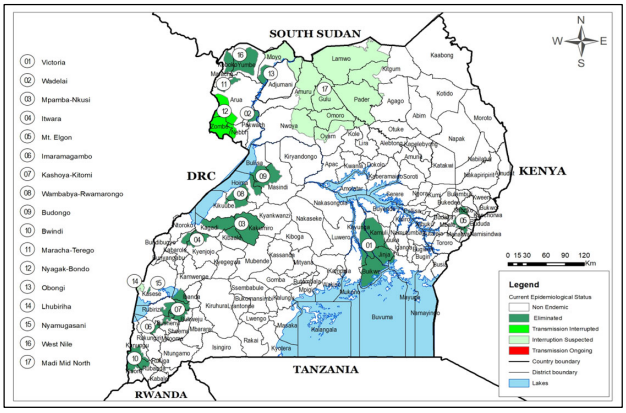
Figure 42

Uganda: Progress of River Blindness Elimination

2007



2022



Ongoing Transmission
Interruption Suspected
Interrupted Transmission
Eliminated

GENERAL RECOMMENDATIONS 2023
CARTER CENTER RIVER BLINDNESS ELIMINATION PROGRAMS

Overview of the RBEP mission: In collaboration with the host governments, RBEP helps to interrupt 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. Decisions are guided by (but not restricted to) the WHO guidelines. In the Americas, the onchocerciasis elimination committee oversees publications, the country onchocerciasis elimination dossier, and the organization of events to publicize progress toward elimination.
- 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 '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) to encourage collaboration and coordination to stop transmission (Figure 14).
- 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.

- RBEP global program staff are encouraged to develop innovative solutions to local problems. Stay informed of pilot funding opportunities through The Carter Center Innovation Hub. Engage program managers and TCC/Atlanta early to ensure support.
- RBEP encourages improved collaboration and transparency among stakeholders and advocates for strengthening national supply chain management to reduce drug supply delays and supply inaccuracies.
- Programs are to collect more information to determine reasons for persistently low treatment coverage.
- TCC field offices will conduct treatment coverage surveys in at least two districts in two subregions/states/zones annually in consultation with Headquarters (HQ) and MOH.
- Include details on MDA activities among refugees, internally displaced persons, and migrants, as well as by gender, in annual reports and presentations.
- 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.
- Any adverse event associated with MDA must be reported to the Atlanta office within 24 hours.
- Seek to increase training, supervision, involvement of kinship groups, and gender balance among CDDs and community supervisors (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 MOH.
- TCC website should house key public domain documents from national onchocerciasis elimination committees of Ethiopia, Nigeria, Sudan, and Uganda. The Onchocerciasis Elimination Program for the Americas (OEPA) domain should house the InterAmerican Conference on Onchocerciasis (IACO) and Program Coordinating Committee (PCC) meetings' conclusions and recommendations.
- 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 from Tom Unnasch, Hassan Hassan, and the University of South Florida (USF) team. In consultation with USF, field laboratories must send samples and requested data to USF for quality control. Reagent and supply orders from these labs must be reviewed promptly by Hassan or his staff so that TCC HQ can purchase and ship supplies promptly. TCC will continue to use the 'OEPA' Ov16 enzyme-linked immunosorbent assay (ELISA) and standard (qualitative) PCR for Ov16 and O-150 testing, respectively.
- Maintain a pool size of 100 flies maximum per pool for O-150 PCR testing in the Americas context, in accordance with USF recommendation.
- Review and consider, internally and with NOECs, the frequent changes in WHO's recommendations, particularly as these relate to 1) 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.
    - Write a letter to the new WHO director of NTDs (Dr. Socé Fall) noting concerns about OEM stage 2 sampling that were noted at the Program Review. Suggest that the onchocerciasis community discuss the controversial stage 2 sampling at the inaugural meeting of GONE (Global Onchocerciasis Network for Elimination).
    - Given its expense, for the time being, TCC RBEP will leave OEM second-stage random sampling mapping to the Federal Ministry of Health (FMOH), WHO/AFRO, GONE, or other partners.
- Through national mechanisms, RBEP offices should monitor the government, Expanded Special Project for Elimination of NTDs (ESPEN), and other partners' 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 subject 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.
- TCC's RB, LF, SCH, and STH Programs aim to assist with the distribution of 79.7 million treatments in 2023.

2023 Treatments and Training Objectives:

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

2023 River Blindness Treatment Targets			
Annual (UTG)	Semiannual (UTG2)	Quarterly (UTG4)	Total
5,502,402	36,380,691	9,148	**41,892,240**

2023 Lymphatic Filariasis Treatment Targets	
Annual (UTG)	Total
17,890,130	**17,890,130**

2023 Schistosomiasis Treatment Targets	
Annual (UTG)	Total
6,171,302	**6,171,302**

2023 Soil-Transmitted Helminths Treatment Targets		
Annual (UTG)	Semiannual (UTG2)	Total
9,177,914	4,616,754	**13,794,668**

2023 Training Objectives	
Total CDDs	Total CSs
296,640	**95,223**

THE AMERICAS

Presenters: Dr. Mauricio Sauerbrey and Silvia Sagastume (The Carter Center), Dr. Oscar Noya (consultant, South Focus Venezuela) and Mr. Joao Luiz Araujo (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 94 percent of the population once endemic for the onchocerciasis, 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. See Figure 15 for a map of the region. 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 can be seen 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 36,933 people living in 667 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 coordination between 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 of an area, and several other indicators, some of which are unique to each country (Figure 19).

For the first time since the COVID-19 pandemic, the annual IACO meeting was held in person (in hybrid format), preceded by a one-day PCC meeting November 16 – 18, 2022. At the PCC meeting, Professor Maria Eugenia Grillet was elected as Chair, replacing Dr. Frank Richards. The focus of the IACO meeting was on insecurity in the YFA. A standalone virtual PCC meeting was also held July 27 – 28, 2022.

The OEPA program received financial support in 2022 from the United States Agency for International Development's (USAID) *Achieve Onchocerciasis Elimination in the Americas* and Merck & Co., Inc., Rahway, New Jersey, and other donors.

Treatments:
In 2022, OEPA assisted Brazil and Venezuela with 47,744 Mectizan treatments, representing 72% of the 2022 treatment target of 66,249. Brazil achieved 58% of its goal, while Venezuela achieved 84% of its goal. Venezuela offered standalone treatments and also resumed four times- per treatment in 67 priority communities. In Brazil, 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. Figures 20 - 21 show detailed treatment information from 2022; the tables have more nuance than is typical because 30 communities transitioned to four-times-per-year treatments halfway through the year.

The 2023 treatment target for OEPA is 67,708 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 56% of treatments that occurred in Venezuela in 2022. In Brazil, 134 Yanomami people assisted Mectizan treatment activities (7, or 5%, of these are women) while in Venezuela 99 IHAs serve the program (three, or 3%, of these are women). 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:
Silvia Sagastume (The Carter Center) presented OEPA team progress on an activity supported by a Carter Center Innovation Hub grant received by Alba Lucía Morales. The grant will support 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 will use the devices to facilitate community education and IHA training, document field work, and quickly access and update data. The study team will interview the HWs before and after using tablets on treatment excursions to learn the impact of the devices.

Country	2022 Treatment Targets	2022 Treatments (%)	2023 Treatment Targets
Brazil	30,964	18,021	27,260
Venezuela	35,285	29,723	40,448
Total	**66,249**	**47,744 (72%)**	**67,708**

THE AMERICAS RECOMMENDATIONS 2023

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.
- The OEPA PCC and country programs are working to stop MDA in the YFA by the year 2025. Completing PTS and obtaining formal WHO verification will take 3-5 years longer.
- Continue work to increase the involvement of IHAs, Yanomami Educators, and Yanomami women. The IHA experience in both countries should be published in a peer-reviewed journal.
- Complete the Innovation Hub-funded project evaluating the impact of smart devices on HWs' performance in Venezuela. Before the second phase of the study, which includes the devices, field test the new health education messages in focus groups comprised of members of the indigenous groups being targeted.
- 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.
- Continue to support, as the programs are able, the use of doxycycline treatment as an important ancillary approach in the final stages of elimination.
- The community-level scoring system ("score card") has evolved into a strong tool that should be continually updated and refined. In addition to discrete national scoring based on their information systems, there is value in having a common scoring system for the overall YFA based on common data variables, such as effective (≥85%) treatment rounds, baseline endemicity, most recent assessment results, and prevailing vector species.
    - Standardization using common variables between the two countries would allow a joint map showing the score by community, which would be especially useful on the international border.
    - The scorecard experience in each country should be published in a peer-reviewed journal.
    - Report treatment coverages by score categories as well as by treatment round categories (high priority based <10 rounds and 10-<20 rounds)
- Hold two in-person PCC meetings: the standalone mid-year PCC meeting and a PCC in tandem with the IACO meeting later in the year.
- Hold the IACO meeting in late 2023. Promote the highest level of political representation at IACO from PAHO, Venezuela, and Brazil, assuming the improved political environment in both countries will allow such open collaboration. Encourage the Lions Clubs International Foundation to maintain support for a Lions representative from each of the six countries to attend IACO. Continue to invite all six OEPA country representatives regardless of verification of elimination status.

VENEZUELA:

- Continue four-times-per-year treatment in the 67 communities selected based on their low number of effective treatment rounds (<10).
- Seek increased involvement of Yanomami women as educators and IHAs who will take part in treatment activities as much as their culture allows. 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. Utilize anthropology consultants, in agreement with CAICET, to supplement this work with culturally sensitive, effective training materials.
- Report any as yet unvisited "new" communities to the health system that 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:

- Improve treatment coverage in 2023.
- Continue work to compile historical community-level treatment data to assist in scorecard community prioritization.
- Complete the PCR analysis of 2022 entomological collections. Follow USF's recommendation to limit the size of fly pools for PCR to maximum 100 fly/heads per pool.
- Seek to understand the high OV16 levels in Auaris.
- PCC should review and resolve the issue of potential cross-reactivity with *Mansonella ozzardi* yielding false-positive OV16 results at its mid-year meeting.

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 285 *woredas* (districts)—approximately one-quarter of the country (Figure 22). The RBEP currently supports activities in 163 endemic 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 starting 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 7.2 million people in 104 (~10%) woredas are at risk of LF nationwide (Figure 23).

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 2022, Ethiopia delivered a total of 27,795,149 Mectizan treatments for river blindness, representing 98% of the 2022 treatment target. This was the largest number of treatments to date for the RBEP in Ethiopia. The TCC-assisted LF program provided 2,514,293 annual treatments with Mectizan and albendazole—also the largest number of LF treatments in the program's history—representing 117% of the 2022 treatment target (Figures 24 and 25). This is a significant improvement over the previous year when several zones missed a treatment round. More than 80,000 villages were reached. The program aims to deliver 30,282,929 semi-annual treatments for RB and 2,306,884 for LF in 2023 (Figure 24).

Training:
A total of 244,940 CDDs were trained in 2022, about 10,000 more than in 2021 and 101% of the annual goal. Additionally, 87,489 (104%) CSs and 15,856 (204%) health extension workers (HEWs) received training. The goals for 2023 are 233,496 CDDs and 81,022 CSs. Most areas are successfully meeting target ratios of community-directed treatment with ivermectin (CDTI) volunteers per community.

Impact:
In 2022, 17 woredas encompassing 1,378,558 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). Additionally, OV16 seroprevalence in children 5-10 years old was less than 1% in 7 of 17 other woredas evaluated and will be reclassified as 'transmission suspected interrupted' and will initiate stop- MDA surveys in 2023.

For LF, Bena Tsemay district, population 70,425, in Southern Nations, Nationalities, and People's Region (SNNPR) passed transmission assessment survey (TAS)-1, thus meeting criteria to stop Mectizan-albendazole MDA. Cumulatively, 1.5 million people in Ethiopia no longer need MDA for

LF (Figure 11). An additional five woredas under PTS in SNNPR passed TAS-2, indicating transmission remains interrupted in those areas. An additional five woredas under PTS in SNNPR passed TAS-2, indicating transmission remains interrupted in those areas (Figure 27).

Special Topics:
Fetene Mihretu (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. The program is undertaking 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. The results of this study are expected in 2023. Simultaneously, black flies from the Wudi Gemzu hot spot were PCR-negative, indicating that transmission is suppressed. These communities may now move from four times per year treatment to twice per year treatment.

The second topic to generate discussion was onchocerciasis elimination mapping (OEM). Ethiopia has undertaken one of the largest OEM initiatives in the world, and the Ethiopia Onchocerciasis Elimination Expert Advisory Committee (EOEEAC) developed its own thresholds for initiating MDA in the absence of clear guidance from WHO. The global onchocerciasis community has struggled with agreeing on the proper survey methodology and minimum thresholds for starting MDA. Application of different thresholds could have a significant impact on the Ethiopia program, either by requiring additional sampling or by indicating MDA in districts where only a few people are positive. Roughly 100 districts fit these criteria, which could increase the number of districts treated by three to five times. The Carter Center will discuss these developments with WHO and partners.

River Blindness			
	2022 Treatment Targets	2022 Treatments (%)	2023 Treatment Targets
UTG2	28,224,658	27,734,668 (98%)	30,282,929
UTG4	67,200	60,481 (90%)	
Total	**28,291,858**	**27,795,149 (98%)**	**30,282,929**

Lymphatic Filariasis			
	2022 Treatment Targets	2022 Treatments (%)	2023 Treatment Targets
UTG	2,156,998	2,514,293 (117%)	2,306,884

Training Objectives			
	2022 Training Targets	2022 Training (%)	2023 Training Targets
CDDs	241,985	244,940 (101%)	233,496
CSs	83,907	87,489 (104%)	81,022
HWs	7,738	15,856 (205%)	9,639

ETHIOPIA RECOMMENDATIONS 2023

GENERAL:

- Work toward a target ratio of at least 1 CDD:50 people, 1 CS:5 CDDs, and 1 CS per village nationwide.
- Consider the publication of the remarkable success in improving gender ratios among CDDs and CSs.

ONCHOCERCIASIS

- Change treatment regimen from four times per year MDA to two times per year in the Wude Gemzu 'hot spot' of the Metema sub-focus now that entomological results are negative. Publish findings (a companion paper was promised in the paper by Katabarwa *et al.*, 2020).
- Investigate the positive entomological results in three sites obtained from PTS activities in the broader Metema sub-focus, per EOEEAC guidance. Study migration patterns during the war to determine if they explain entomological and planned serological survey results.
- Complete mapping in Ethiopia.
    - Complete all 'first stage' mapping activities recommended by the WHO Onchocerciasis Technical Subgroup (OTS), as resources and security allow, in consultation with TCC HQ, EOEEAC, and FMOH.
    - Do not undertake the highly controversial second-stage random sampling mapping until further clarification (see General Recommendations) and input from all other partners.
    - 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. Actively participate in the OEM subcommittee and contribute to clarifying the OTS/village and district-level threshold to commence MDA.
    - Work with HQ to resolve issues among donors who are not willing to support district-level expansion under the EOEEAC guidelines.
- Secure the funding needed to establish twice-yearly MDA in up to 29 new endemic districts identified in the past two years.
- Provide financial and administrative support for the annual EOEEAC meeting and technical support to the committee. Encourage active, high-level participation from the Ministry of Health.
- 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 on the unexpected finding of RB in an area APOC deemed as ecologically unsuitable for onchocerciasis transmission. It was noted at the meeting that some S. damnosum do not bite humans and do not serve as vectors in Ethiopia. In these cases, larval surveys may be positive, but human landing captures are negative.
- Encourage EOEEAC to issue a press release following each meeting and the chair to brief the Minister of Health after each meeting.
- The program should provide updates on the treatment of refugees in border areas assisted by TCC, especially in Gambella.

- 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 invitations for Ethiopian staff to Sudan's new national RB/LF elimination committee meetings.
- Encourage Research Triangle Institute (RTI) and Light for the World to enhance MDA and move to twice-per-year treatments in West Wollega and Kamashi zones, Oromia and Beneshangul-Gumuz regions, to enhance impact.
- Develop enhanced mobilization strategies for MDA in areas with consistently poor MDA coverage, particularly in Itang special woreda and South Omo zone. Enhance interventions in areas failing impact assessments.
- Stop MDA and begin PTS in TCC-assisted areas that met stop-MDA criteria in 2022 and were approved by FMOH.
- Conduct stop MDA assessments in SNNPR and Oromia 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 the Gambella region. Use findings to develop recommendations to increase the impact of interventions on LF elimination.
- 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 strips (FTS) test kits and positive control.
- Obtain dried blood spots (DBS) for OV16 testing during TAS-1 studies if the area is co-endemic with RB and a data gap exists. Publish the 2019 TAS-OV16 study showing utility of this integrated approach for gathering information on onchocerciasis.
- Await direction from FMOH (preferably after consultation with LF Regional Program Review Group [RPRG]) before conducting further LF remapping/reassessments.
- Expand LF MDA to new zones in concert with RB support if the necessary funding can be secured.
- Support the scale-up of MMDP services for LF in accordance with the 2016 national guidelines.
    - Discuss revising MDA household registers with the MOH to collect information on LF morbidity. New registers are typically produced each year between November and February.
    - Use established data collection activities to begin estimating the case burden in TCC areas.
    - Identify designated care facilities in endemic areas in line with WHO guidelines and assess their capacity to provide MMDP care.
    - Train healthcare workers on MMDP as part of pre-MDA training or during advocacy activities after treatment has stopped, building on successful pilots of partner organizations.

NIGERIA

Presenters: Dr. Emmanuel Miri, Dr. Abel Eigege, Dr. Emmanuel Emukah, Dr. Cephas Ityonzughul, Dr. Adamu Sallau and Barminas Kahansim (The Carter Center); Dr. Monsuru Adeleke (Osun University)

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, covering 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 2022 (May 18–20 and December 7–9) with support from TCC. Key recommendations from those meetings are summarized in Figure 28. Carter Center-assisted areas took a significant step forward with the interruption of onchocerciasis transmission in four states (Abia, Anambra, Enugu, and Imo), resulting in the halt of treatment for RB among 18.9 million people—a global record to date!

RBEP assists with RB and/or LF treatments in seven southern states in Nigeria, while Plateau and Nasarawa states in central Nigeria are in PTS after stopping MDA for LF and RB in 2013 and 2018, respectively. Delta state stopped MDA for RB in 2021, and the four aforementioned states will do so in 2023, having qualified to stop MDA in 2022. Figure 29 shows national progress since 2015. The LF Program, where the implementation unit (IU) is the LGA, passed stop-MDA TAS- 1 and stopped MDA for LF in an additional 44 LGAs in 2022, bringing the total that has done so to 89 (63%) of the original 141 LGAs under treatment in TCC-assisted areas. All nine states still have active schistosomiasis and soil-transmitted helminth treatment 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 30 – 31 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 persist 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/Clarke Cares Foundation; and from other generous donors.

Treatments:
The program assisted 43,669,617 total treatments for RB (18,799,027), LF (16,385,041), SCH (415,999), and STH (8,069,550) in 2022, representing 87%, 77%, 8%, and 66% of the treatment targets, respectively. Figures 32 – 33 show annual treatments and targets by disease since 1996. Figure 34 shows RB annual and semiannual treatments versus targets since the program began semiannual treatments in 2016. While COVID-19-related interruptions persisted, the primary reason for low treatment was delays in ordering and receipt of drugs combined with restricted availability from FMOH. The 2023 targets for the four diseases total 35 million, about 25 million fewer than the 2022 targets, due to the incredible progress of the RB and LF programs. Targets for SCH and STH vary by year based on WHO guidelines that alternate years in areas of lower prevalence (see Annex 3 for more detail on these guidelines), as well as a recent decision by the Nigeria national program to target schistosomiasis treatments at the ward level (a

geographic region level between community and district/LGA).
Drug delays in 2022 reflect an issue that has perennially affected treatment coverage in TCC-assisted areas in Nigeria. This impact can be seen with reduced treatments for all four diseases since 2018 (Figures 32 - 34). Treatments were hindered in 2020 when WHO temporarily recommended a halt to NTD MDA campaigns. Drug supply is managed by the national NTD programs, the drug companies, and WHO, but relies on input from implementing partners. A number of factors can impact drug arrival, including manufacturer capacity, customs delays, changes in legal documentation requirements, and delays in inventory reports from other partners. Additionally, delays or insufficient allocation from the FMOH hinder programs' ability to provide treatment to all those in need. 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.

Training:
The Nigeria program trained 62,559 CDDs, 12,781 CSs, 6,805 HWs, and 2,230 teachers in 2021. This was a significant improvement over 2020, although it did not meet targets due to reduced overall activities caused by drug delays and the pandemic. Training targets in 2022 for CDDs, CSs, HWs and teachers are 52,528, 11,840, 6,191, and 4,318 respectively, with some reduction in targets related to RB and LF thanks to reduced treatment areas as states and districts pass impact assessments.

Impact:
In 2022, four TCC-assisted states – Abia, Anambra, Enugu, and Imo, encompassing 18,885,772 people – met the WHO criteria to stop Mectizan treatment for RB, joining Delta state, which passed the same criteria in 2021, and Plateau and Nasarawa, which halted Mectizan in 2018 and achieved RB transmission elimination status in 2021. Only two TCC-assisted states, Ebonyi and Edo, still require Mectizan treatments for RB in 2023 (Figure 28). With the achievements in Abia, Anambra, Enugu, and Imo, 18,885,772 people are no longer at risk of RB transmission, joining 5,400,584 people from Delta, Plateau, and Nasarawa for a total of 24,286,356 people in TCC- assisted formerly RB endemic states. PTS has begun for 13,327,848 residents of Abia, Anambra, Enugu, and Imo, and 2,583,306 people in Delta who live in non-endemic area have already passed TAS-1. PTS in some LGAs of Delta, Enugu, and Imo, encompassing 2,017,364 people, 2,284,240 people, and 3,273,685 people, respectively, cannot begin as Mectizan-albendazole MDA for LF is still on-going.

For LF, 11.7 million people in 44 LGAs in five states passed TAS-1 and qualified to stop LF MDA in 2022. Of the nearly 40,000 children tested for LF antigen using FTS, only four children tested positive. Fieldwork in six LGAs could not be completed due to insecurity and flooding. Cumulatively, 22.4 million people in TCC-assisted areas of Nigeria no longer need MDA for LF (Figure 10), and the country as a whole is making considerable progress towards elimination, with significant increases in passed pre-TAS and TAS in 2022 (Figure 35).

Special Topics:

Dr. Cephas Ityonzughul (The Carter Center) presented the results of the TAS-1 and Pre-TAS studies across southern Nigeria, discussed in the impact section above. Challenges and recommendations centered on curbing the alarming growth in costs for these surveys. His presentation also included LF MMDP work in Plateau and Nasarawa states. In 2022, seven new Hope Groups (support groups for persons with LF disease manifestations) were established in the two states, bringing the total to 34. Eighty-five health personnel were trained to lead existing and new Hope Groups, bringing total leader numbers to 189. There were 87 new Hope Group members in 2022, bringing total membership to 997. The program also supported 97 hydrocele surgeries in 2022. In 2023 LF MMDP work will be expanded to Ebonyi state, including case searches, training of health facilities and Hope Group leaders, training of medical staff, and support of surgeries. This expansion will include a study to assess the mental health of Hope Group participants before and after participation.

Barminas Kahansim (The Carter Center) presented an update on the work of the TCC Nigeria lab in Jos, and TCC's role in domestic lab capacity building in recent years, specifically for onchocerciasis entomology (O-150 PCR) and human serology (OV16 ELISA). The Jos lab has been essential to conducting the analyses required by WHO's RB elimination framework in Nigeria. In addition to conducting analysis for TCC-assisted areas, the lab has processed 32,009 dry blood spots and 6,270 black flies for partner NGOs since 2017 and also has helped to train or retrain lab staff at other institutions to improve national capacity, including at the Nigerian Institute of Medical Research (NIMR), Lagos; University of Jos; and the FMOH (one scientist from each).

Dr. Abel Eigege (The Carter Center) presented on the complex topic of what comes next as programs eliminate both RB and LF. A first priority is to maintain monitoring and evaluation capacity at state and LGA level, as programs must maintain PES for RB and post-validation surveillance for LF until all formerly endemic areas in a country reach elimination endpoints and the country's dossier is approved by WHO. Another consideration is the ability of integrated programs such as SCH and STH to continue treatment after the halt of community-based treatment for RB and LF. Dr. Eigege presented the results of a one-year study in four LGAs aims to evaluate the "mainstreaming" of SCH/STH MDA programs, i.e., the transition from NGO partner support to full support by the primary health care (PHC) system. Preliminary results of this pilot study showed some decreases in coverage for both disease programs, although the STH decrease was not significant. Decreases in SCH coverage were strongly affected by availability of praziquantel. The program believes that State and LGA governments when fully mobilized and sensitized, can fund their deworming program; advocacy, sensitization, proper planning, and budgeting are key. Dr. Eigege presented the anticipated phase-in of mainstreaming of all SCH/STH programs assisted by TCC over the next several years as those LGAs' RB and LF programs reach stop-MDA thresholds. The program looked at options for deployment of the powerful volunteer network of CDDs to other activities as RB/LF MDA ceases and is in discussion with SMOHs and other NTD programs to develop plans. One option already being used is tasking CDDs with case searches for LF, to help provide services to those with LF morbidity and to fulfill the WHO MMDP requirements for LF elimination.

Dr. Monsuru Adeleke (Osun University, NOEC Member) presented on the progress of a remote sensing project support by BMGF. The goals are to leverage high-resolution remotely sensed datasets and machine learning to create a geospatial model predicting the location of suitable black fly habitats and to develop an application to guide field workers to those sites. Dr. Adeleke presented updates on the historical data inputs, challenges due to the lack of standardized entomological data collection across the country, and the results of version 1 of the model. He also reported on efforts at ensuring sustainability and country ownership by training Nigerian

modelers in the tools and techniques of the modeling analysis. The plan is to use version 1 of the model to support entomological assessment site selections in states where FMOH and partners aim to start collections in April 2023.

River Blindness			
	2022 Treatment Targets	2022 Treatments (%)	2023 Treatment Targets
UTG	19,379,589	16,988,666 (88%)	5,502,402
UTG2	2,194,458	1,810,361 (82%)	2,249,317
Total	**21,574,047**	**18,799,027 (87%)**	**7,751,718**

Lymphatic Filariasis			
	2022 Treatment Targets	2022 Treatments (%)	2023 Treatment Targets
UTG	21,217,802	16,385,041 (77%)	7,215,732

Schistosomiasis			
	2022 Treatment Targets	2022 Treatments (%)	2023 Treatment Targets
UTG	5,038,356	415,999 (8%)	6,171,302

Soil-Transmitted Helminths			
	2022 Treatment Targets	2022 Treatments (%)	2023 Treatment Targets
UTG	8,271,265	5,669,684 (69%)	9,177,914
UTG2	4,504,154	2,399,866 (53%)	4,616,754
Total	**12,775,419**	**8,069,550 (66%)**	**13,794,668**

Training Objectives			
	2022 Training Targets	2022 Trainings (%)	2023 Treatment Targets
CDDS	52,528	36,212 (69%)	25,065
CSs	11,840	9,967 (84%)	4,281
HWs	6,191	6,817 (110%)	6,191
Teachers	7,928	5,628 (71%)	7,479

NIGERIA RECOMMENDATIONS 2023

GENERAL:

- Plan a TCC side meeting with FMOH to discuss LF TAS planning and drug supply during the May NOEC.
- Plan a TCC side meeting with FMOH and SMOH regarding retention and redeployment of CDDs for other purposes where MDA for LF and/or RB has stopped, perhaps during the December NOEC. Explore if General Gowon would be willing to play a role in this process.
- Program Directors should attend the FY24 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. Program monthly reports should include accurate and current drug supply updates.
- Maintain a strong focus on communication and security awareness with State MOH, local officials, and community leaders before the commencement of community-based activities.
- Rolling coverage surveys should continue and be targeted to inform programmatic decisions, i.e., areas where there is concern about the quality of MDA or where an epidemiological study is planned. Consider reviewing the data collected from these surveys and preparing an article for publication if warranted.
- Whenever possible, add LF and/or RB sentinel villages (SVs) to the sample in any population-based survey activities being conducted (in these SVs' states or LGAs). This would help us to conduct serial monitoring of SVs.
- Continue providing awards to the best CDD, teacher, Frontline Health Facility (FLHF) worker, village leader, and CS in each state.
- Where MDA continues, increase the number of CDDs, as budgets allow, to reach the target ratio of at least 1 CDD:250 people, 1 CS:5 CDDs, and 1 CS per village. When calculating the population served per CDD, continue keeping urban populations out of the equation since these are typically served directly by HWs.
- 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 the final analysis with HQ and then plan 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 the work of HWs, CDDs, and report submission.
- Advocate for governments to utilize CDDs for other health activities, as RB and LF programs are rapidly reaching stop-MDA criteria.
- Conduct a study to explore the potential health system roles for CDDs in areas that stopped MDA previously (Plateau-Nasarawa) and more recently.

ONCHOCERCIASIS:

- Prioritize reaching good MDA coverage in Ebonyi and Edo State (especially on the Ondo border) to advance these last two TCC-assisted states to RB transmission interruption. Conduct serological surveys in both states in 2023.
- Support a meeting of the NOEC in December and attend the NOEC in May (supported by USAID Act | East, led by RTI).
    - Consider and discuss new methods for identifying any residual hot spots where transmission may be limited to a specific area.

    - Encourage the NOEC to begin to sub-state (e.g., LGA-level) classification in certain states (Ondo, Ebonyi, Taraba), allowing some LGAs to stop MDA and others reclassified as 'red' (treating twice per year). Begin to show this on the NOEC map.
- Continue PES in Plateau and Nasarawa States. PTS in Delta, Abia, Anambra, Enugu, and Imo States cannot begin until LF MDA is halted. 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. Validate the model with data from areas of predicted high and low probability of fly breeding. Advocate for this model to predict vector densities as well as vector presence and to prioritize data from human landing catch rather than larval prospection alone. 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 51 eligible LGAs in South East/South South (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).
- 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 Plateau and Nasarawa 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.
- Launch MMDP activities 1 – 4 in Ebonyi State.
- In the SE/SS states, conduct assessments of LF morbidity case burden during LF MDA.
- Publish results of the Plateau State Wb123 and Ov16 research sponsored by the Task Force for Global Health. Consider additional post-TAS-3 (post-elimination) surveys to demonstrate interruption of transmission.

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

- In LF-only LGAs where TAS-1 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 that STH levels have increased.
- Due to a lack of donor appetite for SCH/STH work, TCC has begun to incrementally transition ownership of SCH/STH to the federal, state, and local governments. Where the RB or LF community-wide platform is being lost due to stop-MDA (community level) determinations, the SCH/STH programs should be mainstreamed into a school-based program so that national funds will transition over a short time to fully support the program. Mainstreaming decisions will vary by LGA and/or state; there are different platforms that may be appropriate in different areas to assume SCH/STH responsibilities.

- Publish results of the Task Force for Global Health-supported ‘Mainstreaming study’ that investigated best practices for the process of transferring full program ownership to the government.

SUDAN

Presenters: Dr. Sara Lavinia Brair, Dr. Tibyaan El-Hussein, and Dr. Isam Zarroug (The Carter Center)

Summary:
Since 1997, TCC has assisted the Sudanese FMOH to eliminate onchocerciasis transmission in the country. Sudan was the first African country to declare a national onchocerciasis elimination policy in 2006. 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). In 2015, transmission elimination was declared in Abu Hamad under WHO elimination guidelines.

In addition to RB, Sudan is endemic for LF. FMOH has targeted elimination of LF 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. The FMOH conducted MDA in some of these localities between 2017 and 2020; no further MDA for LF was conducted until 2022.

In 2022, the Center expanded assistance to the Sudanese FMOH to eliminate RB and LF through a grant from The Reaching the Last Mile Fund, housed within The END Fund, a multi-donor fund, initiated and led by His Highness Sheikh Mohamed bin Zayed Al Nahyan, President of United Arab Emirates.

Treatments:
In 2022, TCC assisted with distributing 243,207 semi-annual RB treatments in the Radom focus (Figure 38). This represented 60% of the treatment target, as access to the Khor Yabus focus continued to be impaired by insecurity that prevented MDA. TCC also assisted with 4,375,042 annual LF treatments in eight states (Kassala, Gedaref, White Nile, Sennar, N. Kordofan, N. Darfur, S. Darfur, and E. Darfur), reaching 79% of the targeted treatment. As of 2022, 54 of the 65 LF-endemic districts (83.1%) have received at least one round of MDA (Figure 39). 2023 treatment targets are provided in the data tables below.

Training:
In 2022, the Sudan program trained 126 volunteers (108 CDDs,11 CSs, and 7 HWs) for the RB program and 4,715 volunteers (4,232 CDDs, 397 CSs, and 86 HWs) for the LF program. 2023 training goals for RB and LF are in the data table below.

Impact:
The Galabat focus, which halted MDA in 2018 and is cross-border to the Ethiopian Metema focus, completed PTS in 2022. A total of 10,525 black flies and 4,479 DBS were collected and tested by O-150 PCR and Ov16 ELISA, respectively. No fly pools or DBS samples were found to be positive with upper 95% confidence limits of 0.018% infective flies and 0.044% seroprevalence, thus meeting the WHO criteria for passing PTS. The acting Federal Minister of Health announced reclassification to transmission elimination during a national RB/LF Program Review meeting held in February 2023 in Khartoum.

Special topics:
Dr. Sara Lavinia Brair (The Carter Center- Sudan) presented on the government structure of the Sudan People's Liberation Movement-North (SPLM-N), the health situation in the Blue Nile, including reported cases of RB and LF, the difficulty associated with accessing the area, and the

result of the negotiations held regarding access to the Blue Nile, which was the granting of permission to work in the region.

River Blindness Sudan			
	2022 Treatment Targets	2022 Treatments (%)	2023 Treatment Targets
UTG2	403,750	243,207 (60%)	403,750

Lymphatic Filariasis Sudan			
	2022 Treatment Targets	2022 Treatments (%)	2023 Treatment Targets
UTG1	5,525,648	4,375,042 (79%)	8,367,514

Training Objectives Sudan RB			
	2022 Training Targets	2022 Trainings (%)	2023 Training Targets
CDDs	1,360	108 (8%)	636
CSs	86	11 (13%)	66
HWs	40	7 (18%)	7

Training Objectives Sudan LF			
	2022 Training Targets	2022 Trainings (%)	2023 Training Targets
CDDs	11,406	4,232 (37%)	9,380
CSs	1,141	397 (35%)	938
HWs	180	86 (48%)	180

SUDAN RECOMMENDATIONS 2023

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 (RoSS), Ethiopia, and the CAR for cross-border issues. Resume cross-border managers meetings.
- Constitute a national RB and LF elimination committee. Provide financial and administrative support for a meeting in 2023.
- Intensify sensitization and health education in parallel with MDA campaigns.
- Seek to understand population movement out of Blue Nile as a result of insecurity and consider assessments for RB and LF in internally displaced persons camps.

ONCHOCERCIASIS

- Conduct RB assessment of the gold miner population in Radom, South Darfur, and review the mining environmental impact on breeding sites.
- As security allows, begin re-mapping to verify the absence of RB transmission by conducting surveys in Central/South Darfur (Marrah Mountain Waterfalls), Northern State (Second, Third, and Sixth Cataracts), Sennar State (Al-Dinder and Al-Rahad Rivers), and South Kordofan (Nuba Mountains Waterfalls).
- Conduct entomological surveys in the Merowe Dam's spillway as a part of PES in the Abu Hamad focus.
- Evaluate the onchocerciasis transmission status in the Blue Nile State (Khor Yabous) if the security situation allows.
- Unfortunately, TCC does not support work in corresponding areas across the border from Khor Yabus in Ethiopia (Assosa and Kemashi). Sudan and TCC should encourage the Ethiopian FMOH and RTI/Light for the World to conduct surveys in Assosa and Kemashi along the border with Sudan to determine the extent of current transmission.
- Publish a peer-reviewed article on the Galabat focus elimination.

LYMPHATIC FILARIASIS

- Develop LF National Guidelines and conduct training with SMOH and FMOH staff.
- Conduct remapping “mini-TAS” surveys in four localities classified in 2016 as non-endemic but with serological evidence of potential LF transmission.
- Conduct Pre-TAS in three localities in South Darfur (Nyala, North Nyala, and Ed Al Fursan), where four to five rounds of MDA have occurred since 2016.
- Work with the FMOH to obtain details of disease burden from baseline mapping and history of MDA by locality.
- Continue morbidity management and disability prevention (MMDP) situational assessment by collecting lymphedema and hydrocele case counts and health facility capacity information during MDA activities.

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.

TCC'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 2022, TCC assisted with distributing 3,194,676 treatments (including passive and refugee treatments), reaching 106% of the treatment target of 3,022,852 (Figure 40). There were 173,277 passive treatments, and 191,882 refugees from the RoSS received treatments. See the 2023 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 a total of 32,144 Community-Directed Intervention workers in 2022. 24,949 CDDs (47% female), 7,063 CSs (29% female), and 132 HWs received training. The current ratio of CDDs to the population served was 1 CDD to 70 persons in 2022. The ratio of CDDs per CS was 4:1, which is in line with the minimum requirement of 4 CDDs: 1 CS. See the data tables below for the 2023 training targets.

Impact:
In 2022, the Lhubiriha focus was reclassified to "transmission suspected interrupted," meaning Uganda no longer contains any foci of ongoing transmission. Three additional foci, Budongo, Bwindi, and Maracha-Terego, completed PTS and were reclassified from "transmission interrupted" to "transmission eliminated." In total, 14 foci are classified as "transmission eliminated," one focus is classified as "transmission interrupted" and under PTS, and two foci are classified as "transmission suspected interrupted" (Figure 41). The total population no longer at risk for RB in the 14 "transmission eliminated" foci is 5.5 million. The Madi Mid-North (MMN) and Lhubiriha foci remain under twice-per-year treatment with Mectizan, and both share cross-border transmission with the RoSS and the Democratic Republic of Congo (DRC), respectively (Figure 42).

River Blindness Treatments Uganda			
	2022 Treatment Targets	2022 Treatments (%)	2023 Treatment Targets
UTG2	3,022,852	2,829,517 (94%)	3,113,540
Refugees	0	191,882	272,595
Passive	0	173,277	189,042
Total	**3,022,852**	**3,194,676**	**3,575,177**

Training Objectives Uganda			
	2022 Training Targets	2022 Trainings (%)	2023 Training Targets
CDDs	25,688	24,949 (97%)	28,063
CSs	6,779	7,063 (104%)	8,916
HWs	97	132 (136%)	148

UGANDA RECOMMENDATIONS 2023

GENERAL:

- In areas with active CDDs, work toward a target ratio of at least 1 CDD:74 people and 1 CS:4 CDDs.
- Continue PTS activities, including a serological evaluation, in the Nyagak-Bondo focus, currently classified as “transmission interrupted.” The analysis will determine if the focus is reclassified as “transmission eliminated.”
- Provide financial and administrative support for the 2023 Ugandan Onchocerciasis Elimination Expert Advisory Committee (UOEEAC) meeting.
- Invite representatives from the RoSS and the DRC) to UOEEAC meetings and seek an invitation for the FMOH to attend RoSS and DRC national RB elimination committee meetings. Provide French-English interpretation for the DRC representatives.
- Conduct a study to determine what the former CDDs in eliminated foci are doing post-elimination.
- Conduct a participation assessment to determine the cause of low CDD participation during MDA.
- Draft a manuscript reporting Budongo OV16 rate decay in children in the absence of vectors.

MADI-MID NORTH (MMN) AND LHUBIRIHA

- Conduct a stop-MDA evaluation (entomology and serology) in the seven southern districts of MMN as recommended by UOEEAC.”
- Coordinate with RoSS and DRC MOH programs in cross-border 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 RoSS and DRC cross-border areas.
    - If requested by RoSS MOH, provide technical assistance for entomological surveillance in the 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.
- Continue community-directed S&C activities for *Simulium damnosum* vector control in three districts of the MMN focus (Amuru, Kitgum, and Nwoya).

ANNEX 1: River Blindness Elimination Program Background

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 (sl). *Simulium* species black flies breed in rapidly flowing rivers and streams, thus leading to the common name for the disease, "river blindness."[4]

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 2017 that at least 220 million people required preventive chemotherapy against onchocerciasis, and 1.15 million had vision loss.[4] Approximately 205 million people live in endemic areas worldwide and are therefore at risk of infection; more than 99% of those at risk live in sub-Saharan Africa. Globally, 1.8 million people live in areas that no longer require onchocerciasis MDA. Onchocerciasis also exists in Latin America. 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 (WER) on October 1, 2021 (No 39, 2020, 96, 477–484).

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 ≥2%). 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 co-endemicity of the parasitic worm Loa loa. Mectizan treatment in a person with high *Loa loa* parasite

[4] https://www.who.int/news-room/fact-sheets/detail/onchocerciasis

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') 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; they may be more senior CDDs. This grouping may be managed by frontline HWs, similar to Ethiopia, where distributors and supervisors are organized 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 villages (ARVs) 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 microfilariae (mf) in skin prevalence ≥ 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.[5]

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 REMO mapping 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 ARVs 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 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.

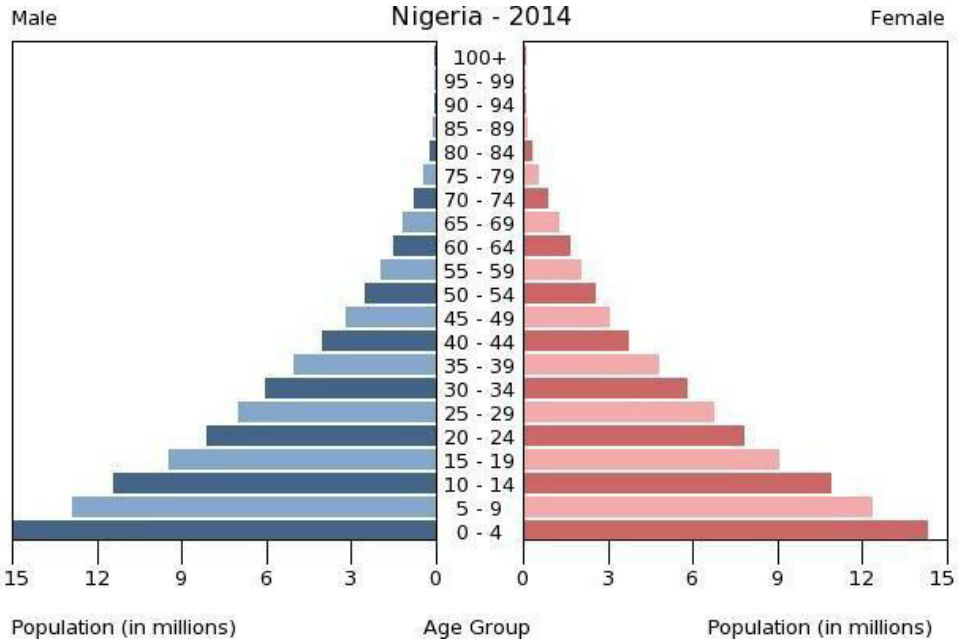
The data from monthly reports are supplemented with additional information at the annual TCC RBEP Review held during the first quarter of the following year. At these reviews, TCC program directors and partners convene to finalize treatment figures for the previous year, establish new treatment objectives for the coming year, and discuss results from monitoring and research initiatives. TCC reports its final treatment figures to the Mectizan Donation Program (MDP),

[5] World Health Organization. Report on the fourth meeting of the WHO onchocerciasis technical advisory subgroup: virtual meeting, 28−29 October 2020. Geneva: World Health Organization; 2021.

Merck, and the non-governmental development organization (NGDO) Onchocerciasis Coordination Group.

RBEP Treatment Indices: Treatments are reported (Figure 5) as number of persons and number of ARVs 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 ARVs targeted for mass distribution receive community-wide Mectizan treatment. The eligible at-risk population includes all persons living in ARVs 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., *American Journal of Tropical Medicine and Hygiene* 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 so ineligible for Mectizan treatment (see example below, Nigeria, where the under 5 population is 15%).



[6]

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.

[6] Source: CIA Factbook. https://www.cia.gov/library/publications/the-world-factbook/geos/ni.html.

ANNEX 2: The Lymphatic Filariasis (LF) 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 (donated by GSK/The Task Force for Global Health), or diethylcarbamazine (DEC, donated by Eisai pharmaceuticals) 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. Disease mapping of the country confirms that Nigeria is second globally (behind India) in human suffering from this parasite. With 761 out of 774 LGAs of 36 States and the Federal Capital Territory mapped, 572 LGAs (75%) are endemic, and over 130 million Nigerians are at risk.

Elimination of LF as a Public Health Problem in Plateau and Nasarawa States: In Plateau and Nasarawa States, TCC, working with the FMOH of Nigeria and with state and local government ministries, assisted in establishing an LF elimination program. The 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 (see Figure 1 below).

The focus in Plateau and Nasarawa states is shifting to the second pillar of eliminating LF as a public health problem: 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 the states 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). These tasks are necessary to complete elements of the national dossier for WHO.

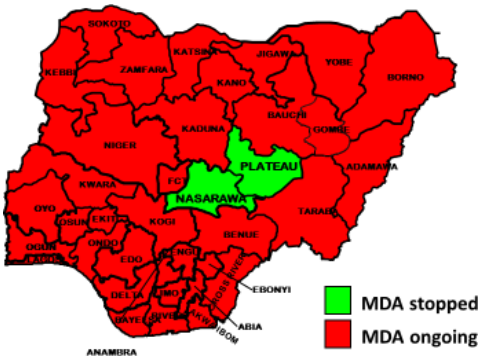


Figure 1: Elimination of LF in Plateau and Nasarawa states in 2017

***Scale-Up the LF Program in the Seven TCC-Assisted States in Southern Nigeria*:** 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.

LF and Malaria in Nigeria: Through a 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 that provided roughly 75,000 treatments annually. Today, the program delivers over 800,000 treatments each year, and several passed TAS-1, stopped over 600,000 treatments, and begun PTS (TAS-2 and TAS-3).

LF in Sudan: Through a grant from The Reaching the Last Mile Fund, housed within the END Fund and led by His Highness Sheikh Mohamed bin Zayed Al Nahyan, the Crown Prince of Abu Dhabi, in 2022, The Carter Center enhanced assistance for RB and expanded support to the Ministry of Health for LF elimination. 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. In 2022, the Carter Center assisted in distributing 4.4 million LF treatments in 30 districts of eight states.

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

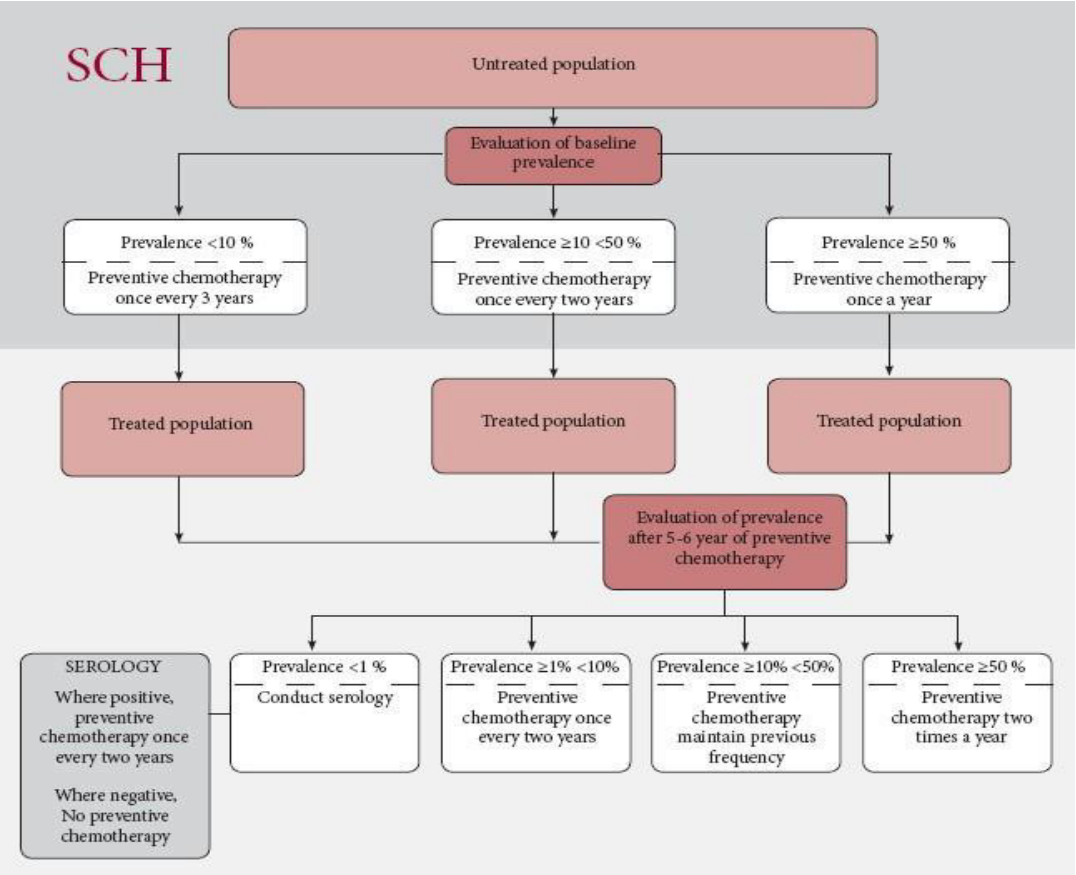
SCHISTOSOMIASIS

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 programs continue to follow 2011 WHO guidelines for disease (morbidity) control (shown below), as operational guides in support of the new 2022 guidelines on control and elimination of schistosomiasis[7] are not yet available. Note that the 2011 guidelines may call for praziquantel preventive chemotherapy once every 2 – 3 years, depending on parasite prevalence in a district. For this reason, treatment numbers in the same state can be very different from year to year, and training and logistics become much more complicated compared to annual or twice-per-year treatment. In 2022, WHO released new guidelines, with adjustments to treatment thresholds and a change in strategy to include adults in some areas. Programs await upcoming WHO manuals that will operationalize the new guidelines and are in discussions about how to adhere to the new guidelines despite a lack of change in Merck KGaA's donation focus on children.

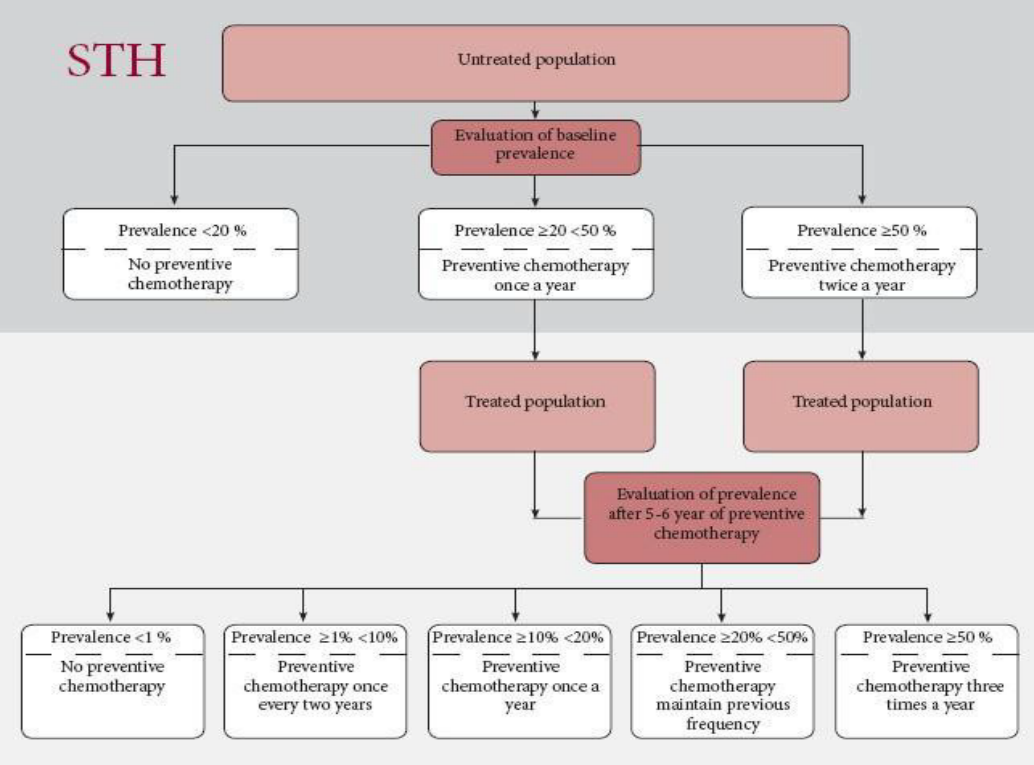
[7] World Health Organization (2022). WHO guideline on control and elimination of human schistosomiasis. Geneva.



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 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 current WHO guidelines for STH (see above) focus on providing treatment to school-aged children, and unlike SCH did not experience an update in 2022. 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. Although STH treatments can be given (as with SCH) once every two years in a district, guidelines differ from SCH in that they commonly call for MDA twice per year. As with SCH, 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 (alternating year treatment schedules for schistosomiasis up to every third year compared with twice-per-year treatment programs for STH in some areas); 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.

SCH/STH work under USAID's Act to End NTD’s | East project, led by RTI International, focuses on “mainstreaming” the two diseases into the large healthcare delivery system, abandoning the vertical MDA approach to control. We believe it is likely that there will be less support in the near future for the TCC SCH/STH program. Accordingly, 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: A Timeline of the River Blindness Campaign at The Carter Center

- **2022:** RBEP surpassed 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 qualified to halt RB treatments. 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 2.8m people and stop LF treatments for 3.4m 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 (*The 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, TX. 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 by Year Authored or Coauthored by RBEP Personnel

2022 publications are in bold print.

Anonymous. Progress in eliminating onchocerciasis in the WHO Region of the Americas: Advances in reaching the last endemic communities of the South Focus in the Bolivarian Republic of Venezuela. *Wkly Epidemiol Rec.* 2022. 97, 481- 484.

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Anonymous. Progress in eliminating onchocerciasis in the WHO Region of the Americas: disruption of ivermectin mass drug administration in the Yanomami focus area due to the COVID-19 pandemic. *Wkly Epidemiol Rec*. 2021. 96, 477-484.

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Anonymous. Progress in eliminating onchocerciasis in the WHO Region of the Americas: advances towards transmission suppression in parts of the Yanomami focus area. *Wkly Epidemiol Rec*. 2020; 95: 484–487

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ANNEX 6: 2022 RBEP Program Review Agenda

River Blindness, Lymphatic Filariasis, and Schistosomiasis Program Review Agenda			
Wednesday, March 8, 2023			
Start	**End**	**Title**	**Speaker**
8:00 AM	8:10 AM	Day 1 Welcome and Introduction	Dr. Gregory Noland
8:10 AM	8:15 AM	Welcoming Remarks	Dr. Kashef Ijaz
8:15 AM	8:20 AM	Goodwill Message	Dr. Tedros Ghebreyesus
8:20 AM	8:40 AM	Carter Center River Blindness Elimination Programs Overview	Dr. Gregory Noland
8:40 AM	8:45 AM	Video - Mectizan Donation Program: 35 Years of Milestones	
8:45 AM	9:05 AM	Uganda: Treatments and Impact	Mr. David Oguttu
9:05 AM	9:20 AM	*Discussion*	
9:20 AM	9:35 AM	Uganda: Training, Integration, and Community Ownership	Dr. Edridah Muheki
9:35 AM	9:50 AM	*Discussion*	
9:50 AM	10:05 AM	BREAK	
10:05 AM	10:25 AM	Sudan: RB Treatments and Impact	Dr Isam Zarroug
10:25 AM	10:35 AM	*Discussion*	
10:35 AM	10:55 AM	Sudan: LF Treatments and Impact	Dr. Tibyaan Elhussein
10:55 AM	11:05 AM	*Discussion*	
11:05 AM	11:20 AM	Update on Access to Blue Nile State	Dr. Sara Lavinia
11:20 AM	11:30 AM	*Discussion*	
11:30 AM	11:45 AM	GONE Network Introduction	Dr. Maria Rebollo-Polo
11:45 AM	11:55 AM	*Discussion*	
11:55 AM	12:00 PM	Day 1 Closure	Dr. Gregory Noland

River Blindness, Lymphatic Filariasis, and Schistosomiasis Program Review Agenda			
Thursday, March 9, 2023			
Start	**End**	**Title**	**Speaker**
8:00 AM	8:05 AM	Day 2 Introduction	Dr. Gregory Noland
8:05 AM	8:30 AM	Nigeria: Treatments	Dr. Emmanuel Miri
8:30 AM	8:40 AM	*Discussion*	
8:40 AM	9:00 AM	Nigeria: Training, Integration and Community Ownership	Dr. Adamu Sallau
9:00 AM	9:10 AM	*Discussion*	
9:10 AM	9:35 AM	Nigeria: RB Stop-MDA Surveys (Enugu, Anambra, Imo & Abia)	Dr. Emmanuel Emukah
9:35 AM	9:45 AM	*Discussion*	
9:45 AM	10:00 AM	BREAK and Group Photo	
10:00 AM	10:25 AM	Nigeria: LF Impact and MMDP	Dr. Cephas Ityonzughul
10:25 AM	10:35 AM	*Discussion*	
10:35 AM	10:50 AM	Nigeria Lab/Domestic Capacity Building	Barminas Kahansim
10:50 AM	11:00 AM	*Discussion*	
11:00 AM	11:20 AM	Nigeria: SCH/STH Mainstreaming Study and What's Next After RB/LF Elimination?	Dr. Abel Eigege
11:20 AM	11:30 AM	*Discussion*	
11:30 AM	11:45 AM	Nigeria: RB Black Fly Environmental Habitat Sustainability Modeling Project	Dr. Monsuru Adeleke
11:45 AM	11:55 AM	*Discussion*	
11:55 AM	12:00 PM	Day 2 Closure	Dr. Gregory Noland

River Blindness, Lymphatic Filariasis, and Schistosomiasis Program Review Agenda			
Friday, March 10, 2023			
Start	**End**	**Title**	**Speaker**
8:00 AM	8:05 AM	Day 3 Welcome	Dr. Gregory Noland
8:05 AM	8:25 AM	Ethiopia: RB Treatments and Impact	Anley Haile
8:25 AM	8:35 AM	*Discussion*	
8:35 AM	8:55 AM	Ethiopia: LF Treatments and Impact	Aderajew Mohammed
8:55 AM	9:05 AM	*Discussion*	
9:05 AM	9:20 AM	Ethiopia: Training, Integration, Community Ownership, and Capacity Building	Yohannes Eshetu
9:20 AM	9:30 AM	*Discussion*	
9:30 AM	9:45 AM	Ethiopia: Updates on PTS and Hotspot Investigation	Fetene Mihretu
9:45 AM	9:55 AM	*Discussion*	
9:55 AM	10:10 AM	BREAK	
10:10 AM	10:30 AM	OEPA Overview	Dr. Mauricio Sauerbrey
10:30 AM	10:40 AM	*Discussion*	
10:40 AM	10:55 AM	Brazil Amazonas Focus	João Luiz Araujo
10:55 AM	11:05 AM	*Discussion*	
11:05 AM	11:20 AM	Venezuela South Focus	Dr. Oscar Noya
11:20 AM	11:30 AM	*Discussion*	
11:30 AM	11:40 AM	OEPA: Electronic Device Study	Silvia Sagastume
11:40 AM	11:45 AM	Electronic Device Video	
11:45 AM	11:55 AM	*Discussion*	
11:55 AM	12:00 PM	Closing Discussion	Dr. Gregory Noland

ANNEX 7: List of Program Review Participants

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