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CARTER CENTER

Waging Peace. Fighting Disease. Building Hope.

SUMMARY
2020 VIRTUAL PROGRAM REVIEW
RIVER BLINDNESS ELIMINATION PROGRAMS
ETHIOPIA, NIGERIA, OEPA, SUDAN, AND UGANDA
MARCH 10-12, 2021
THE CARTER CENTER
ATLANTA, GA

AUGUST 2021

Donors to The Carter Center River Blindness Elimination, Lymphatic Filariasis Elimination, and Schistosomiasis/Soil-Transmitted Helminths Control Programs*

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USAID's Act to End NTDs | East Program, led by RTI International
USAID's Achieve Onchocerciasis Elimination in the Americas Program
World Health Organization

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, the Crown Prince of Abu Dhabi*

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ACRONYMS

AJTMH	American Journal of Tropical Medicine and Hygiene
APOC	African Program for Onchocerciasis Control
ARV	At-Risk Village
ATP	Annual Transmission Potential
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 Congo
EOEEAC	Ethiopia Onchocerciasis Elimination Expert Advisory Committee
ELISA	Enzyme-linked immunosorbent assay
ESPEN	Expanded Special Project for Elimination Neglected Tropical Diseases
FLHF	Frontline Health Facility
FMOH	Federal Ministry of Health
FTS	Filarial Test Strip
GLIDE	The Global Institute for Disease Elimination
HDA	Health Development Army
HEW	Health Extension Worker
HQ	Headquarters
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
NASA	National Aeronautics and Space Administration
NGDO	Non-Governmental Development Organization

ACRONYMS *Continued*

NOEC	Nigeria Onchocerciasis Elimination Committee
NTD	Neglected Tropical Disease
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
PTS	Post-Treatment Surveillance
QGIS	Geographical Information System
RB	River Blindness
RBEP	River Blindness Elimination Program
REMO	Rapid Epidemiological Mapping of Onchocerciasis
RPRG	Regional Program Review Group
RSS	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	Treatment Assessment Survey
TCC	The Carter Center
UOEEAC	Ugandan Onchocerciasis Elimination Expert Advisory Committee
USAID	United States Agency for International Development
USF	University of Southern Florida
UTG	Ultimate Treatment Goal
WER	Weekly Epidemiological Record
WHO	World Health Organization
YFA	Yanomami Focus Area

GLOSSARY

Definitions of Control, Elimination and Eradication for NTDs[1]

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.

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***.

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***.

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***.

Phases of Onchocerciasis Transmission[2]

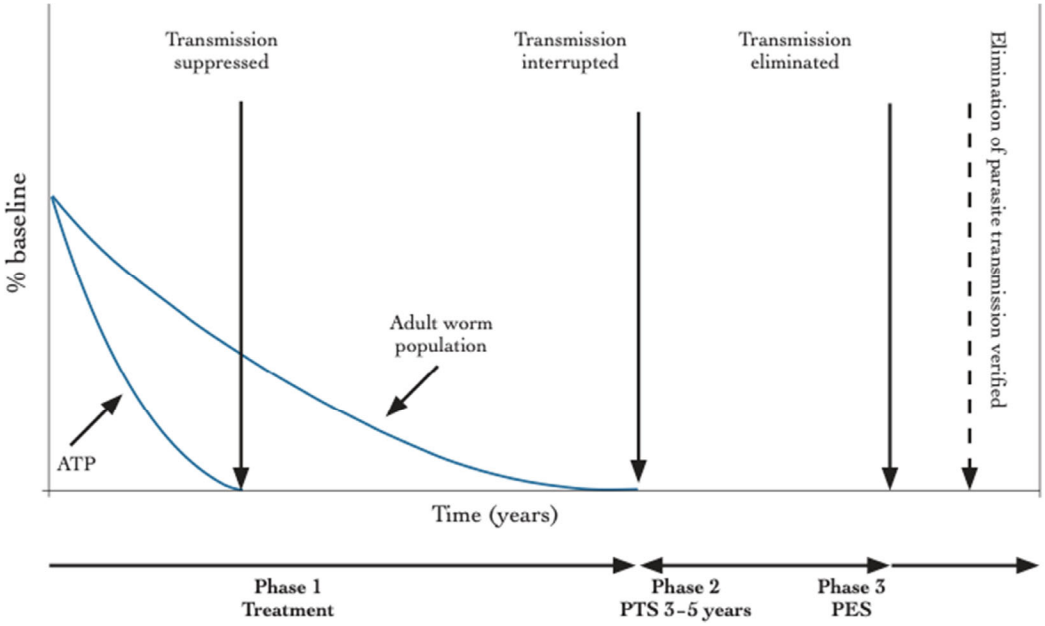
Transmission Suppressed: The absence of infective larvae (L3s) in the *Simulium* vector population. Infectivity can be suppressed through drug (ivermectin) pressure, despite the potential for re-initiation of transmission through the presence of a population of adult worms capable of producing microfilariae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

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

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

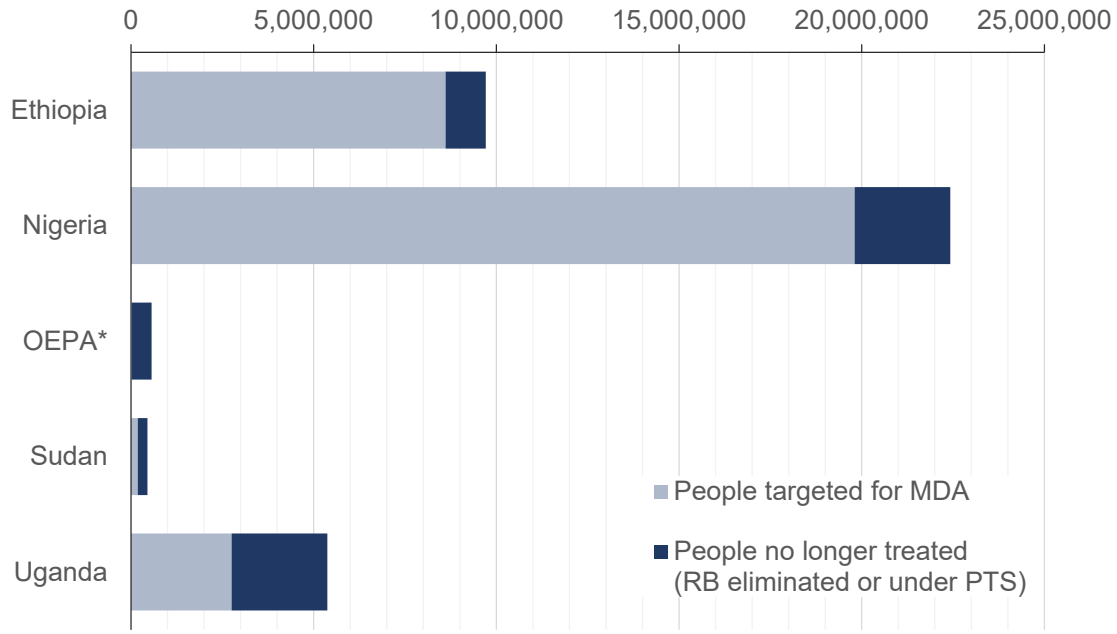
RIVER BLINDNESS		
Country	Total Population residing in areas where MDA stopped 2009-2020	Stopped MDA in 2020
ETHIOPIA	1,100,000	0
NIGERIA	2,618,861	0
OEPA[1]	538,517	0
SUDAN	264,811	0
UGANDA[2]	2,621,227	0
TOTAL	**7,143,416**	**0**

[1]Representing Brazil, Colombia, Ecuador, Guatemala, Mexico and Venezuela.
[2]Excludes the eliminated Victoria focus (not TCC-assisted, eliminated in the 1970s), population 2.8 million.

LYMPHATIC FILARIASIS		
Country	Populations NOT on MDA in 2020 (both eliminated and in PTS)	Stopped MDA in 2020
ETHIOPIA	1,171,110	0
NIGERIA	7,258,307	0
TOTAL	**8,429,417**	**0**

Population Currently and Previously Targeted for Mectizan® Treatment

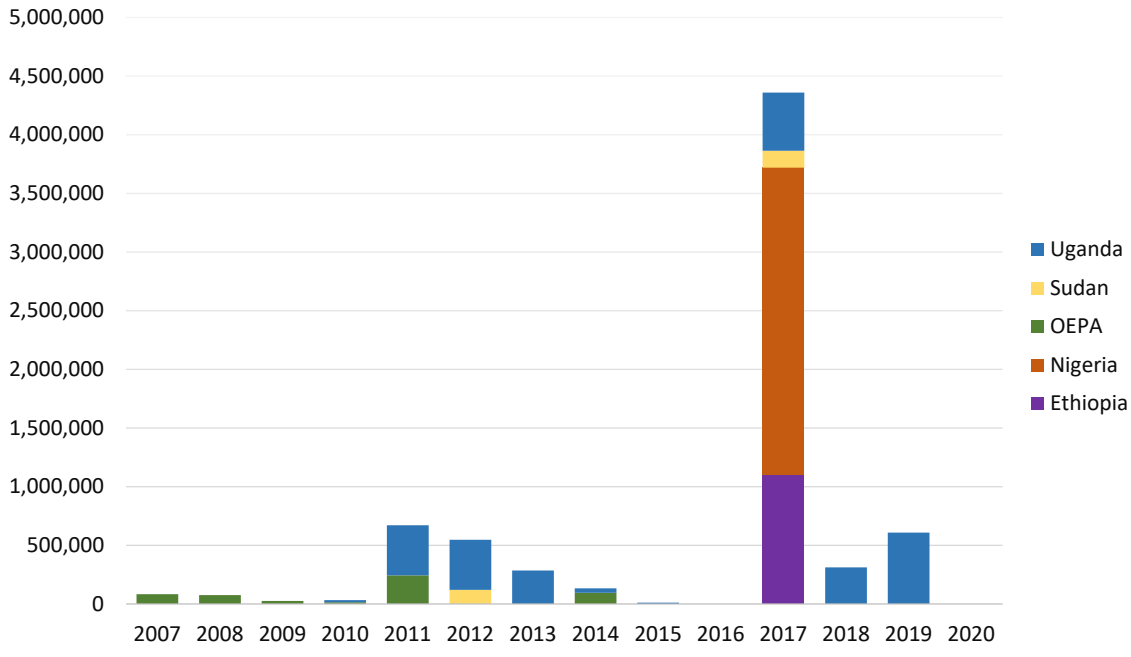
7 million people in ten Carter Center-assisted countries no longer need treatment as a result of our river blindness elimination partnership



**OEPA: Representing Brazil, Colombia, Ecuador, Guatemala, Mexico, and Venezuela*

Figure 4

Onchocerciasis Stopped Treatments by Country and Year 2007-2020



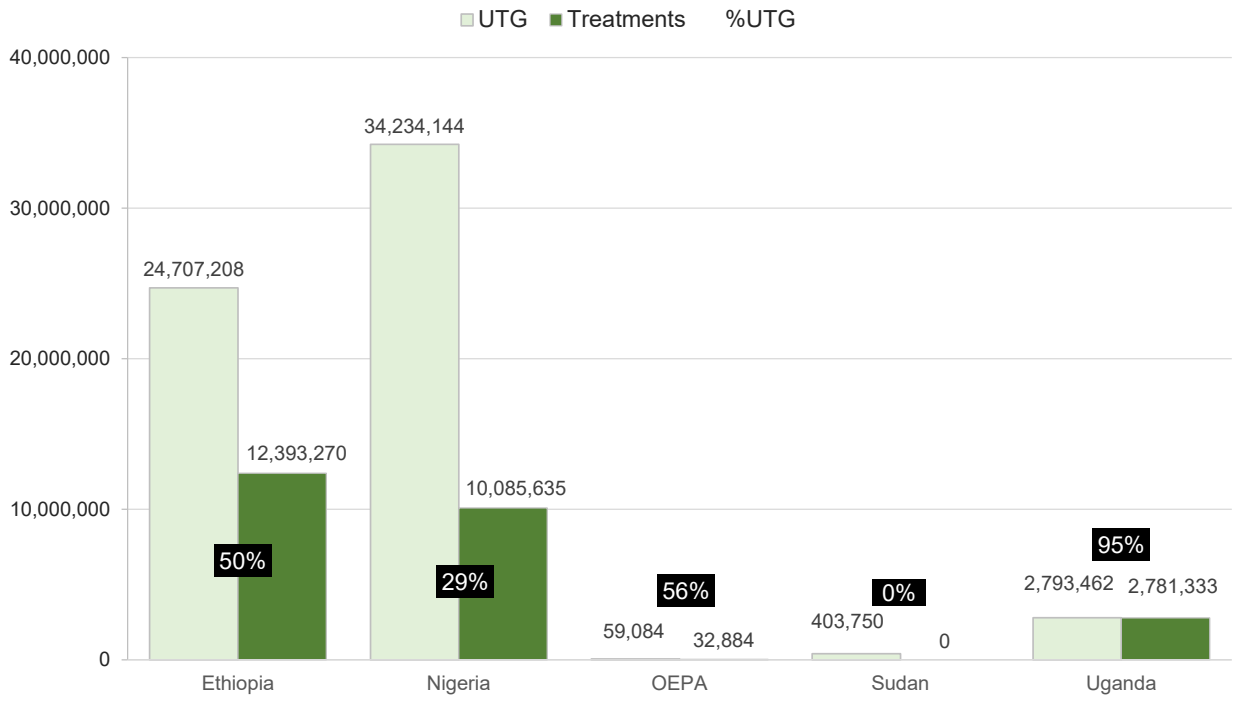
OEPA: Represents Brazil, Colombia, Ecuador, Guatemala, Mexico, and Venezuela

RBEP-Assisted Programs: Mectizan® Treatments/Targets 1996 – 2020 and 2021 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.*

Figure 6

2020 Mectizan® Ultimate Treatment Goals (UTG) and Treatments for TCC-assisted Areas



Carter Center River Blindness Elimination Programs Cumulative Treatments 1996-2020

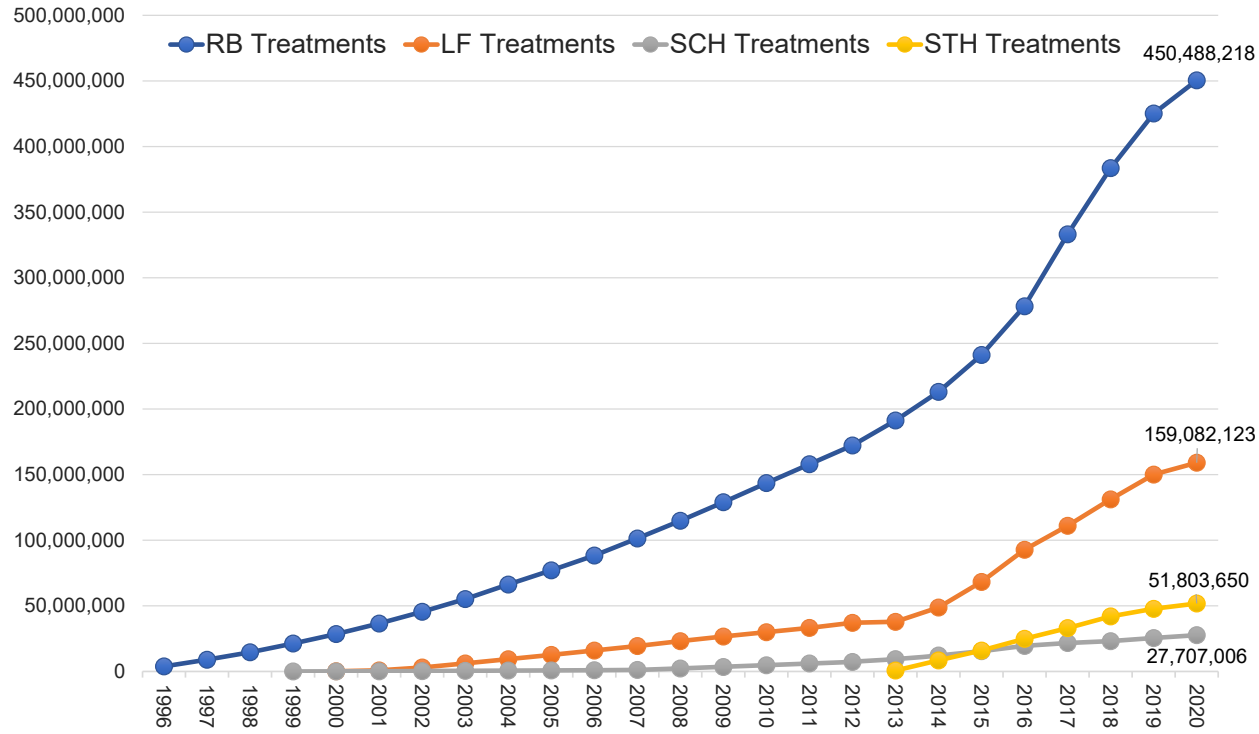
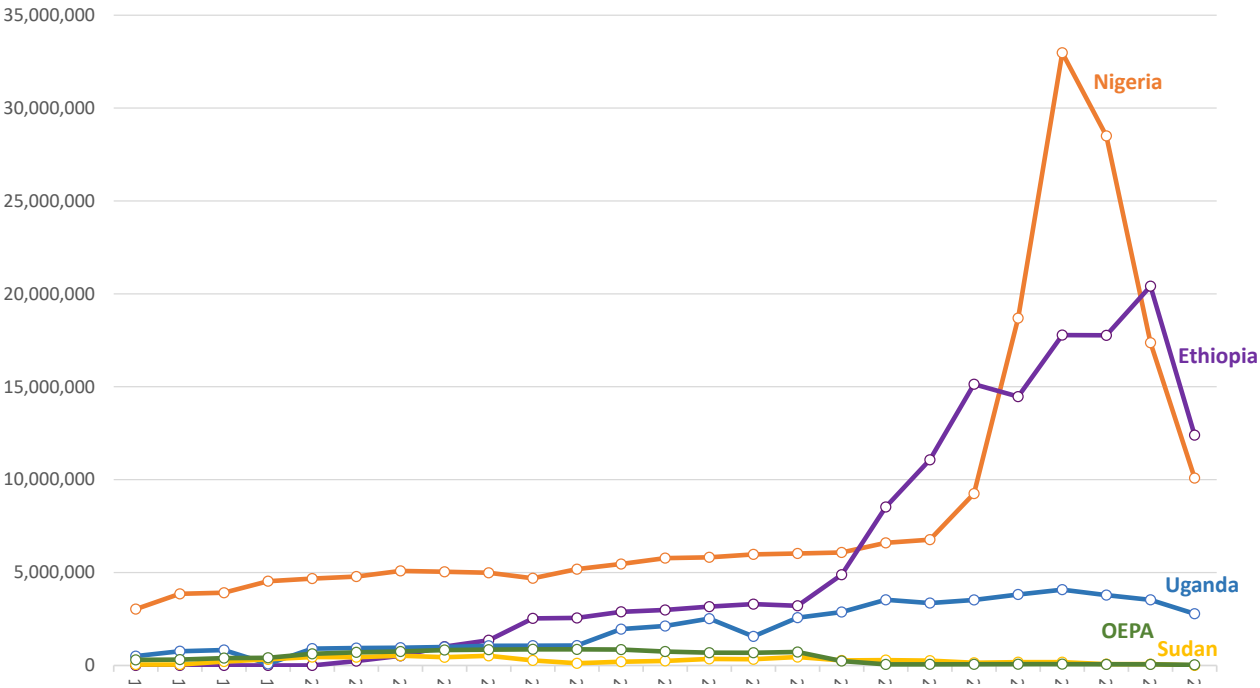
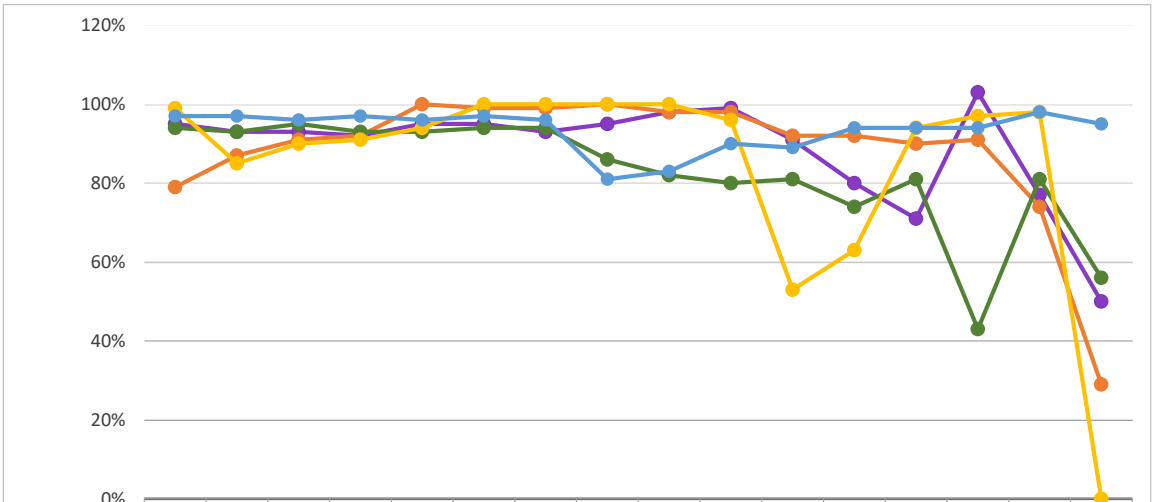


Figure 8

Carter Center-Assisted River Blindness Elimination Program: Mectizan® Treatments by Country/Program 1996 – 2020



River Blindness Program: Reported Treatment Coverage (Eligible Population) by Country/Program, 2005 – 2020

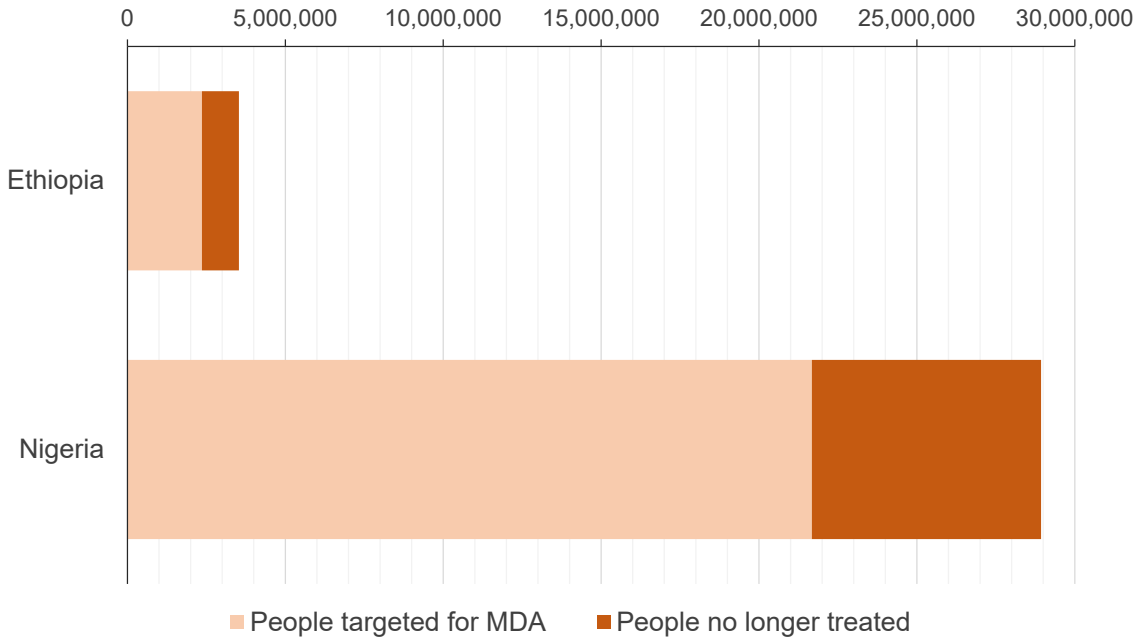


	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Ethiopia	95%	93%	93%	92%	95%	95%	93%	95%	98%	99%	91%	80%	71%	103%	77%	50%
Nigeria	79%	87%	91%	92%	100%	99%	99%	100%	98%	98%	92%	92%	90%	91%	74%	29%
OEPA	94%	93%	95%	93%	93%	94%	94%	86%	82%	80%	81%	74%	81%	43%	81%	56%
Sudan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

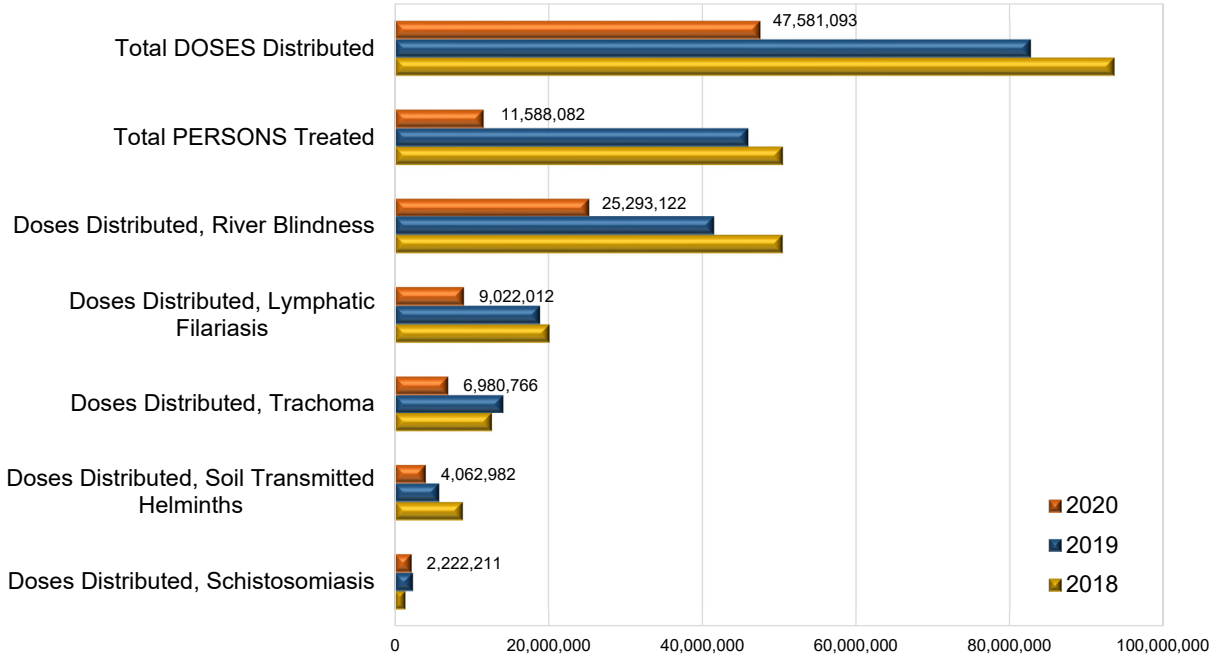
Figure 10

Population Currently and Previously Targeted for Lymphatic Filariasis Treatment

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



Carter Center-Supported Treatment Doses and Persons Treated for Neglected Tropical Diseases, 2018 – 2020

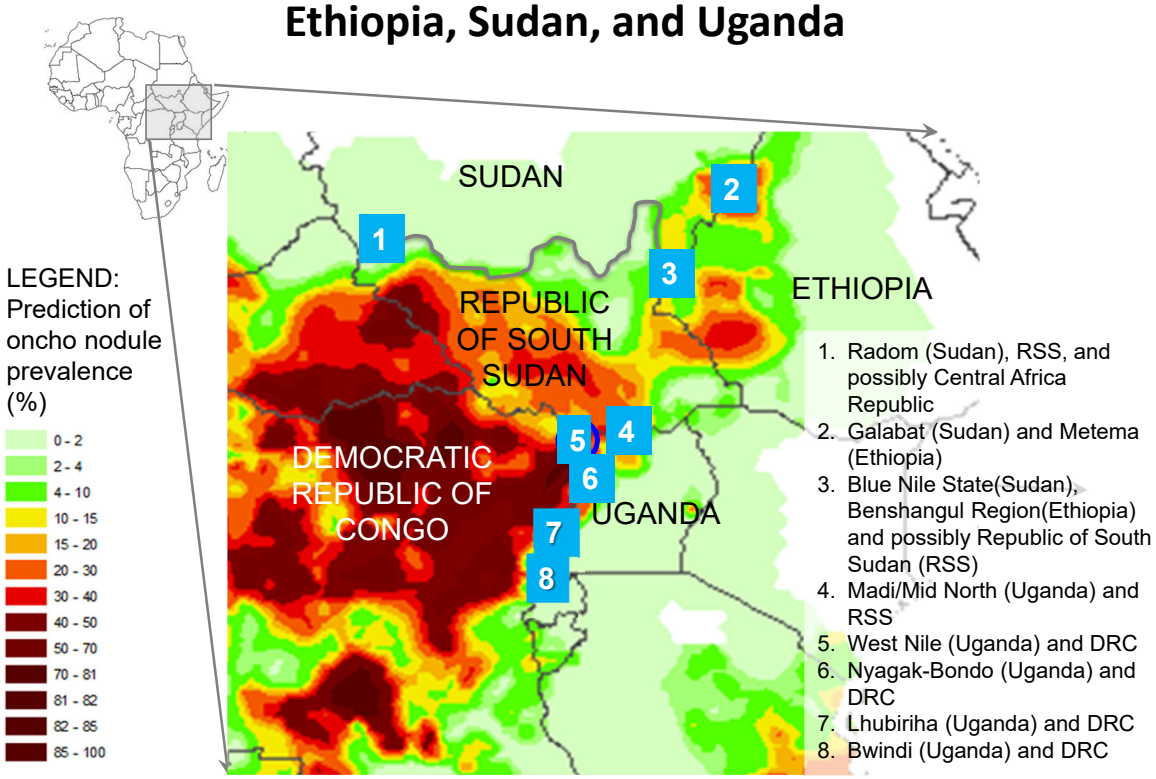


- *Trachoma 2020 doses are provisional.*
- *The decrease in treatment between 2019 and 2020 is due to the COVID-19 pandemic*
- *The decrease in treatment between 2018 and 2019 is attributable to a Mectizan delay in Ethiopia and Nigeria.*

The 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 12

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



1. Radom (Sudan), RSS, and possibly Central Africa Republic
2. Galabat (Sudan) and Metema (Ethiopia)
3. Blue Nile State(Sudan), Benshangul Region(Ethiopia) and possibly Republic of South Sudan (RSS)
4. Madi/Mid North (Uganda) and RSS
5. West Nile (Uganda) and DRC
6. Nyagak-Bondo (Uganda) and DRC
7. Lhubiriha (Uganda) and DRC
8. Bwindi (Uganda) and DRC

Community-Directed Distributors (CDDs) Trained 2004 – 2020 and 2021 Total Targets

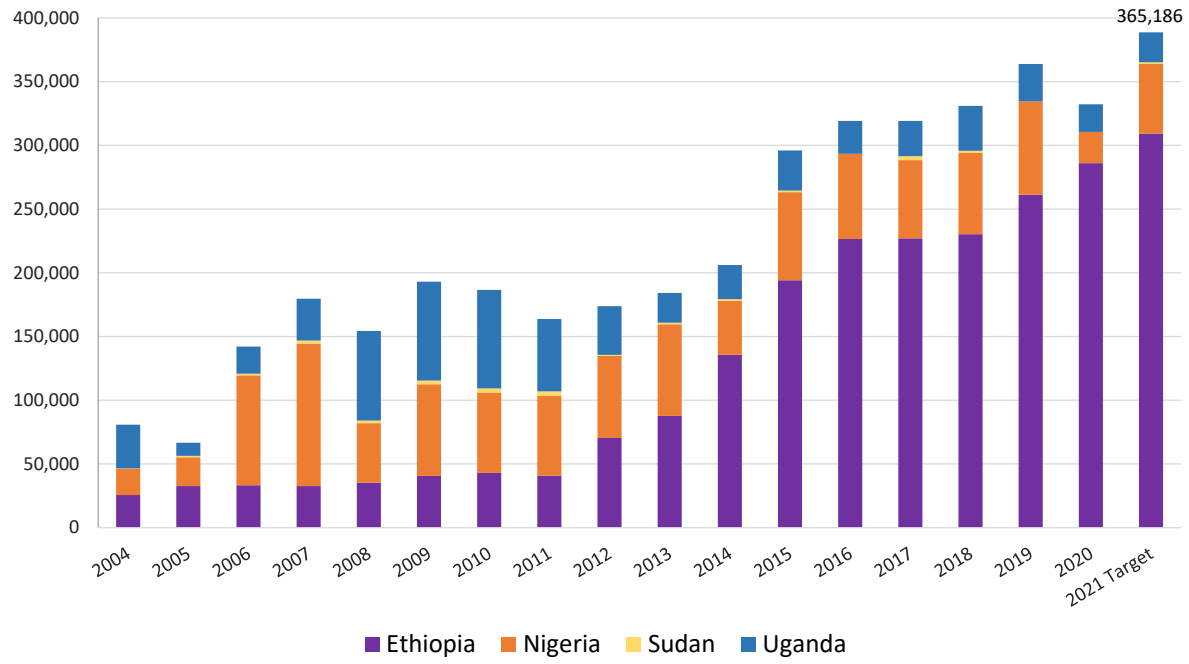
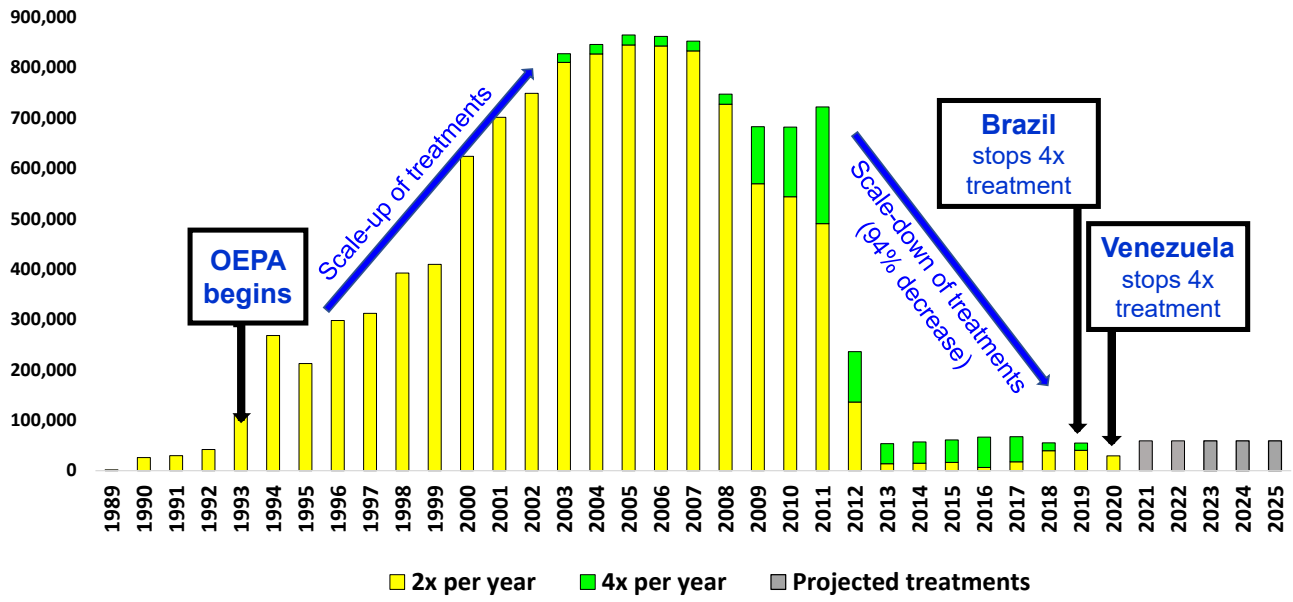


Figure 14

Mectizan® Treatment for Onchocerciasis in the Americas 1989 - 2020



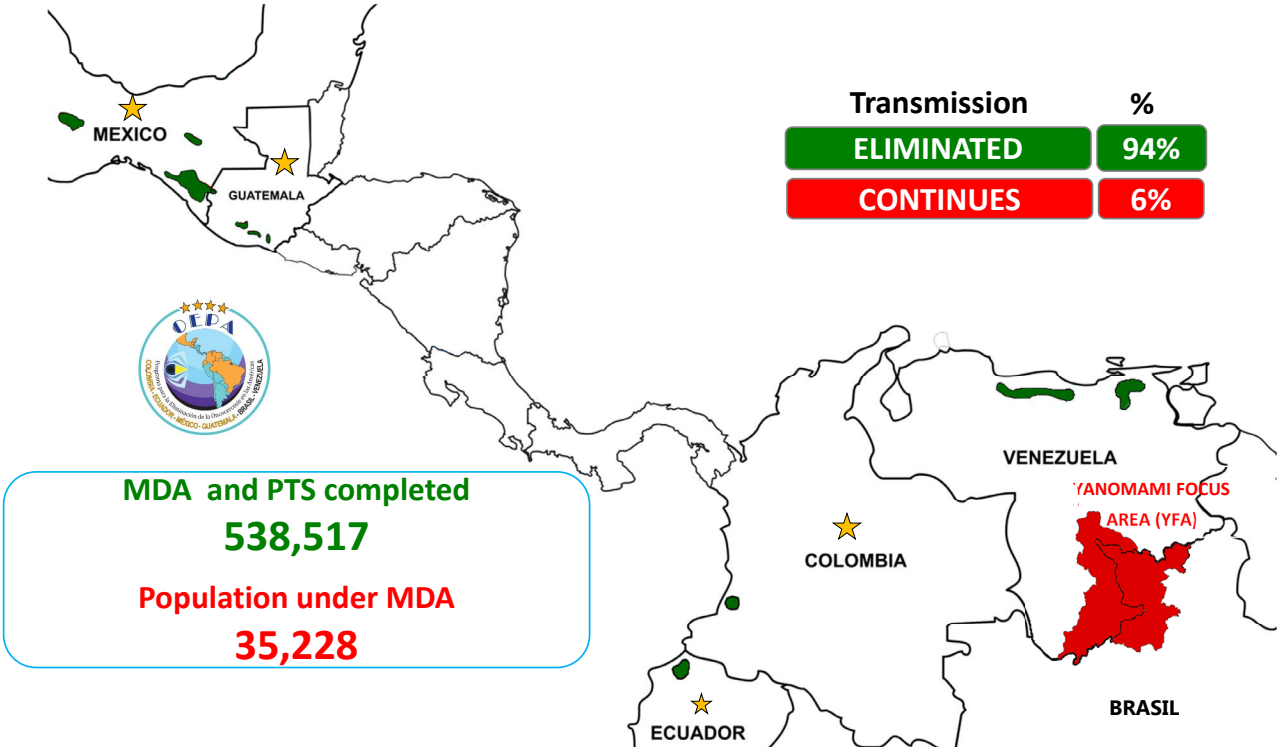
OEPA: Regional Population at Risk, No Longer at Risk and Eligible for Treatment in 2020

Country	Focus	Number of communities	Population out of risk	Population at risk	Population eligible for treatment	Transmission status
COL ★	Lopez de Micay-COL	1	1,366			Eliminated in 2010 Verified in 2013
ECU ★	Esmeraldas-ECU	119	25,863			Eliminated in 2012 Verified in 2014
MEX ★	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			
GUA ★	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			
VEN	Northcentral -VEN	45	14,385			Eliminated in 2013
	Northeast -VEN	465	95,567			Eliminated in 2017
	South-VEN	**373**		17,502	15,229	Ongoing
BRA	Amazonas-BRA	**272**		17,726	14,313	Ongoing
	Regional total	**2,463**	538,517	35,228	29,542	

★ WHO has verified elimination in four out of six regional countries.

Figure 16

Geographic distribution and transmission status of onchocerciasis in the Americas in 2020

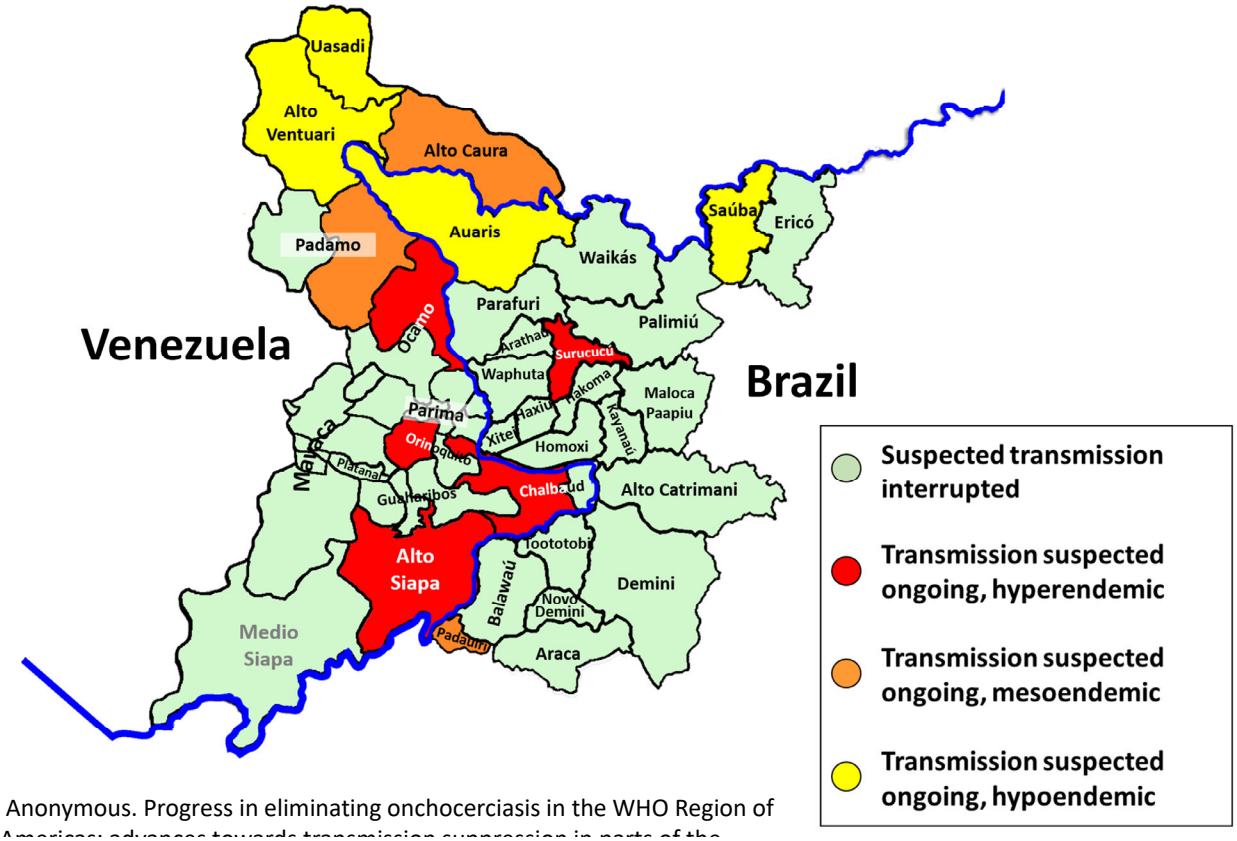


Mectizan® Treatments Distributed in Brazil and Venezuela, 2020

Focus	Communities				Pop. at risk 2x/year	Eligible for treatment	Treated 1st Rd	% Cov 1st Round	Comms reached 1st Rd	Treated 2nd Rd	% Cov 2nd Rd	Comms reached 2nd Rd	UTG(2)	Treated UTG(2)	% Cov UTG(2)
	Total	Hyper	Meso	Hypo											
Amazonas-BRA	272	121	78	73	17,726	14,313	11,592	81%	262	10,956	77%	257	28,626	22,548	79%
South-VEN	373	254	46	73	17,502	15,229	77	1%	3	10,269	67%	255	30,458	10,336	34%
Total	645	375	124	146	35,228	29,542	11,669	39%	265	21,215	72%	512	59,084	32,884	56%

Figure 18

Yanomami Focus Area in 2020



Ref: Anonymous. Progress in eliminating onchocerciasis in the WHO Region of the Americas: advances towards transmission suppression in parts of the

Cumulative Treatment Rounds >85% Distributed at the Venezuela South Focus, by Subarea 1995 - 2020

Transmission suspected interrupted
22 subareas (71%), 228 communities (61%), 11,579 individuals (66%)

Ongoing Transmission
9 subareas (29%), 145 communities (39%), 5,923 individuals (34%)

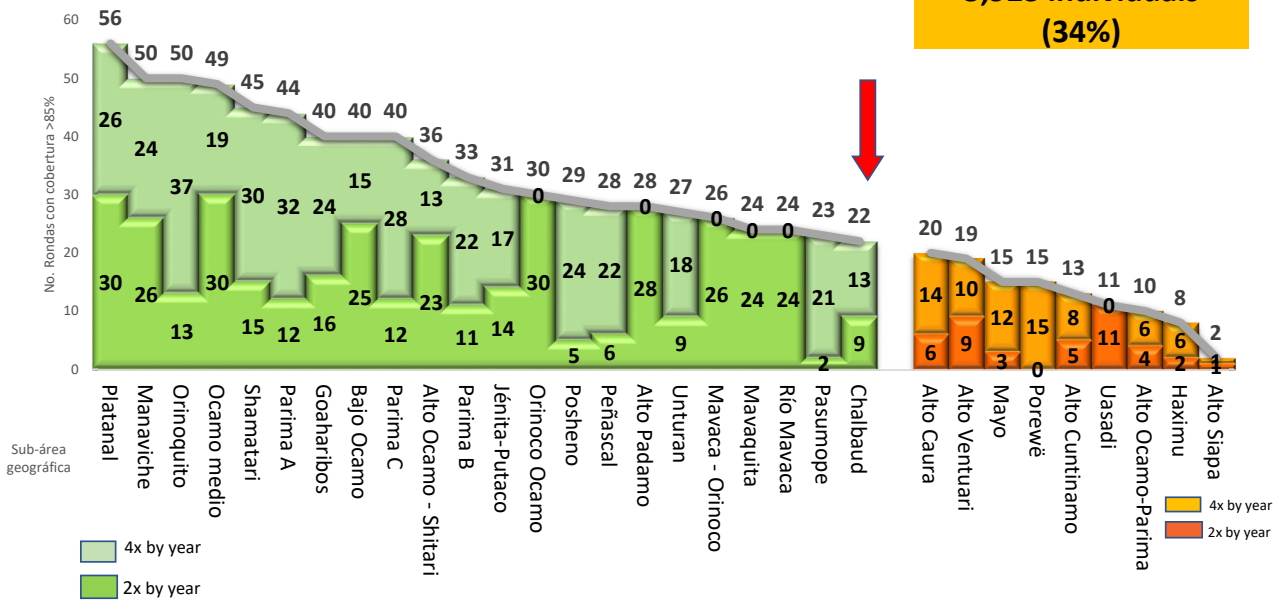
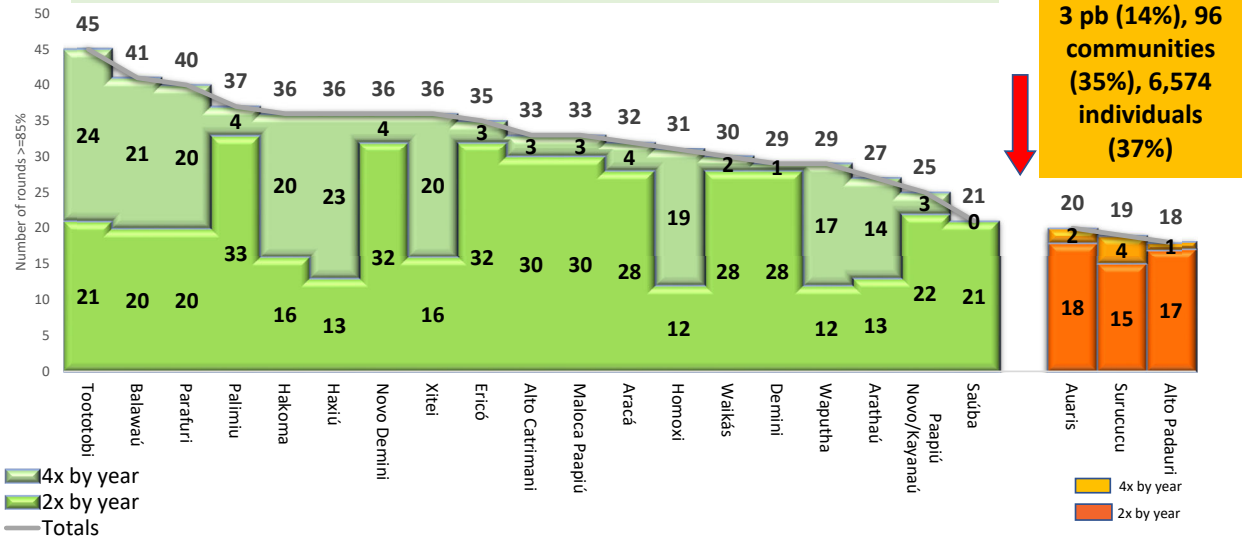


Figure 20

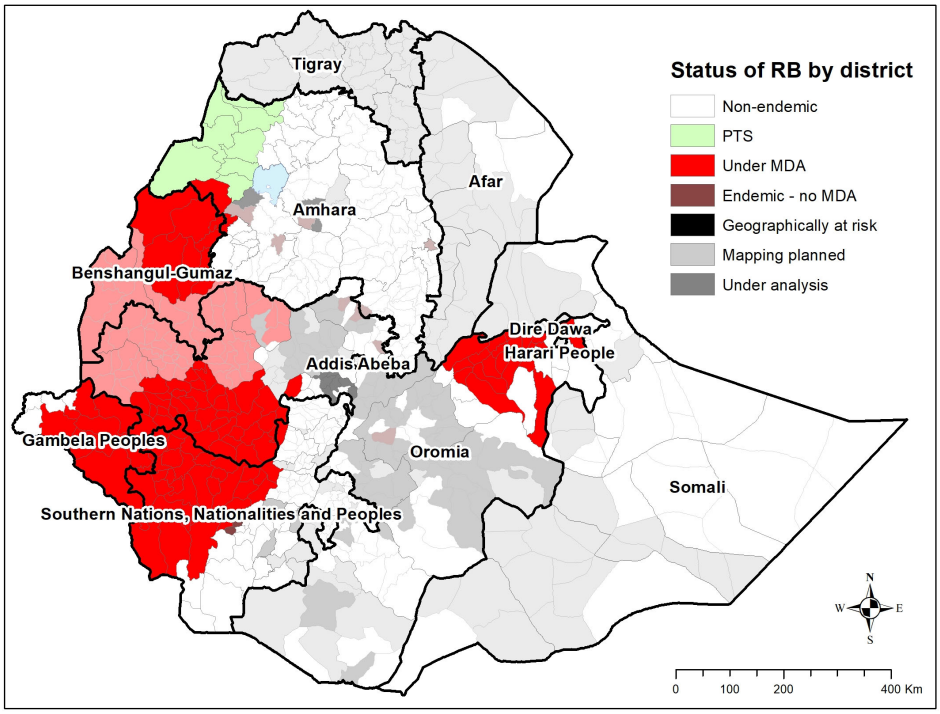
Cumulative Treatment Rounds >85% Distributed at the Amazonas Focus of Brazil, by *polo base* 2003 - 2020

Transmission suspected interrupted
19 *polos base* (86%), 176 communities (65%), 11,152 individuals (63%)

Ongoing Transmission
3 pb (14%), 96 communities (35%), 6,574 individuals (37%)



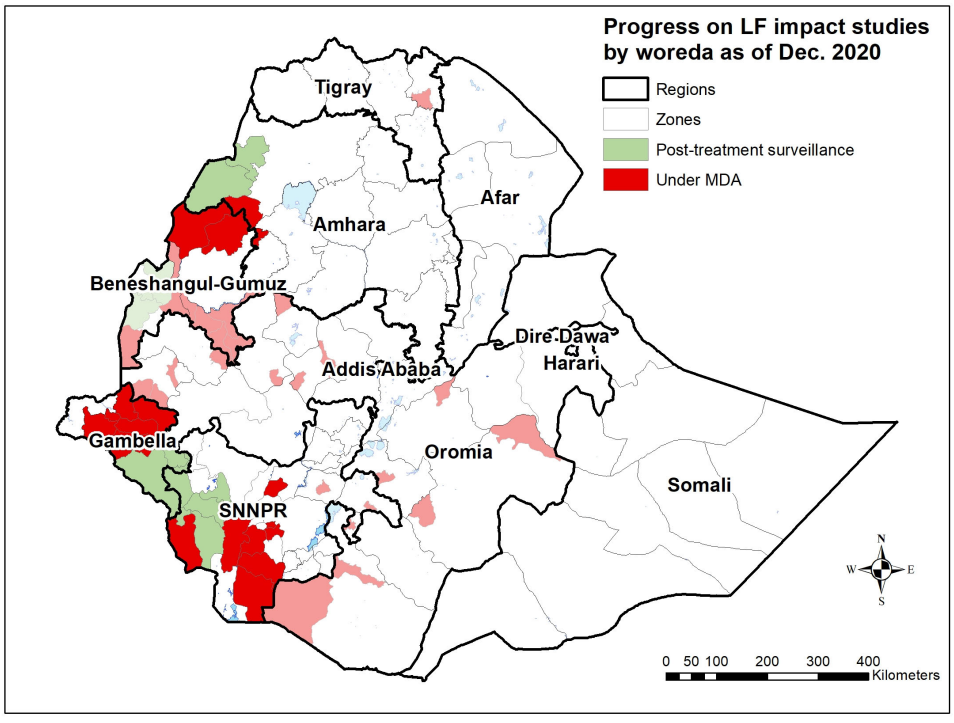
River Blindness Elimination: Progress by Woreda (District) in Ethiopia



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

Figure 22

Lymphatic Filariasis Elimination: Progress by Woreda (District) in Ethiopia



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

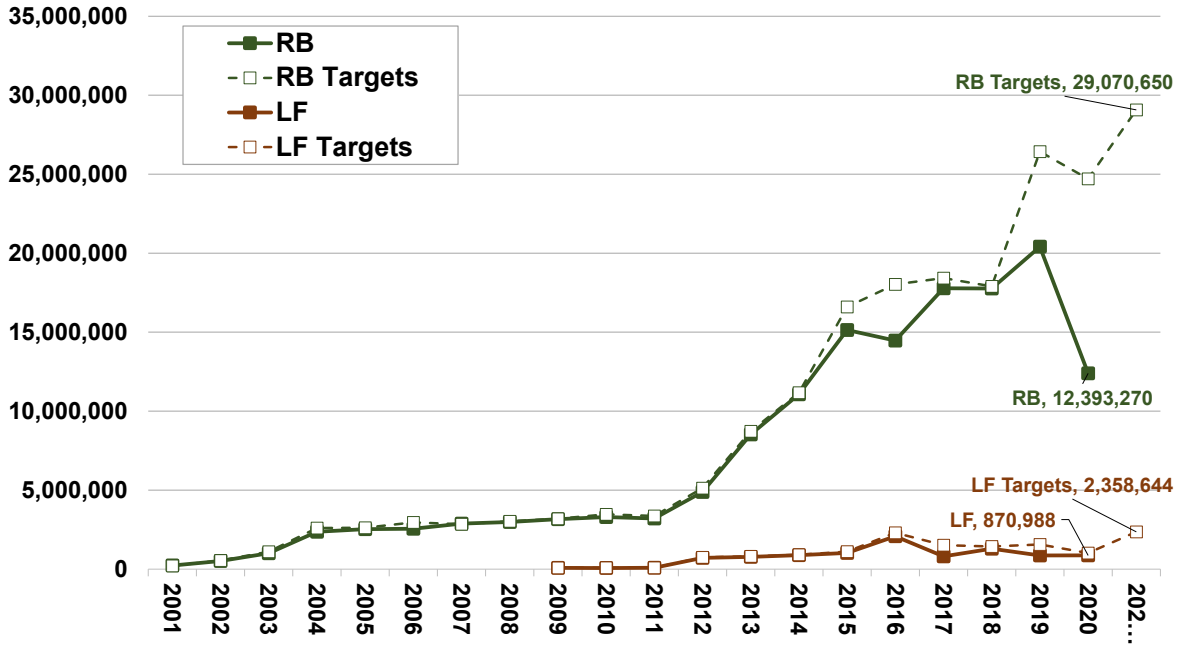
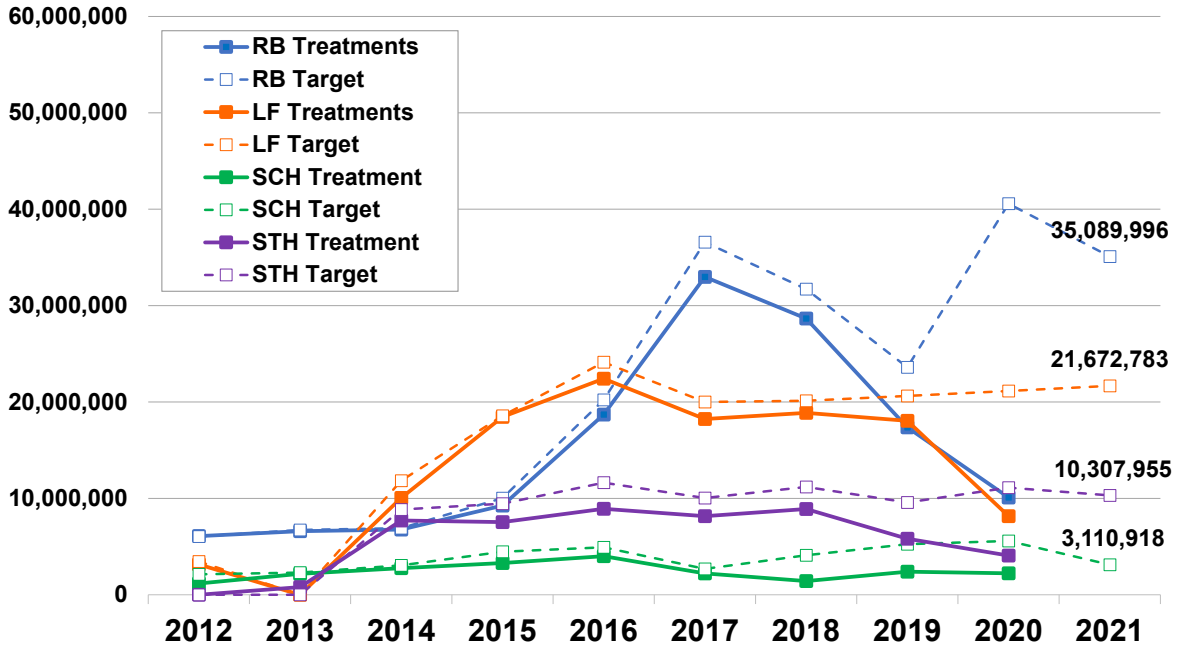
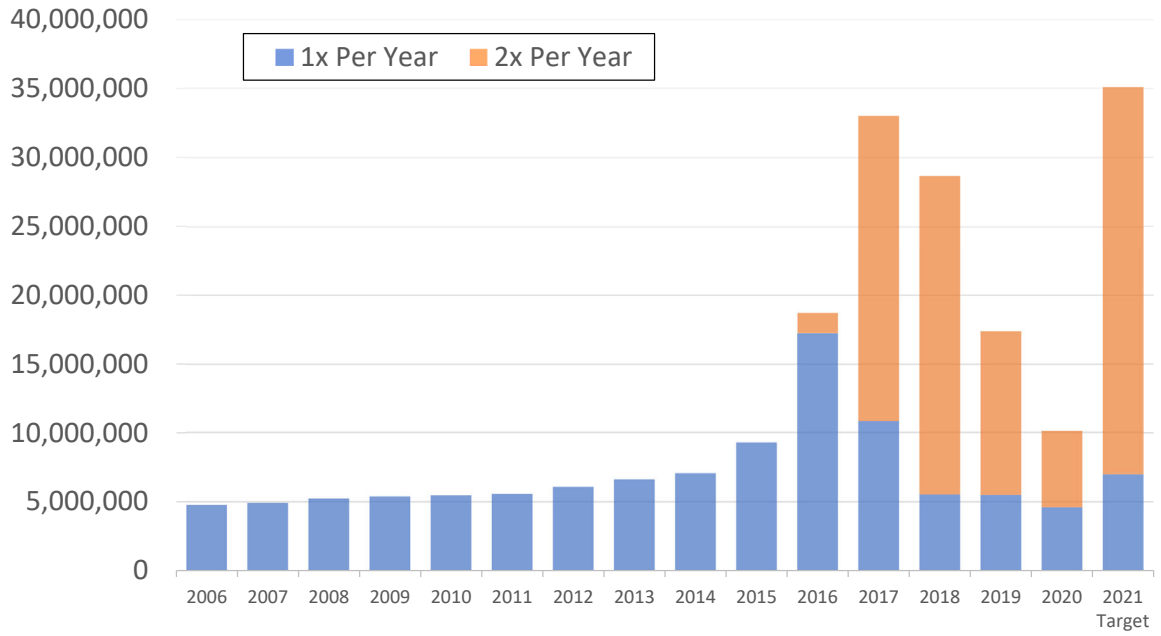


Figure 24

Nigeria: Carter Center Assisted River Blindness (RB), Lymphatic Filariasis (LF), Soil Transmitted Helminths (STH) and Schistosomiasis (SCH) Treatments and Targets



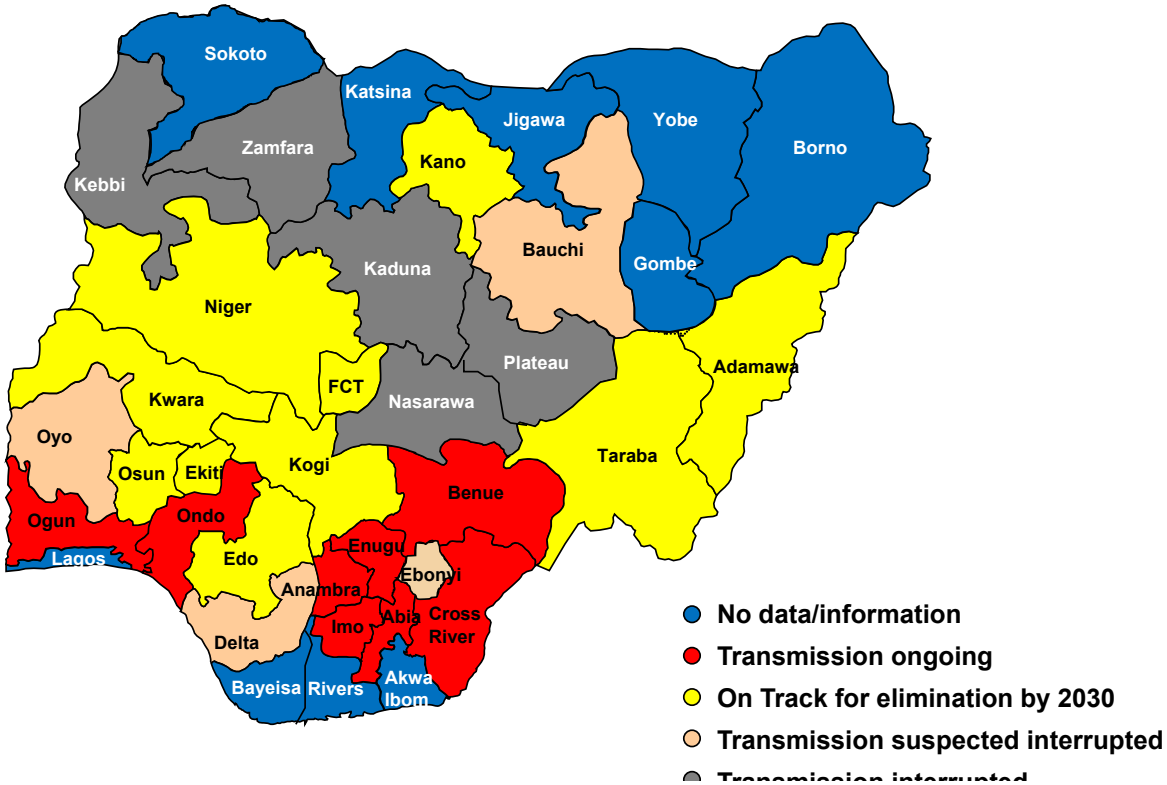
Nigeria: Annual and Semiannual Mectizan® Treatments in RBEP-Assisted Areas



** The decrease in treatment in 2018 is due to Plateau and Nasarawa halting treatment due to transmission interruption, in 2019 is due to delayed arrival of Mectizan, and in 2020 is due to COVID-19 pandemic*

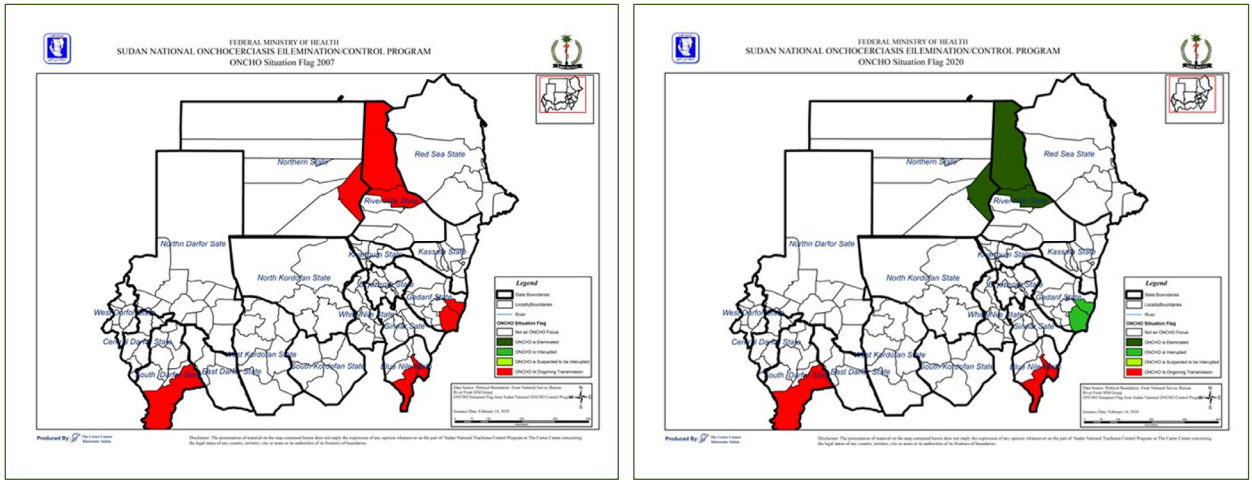
Figure 26

Status of Onchocerciasis Elimination in Nigeria, 2020



Sudan: Progression of Onchocerciasis Elimination

2007 **2020**



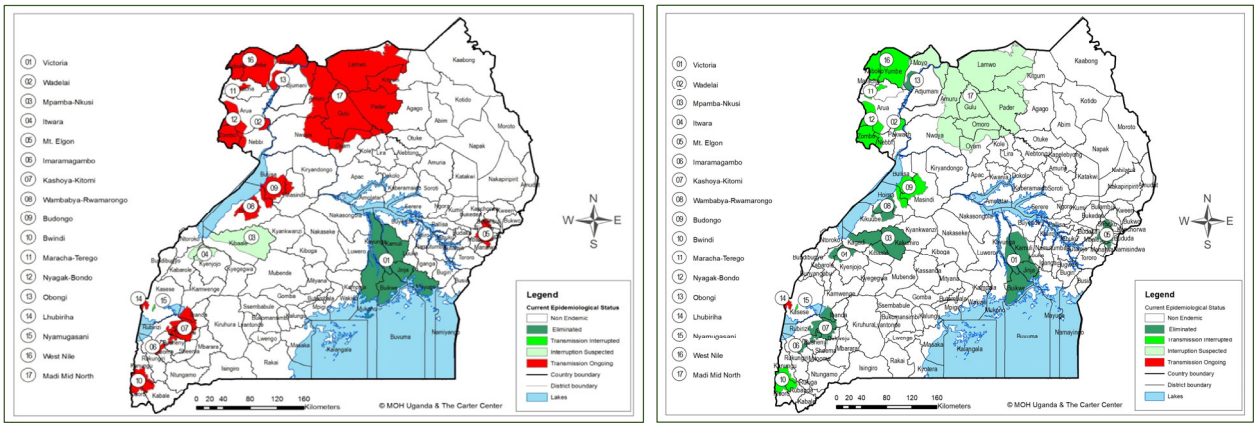
Red = Foci with ongoing transmission

Figure 28

Sudan Progress in Onchocerciasis Elimination: Foci Status 2007-2020

Uganda: Thirteen Years of Progress in Eliminating Onchocerciasis Transmission

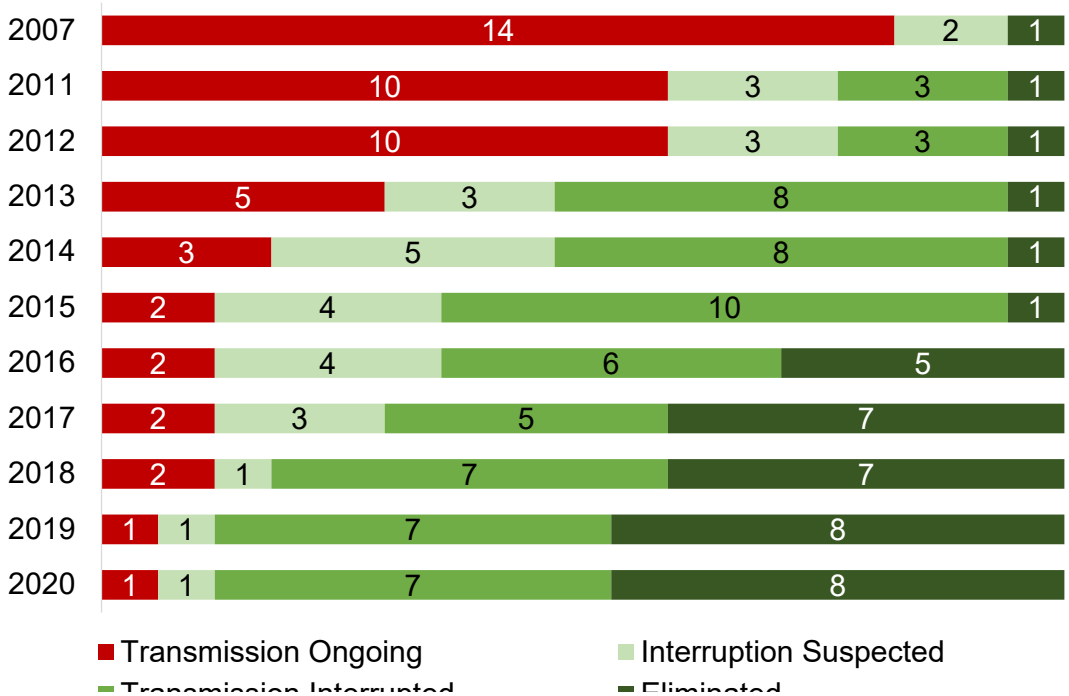
2007 **2020**



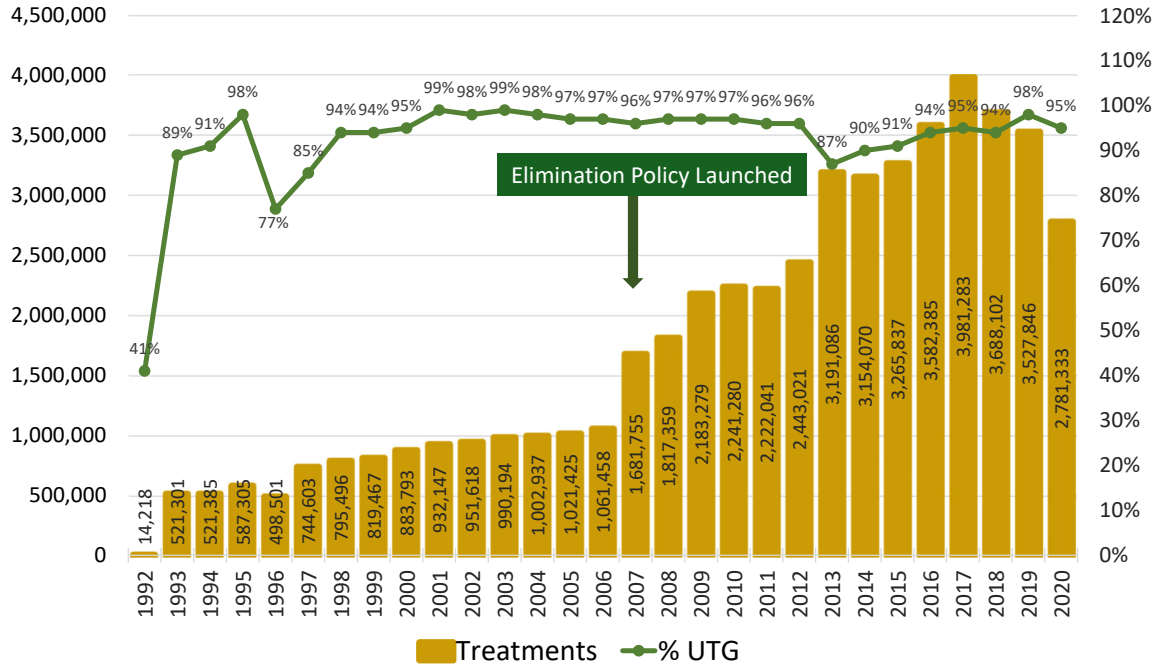
Red = Foci with ongoing transmission

Figure 30

Uganda Progress in Onchocerciasis Elimination Foci Status 2007-2020



Uganda Carter Center-Assisted Mectizan Treatments 1992-2020



EXECUTIVE SUMMARY

The 25th Annual Review Meeting of the Carter Center (TCC) River Blindness Elimination Program (RBEP) was held virtually from March 10–12, 2021. The RBEP Atlanta-based staff, RBEP-assisted countries' staff, Ministry of Health (MOH) officials, key partners, and donors focused on the 2020 achievements, challenges, operational research, and recommendations for 2021 activities.

The meeting was chaired by Dr. Gregory Noland, new Director of the TCC's River Blindness (RB), Lymphatic Filariasis (LF), Schistosomiasis (SCH), and Malaria programs. Dr. Noland celebrated the founding vision and impact of Dr. Frank Richards, who will remain a Senior Advisor to the RBEP. The meeting opened with an introductory conversation between Jason Carter, Chairman of TCC's Board of Trustees, TCC's new CEO, Ms. Paige Alexander, and new Vice President of TCC Health Programs, Dr. Kashef Ijaz. Dr. Tedros Adhanom Ghebreyesus, Director General of the World Health Organization (WHO), conveyed a goodwill message to begin proceedings.

The goal of the RBEP is to assist MOH in six countries[3] to eliminate RB transmission. The strategy for elimination in RBEP programs is mass drug administration (MDA) with ivermectin (Mectizan®, donated by Merck & Co., Inc., Kenilworth, NJ, USA), 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 WHO-verified national elimination of onchocerciasis from Colombia (2013), Ecuador (2014), Mexico (2015), and Guatemala (2016). The Abu Hamad Focus in Sudan was the first focus in Africa to eliminate onchocerciasis transmission; since then, seven foci in Uganda have followed. The approach to RB elimination is defined by WHO guidelines, which provide three milestones (Figure 1): 1) transmission suppressed; 2) transmission interrupted and MDA halted; and 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. As a result of our RB elimination partnership, 7 million people no longer need Mectizan treatment in TCC-assisted areas in ten countries (Figures 2-4).

In 2020, TCC assisted with 25,293,122 mass ivermectin treatments for RB in the Americas, Ethiopia, Nigeria, and Uganda. While this represents only 41% of the 2020 treatment target of 62 million due to COVID-19-related delayed or skipped MDA campaigns, the 2020 treatments are still greater than annual treatment totals for years prior to 2015 (Figure 5). Country-specific treatments are shown in Figure 6. A goal of 68 million treatments has been set for 2021 with the expectation that programs will be able to safely resume activities.

Cumulative RB treatments since 1996 have now reached 450 million (Figure 7). Figures 8 and 9 show TCC-assisted treatments and annual coverage geographically. 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 is an integrated program that includes LF in Ethiopia and Nigeria, and SCH and soil-transmitted helminthiasis (STH) in Nigeria. As a result of our LF elimination partnership, 8.6 million people in Ethiopia and Nigeria no longer need treatment (Figures 2, 10). In 2020, TCC assisted with the distribution of 9,022,012 ivermectin and albendazole (donated by GSK) treatments for LF (41% of the 2020 treatment target), 2,222,211 praziquantel (donated by Merck KGaA, Germany)

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

treatments for SCH (48% of the treatment target) and 4,062,982 mebendazole (donated by Johnson & Johnson) or albendazole (GSK) treatments for STH (34% of the treatment target) in 2020 (Figure 11). Cumulatively, TCC has assisted in 159,082,123 LF treatments, 27,707,006 SCH treatments, and 51,803,650 STH treatments (Figure 7). RB treatments represented 53% of the 48 million MDA treatments for RB, LF, SCH, STH, and trachoma assisted by TCC (Figure 11).

The 2020 Review highlighted the impact of the COVID-19 pandemic on national onchocerciasis elimination programs that included a halt to MDA campaigns, community-based surveys, and other activities in compliance with WHO guidance issued April 1st, 2020. Cross border activities in special intervention zones (SIZs) (Figure 12) were also suspended due to international border closures. Modeling data indicate that mature programs with a longer history of MDA for onchocerciasis (or LF) will be most insulated from the effects of skipped MDA and that biannual MDA for RB is more effective than increasing coverage for mitigating the impact of COVID-19 on MDA[4]. The meeting also highlighted program innovation and resiliency to safely resume activities following WHO revised guidance in July 2020, with Uganda's onchocerciasis elimination program, assisted by TCC, as one of the first large-scale MDA campaigns to resume in 2020.

Our work would not be possible without a grassroots network of community-directed drug distributors (CDDs) who provide the treatments along with health education. A combined 365,186 CDDs were trained in 2020, all of whom were trained and mentored by MOH personnel working in affected districts assisted by TCC (Figure 13).

TCC mourns the loss of all those who died in 2020, including the Hon. Dr. Tebebe Berhan of the Lions Clubs of Ethiopia, who was a champion for all neglected tropical disease (NTD) elimination efforts in Ethiopia and Africa. He will be dearly missed.

[4] Hamley, J. I. D., et al. (2021). "What does the COVID-19 pandemic mean for the next decade of onchocerciasis control and elimination?" *Transactions of the Royal Society of Tropical Medicine and Hygiene* **115**(3): 269-280.

2021 GENERAL RECOMMENDATIONS FOR 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. TCC/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 should be guided by (but not restricted to) the WHO guidelines.
- Conducting new assessments to help delimit the precise borders of African onchocerciasis transmission zones ('foci') and (buffer zones between transmission zones) that can assist our elimination agenda in TCC/RBEP-assisted areas.
- Defining areas of active onchocerciasis transmission, including within the so-called 'hypoendemic' onchocerciasis areas that have traditionally not been targeted for ivermectin treatment under previous WHO/African Program for Onchocerciasis Control (APOC) disease control policy.
- Enhancing interventions (two- or four-times-per-year ivermectin 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 SIZs and encouraging the needed collaboration on both sides to stop transmission.
- Monitoring the impact of interventions using sensitive and specific tools. Consider integrated monitoring especially in RB/LF overlap areas when stop MDA decisions are being considered.
- TCC health programs should continue COVID-19 risk mitigation as recommended by WHO, their national programs, and TCC Atlanta, including use of masks, hand hygiene, social distancing measures, and modified protocols for trainings, surveys, and other large gatherings. National and international meetings should be conducted virtually where possible until travel can safely resume.
- Based on the successful experience with the virtual TCC Program Review meetings in 2020 and 2021, maintain a virtual option even when in-person Program Review meetings resume. The expanded participation of country program staff in 2021 in particular produced a richer and more inclusive meeting for staff and partners and increased awareness for country staff.
- When the opportunity exists, consider conducting LF and RB evaluations in tandem, using modified sampling strategies recommended by the WHO Onchocerciasis Technical Subgroup (OTS).
- TCC/RBEP encourages improved collaboration and transparency among stakeholders to reduce drug supply delays and supply inaccuracies.
- Programs should collect more information to explain when they have communities with low coverage indicated on the Likert-scale coverage graphic.
- TCC field offices should conduct treatment coverage surveys in at least two districts in two

subregions/states/zones annually, in consultation with Headquarters (HQ) and MOH.

- Include details on MDA activities among refugees and internally displaced persons in annual reports and presentations.
- TCC/RBEP encourages the MOH to submit drug applications to WHO and the Mectizan Donation Program (MDP) as early as possible; timely drugs are 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 submitted with applications can be interim but must be included. Keep TCC/RBEP HQ informed on the process.
- Seek to increase training, supervision, involvement of kinship groups, and gender balance among CDDs and community supervisors (CSs).
- The TCC website should house key public domain documents from national onchocerciasis elimination committees of Ethiopia, Nigeria, and Uganda. The Onchocerciasis Elimination Program for the Americas (OEPA) domain should house 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 by Dr. Thomas Unnasch and his team at the University of South Florida (USF). In consultation with USF, field laboratories should send samples and/or data to USF for quality control purposes. Reagent and supply orders from these labs must be reviewed promptly by Dr. Unnasch or his staff so that TCC HQ can purchase and ship supplies in a timely manner. TCC will continue to use the 'OEPA' OV16 enzyme-linked immunosorbent assay (ELISA) and standard (qualitative) PCR for OV16 and O-150 testing, respectively. Review and consider, internally and with national onchocerciasis elimination committees, the frequent changes in recommendations being produced by the WHO OTS and the Task Force for Global Health, particularly as these relate to the mapping of onchocerciasis in presumably hypoendemic areas and new diagnostic approaches. The changing recommendations are causing considerable confusion for the programs and imply resource expenditures that TCC is unable to support at this time.
- Through national mechanisms, TCC/RBEP offices should monitor financial contributions of government, WHO's Expanded Special Project for Elimination of NTDs (ESPEN), and other partners for elimination efforts in RBEP-assisted areas.
- TCC/RBEP program staff must complete or renew their Emory Institutional Review Board (IRB) certification if they are to be involved with work that is considered human subjects research. Coordinate with HQ staff regarding all IRB determinations and compliance.
- In fulfillment of the second pillar of the Global Programme to Eliminate LF, ensure that CDDs collect and report LF morbidity data in Ethiopia and Nigeria. Begin reporting these data as part of annual program reports.
- TCC's RB, LF, SCH and STH Programs aim to assist with the distribution of 104 million treatments for NTDs in 2021.

2021 Treatments and Training Objectives:
UTG = Ultimate (annual) Treatment Goal
UTG2 = Twice-per-year Treatment Goal
UTG4 = Four-times-per-year Treatment Goal

2021 River Blindness Treatment Targets			
Annual (UTG)	Semiannual (UTG2)	Quarterly (UTG4)	Total
7,352,274	60,093,717	61,179	**67,507,170**

2021 Lymphatic Filariasis	
Annual (UTG)	Total
24,031,427	**24,031,427**

2021 Schistosomiasis	
Annual (UTG)	Total
3,110,918	**3,110,918**

2021 Soil-Transmitted Helminths		
Annual (UTG)	Semiannual (UTG2)	Total
6,263,268	4,044,687	**10,307,955**

2021 Training Objectives	
Total CDDs	Total CSs
365,186	**115,271**

THE AMERICAS

Presenter: Dr. Mauricio Sauerbrey (The Carter Center)

Summary:
OEPA is a coalition led by TCC that includes the MOH 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). The OEPA treatment history over almost 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 14).

Details on the original and current transmission zones of the Americas, including transmission status by focus, can be seen in Figures 15 - 16. 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. According to program records, around 35,228 people are at risk of onchocerciasis there. The challenge with the YFA lies in the remoteness of its nomadic population, the lack of high-level coordination between Brazil and Venezuela, and the current political, humanitarian and health crises in Venezuela. OEPA presented a detailed plan to complete a partially constructed airstrip in Siapa Valley, Venezuela. This will allow more affordable and regular access to the most remote YFA communities, where it is likely that transmission is still ongoing.

Due to the COVID-19 pandemic, the annual IACO conference was held virtually December 1 – 2, 2020. The PCC, which usually meets twice annually, did not meet in 2020.

The OEPA program received financial support from the United States Agency for International Development (USAID), Lions Clubs International Foundation, The Global Institute for Disease Elimination (GLIDE), and Merck & Co., Inc., Kenilworth, NJ, USA in 2020.

Treatments:
In 2020, OEPA assisted Brazil and Venezuela with 32,884 Mectizan treatments, representing 56% of the 2020 treatment target of 59,084. Brazil achieved 79% of its treatment goal as ivermectin treatments were offered alongside essential health services during the COVID-19 pandemic. In contrast, Venezuela's stand-alone treatments were delayed based on WHO COVID-19 prevention guidelines. Eventually the program conducted risk assessments and mitigation activities that enabled treatments to commence late in the year. In addition to the pandemic, the program had challenges with fuel supply and available flight hours to visit many of its endemic communities. Thus, Venezuela was only able to achieve 34% of its treatment goal in 2020. Figure 17 shows detailed treatment information from 2020.

Challenges of 2020 notwithstanding, the program has conducted 20 or more rounds of high-coverage treatment in 61% of the communities of the YFA (Figures 18 - 20), which means that transmission in these communities is likely interrupted[5] (see full list of RBEP publications in Annex 8).

[5] World Health Organization (2020). "Progress in eliminating onchocerciasis in the WHO Region of the Americas: advances towards transmission suppression in parts of the Yanomami focus area." *Weekly Epidemiological Record* **95**(40): 484-488.

The 2021 treatment target for OEPA is 60,898 treatments.

Training:
OEPA engages local Yanomami people from endemic communities of both Brazil and Venezuela to serve as Indigenous Health Agents (IHAs), providing health services in this challenging area. IHAs delivered 75% of treatments that occurred in Venezuela in 2020. In Brazil, 147 Yanomami people assisted Mectizan treatment activities (seven, or 5%, of these are women) while in Venezuela 49 IHAs serve the program (four, or 3%, of these are women). While Brazil did not train any IHAs anew in 2020, Venezuela held workshops in 18 communities, and 47 of their 49 IHAs participated.

Special Topics:
Dr. Carlos Botto (Coordinator of the Venezuela South Focus program) presented a history of identification of Yanomami communities previously unknown to the country's health system. In the past five years, satellite mapping exercises conducted by National Aeronautics and Space Administration (NASA), the University of Georgia, and Maxar (a private imaging company) have located 31 unregistered communities. Twenty-six of these have been visited so far, and 23 of those were found to be onchocerciasis endemic and have begun receiving treatment. Dr. Botto emphasized that IHAs have also been essential in identifying communities, resulting in 58 onchocerciasis-endemic communities being brought into the program since 2010. He noted that in areas where IHAs are active, no unregistered villages have been found by satellite (suggesting that IHAs have provided a comprehensive understanding of the areas where they operate). We believe we are now close to knowing the full extent of onchocerciasis-endemic communities in Venezuela (currently numbering 373).

	2020 Treatment Targets	2020 Treatments (%)	2021 Treatment Targets
UTG2	**59,084**	**32,884 (56%)**	**60,898**

THE AMERICAS 2021 RECOMMENDATIONS

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 new WHO NTD Roadmap sets the target year for onchocerciasis transmission elimination in the Americas as 2025. The OEPA PCC takes this to mean that MDA should stop by the year 2025. Conducting PTS and getting formal verification will take longer.
- Pursue the request of a new shipment of Mectizan to cover 2022-2023, needed in countries by November 2021.
- Both country programs are encouraged to take advantage of their COVID-19 vaccination campaigns in the YFA to distribute ivermectin treatment for onchocerciasis.
- The programs should work to reach high treatment coverage (>85%) in each treatment round. This is particularly critical in light of missed treatments during the pandemic; the EuSimon modelling exercise in 6 communities suggested no risk of disease recrudescence as long as high treatment coverages are achieved in 2022.
- Continue the anthropologist consultancies that are helping the program to understand Yanomami movements and cultural outlooks pertinent to the treatment program, pursuing increased involvement of IHAs and Yanomami women.
- Train more IHAs and Yanomami Educators and continue the important advances in encouraging participation of Yanomami women. Document the participation of each of these groups.
- Conduct epidemiological assessments (serology, entomology) in non-sentinel areas when the pandemic allows.
- Continue work to compile previous monitoring results (particularly serology and entomology) into subregion- or community-specific graphs and tables to better track progress over time.
- Continue, as the programs are able, the use of doxycycline treatment as an important ancillary approach in the final stages of elimination.
- The village level scoring system should be maintained and further refined. A common scoring system for the overall Yanomami Area should be developed based on common data variables, such as effective (>85%) treatment rounds, baseline endemicity, most recent assessment results and prevailing vector species.
- Refine the geographical information system (QGIS), the common mapping platform of the two countries' technical teams working separately, tracking community treatment performance and epidemiological indicators listed above, and adding or changing coordinates as communities split and relocate, or new communities are identified.
- Continue to invite all six OEPA country representatives to IACO regardless of verification of elimination status.
- Hold the 2021 midyear PCC meeting virtually due to the COVID-19 pandemic.
- Hold IACO virtually in 2021. Promote the highest level of political representation at IACO from PAHO, Venezuela and Brazil, assuming the political environment in both countries allows such open collaboration. Encourage the Lions Clubs International Foundation to maintain support to a Lions representative from each of the six countries to attend IACO.

VENEZUELA:

- A high priority in 2021 is completion of the airstrip in the Siapa river valley to allow the landing of fixed-wing planes, to attain sustainable treatment distribution in remote endemic communities in the area.
- Source airplane fuel in Venezuela so that all 13 airstrips can be visited and maintained before they become overgrown again.
- Since helicopter flights are not available due to expense; consider alternatives like additional IHAs, fixed-wing, boat and foot access, etc.
- Continue using satellite imagery to identify unknown communities and monitor the movements of known communities. New communities (previously unrecognized by the program) need to have 1) a confirmatory 'fly-over' or site visit to confirm they are inhabited; 2) Ov16 and skin snip assessments; and 3) if the village is confirmed to be onchocerciasis endemic, Mectizan treatment should be started immediately.
- Seek new ways to channel funding to support PES entomology activities in NE Venezuela.
- Continue to support identification and training of Yanomami residents as IHAs who will take part in treatment activities, including Mectizan distribution and malaria treatment. Track the number of IHAs in each program and establish common indices to monitor their performance (such as ratio of IHAs:persons treated, IHAs/community, number of female IHAs, etc.) and report malaria diagnosis and treatment data to demonstrate ancillary program benefits
- Seek medical commodities from PAHO country delegation in Venezuela (especially malaria diagnostics and therapeutics) for the medical teams visiting the Yanomami area, to provide these urgently needed services to as many people as possible during the onchocerciasis program visits.

BRAZIL:

- Fill the recently vacant field supervisor position as soon as possible and follow the progress of the four field supervisors.
- Fiocruz' Laboratory should work to obtain the serology Ov16 processing quality certification from Dr. Unnasch' Regional Reference Lab.

ETHIOPIA

Presenters: Dr. Zerihun Tadesse and Mr. Mohammed Hassen (The Carter Center)

Summary:
Since 2001, TCC has assisted the Ethiopian MOH to eliminate transmission of onchocerciasis in the country. The RBEP has been providing primarily twice-per-year treatments for RB since 2016 to aggressively reach the MOH's goal of onchocerciasis elimination by 2025. Ethiopia is home to the first cross-border focus to break transmission of onchocerciasis—the Metema-Galabat focus in northwestern Ethiopia - eastern Sudan. TCC has assisted the Ethiopian LF program since 2009. The RB and LF programs have expanded significantly in the last five years; the geographic scope of the program is shown in Figures 21 and 22. Activities this year were limited primarily by the COVID-19 pandemic, which prevented semi-annual treatment from occurring in RB-endemic areas the country. Extensive risk assessment and mitigation activities were undertaken, and substantial quantities of personal protective equipment were procured before activities resumed.

Due to the COVID-19 pandemic, the annual Ethiopia Onchocerciasis Elimination Expert Advisory Committee (EOEEAC) was held virtually October 27 – 29, 2020.

TCC's work in Ethiopia is based on a longstanding partnership with the MOH and receives support from Lions Clubs International Foundation, through the Lions/Carter Center SightFirst Program, 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, The Task Force for Global Health, and other donors.

Treatments:
In 2020, Ethiopia delivered a total of 12,393,270 Mectizan treatments, representing 50% of the 2020 treatment target (Figure 23). The TCC-assisted LF program provided 870,988 annual treatments with Mectizan and albendazole, representing 85% of the 2020 treatment target. More than 72,000 villages were reached. The program aims to deliver 29,009,471 semi-annual and 61,179 quarterly treatments for RB and 2,358,644 for LF in 2021.

Training:
A total of 285,995 CDDs were trained in 2020, about 24,000 more than in 2019 and 82% of the annual goal. Additionally, 94,865 (76%) CSs and 9,448 (98%) health extension workers (HEW) received training. The goals for 2021 are 309,224 CDDs and 103,075 CSs.

Special Topics:
Aderajew Mohammed (TCC) presented the status of onchocerciasis elimination mapping Ethiopia. The goal of this comprehensive exercise is to determine the endemicity of every district in the country. After several years and thousands of samples, only 17 districts remain to be mapped. Based on current data, 20 districts, representing 2.5 million are newly identified as needing ivermectin treatment. Dr. Paul Cantey (CDC) presented an update from the WHO OTS as well as an algorithm for integrating LF transmission assessment surveys (TAS) with RB mapping surveys – which Ethiopia has already done recently. Dr. Wilma Stolk (Erasmus MC/NTD Modelling Consortium) presented mathematical models to elucidate transmission suppression in the Ethiopian context.

River Blindness			
	2020 Treatment Targets	2020 Treatments (%)	2021 Treatment Targets
UTG2	24,643,032	12,344,972 (50%)	29,009,471
UTG4	64,176	48,298 (75%)	61,179
Total	**24,707,208**	**12,393,270 (50%)**	**29,070,650**

Lymphatic Filariasis			
	2020 Treatment Targets	2020 Treatments (%)	2021 Treatment Targets
UTG2	**1,018,790**	**870,988 (85%)**	**2,358,644**

Training Objectives			
	2020 Training Targets	2020 Training (%)	2021 Training Targets
CDDs	275,985	285,995 (104%)	309,224
CSs	90,722	94,865 (105%)	103,075
HWs	10,382	9,448 (91%)	11,453

ETHIOPIA 2021 RECOMMENDATIONS

GENERAL:

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

ONCHOCERCIASIS:

- Develop a long-term evaluation schedule for the Wude Gemzu 'hot spot' in the Metema sub-focus to confirm interruption of transmission. Document the absence of parasites in flies from the buffer zone surrounding the broader Metema sub-focus. Publish findings (a companion paper was promised in the paper by Katabarwa *et al.*, 2020).
- Maintain good coverage in the four-times-per-year MDA in the Wude Gemzu 'hot spot' as best as possible given security issues there.
- Complete all 'first stage' mapping activities as resources and security allow and in consultation with TCC HQ and MOH. Leave second-stage mapping to MOH, ESPEN or other partners. Only 17 districts remain for serological investigation. Discuss recommendations from WHO OTS before further MDA expansion. The current EOEEAC guidance relies on a woreda-level prevalence of ≥2% of adults positive for Ov16 antibodies, while that of OTS is $\geq$2% in any village in the district. 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 13 districts (11 new and two additional new districts in adjacent areas) in Amhara, Oromia, and Southern Nations, Nationalities and People's Region (SNNPR). This was recommended in 2020 but not undertaken due to funding constraints.
- Provide financial and administrative support for the 2021 EOEEAC meeting.
- Publish findings from East and West Hararghe zones, where dried blood spot (DBS)-positive children were recently found. Entomological surveillance is underway and would be key to include in such a publication. This part of Ethiopia was previously considered by APOC to be ecologically unsuitable for onchocerciasis transmission.
- Work with USF to resolve the issues with the PCR test in the Ethiopia lab.
- 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 treatment of refugees in border areas assisted by TCC, especially in Gambella.
- Undertake collaborative MDA activities in Beneshangul-Gumuz region with neighboring areas of Sudan.
- Develop enhanced mobilization strategies for MDA in areas with consistently poor coverage.
- Continue stop MDA assessments in SNNPR and Oromia.

LYMPHATIC FILARIASIS:

- Investigate MDA coverage, community perception, migration patterns, and long-lasting insecticidal (bed) nets (LLIN) ownership in woredas that failed Pre-TAS. Develop recommendations from findings to increase the impact of interventions on LF.
- In consultation with HQ and MOH-NTD secretariat, conduct pre-TAS and TAS studies in eligible areas. Work with MOH to coordinate the order and delivery of filarial test strips (FTS) and positive control.
- Obtain DBS for OV16 testing during TAS studies, if indicated. Publish 2019 TAS-OV16 study showing utility of this approach for gathering information on onchocerciasis.
- Await direction from MOH (preferably after consultation with LF Regional Program Review Group [RPRG]) before conducting further LF remapping/reassessments.
- Begin MDA in nine LF-endemic woredas identified through 2019 remapping surveys where TCC already assists with RB MDA.
- If necessary, funding can be secured, expand MDA where indicated in concert with expansion of RB support to new zones.

NIGERIA

Presenters: Dr. Emmanuel Miri and Dr. Emmanuel Emukah (The Carter Center)

Summary:
Since 1996, TCC has assisted the Nigerian Federal Ministry of Health (FMOH) to eliminate transmission of onchocerciasis in the country. In Nigeria, the RBEP is an integrated NTD program that also works towards elimination of LF, and control of SCH and STH. Nine states, covering 168 districts, called local government areas (LGAs), are assisted by our programs. 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. NOEC meetings are supported by TCC. Due to the COVID-19 pandemic, neither of the semi-annual NOEC meetings were held in 2020.

In addition to LF MDA in southern Nigeria, TCC supports LF Morbidity Management and Disability Prevention (MMDP) in Plateau and Nasarawa. These two states work to improve the preparedness of the healthcare system to provide adequate care for those suffering from chronic LF (lymphedema, hydrocele), which persist even when LF transmission has been eliminated. Our objective is to meet or exceed WHO's required level of MMDP work that would support the two states' claim 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 NTDs | East Program, led by RTI International, IZUMI Foundation for LF MMDP, The Task Force for Global Health, Clarke Mosquito Control/Clarke Cares Foundation, and other generous donors.

Treatments:
RBEP assists with RB and LF treatments in seven southern states in Nigeria; Plateau and Nasarawa states in central Nigeria stopped MDA for LF and RB in 2013 and 2018, respectively. All nine states have active SCH and STH treatment programs. The program assisted 24.5 million treatments for RB, LF, SCH, and STH in 2020, of a combined target of 78.8 million. Treatment coverage for all four diseases was heavily impacted by the pause in activities necessitated by the COVID-19 pandemic. To satisfy WHO, donor and TCC risk mitigation recommendations, programs were unable to resume treatments until November; therefore, coverage for each of the four NTDs ranged from 25% to 48%, and only one round of treatment was provided in areas targeted for semiannual treatments. The 2021 targets for the four diseases total 70.1 million. Figure 24 shows annual treatments and targets by disease since 2012. Targets for SCH and STH vary by year based on WHO guidelines that alternate years in areas of lower prevalence (See Annex 7 for more detail on these guidelines).

An issue that has perennially affected treatment coverage in Nigeria is delays in receipt of drugs. Drug supply is managed by the national NTD programs, the drug companies, and WHO, but relies on input from implementing partners. Several factors can impact drug arrival, including customs delays, changes in legal documentation requirements, delays in inventory reports from other partners that can slow approval of drug applications, and delays in production of or shipment of drugs. The TCC Nigeria office makes all efforts 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. Late drug receipt is a particular threat to semiannual treatments for RB elimination (Figure 25).

Training:
The Nigeria program trained 24,519 CDDs, 2,576 CSs, and 4,174 health workers in 2020. This was well under the target due to the pandemic. See 2021 targets in the data tables below.

Special Topics:
Dr. Adamu Sallau (TCC) presented results from a "reclassification" survey conducted in four states (Abia, Anambra, Enugu, and Imo) to determine whether they qualify to be moved from "transmission ongoing" (red on the NOEC map in Figure 26) to "transmission suspected interrupted" (tan on the map). Over 3,000 children per state were tested for OV16 antibodies. Abia and Imo each had one positive child, Enugu had two and Anambra had three. Results will be presented at the May 2021 NOEC meeting. If the NOEC recommends reclassifying states to tan, they will commence stop-MDA entomological surveys.

Dr. Cephas Ityonzughul (TCC) presented LF pre-TAS results from 48 LGAs. Results from over 28,000 persons tested for LF antigen using the FTS rapid diagnostic showed that antigen prevalence was less than 2% in 46 LGAs, meaning a full TAS should be conducted in those LGAs to determine whether LF MDA can be halted.

Dr. Abel Eigege (TCC) reported progress on MMDP work in Plateau and Nasarawa. In 2020, eight new Hope Groups (support groups for persons with LF disease manifestations) were established, bringing the total to 20. Forty-eight health personnel were trained to lead existing and new Hope Groups, and 86 new members began receiving this service. The program also supported 235 hydrocele surgeries in 2020.

River Blindness			
	2020 Treatment Targets	2020 Treatments (%)	2021 Treatment Targets
UTG	6,779,049	4,584,890 (68%)	6,948,524
UTG2	27,455,095	5,500,745 (20%)	28,141,472
Total	**34,234,144**	**10,085,635 (29%)**	**35,089,996**

Lymphatic Filariasis			
	2020 Treatment Targets	2020 Treatments (%)	2021 Treatment Targets
UTG	**21,144,179**	**8,151,024 (39%)**	**21,672,783**

Schistosomiasis			
	2020 Treatment Targets	2020 Treatments (%)	2021 Treatment Targets
UTG	**4,596,526**	**2,222,211 (48%)**	**3,110,918**

Soil Transmitted Helminths			
	2020 Treatment Targets	2020 Treatments (%)	2021 Treatment Targets
UTG	7,055,149	1,936,695 (42%)	6,263,268
UTG2	4,943,174	1,108,373 (22%)	4,044,687
Total	**11,998,323**	**4,062,982 (39%)**	**10,307,955**

Training Objectives			
	2020 Training Targets	2020 Trainings (%)	2021 Training Targets
CDDs	67,583	24,519 (36%)	54,602
CSs	12,901	2,576 (20%)	12,110
HWs	7,340	4,174 (57%)	7,475
Teachers	16,627	8,471 (51%)	7,814

NIGERIA 2021 RECOMMENDATIONS

GENERAL:

- Program Directors should attend the FY22 drug application package preparation meeting to be held by the FMOH.
- Increase communication and security awareness with State MOH, local officials, and community leaders before commencement of community-based activities.
- Rolling surveys should be smaller in scale and budget than those promoted by WHO. Coverage evaluations of any kind should inform programmatic decisions, so they should be directed to areas where there is concern about the quality of MDA or where an epidemiological study is planned. Sampling should be based on the entire population and questionnaires should be tailored to evaluate the reach of health education and messaging as well as MDA.
- 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. Also consider conducting LF and RB assessments in tandem using the sampling strategies recommended by WHO OTS.
- Continue providing awards in each state to the best CDD, teacher, Frontline Health Facility (FLHF) worker, village leader and CS.
- The ratio of CDDs per persons treated has increased with treatment expansion far beyond the national 1:250 limit. Increase the number of CDDs as budgets allow, working to reach the target ratio of at least 1 CDD:250 people, 1 CS:5 CDDs and 1 CS per village. When calculating population served per CDD, remove urban populations from the equation since these are typically served directly by health workers.
- Complete the analysis of the pilot CDD attrition study (based on Kaplan-Meier survival methodology), which was delayed due to the COVID-19 pandemic. Review final analysis with HQ and then make plans to expand the study by establishing the number of CDDs that will be studied (with good gender representation). Explore the relationship of increasingly complicated registers and roll-up forms to CDD attrition rates, perhaps using focus groups of CDDs and their supervisors.
- Work with the different levels of government to effectively track drug supply, including reverse supply logistics.

ONCHOCERCIASIS:

- Support two meetings of the NOEC, in May and December.
- At the May NOEC meeting, present results of recent assessments, and conduct subsequent assessments according to NOEC recommendations:
    - The results of OV-16 assessments of Abia, Anambra, Enugu and Imo indicate that three states appear to have met the criteria to move to entomology if the NOEC agrees, while Anambra is pending skin snip data that will indicate whether it too could move to entomology.
    - The entomology assessment in Delta indicates that treatment there could be halted and PTS launched if the NOEC agrees. The entomology assessments in Plateau and Nasarawa indicate that NOEC should reclassify those two states as "transmission eliminated" (a first for Nigeria).

Encourage the NOEC to begin to classify certain states (Ondo, Taraba) by LGA to capture that some LGAs are 'red' (treating twice per year). Begin to show this on the NOEC map.

- 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. Obtain USF training for TCC lab technician on PCR in skin snips.
- All South East/South South (SE/SS) states should continue prospecting the entomological sites preselected by the NOEC for future stop-MDA entomological assessments. Those sites that are not producing sufficient numbers of vectors will need to be replaced by better sites (and permission for site changes made to the NOEC). Maintain good records so that the coordinates can be assessed in a proposed remote sensing study to assess productivity of entomological sites in Nigeria. In consultation with headquarters, calibrate black fly collection by traps with nearby collections by human attractants so that Annual Transmission Potential (ATP) calculations are possible.

LYMPHATIC FILARIASIS/MALARIA:

- TCC Nigeria should coordinate with WHO-Geneva, a WHO Nigeria representative, the FMOH and other implementing partners to align FTS orders and ensure they are submitted and received in a timely manner.
- The 16 LGAs that passed pre-TAS in 2019 and the 46 that passed in 2021 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).
- A pre-TAS should occur within six months for all LGAs that became eligible after the most recent treatment round.
- Prioritize Ebonyi state, particularly LGAs that failed pre-TAS, for LLIN donated by Clarke Mosquito Control/Clarke Cares Foundation.
- The program in Plateau and Nasarawa should ensure that WHO requirements for MMDP are met. With support from the IZUMI Foundation and in close consultation with HQ, continue MMDP activities in Plateau and Nasarawa states including 1) assessment of burden, 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. Consider publishing the results of hydrocele assessment surveys that identified high rates of inguinal hernia.
- In the SE/SS states, conduct assessments of LF morbidity case burden during LF MDA or pre-TAS/TAS assessments. Support other MMDP work in LGAs that have stopped MDA (after passing TAS-1). It is important to note that USAID's Act to End NTDs | East Program led by RTI International, does not support MMDP work, so budgetary constraints limit the degree of TCC support for MMDP.
- Publish results of the Plateau state Wb123 and OV16 research sponsored by the Task Force for Global Health.
- Consider entomological collections in LGAs where we have stopped LF MDA in SE/SS states.

- Discuss with the FMOH, NOEC, WHO and other authorities the FMOH LF policy demanding that pre-TAS and TAS not be done until six months after MDA; these policies are a threat to the states where twice-per-year ivermectin treatment is being implemented for RB elimination (the 'red states').

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

- Due to an anticipated reduction in funding of SCH/STH work by USAID in future years, TCC is beginning a process to incrementally transition ownership of SCH/STH to the federal, state, and local governments. In LGAs where RB or LF community-wide MDA is ongoing, integrate the SCH/STH treatments into the RB or LF platform, co-administering drugs. 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 such that national funds will transition over a short time period 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. We should monitor this process carefully for evidence of decreasing MDA coverage in the school-aged target population.
- Publish in a peer-reviewed journal the results of the SCH/STH impact assessment in Plateau and Nasarawa that includes intensity of infection determinations.

SUDAN

Presenter: Dr. Isam Zarroug (Sudan Federal Ministry of Health)

Summary:
Since 1997, TCC has assisted the Sudanese FMOH to eliminate transmission of onchocerciasis in the country. Sudan was the first African country to declare a nationwide onchocerciasis elimination policy in 2006. There are four transmission foci, Abu Hamad (River Nile State), Galabat (Gedaref state), Khor Yabus (Blue Nile state), and Radom (South Darfur state). In 2015, Abu Hamad was declared eliminated under WHO elimination guidelines. The Galabat sub-focus interrupted transmission in 2016, but continued MDA for 2 years (2016-2017) until Ethiopia interrupted transmission in Matama sub-focus. Transmission interruption was declared in Galabat sub-focus in 2018, and the area remains under PTS. Khor Yabus, and Radom foci continue to have ongoing transmission (Figures 27 and 28).

Treatments:
In 2020, Sudan continued to suffer from political instability, hyper-inflation, and fuel shortages. These factors, combined with the COVID-19 pandemic allowed for only one round of treatments provided in the Radom, South Darfur focus, however the treatment data is still pending. Sudan aims to provide 403,750 treatments in 2021, in the Radom focus, security permitting. The Khor Yabus focus continues to be disrupted by insecurity and political instability. TCC provides technical support to Sudan, while all financial support is currently provided by the Sudan government.

Training:
Due to the pandemic, training was not completed in Sudan for 2020. The goal for 2021 is to train 1,360 CDDs and 86 CSs.

River Blindness			
	2020 Treatment Targets	2020 Treatments (%)	2021 Treatment Targets
UTG	**403,750**	**0 (0%)**	**403,750**

Training Objectives			
	2020 Training Targets	2020 Trainings (%)	2021 Treatment Targets
CDDs	1,360	0 (0%)	1,360
CSs	86	0 (0%)	86
HWs	40	0 (0%)	40

SUDAN 2021 RECOMMENDATIONS

GENERAL:

- Work toward a target ratio of at least 1 CDD:100 people, 1 CS:5 CDDs and 1 CS per village.
- Coordinate with Ethiopia, the Republic of South Sudan (RSS) and the Central African Republic (CAR) for cross-border issues.

GALABAT FOCUS (GEDAREF STATE):

- Conduct the third-year PTS exercise focusing (in accord with WHO guidelines) on entomological assessments. However, in the PTS evaluation of the cross-border regions adjoining Ethiopia's Wude Gemzu hot spot, serology (OV16) assessments are also needed.

RADOM (SOUTH DARFUR):

- If the security situation in South Darfur allows, seek funds to launch the expanded MDA program that would include twice per year treatments. Further assessments to determine the limits of the Radom focus are also needed. These activities should involve detailed discussions with the Atlanta office.

BLUE NILE STATE:

- If the security situation in Blue Nile allows, seek funding to evaluate the status of onchocerciasis transmission in Khor Yabus, Wad Elmahi and Geissan districts of the Blue Nile state. Data suggests that there are few breeding sites in these areas and that infections may be acquired in Ethiopia. Additional surveys should be done in coordination with similar surveys in corresponding areas across the border in Ethiopia. TCC is unable to help with cross-border activities on the Ethiopia side in Assosa and Kemashi (where RBEP Ethiopia does not assist). Sudan and TCC should encourage the MOH-Ethiopia and RTI/Light for the World NGO partners to conduct surveys in Assosa and Kemashi in Ethiopia along the border with Sudan.
- Disease assessment surveys in Khor Yabus focus will be a challenge, with many roads in RSS and Sudan still landmined. Assessments should take place after population movements returning to their old villages have stabilized such that the assessments give a good account of human infection rates. Entomological surveys will be important given the reports of few breeding sites having been identified.

UGANDA

Presenters: Ms. Peace Habomugisha and Ms. Annet Khainza (The Carter Center)

Summary:
Since 2007, TCC has assisted the Ugandan MOH to eliminate transmission of onchocerciasis in the country, based on a flexible strategy of twice-per-year treatment, and where feasible, vector elimination/control using ground-based larviciding (Abate® from BASF). In 2007, Uganda declared a goal of RB transmission elimination from its 16 transmission zones (foci) excluding the Victoria Nile focus, which had been eliminated in early 1970s. The status of progress in 2020 remained as it was in 2019: eight foci are classified as "eliminated"; seven as "transmission interrupted"; one focus (Madi Mid-North [MMN]) as "transmission interruption suspected" and one (Lhubiriha) as "ongoing transmission". Both the MMN and Lhubiriha foci remain under twice-per-year treatment with ivermectin (Figures 29 and 30). Uganda also has important cross-border foci shared with the Democratic Republic of Congo (DRC). After being affected by COVID-19, Uganda was one of the first countries to restart a major NTD MDA campaign that included bi-annual treatment for onchocerciasis elimination.

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 Program (led by RTI International), ELMA Philanthropies, and BASF Corporation.

Treatments:
In 2020, 2.8 million treatments were administered, including 142,584 passive treatments, reaching 95% of the treatment target (Figure 31). The MMN focus administered 2,403,306 treatments (94%) and the Lhubiriha focus administered 235,443 (97%). The treatment target for 2021 is 2,881,875 million treatments. In addition, it is projected that 178,190 passive treatments and 407,944 refugees from the Republic of South Sudan (RSS) will be treated. Overall treatments are projected to be 3,468,009 from 12 districts (including passive treatments and refugees).

Training:
The Uganda program trainings occurred prior to the pandemic lockdown, allowing for the training, or retraining, of 27,949 Community Directed Treatment with Ivermectin (CDTI) workers in 2020. 21,691 CDDs (45% female), and 6,258 CSs (30% female) were trained. The current ratio of CDDs to population served is 1 CDD to 74 persons, and the CS to CDD ratio is at least 1:3. The 2021 goal is to train 23,488 CDDs and 6,338 CSs.

Special Topics:
Mr. David Oguttu (Uganda MOH) discussed the "slash and clear" (S&C) approach to vector control that has proven to be effective in controlling *Simulium* vectors of onchocerciasis in Uganda. The approach relies on community-directed clearing of river vegetation at a distance of 1 to 2 kms up- and down-river from communities. In 2020, S&C was expanded to the high-risk communities of Amuru, Kitgum, and Nwoya districts in the MMN focus. This expansion will continue into 2021 until all relevant high-risk or first line communities are reached where S&C activities are feasible.

Dr. Moses Katabarwa (TCC) presented plans to conduct onchocerciasis delineation mapping in MMN.

River Blindness			
	2020 Treatment Targets	2020 Treatments (%)	2021 Treatment Targets
UTG2	**2,793,462**	**2,638,749 (95%)**	**2,881,875**

Training Objectives			
	2020 Training Targets	2020 Trainings (%)	2021 Treatment Targets
CDDs	23,488	21,691 (92%)	23,488
CSs	6,168	6,258 (101%)	6,338
HWs	97	104 (107%)	97

UGANDA 2021 RECOMMENDATIONS

GENERAL:

- Work toward a target ratio of at least 1 CDD:74 people, and 2 or more CS per community (at least 1 CS:3 CDDs).
- Continue PTS activities in three foci (Budongo, Bwindi, and Nyagak-Bondo). PTS activities include epidemiology, entomology, and serology surveys.
- Continue post-treatment advocacy and sensitization meetings in foci where treatment was stopped, yet the communities continue to demand treatment (Budongo, Bwindi, and Nyagak-Bondo).
- Follow results of LF TAS-1 evaluations (planned for 2021) in Maracha-Terego focus, where RB transmission was interrupted in 2012, but PTS has not yet begun due to ongoing LF MDA. TAS-1 results to be presented at the August 2021 Uganda Onchocerciasis Elimination Expert Advisory Committee (UOEEAC) meeting for RB PTS recommendation.
- Provide financial and administrative support for the 2021 UOEEAC meeting.
- Conduct a study to determine what the former RB CDDs in eliminated foci are doing now that onchocerciasis interventions have been halted.
- Continue to integrate the MOH and WHO Standard Operating Procedures (SOPs) into MDA, and all other pre-MDA activities including trainings and COVID-19 preventive messages in program activities.

MADI-MID NORTH (MMN) AND LHUBIRIHA:

- Report at the 2021 UOEEAC meeting the results from serological and entomological assessments conducted in the border 'fringe areas' of MMN, per UOEEAC recommendations.
- Continue supporting MOH in carrying out cross-border elimination activities in SIZs with their counterparts in DRC and RSS whenever the situation allows. New efforts need to be made on planning and field activities in the now post-Ebola DRC area bordering with the Lhubiriha focus.
- Expand community-directed S&C activities for *Simulium* vector control to selected communities in other districts of the MMN focus and advocacy for S&C at all levels in each selected district. Finalize S&C national guidelines.

ANNEX 1: 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”.

In humans, the adult worms cluster in subcutaneous fibrous onchocercomas (commonly referred to as ‘nodules’) that are often visible and/or palpable. In these nodules, fertilized females release first-stage larvae (microfilariae [mf]) that migrate in 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 develop into the third stage larvae (L3) that are infectious to humans on subsequent blood meals. In the humans, the larvae then develop into adult worms and so continues the life cycle. There are no known environmental or epidemiologically important animal reservoirs of *O. volvulus*.

The WHO estimated in 2017 that 20.9 million people are infected and 1.15 million had vision loss.[6] 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. Onchocerciasis also exists in Latin America. Periodic MDA with oral Mectizan (ivermectin, donated by Merck & Co., Inc., Kenilworth, NJ, USA) tablets prevents eye and skin disease caused by *O. volvulus,* and may also be used to reduce or even interrupt transmission of the disease depending on the duration and frequency of treatment, the efficiency of the vector, and 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 November 6, 2020 (No. 45, 2020, 95, 545–556).

TCC RBEP is dedicated to safe and sustainable mass distribution of Mectizan (together with health education) to eliminate onchocerciasis transmission. The distinction between control (of disease) and TCC’s approach to elimination (of transmission) is important. In the control approach, Mectizan is distributed only once-per-year in areas where the eye and skin disease from the infection is greatest (the so-called ‘meso/hyperendemic’ areas where nodule rates are ≥20%). In control programs, MDA will likely need to continue indefinitely because onchocerciasis transmission persists, and people continue to get new infections (‘open system’); sustainability of control programs and indefinite effectiveness of the drug are vital in this scenario. In the elimination approach, Mectizan treatment is used more intensively to ‘close the system’ to eventually break transmission. Treatment is given twice-per-year and included areas where nodule rates are <20% (hypoendemic areas). At a point when the residual parasites in the human population are so compromised as 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.

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

A historical barrier to treatment in some parts of Nigeria where TCC works has been co-endemicity of the parasitic worm *Loa loa*; Mectizan treatment in a person with high *Loa loa* parasite loads (>20,000 *Loa loa* microfilaria per ml blood) can result in serious central nervous system adverse reactions, with complications that can lead to coma or death. In partnership with the federal and local governments of Nigeria, TCC conducted a large survey in Nigeria in 2016 using a recently developed technology called the 'LoaScope' and 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 American Journal of Tropical Medicine and Hygiene [*AJTMH]*) were reviewed by the Mectizan Expert Committee and the FMOH of Nigeria, and both gave their permission to use ivermectin MDA treatment in *Loa loa* areas in Nigeria that are ivermectin-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. Annex 3 is a discussion of this reporting process, as well as treatment indices used by the program and in this report. 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 are the multiplication of the UTG by 2 or by 4, respectively, and are 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 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 CDDs through a process known as CDTI. CDTI was perfected by the Tropical Disease Research program of WHO and was broadly introduced into the APOC-supported project areas throughout Africa in the late 1990's. 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 own kinships/family or neighborhoods, and decisions and treatment activities are handled 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. The ratio of CDDs per population that our programs have pursued historically has been at least 1 CDD per 100 persons to be treated. Ethiopia, using its HDA, has moved towards supporting a ratio of 1 CDD:50 persons. Uganda is steadily increasing its concentration of CDDs with an ultimate goal of 1 CDD:60 persons.

CDDs are supervised by CSs. These are often but not always district level health personnel; they may be more senior CDDs. This grouping may be overseen by frontline health workers, such as in Ethiopia where distributors and supervisors are overseen by the 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"; and 4) allowing community members to choose their own 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 also highly engaged in other community-based health interventions, such as water provision and sanitation, malaria control, immunization, and integrated NTD control efforts.

ANNEX 2: A Timeline of the River Blindness Campaign at The Carter Center

- **2020:** NTD programs worldwide temporarily 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 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.' Cross-border activities between Uganda and the DRC were halted however, because of the DRC Ebola outbreak. 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 vegetation clearance (S&C) 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 prevalence of infection compared to a 2013 baseline was demonstrated in many areas. In the East and West Harage zones of eastern Ethiopia, 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 ivermectin MDA decision for 1.2 million persons in the cross-border Galabat/Metema onchocerciasis transmission zone. Nigeria halts MDA 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 for elimination of 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 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.
- **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 ivermectin 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 ivermectin 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 ivermectin 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 ivermectin 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:** 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 (ivermectin alone). The challenge is noted of the parasite *Loa loa*, which occurs in some areas that have RB: ivermectin given to a person having *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 as a result of 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 agrees 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 of 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 African Programme for *Onchocerciasis* Control (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 3: The Carter Center RBEP 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 the WHO to define endemic "zones" that should capture most or all villages having onchocercal nodule rates ≥ 20% in adults (which roughly corresponds to an 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 QGIS, 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 ivermectin-naïve areas are being reassessed based on new mapping guidelines set by that country's national onchocerciasis elimination committee, typically using OV16 serology. Most recently the new WHO OTS has suggested that OV16 testing be conducted in samples of adult residents. Proposed serological thresholds launching MDA range from 2% to 5%.[7]

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. 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

[7] WHO Weekly Epidemiological Record 2018; 93(47): 633–648.

are recommended for the twice per year (or four times per year) 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 the TCC HQ 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 CDDs or national 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.

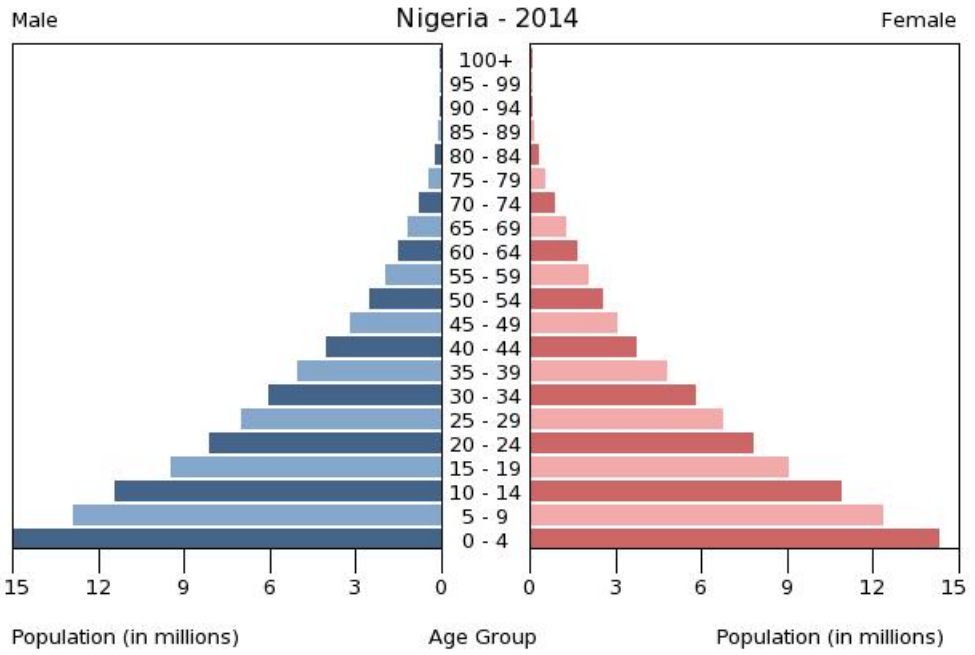
Summary reports of numbers of villages and persons treated are compiled from the village registers by the CDDs and their CSs, then forwarded to the district level. District-level summary reports are forwarded (whenever possible through MOH surveillance and reporting channels) to both the state MOH headquarters and the national TCC offices, which forward the data monthly to RBEP in Atlanta. In the Americas, the MOH 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 PCC, IACO and PAHO/WHO in its regular meetings; OEPA updates are provided annually in WHO's *WER* articles (See Annex 8 for references to these publications). African MOH report their annual results directly to WHO, which has recently begun producing 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, all 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 MDP, 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. It is important to note that some programs report treatment coverage only of those villages that were reached, rather than coverage based on all villages in the targeted area (e.g., both villages reached and those that were missed).

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 MDP. 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%).



[8]

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.

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

ANNEX 4: List of Program Review Participants

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Mr. Gadisa Mohammed
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Mr. Birhanu Nigussie
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Mr. Eshetu Sata
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Dr. Nathaniel Smith
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Ms. Emily Toubali

Consultants
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Mrs. Teresa Coleman

ANNEX 5: 2020 RBEP Program Review Agenda

River Blindness, Lymphatic Filariasis, and Schistosomiasis Program Review Agenda

Wednesday, March 10, 2021
Uganda Time: 15:00 - 19:00

Start	End	Title	Speaker
7:00 AM	7:05 AM	Welcome	Dr. Kashef Ijaz
7:05 AM	7:20 AM	Introductory Conversation	Mr. Jason Carter, Ms. Paige Alexander, and Dr. Kashef Ijaz
7:20 AM	7:25 AM	Goodwill Message	Dr. Tedros Adhanom Ghebreyesus
7:25 AM	7:55 AM	RBEP Overview	Dr. Gregory Noland
7:55 AM	8:00 AM	Video: RB Elimination Nasarawa, Nigeria (MDP)	
8:00 AM	8:30 AM	Uganda: Treatments and Impact	Ms. Peace Habomugisha
8:30 AM	8:45 AM	*Discussion*	
8:45 AM	9:00 AM	*BREAK*	
9:00 AM	9:30 AM	Uganda: Training, Integration, Community Ownership and COVID Activities	Ms. Annet Khainza
9:30 AM	9:45 AM	*Discussion*	
9:45 AM	10:00 AM	Uganda: Slash & Clear/Site Definitions for Target Vector Control	Mr. David Oguttu
10:00 AM	10:10 AM	*Discussion*	
10:10 AM	10:25 AM	Uganda: Delineation of Madi-Mid North Focus	Dr. Moses Katabarwa
10:25 AM	10:35 AM	*Discussion*	

River Blindness, Lymphatic Filariasis, and Schistosomiasis Program Review Agenda

Thursday, March 11, 2021
Ethiopia Time: 15:00 - 19:00 Sudan Time 14:00 - 18:00

Start	End	Title	Speaker
7:00 AM	7:05 AM	Day 2 Introduction	Dr. Gregory Noland
7:05 AM	7:35 AM	Ethiopia: RB Treatments, Impact, Training, Integration, and Community Ownership	Dr. Zerihun Tadesse
7:35 AM	7:45 AM	*Discussion*	
7:45 AM	8:00 AM	Ethiopia: LF Treatments and Impact	Mr. Mohammed Hassen
8:00 AM	8:10 AM	Discussion	
8:10 AM	8:25 AM	OTS Update - OEM Thresholds	Dr. Paul Cantey
8:25 AM	8:35 AM	*Discussion*	
8:35 AM	8:50 AM	Ethiopia: Mapping and Expansion	Mr. Aderajew Mohammed
8:50 AM	9:00 AM	*Discussion*	
9:00 AM	9:15 AM	*BREAK*	
9:15 AM	9:30 AM	Ethiopia: Modelling for Transmission Suppression	Dr. Wilma Stolk
9:30 AM	9:40 AM	*Discussion*	
9:40 AM	9:55 AM	Ethiopia: Expansion of Laboratories for Onchocerciasis	Dr. Charles Mackenzie
9:55 AM	10:05 AM	*Discussion*	
10:05 AM	10:30 AM	Sudan: Treatments, Impact, Assessments and Training	Dr. Isam Zarroug
10:30 AM	10:40 AM	*Discussion*	
10:40 AM	10:50 AM	Sudan: Peace-Health Initiative Update	Mr. Ben Spears
10:50 AM	11:00 AM	*Discussion*	

River Blindness, Lymphatic Filariasis, and Schistosomiasis Program Review Agenda

Friday, March 12, 2021

Nigeria Time: 13:00 - 17:00, Guatemala Time 06:00 - 10:00, Venezuela Time 08:00 - 12:00

Start	End	Title	Speaker
7:00 AM	7:05 AM	Day 3 Introduction	Dr. Gregory Noland
7:05 AM	7:30 AM	Nigeria: Treatments and Impact	Dr. Emmanuel Miri
7:30 AM	7:40 AM	*Discussion*	
7:40 AM	8:00 AM	Nigeria: COVID adaptations, Training, Costs and Mainstreaming	Dr. Emmanuel Emukah
8:00 AM	8:10 AM	*Discussion*	
8:10 AM	8:25 AM	Nigeria: Pre-TAS and TAS Report	Dr. Cephas Ityonzughul
8:25 AM	8:35 AM	*Discussion*	
8:35 AM	8:50 AM	Nigeria: State Reclassification	Dr. Adamu Sallau
8:50 AM	9:00 AM	*Discussion*	
9:00 AM	9:15 AM	*BREAK*	
9:15 AM	9:30 AM	Nigeria: Lymphatic Filariasis MMDP	Dr. Abel Eigege
9:30 AM	9:40 AM	*Discussion*	
9:40 AM	10:10 AM	OEPA Overview	Dr. Mauricio Sauerbrey
10:10 AM	10:20 AM	*Discussion*	
10:20 AM	10:35 AM	OEPA - Satellite Mapping in Venezuela	Dr. Carlos Botto
10:35 AM	10:40 AM	*Discussion*	
10:40 AM	10:55 AM	Closing Discussion	Dr. Gregory Noland
10:55 AM	11:00 AM	Closing Remarks	Dr. Kashef Ijaz

ANNEX 6: 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. Mf are picked up by mosquitoes, 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® (donated by Merck & Co., Inc., Kenilworth, NJ, USA) 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 combination 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 early years of the program. The MDA program was launched in 2000 following disease mapping in 1998-99. After years of high treatment coverage, together with LLIN distribution by the malaria program, LF transmission was broken in the two states in 2012. Subsequent TAS surveys (TAS2 and TAS3) 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 as a result of 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 now shifting to the second pillar of the elimination of 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 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.

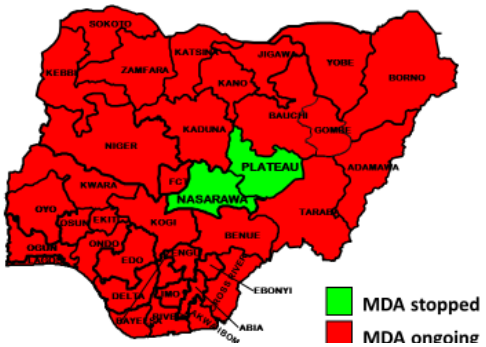


Figure 1: Elimination of LF in Plateau and Nasarawa states in 2017

***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 the federal and local governments of Nigeria, conducted a large survey in 2016. The study determined that levels of *Loa loa* were not sufficient in TCC-supported areas to preclude treatment (Emukah et al., *AJTMH* 2018). Our results were favorably reviewed by the Mectizan Expert Committee; the program is now supporting annual ivermectin 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 had significant impact on 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; LLIN 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: The much smaller LF program in Ethiopia was launched in 2008 in tandem with TCC's Malaria Program, which was engaged in assisting the MOH to distribute 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 had an impact on LF transmission and the 'killing two birds with one stone' strategy of fighting malaria and LF with LLINs were the primary reason the MOH decided to launch 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 is delivering over 800,000 treatments each year, and several passed TAS-1, stopped over 600,000 treatments and begun PTS (TAS-2 and TAS-3).

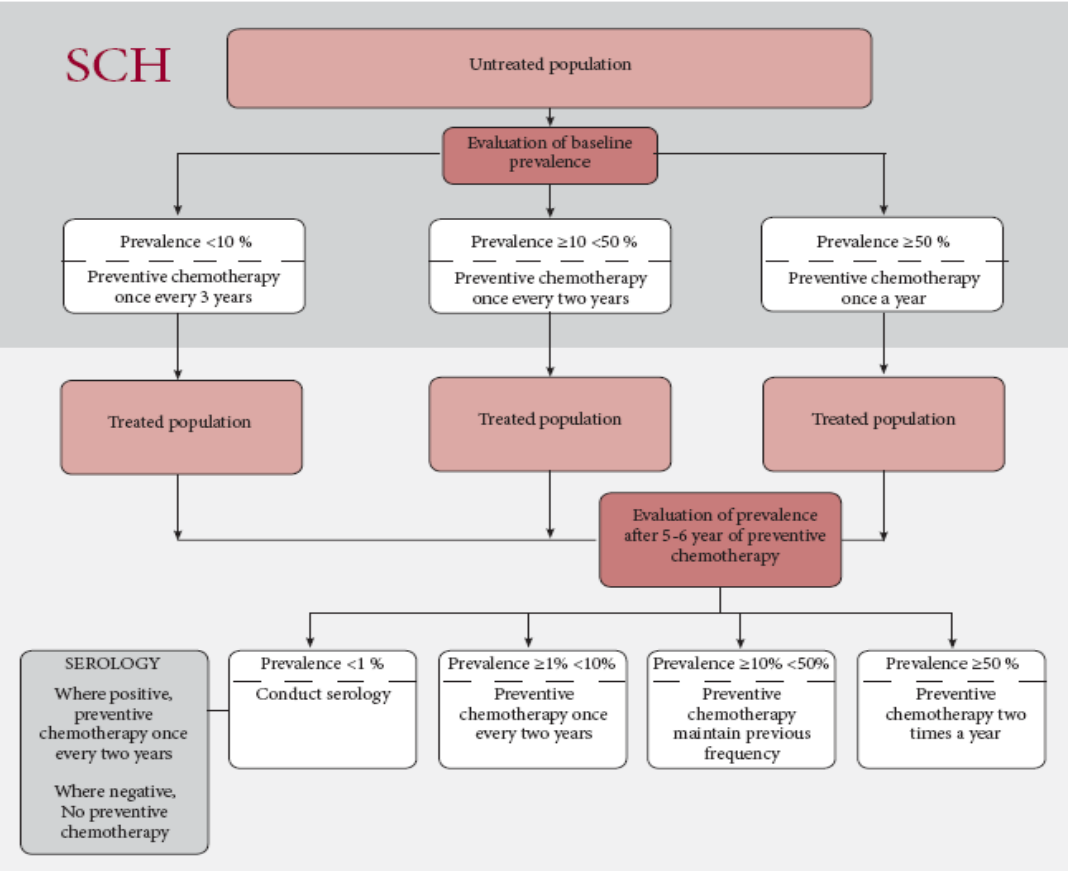
ANNEX 7: The Schistosomiasis/Soil-Transmitted Helminthiasis Control Program

SCHISTOSOMIASIS (SCH)

SCH is a parasitic disease acquired from skin contact with freshwater 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 penetrate the skin and migrate through the body as 'schistosomula' parasitic forms. They develop into adult male and female worms when they reach the venules of the intestines (intestinal SCH caused by *Schistosoma mansoni*) or bladder and genitals (urinary SCH caused by *S. haematobium*). It is important to note that in Africa where TCC is working, SCH exists as these two different infections that 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 the 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, as well as in their urine and feces. Adults most commonly suffer from liver fibrosis and esophageal bleeding (intestinal SCH) or bladder and cervical cancer (urinary SCH). School-aged children (ages 5 to 14) may have abdominal pain, anemia, and (in urinary SCH) bloody urine. They act as the main disseminators by contaminating water with excreta. MDA with the safe and effective oral medicine praziquantel can significantly reduce SCH 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 SCH. The Merck KGaA/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.

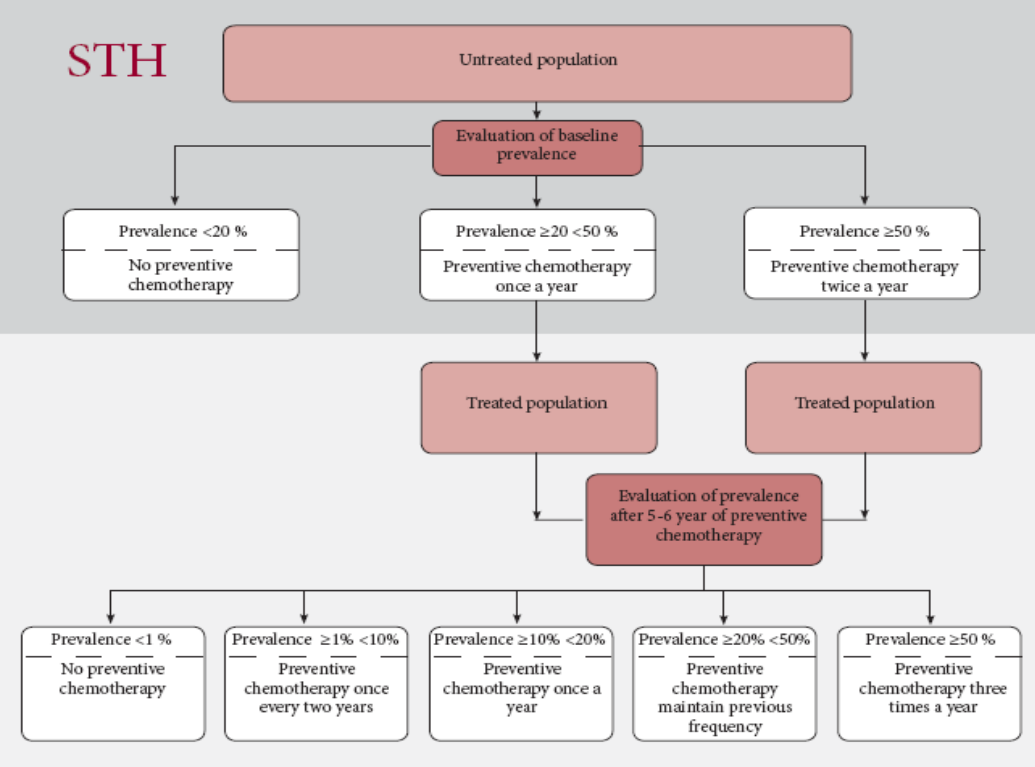
TCC's SCH programs follow WHO guidelines for disease (morbidity) control (shown below). Note that the guidelines may call for praziquantel preventive chemotherapy once every 2 – 3 years, depending on parasite prevalence in a district. For this reason, treatment numbers in the same state can be very different from year-to-year, and training and logistics become much more complicated compared to annual or twice-per-year treatment. The guidelines are currently in the process of revision.



Transmission is unlikely to be interrupted by this 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 (STH)

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, except for hookworms, which have their heaviest infections in adults.



Transmission of STH 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 then 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) are in many ways like those of SCH in that they focus on providing treatment to school-aged children. STH MDA programs are for morbidity control; transmission will not be interrupted until open defecation is halted through deployment and the use of sanitary systems. 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.

It is notable that the different species of worms 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 ivermectin/albendazole combinations given for LF improve whipworm cure rates.

The challenges for TCC Nigeria in implementing SCH and STH programs include: 1) complex WHO guidelines that result in different regimens tailored to district epidemiology (alternating year treatment schedules for SCH up to every third year compared with twice-per-year treatment programs for STH in some areas); 2) a focus on a Ministry of Education (school-based) approach rather than the traditional MOH (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) difficulty in justifying the closure of a longstanding distribution infrastructure that works well (community-based) to start a new approach (school-based); and 9) loss of high-quality STH control resulting from community-wide LF MDA with the most potent STH treatment (ivermectin and albendazole) when LF programs that pass TAS assessments cease treatment.

The written description of SCH/STH work under USAID's Act to End NTDs | East Program (led by RTI International) focuses on "mainstreaming" the two diseases into the large healthcare delivery system and to abandon the vertical MDA approach to control. We believe it is likely that there will soon be less support for the TCC SCH/STH program. Accordingly, in LGAs where the RB or LF platform does not exist, we are developing plans to transfer support of MDA fully to the MOH and Education.

ANNEX 8: Publications by Year Authored or Coauthored by RBEP Personnel

2020 publications shown in bold.

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Certain sections of this report are based upon work made possible thanks to the generous support of the American People through the United States Agency for International Development[1] (USAID) and the Act to End Neglected Tropical Diseases (NTDs) | East Program, led by RTI International.

Further, certain sections of this report are based upon work made possible thanks to the generous support of the American People through the United States Agency for International Development[2] (USAID) and the *Achieve Onchocerciasis Elimination in the Americas* Program.

Its contents are solely the responsibility of the authors and do not necessarily represent the official views of RTI International or the United States Agency for International Development.

1 Through Cooperative Agreement # 7200AA18CA00040
2 Through Cooperative Agreement # 7200AA20CA00015 and Grant #AID-OAA-G-12-00020