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Summary
2013 Program Review for The Lions-Carter Center SightFirst

RIVER BLINDNESS ELIMINATION PROGRAMS

Ethiopia, Nigeria, OEPA, Sudan, and Uganda

3-5 March 2014
The Carter Center
Atlanta, GA

October 2014

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And to many others, our sincere gratitude.

*We appreciate the support of the donors listed here, whose funding was utilized in 2013 for the activities described in these proceedings.

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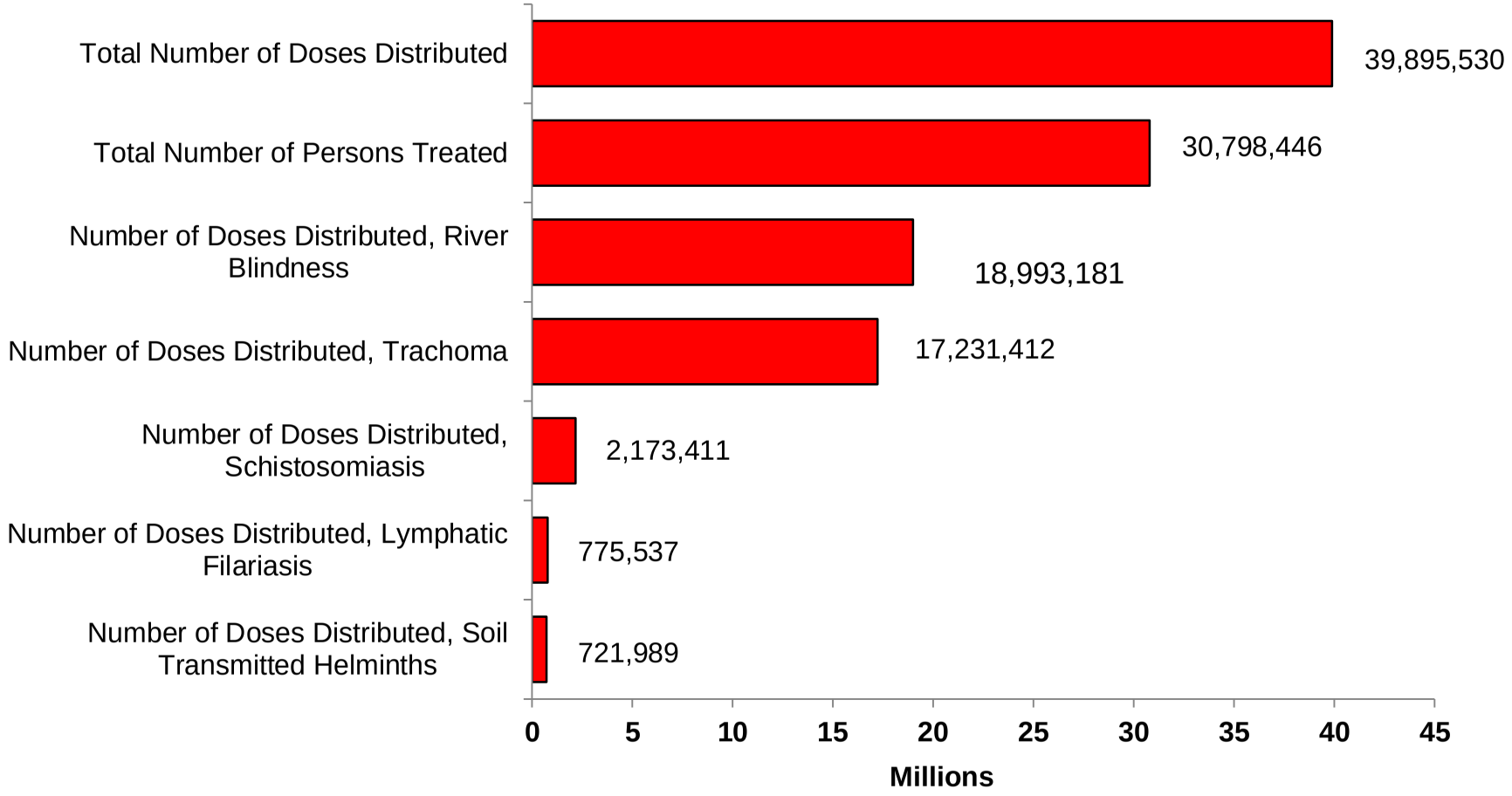

The Carter Center is grateful for our Ministry of Health partners and the many donors and pharmaceutical companies who have made financial and in-kind contributions to make possible these treatments.

Treatment for trachoma is azithromycin (donated by Pfizer); river blindness is ivermectin (Mectizan®, donated by Merck); lymphatic filariasis is albendazole (donated by GSK) and ivermectin (Merck), and schistosomiasis is praziquantel (mostly donated by Merck KGaA)

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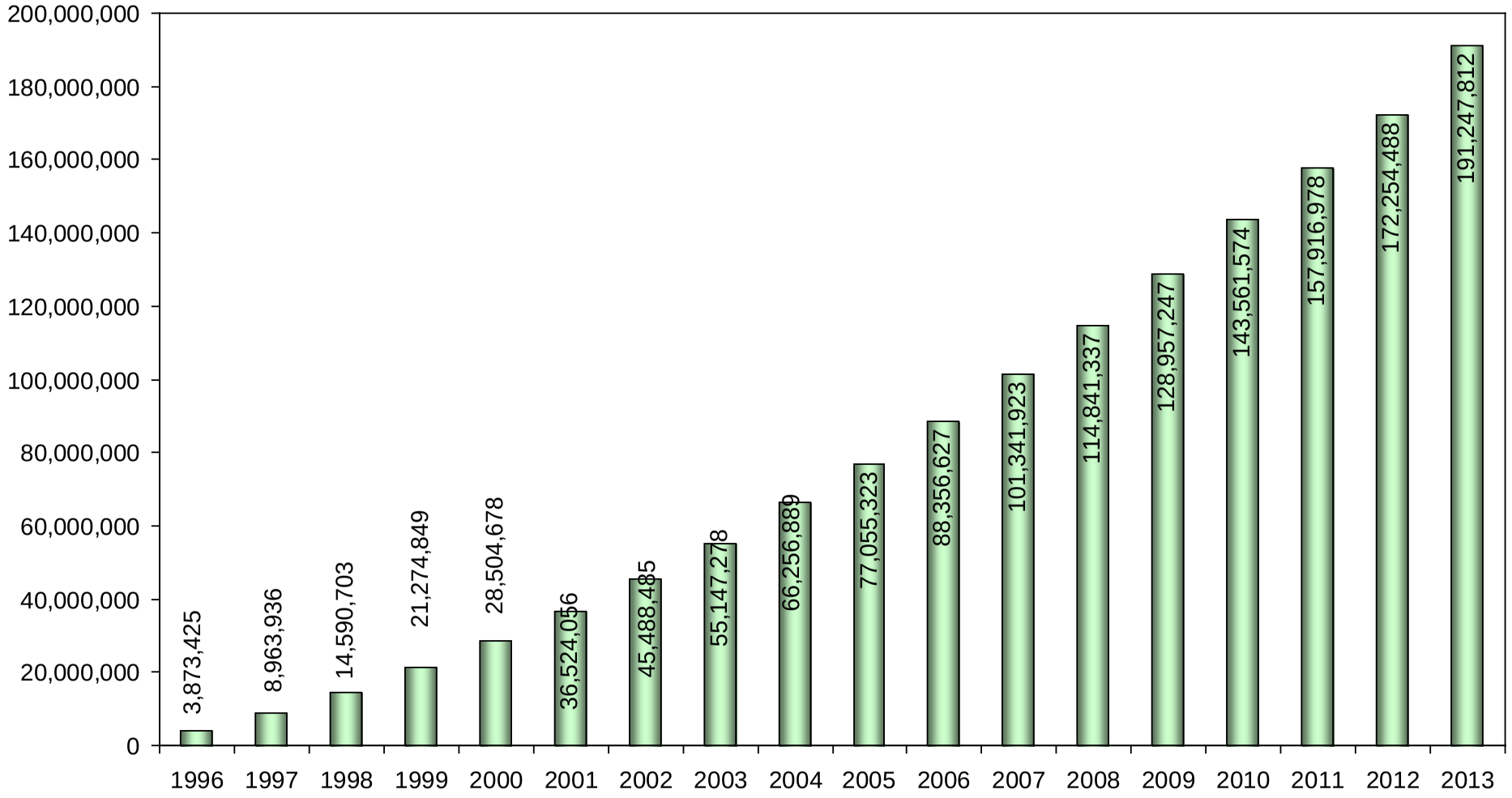
190m Cumulative Mectizan® Doses (Treatments) for RB Delivered by Carter Center RBEP-Assisted Programs 1996 – 2013*



*RB = River Blindness, RBEP = River Blindness Elimination Program

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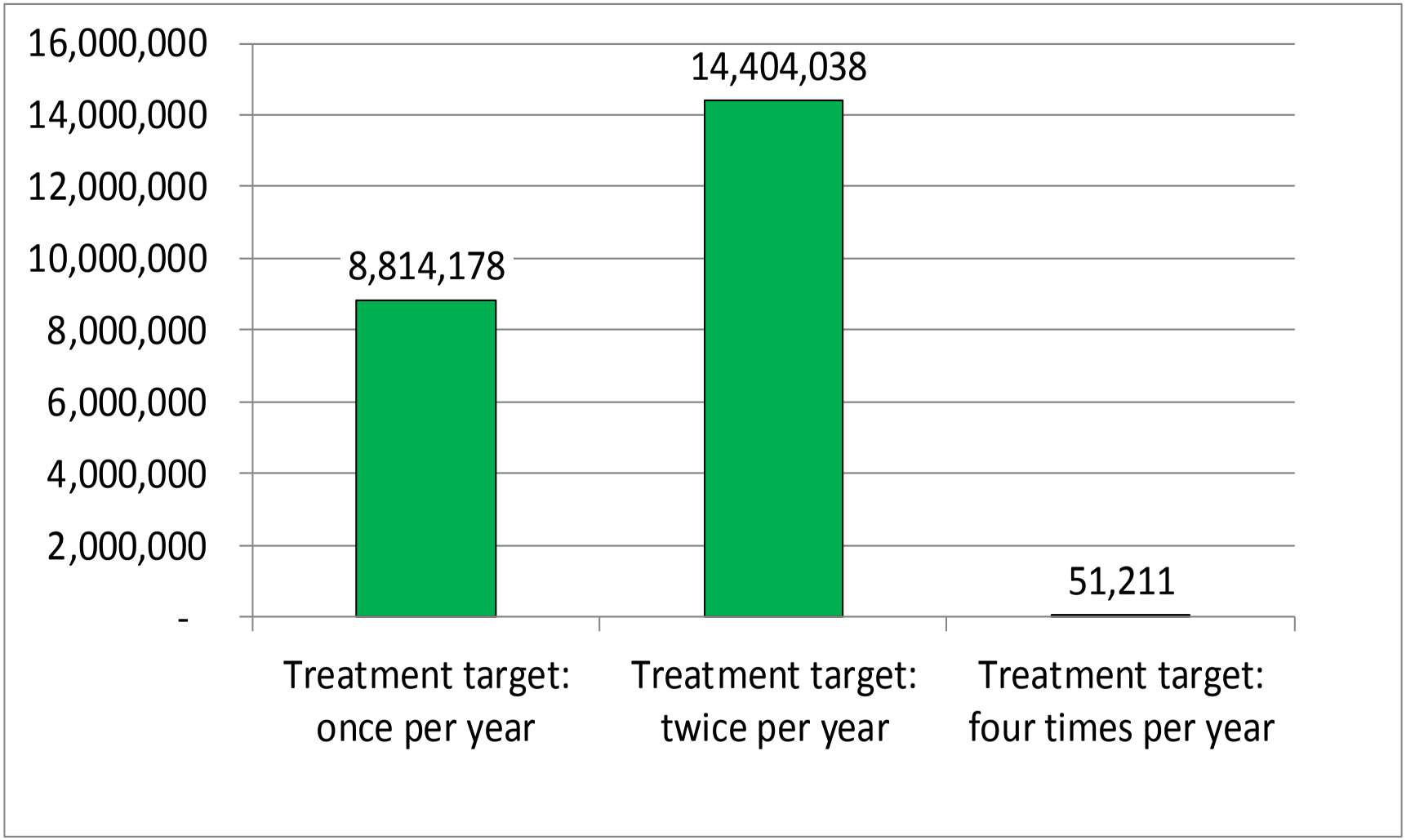

*Carter Center River Blindness Elimination Program

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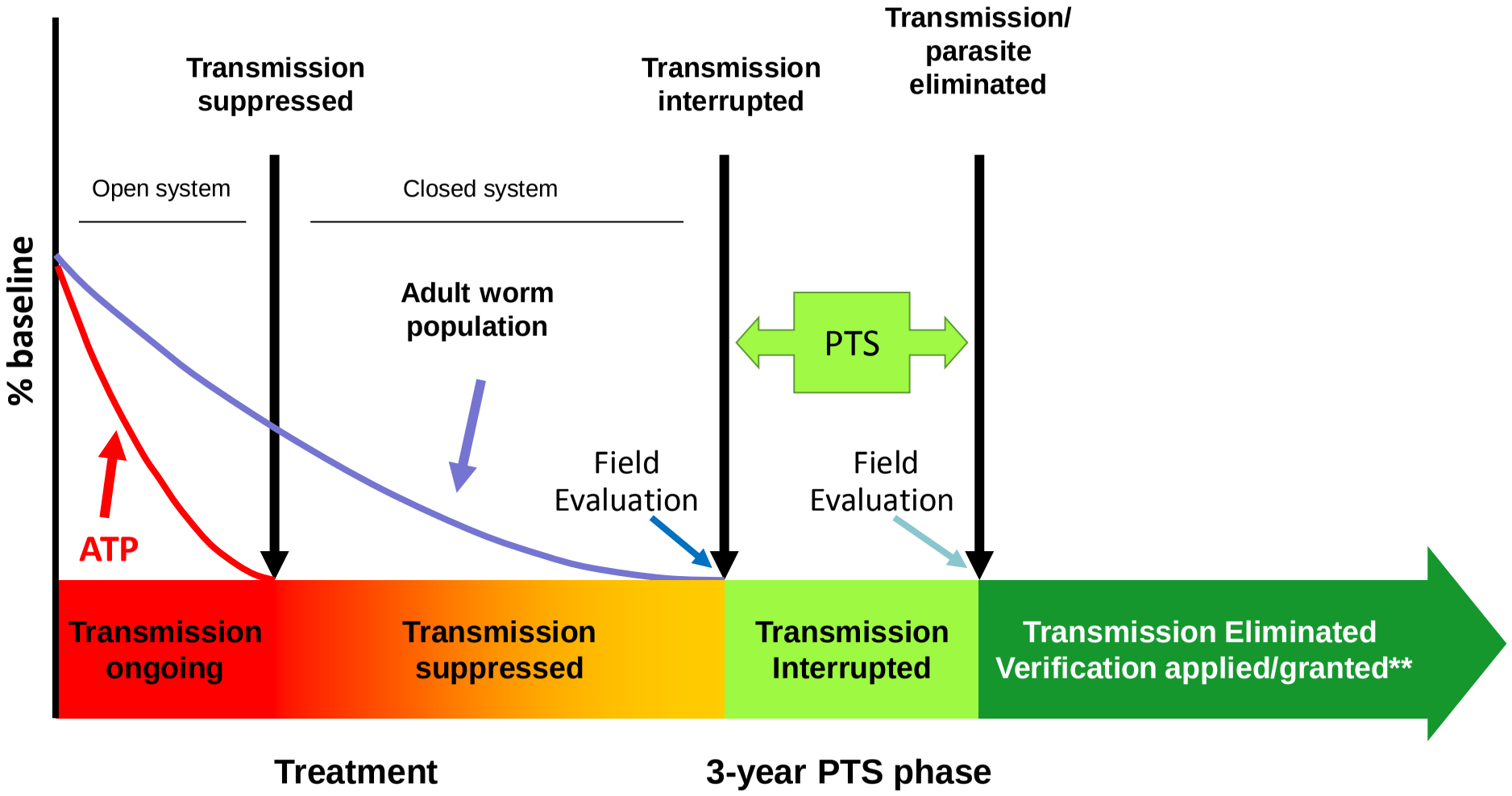


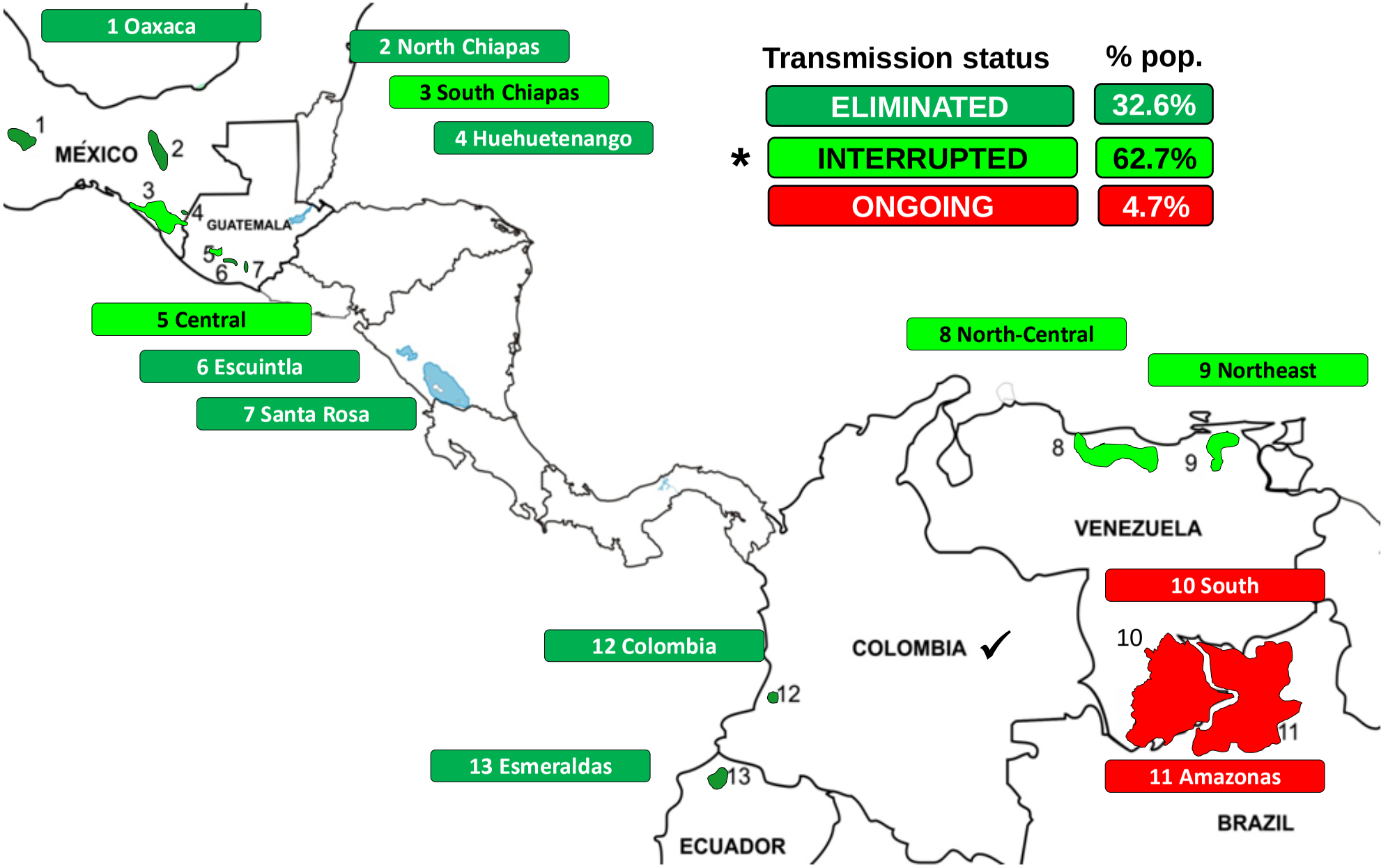
*WHO Report, (2001). *Certification of elimination of human onchocerciasis: Criteria and procedures*. Following a WHO meeting on "Criteria for Certification of interruption of transmission/elimination of human onchocerciasis" (document WHO/CDS/CPE/CEE/2001.18a). Geneva, World Health Organization.

**Once transmission has been eliminated in all foci in a single country, final verification can be requested to PAHO/WHO

***Post Treatment Surveillance

Frontispiece
Figure F

Geographic distribution of onchocerciasis and transmission status in the Americas, 2013



- ✓ Country has been verified by WHO free of onchocerciasis. Colombia is the only country in the world that has this recognition
- ✓ * Still in Post Treatment Surveillance

Updated: February 2014

Frontispiece
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Verification of elimination in Colombia by WHO
Bogota, July 2013

President Carter and Colombian Minister of Health Dr. Uribe watch President Santos receive the onchocerciasis elimination verification certificate. Credit: The Carter Center.

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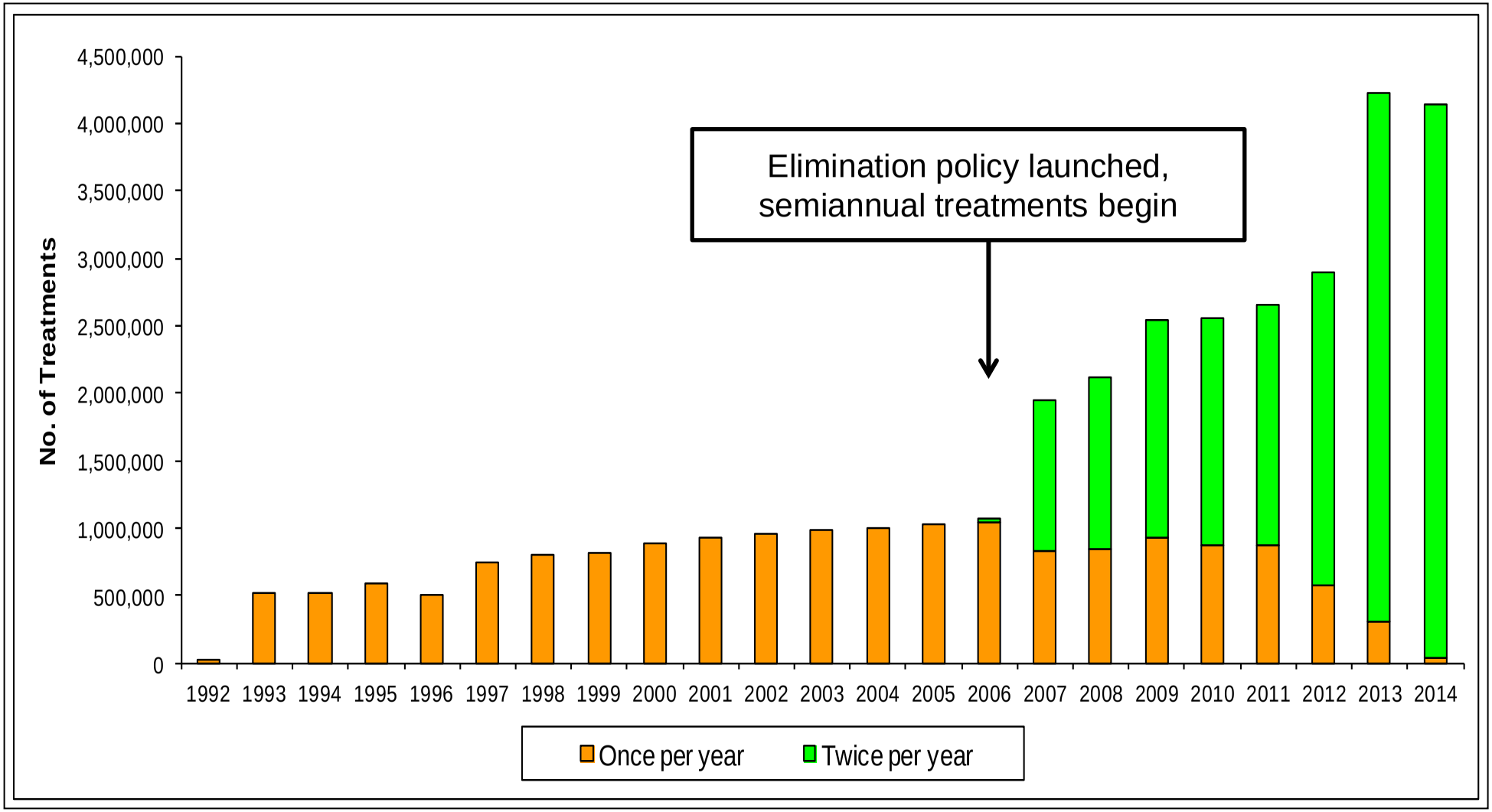

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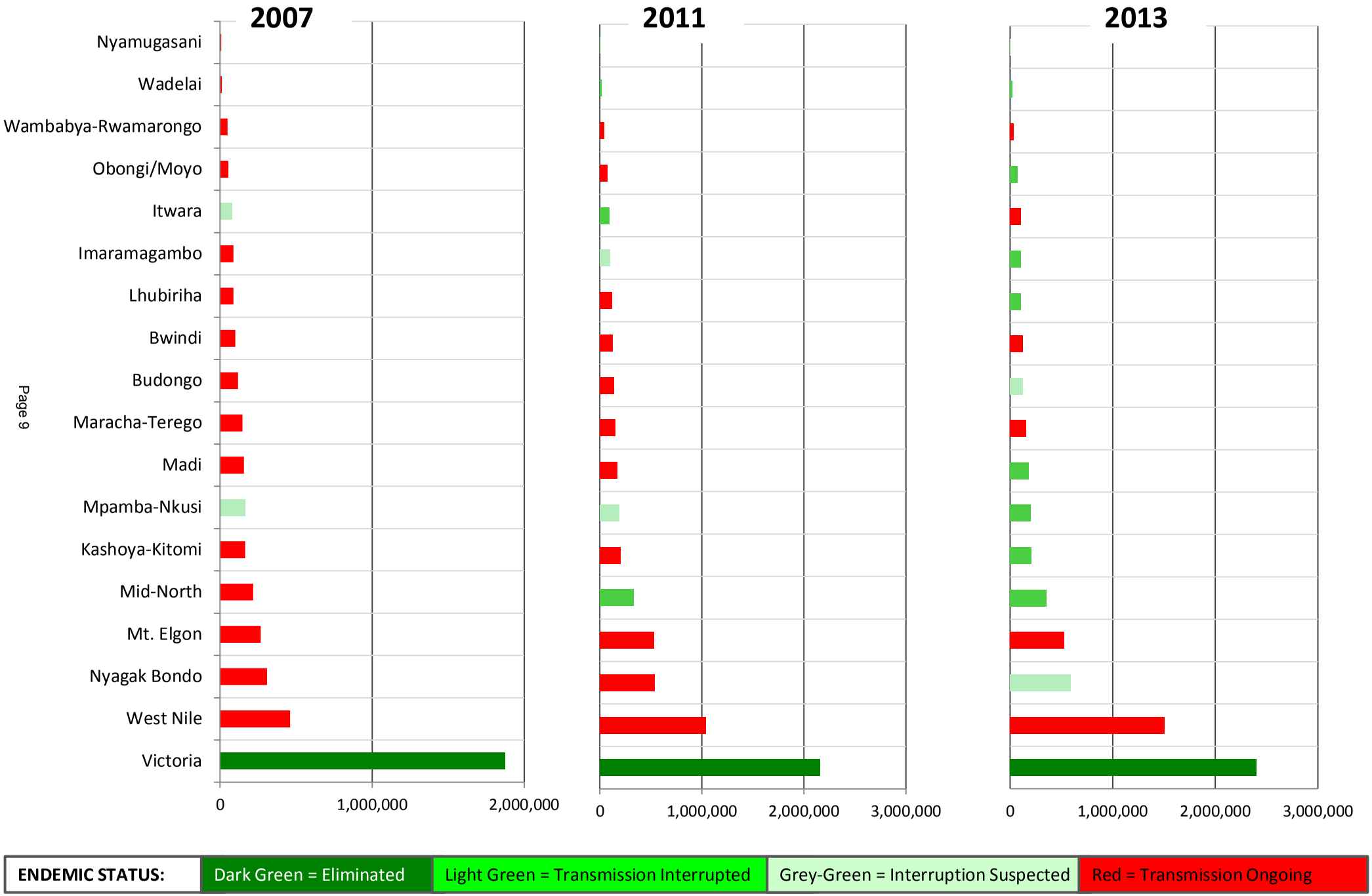
Evolution of Elimination of River Blindness in Uganda: Population Size by Focus and by Endemic Status



ENDEMIC STATUS:	Dark Green = Eliminated	Light Green = Transmission Interrupted	Grey-Green = Interruption Suspected	Red = Transmission Ongoing

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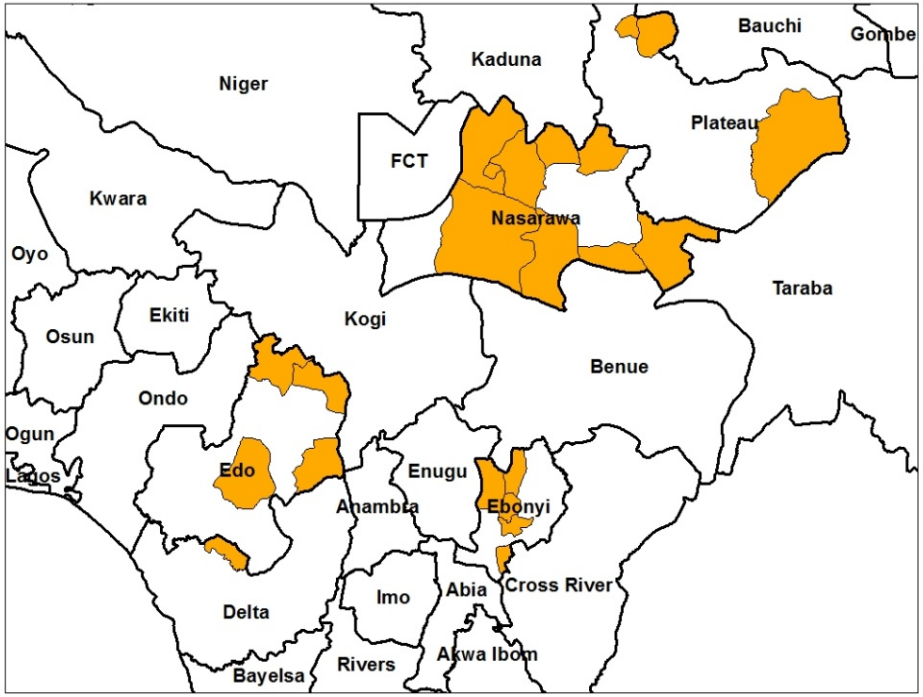
Figure J

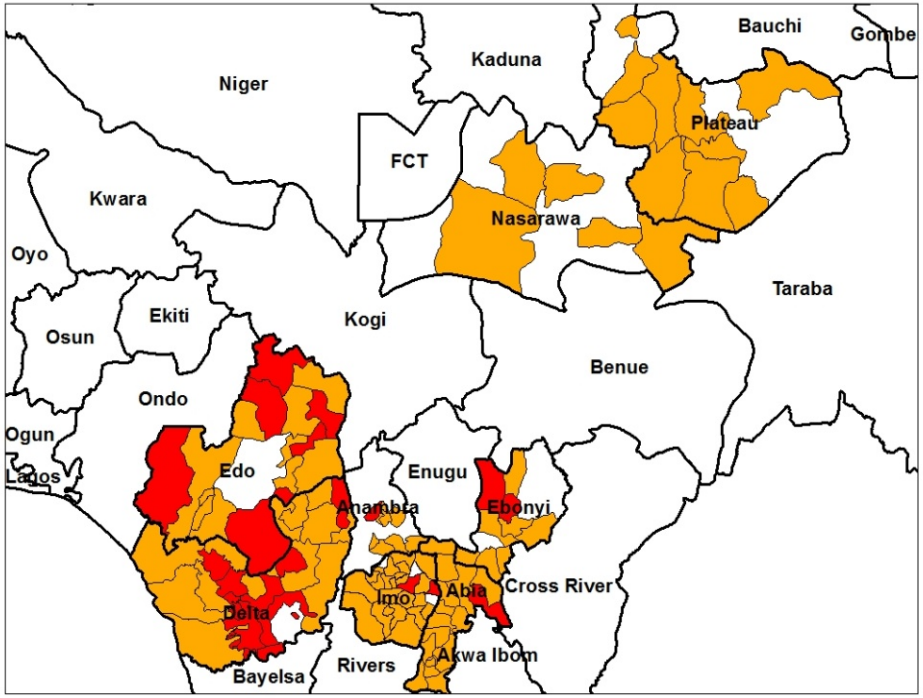
Nigeria 2013 mapping results* for schistosomiasis and soil-transmitted helmithiasis (STH)

Schistosomiasis prevalence >10%



> 10% Schistosomiasis Prevalence

STH prevalence >20%



> 20% STH Prevalence

≥ 50% STH Prevalence

***Based on over 100,000 stool examinations (Kato-Katz)**

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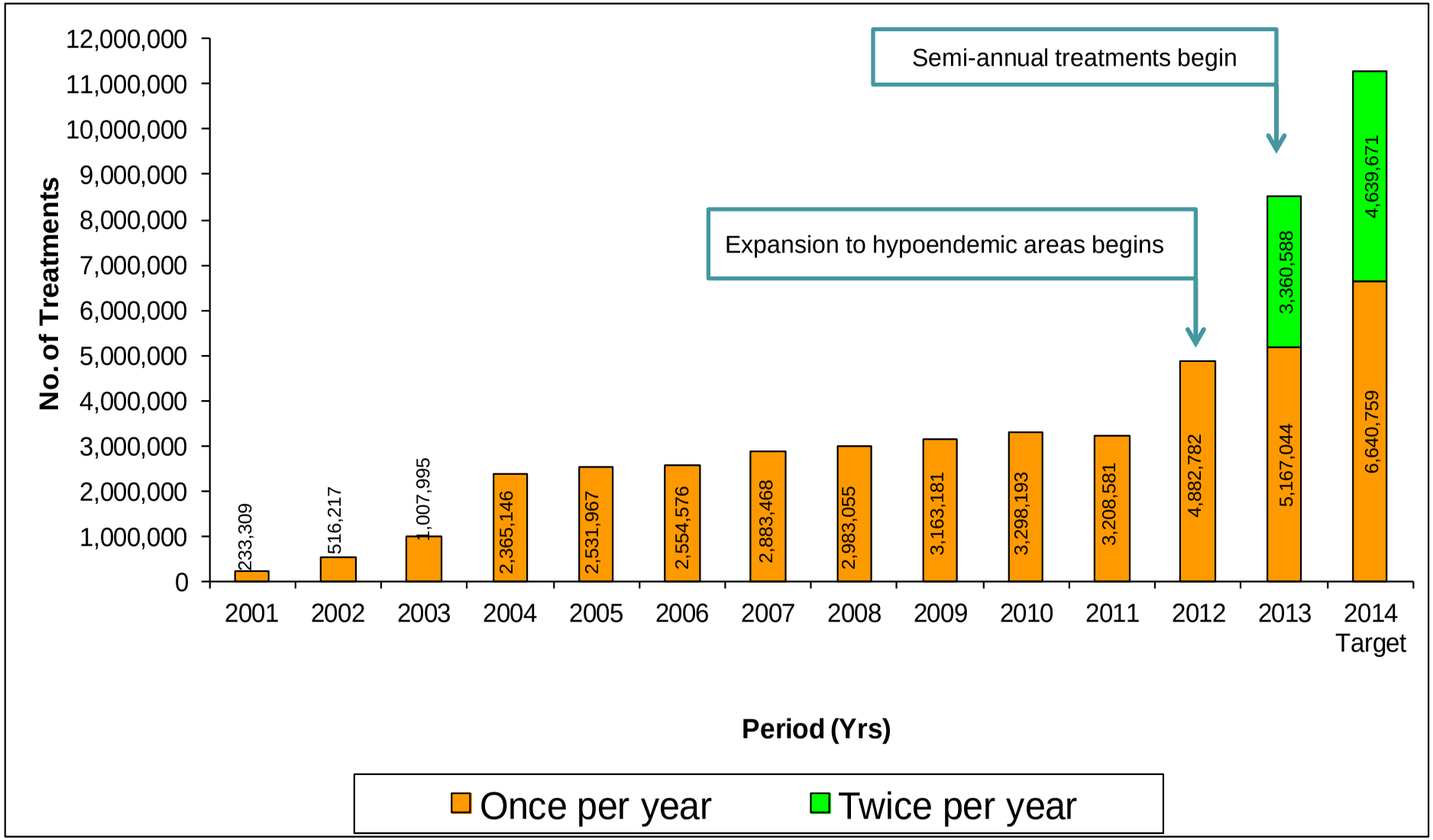
Figure K

Ethiopia: Increasing Carter Center-assisted Mectizan® treatments under elimination strategy



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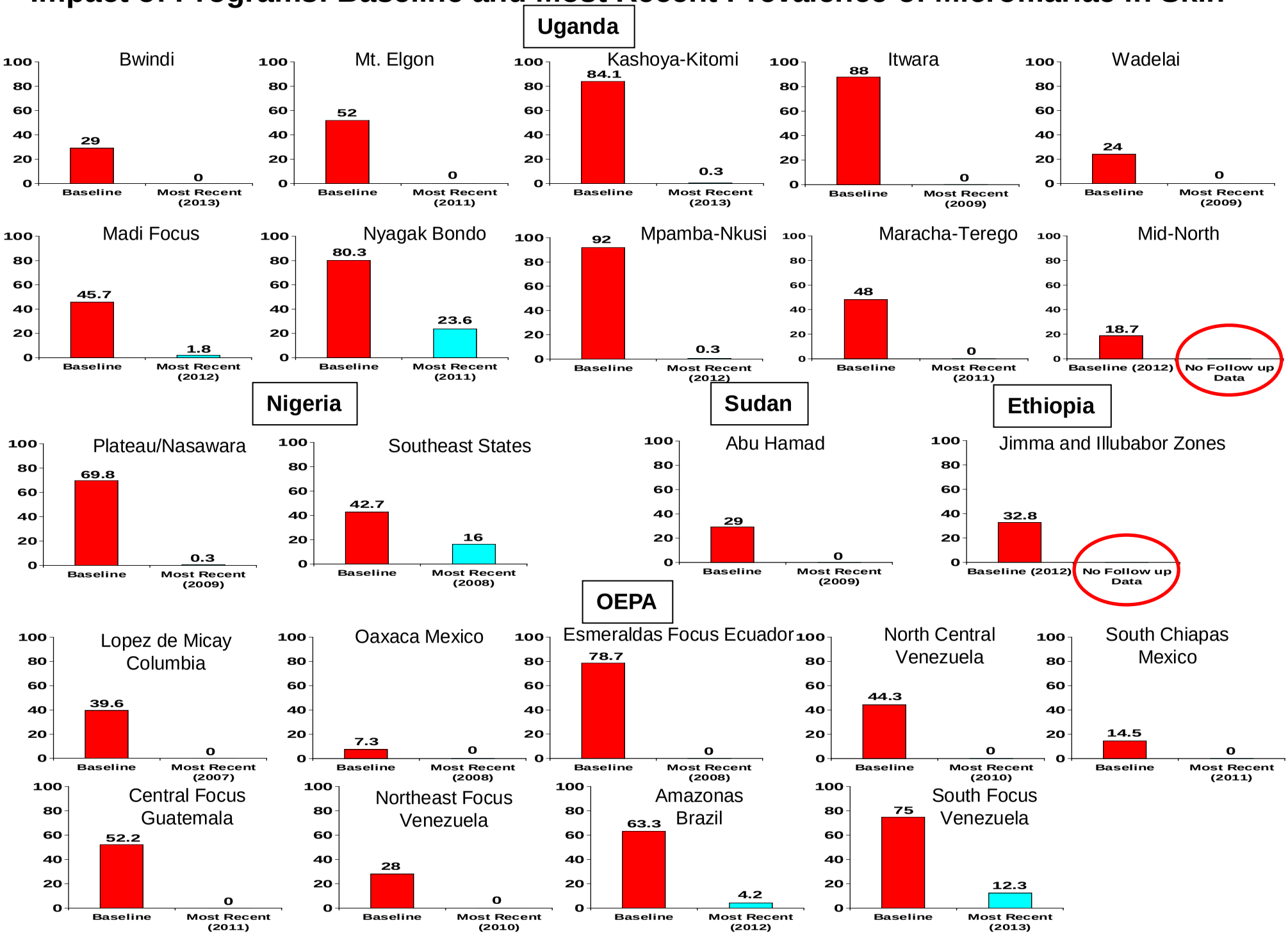


HIGHLIGHTS OF THE PROGRAM REVIEW

Over 80 professionals from 11 countries attended the 18th Review of the River Blindness Elimination Program (RBEP) of The Carter Center (TCC), which was held from 3 – 6, March 2014 (meeting photo, Frontispiece Figure A).

Through programs and technical assistance, the goals of which are to eliminate river blindness (RB), the RBEP assists the ministries of health (MOHs) of 10 countries[1] to either distribute Mectizan® (ivermectin, donated by Merck) or conduct post-treatment activities (if the country has interrupted disease transmission). Much of our work is undertaken in collaborative initiatives with Lions Clubs International Foundation (LCIF) and the United States Agency for International Development (USAID) ENVISION project led by RTI International and funded by USAID. The RBEP also helps countries integrate RB efforts with activities against lymphatic filariasis (LF), malaria, schistosomiasis, soil transmitted helminthiasis (STH), and trachoma when feasible. In 2013, all TCC programs providing mass drug administration (MDA) for the neglected tropical diseases (NTDs) assisted ministries of health to provide 39.8 million treatments to 30.8 million persons (Frontispiece Figure B); the RBEP and its partners provided nearly 19 million Mectizan® treatments for RB. From 1996 to 2013, TCC's RBEP has assisted over 190 million Mectizan® treatments (Frontispiece Figure C).

In 2013, the program was renamed River Blindness Elimination Program, to indicate an important move in all assisted areas from a control strategy to a transmission interruption strategy for RB (medical term: onchocerciasis). The change has resulted in 1) a transition from once to twice per year Mectizan® treatments in many areas, 2) geographic expansion of treatment, 3) enhanced monitoring of impact using more sensitive laboratory based assessment procedures, and 4) strengthening of national decision-making processes related to when it is safe to stop MDA. The magnitude of the move away from annual treatments to biannual (or even quarterly in parts of the Americas) treatments is shown in Frontispiece Figure D; in 2014 the majority of treatments will be provided using the twice-per-year strategy. Four of the six affected countries in the Americas are no longer providing treatment because they have interrupted or eliminated transmission.[2]

The change in goals in Africa was due mainly to recent decisions by the ministries of health of Ethiopia and Nigeria to make their goal RB transmission elimination, rather than control, in order to coordinate with LF elimination activities. The approach to elimination is defined by four phases (Frontispiece Figure E): 1) Transmission ongoing ('open system'); 2) Transmission suppressed ('closed system'); 3) Transmission interrupted; 4) Transmission eliminated.

[1] Brazil, Colombia, Ecuador, Ethiopia, Guatemala, Mexico, Nigeria, Sudan, Uganda and Venezuela

[2] Note that because this report is based on 2013 work done after the RBEP name change occurred, "RBEP" will be used in most of the text, even when referring to pre-2013 activities.

TCC's Onchocerciasis Elimination Program for the Americas (OEPA) has stopped MDA in 11 of 13 endemic foci in six countries in the Americas (Frontispiece Figure F). In 2013, Colombia became the first country in the world to receive verification of elimination from the World Health Organization (WHO) (Frontispiece Figure G). In 2013, OEPA assisted Ecuador in its submission of a request to WHO to assess whether the country has also eliminated onchocerciasis, as our evidence suggests.

The Uganda Onchocerciasis Elimination Expert Advisory Committee (UOEEAC) recommended to the MOH in 2013, that treatments be halted in two more foci. Transmission will have been interrupted in eight of the 18 foci that were endemic for river blindness in Uganda. Data from four more foci where transmission interruption is suspected will be considered by UOEEAC in 2014. Scale up of twice-per-year treatment (semiannual) and vector elimination/control have been the main strategies in Uganda since the country launched its elimination effort in 2007 (Frontispiece Figure H). Frontispiece Figure I depicts the changing elimination status of each focus by year between 2007 and 2013, with each panel showing the foci stratified by population size.

The Federal Ministry of Health of Sudan declared the interruption of onchocerciasis from the Abu Hamad focus in May 2012 and stopped treatment there. TCC continues to assist in the three year post-treatment surveillance phase of that program, required prior to declaration of transmission elimination.

In Nigeria, RBEP mounted a major NTD mapping exercise in 2013, with USAID's ENVISION project led by RTI International support, for trachoma, STH and schistosomiasis in the nine states the Carter Center assists. Based on these results, plans were made to expand mass drug administration using praziquantel, albendazole or mebendazole in multiple areas in southeast Nigeria in 2014 (See Frontispiece Figure J). Findings in the trachoma mapping results indicate no major additional trachoma MDA activities are needed in Carter Center-assisted states.

The RBEP assisted Ethiopia in launching twice-per-year treatment in many assisted areas in 2013, sending total treatments to 8.5 million (an increase of 77% from 2012). This will further increase in 2014 to an estimated 11.2 million, due to another expansion of twice per year treatments in the remaining early CDTI zones (Jimma and Illubabor) that have previously been receiving a single dose of ivermectin annually (Frontispiece Figure K). The Carter Center, with technical assistance from the University of South Florida, is helping to establish a new molecular laboratory that will use more sophisticated and sensitive techniques to support the national elimination activities.

BACKGROUND

Human onchocerciasis, an infection caused by the parasitic worm *Onchocerca volvulus,* causes chronic skin disease and severe itching, as well as eye lesions that can progress to visual loss or complete blindness. The worms live in fibrous 'nodules' that often can be felt just under the skin. Onchocerciasis is transmitted by small black flies

that breed in rapidly flowing rivers and streams, thus leading to the common name for the disease, “river blindness”. The WHO estimates that approximately 37.2 million people are infected and 770,000 are blinded or severely visually impaired in 38 endemic countries. Approximately 123 million people live in endemic areas worldwide and are therefore at risk of infection; more than 99% of those at risk reside in Africa. Periodic mass treatment with the oral tablet Mectizan® (ivermectin, donated by Merck) 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 geographic extent of the distribution programs. (See Annex 1 and 2 for further details.)

TCC’s RBEP is dedicated to safe and sustainable mass distribution of Mectizan® with health education to eliminate onchocerciasis. The distinction between control and elimination is important. In the control approach, Mectizan® distribution in a substantial number of endemic areas will likely need to continue indefinitely because onchocerciasis transmission persists and people continue to get new infections (‘open system,’ Frontispiece E); sustainability of control programs is vital. In the elimination approach, Mectizan® treatment is used more intensively to ‘close the system’ so that transmission can eventually be broken. At a point when the residual parasites in the human population are unable to recover, the MDA can be stopped. In 2012 and prior, the elimination of onchocerciasis was the program goal in the Americas, Uganda and the Abu Hamad focus in Sudan. In 2013, a new goal was set to stop transmission in all areas where RBEP assists. Of note, onchocerciasis elimination is now the stated goal of all the governments where RBEP assists. We also advocate for our programs to cooperate and integrate when possible with the national LF programs of the countries where we assist.

Local Lions Clubs and the Lions Clubs International Foundation (LCIF) are special partners of TCC in the battle against RB under the Lions-TCC SightFirst Initiative. When TCC assumed the functions of the River Blindness Foundation (RBF) in 1996, TCC also adopted RBF’s collaboration with local Lions Clubs in Cameroon, Nigeria and Uganda. Since 1997, LCIF has generously provided grants to TCC to help control or eliminate RB through their SightFirst I and SightFirst II Initiatives. In the first phase (Lions SightFirst I Initiative) the LCIF and TCC partnership encompassed controlling RB in five countries in Africa (Cameroon, Ethiopia, Nigeria, Sudan, and Uganda) and efforts toward eliminating RB altogether in the six endemic countries of the Americas. The second phase (SightFirst II Initiative) currently provides support for RB elimination work in Ethiopia and Uganda.

In 2003, TCC’s RBEP received its first support from the Bill & Melinda Gates Foundation for OEPA through a matching grant that drew additional funding from LCIF, Merck, and more than 70 other donors. The Gates Foundation provided a supplemental grant of $2 million to OEPA in 2011. Between 2006 and 2011, the Gates Foundation provided support to TCC’s integrated programs (which included RB) in Nigeria.

In 2012, USAID pledged significant financial support to TCC for OEPA, in partnership with the CDC, and that support continues. In 2013, USAID has provided substantial support for the Uganda river blindness elimination program through the ENVISION program, which is led by RTI International. In 2013, the ENVISION program in Nigeria supported MDA for RB in the southeast (SE) states as well as MDA for RB, schistosomiasis and STH in Plateau and Nasarawa. The ENVISION program also supported major surveys for trachoma, STH and schistosomiasis in all un-assessed LGAs in Carter Center-assisted states. Based on these results, limited STH treatments began in 2013 in Plateau and Nasarawa states, and plans were made for expanded 2014 MDA with praziquantel, albendazole or mebendazole treatments for STH, LF and SCH where applicable.

Other external RBEP partners include the WHO, the African Program for Onchocerciasis Control (APOC)[1], and the World Bank, as well as other foundations, corporations, governments, and nongovernmental development organizations (NGDOs). Of course, the RBEP would not be possible without Merck's donation of Mectizan®.

A major focus of TCC is reaching the best possible treatment coverage, monitored through routine monthly reports by assisted programs (Figure 1) and periodic coverage surveys and on achieving impact on RB itself. Annex 2 is a discussion of this reporting process and treatment indices used by the program and in this report. Important coverage terms include the **Ultimate Treatment Goal** (**UTG**), which is the number of treatment-eligible people living in a program area (persons >5 years of age); the **UTG(2) and UTG(4)**, used by elimination programs in areas where semiannual or quarterly treatments are required to break transmission; the **Annual Treatment Objective** (**ATO**), which is an interim target population in programs that are not operating at full scale due to initial operational limitations or financial resource constraints; and **full coverage**, which is defined as >90% achievement of the UTG, UTG(2), or UTG(4) (85% for OEPA). **Passive treatments** are Mectizan® treatments for onchocerciasis provided through health care units located in hypoendemic communities (where estimated onchocerciasis nodule prevalence is under 20%) in the control program strategy. In elimination programs, hypoendemic villages receive mass treatment (not passive). As TCC-assisted programs are transitioning to the elimination mode, passive treatments are being phased out of TCC strategy. Refer to Figure 2 coverage of treatment goals over time; this figure demonstrates the impressive progress each program has made toward the high coverage we are now seeing.

Mectizan® tablets are distributed in Africa at the community level by grassroots community volunteers known as Community Directed Distributors (CDDs) through a process known as Community Directed Treatment with Ivermectin (CDTI); CDTI was perfected by the Tropical Disease Research (TDR) program of WHO and was broadly introduced into APOC-supported project areas throughout Africa in the late 1990's. In some areas, TCC's RBEP focuses on "kinship-enhanced CDTI," an approach that

[1] TCC RB projects no longer receive substantial APOC support; they are beyond the 5-7 year APOC project horizon. (See Annex 8.)

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 or neighborhoods within every community where decisions and activities about treatments are handled. This 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 health workers 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 ratio of CDD per population set by APOC is at least 1 CDD per 100 persons to be treated in all communities. The Ethiopia government policy uses members of its Health Development Army to support a ratio of 1 CDD per 30 persons.

The CDDs and community supervisors 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.

SUMMARY OF THE MEETING

The 18th Program Review focused on the 2013 achievements, challenges and research of TCC-assisted onchocerciasis elimination programs. The Review also addressed other diseases and public health initiatives in which TCC helps countries integrate RB programs with LF, malaria, schistosomiasis, soil-transmitted helminths, trachoma, and Vitamin A supplementation programs. A major goal was to provide recommendations for each program.

Dr. Frank Richards, director of TCC's LF, Malaria, RB, and Schistosomiasis Programs, co-chaired the meeting with the field office heads of the TCC RBEP: Dr. Nabil Aziz (Country Representative, Sudan), Ms. Peace Habomugisha (Country Representative, Uganda), Dr. Emmanuel Miri (Country Representative, Nigeria), Dr. Mauricio Sauerbrey (Director, OEPA), and Dr. Zerihun Tadesse (Director of Programs, Ethiopia). Attendees included representatives from the following: the ministries of health of Ethiopia, Nigeria, Sudan, and Uganda; the African Program for Onchocerciasis Control; CBM; U.S. Centers for Disease Control and Prevention; Children Without Worms; Clarke Mosquito Control; Sir Emeka Offor Foundation; Eck Institute for Global Health; Emory University; GlaxoSmithKline; International Task Force for Disease Eradication; Izumi Foundation; John Hopkins School of Public Health; Lions Clubs International Foundation; Liverpool John Moores University; Mectizan Donation Program; Merck; Pan American Health Organization/WHO; RTI International; Sightsavers; Task Force for Global Health; The Atlanta Journal Constitution; University of Notre Dame and University of South Florida. (See Frontispiece Figure A for the group photo of participants and Annexes 3, 4 and 5 for a complete participant list, contact list, and agenda.)

In 2013, TCC delivered a record-breaking 18,993,181 Mectizan® treatments in 37,583 villages in 6 countries, a 32% increase from 2012, and 95 percent of its treatment target (Figure 3). Overall, 191,247,812 cumulative treatments have been provided since the RBEP was launched in 1996 (Frontispiece Figure C) and it is anticipated that the 200 million mark will be broken in mid-2014. A 2014 goal of more than 23 million treatments (an increase of 21% over 2013 achievements) was set (Figure 3). See Figure 4 for an illustration of treatments over the years by geographic region. The impact of Mectizan® treatments on microfilariae in the skin, by country or project area where available, is shown in Frontispiece Figure L. No follow up data are yet available for Mid North focus (Uganda) or for Ethiopia.

The Review also highlighted Carter Center-assisted mass drug administration activities in several other NTD efforts, including lymphatic filariasis (775,537 treatments in 2013), schistosomiasis (2,173,411 treatments in 2013), and soil-transmitted helminthes (721,989 treatments in 2013).

The program would not be possible without a grassroots network of community-directed drug distributors. Nearly 186,000 distributors were trained in 2013, supervised by almost 37,000 community supervisors and ministry of health district personnel. The increasingly strong collaboration with the USAID's ENVISION project led by RTI International in Nigeria and Uganda has resulted in a projected massive increase in 2014 of Carter Center-assisted treatments for LF (12.2 million), STH (8.7 million) and schistosomiasis (2.9 million), largely in Nigeria. In 2013, GSK provided support for three years to the malaria and lymphatic Filariasis programs in Nigeria. This grant will help to increase LLIN ownership in Plateau State.

TCC-assisted programs have worked continually to enhance a sustained level of grassroots community involvement in these MDA programs. As noted above, an important part of this strategy is to include more women in the training sessions and distribution process. Figure 5 shows the progress of these efforts. In 2001, 19% of CDDs were female; that number rose to 49% in 2013.

***Americas*:**

RBEP's Onchocerciasis Program for the Americas (OEPA) supports a coalition that includes the ministries of health of the six endemic countries in the region (Brazil, Colombia, Ecuador, Guatemala, Mexico and Venezuela), local Lions clubs and LCIF, the Bill & Melinda Gates Foundation, the Pan American Health Organization (PAHO)/ WHO, MDP, the CDC and USAID.

In 2013, Colombia became the first country to be verified by the World Health Organization (WHO) as onchocerciasis-free. In 2014, Ecuador was visited by a WHO verification team; results are pending. Guatemala and Mexico have stopped MDA and will complete their third year PTS activities in 2014.

Once a threat to some half a million people in six countries, only five percent of the originally at-risk populations deep in the Amazon rainforest, currently experience transmission of onchocerciasis in the Americas. OEPA's priority continues to be this last area with ongoing disease transmission, spanning the border of Brazil and Venezuela. For years OEPA used a twice-per-year treatment strategy, but it is increasingly adopting a four-times-per-year approach in its endgame strategy to accelerate the breaking of transmission among the indigenous Yanomami population in this region.

***Uganda*:**

The Uganda program administered over 3.5 million Mectizan® treatments in 2013, provided by at least 23,377 CDDs trained during 2013. Of the 2013 treatments, 301,285 were annual treatments in control areas and 3,225,411 were twice per year treatments in elimination areas (Figure 1). Progress towards elimination by 2020 continues to be made in Uganda, and in 2013 the Ugandan Onchocerciasis Elimination Expert Advisory Committee (UOEEAC) recommended treatments be halted in two more foci (Wambabya-Rwamarongo and Kashoya–Kitomi). Assuming acceptance of this recommendation by the Ministry of Health, transmission will have been interrupted in 8 of the 18 originally endemic river blindness foci in Uganda. Data from four more foci where transmission interruption is suspected will be considered by UOEEAC in 2014. The major other challenges in Uganda now are cross border transmission for onchocerciasis especially on the western border with Democratic Republic of Congo, and possibly in northwestern Uganda with the Republic of South Sudan. In addition, the CDTI approach in the post conflict Mid North focus of northern Uganda needs to be established in order to better engage communities themselves in the MDA process. The Carter Center's work in Uganda is based on a partnership with the Ministry of Health, Lions Clubs, and the Lions Clubs SightFirst Program, and USAID's ENVISION project led by RTI International.

***Sudan*:**

Sudan's government effort to eliminate river blindness delivered 285,050 treatments, administered by 1,256 CDDs. Of these treatments, 263,853 were twice per year in the Gadarif focus bordering Ethiopia. The Carter Center will assist in third year post-treatment surveillance (PTS) activities in the Abu Hamad focus in 2014, and cross border transmission surveys between Sudan and Ethiopia.

***Nigeria*:**

RBEP assisted in 6,596,039 Mectizan® treatments for river blindness in Nigeria in 2013, assisted by 71,883 CDDs. Early in 2013, the Minister of Health announced a goal of onchocerciasis elimination by 2020. The Federal Ministry of Health, however, has not yet formally accepted a twice-per-year strategy for onchocerciasis elimination. The RBEP is advocating twice-per-year treatments in several states of Nigeria that are

currently assisted by TCC in order to more rapidly advance the country toward transmission elimination.

The Carter Center's lymphatic filariasis (LF) program in Plateau and Nasarawa states demonstrated in 2012 that transmission of LF had been interrupted in those two states, and over 3 million annual MDA treatments with Mectizan® and albendazole (donated by GSK) were halted in 2013. Distribution of long-lasting insecticidal bed nets by the TCC's malaria program contributed to this success. In 2014, with support from USAID's ENVISION project led by RTI International, LF treatments should be initiated in the other seven Nigerian states TCC assists. In addition to GSK's donation of albendazole, the company also provides financial support focused on Plateau state.

The Carter Center assisted in 2,173,411 praziquantel treatments for schistosomiasis in Delta, Edo, Nasarawa, and Plateau states in 2013. The majority of the praziquantel used in Nigeria is donated to The Carter Center through the World Health Organization by Merck KGaA (E-Merck) of Germany. The Izumi Foundation supports this activity in Delta and Edo states.

In 2013, RBEP with its MOH partners completed a mapping exercise involving over 100,000 examinations for trachoma, STH and schistosomiasis in Nigeria, with support from USAID's ENVISION project led by RTI International.

***Ethiopia*:**

In 2013, The Carter Center's Ethiopian program began a major change from annual to twice-per-year treatments for river blindness in six of the eight zones it assists, under a new national policy of onchocerciasis elimination by 2020. In doing so, Ethiopia surpassed Nigeria for the first time as the country where TCC's RBEP assists the most Mectizan® treatments (Figure 4); a total of 8,527,632 treatments were provided in 2013, with 6.6 million of these under the twice-per-year strategy. Over 90,000 community drug distributors were trained, about 20,000 more than in 2012, to accommodate the increasing responsibilities of twice-per-year treatments and a larger target population. A molecular laboratory based at the Ethiopia Public Health Institute (EPHI) with financial support from The Carter Center and LCIF was renovated, equipment and supplies ordered, and one staff seconded from the institute trained at Prof. Tom Unnasch's laboratory at the University of South Florida. This laboratory, which should be operational in October 2014, will play a key role in monitoring interruption of onchocerciasis transmission in Ethiopia. The Carter Center's work in Ethiopia is based on a longstanding partnership with the Ministry of Health, Lions Clubs, and the Lions Clubs SightFirst Program.

2014 GENERAL RECOMMENDATIONS FOR THE CARTER CENTER RIVER BLINDNESS ELIMINATION PROGRAM

In collaboration with the host governments, RBEP helps interrupt onchocerciasis transmission ('elimination') in Carter Center-assisted River Blindness Elimination Program (TCC/RBEP) assisted areas in Africa by 2020. This includes:

- Helping to empower national onchocerciasis committees to review their data and make decisions.
- New assessments to help delimit the precise borders of African onchocerciasis transmission zones ('*foci*') that are targeted for elimination in TCC/RBEP assisted areas.
- Enhanced interventions (twice or four times per year ivermectin treatment, vector control, etc) where transmission persists or in new foci where treatments have never been given.
- New work in defining active transmission within the so-called 'hypoendemic' onchocerciasis areas that have traditionally not been targeted for ivermectin treatment under previous WHO/APOC disease control policy.
- Enabling decisions to stop interventions and enter into PTS, guided (but not restricted) by WHO guidelines.

RBEP will seek dedicated funding that will support enhanced river blindness elimination interventions and activities.

Encourage WHO (APOC, PAHO) and the concerned Ministries of Health to evaluate and treat cross border foci in a coordinated manner.

All RBEP African programs should undertake treatment coverage questionnaire surveys that provide 95% confidence intervals. The surveys could be based on either USAID's ENVISION project led by RTI International or Trachoma coverage survey models.

Submit drug applications to WHO and MDP as early as possible, and no later than August of the year before the drug is needed. This is especially important as programs move to twice per year treatments in many areas. Work with national agencies to facilitate appropriate documentation and clearance for all medications. Because drug requests are made well before treatment activities are done, treatment denominators will require adjustment during the treatment year. Keep TCC headquarters copied on all related correspondence.

In African programs, seek to increase training, supervision, involvement of kinship groups, and gender balance among CDDs and community supervisors. Work toward a target ratio of at least 1 CDD:100 people and 1 community supervisor:5 CDDs.

Maintain laboratory support by TCC/RBEP for serology, entomology, and parasitology (including PCR testing in vectors and skin snips) led by University of Southern Florida (Dr. Thomas Unnasch).

Through national mechanisms, monitor government and partner financial contributions for elimination efforts in RBEP-assisted areas.

Seek more Lions participation to help maintain program visibility and support wherever possible.

Carter Center program staff must complete or renew the Emory IRB certification if they are to be involved with research programs.

Overall Treatment Objective for onchocerciasis for 2014: 23,313,287

River Blindness:

Quarterly UTG(4):	**54,176**
Semiannual UTG(2):	**13,628,351**
Annual UTG:	**9,630,760**

Training Objective for 2014:

CDDs:	**203,272**
Community Supervisors:	**46,322**

Schistosomiasis/Soil Transmitted Helminths

Annual UTG SCH:	**3,056,576**
Annual UTG STH:	**7,606,802**

CDDs:	**41,938**
Community Supervisors:	**9,409**

Lymphatic Filariasis

Annual UTG:	**12,200,898**

CDDs:	**29,546**
Community Supervisors:	**7,087**

Figure 1

2013 Mectizan® Mass Treatment Figures for Carter Center River Blindness Elimination Program (RBEP)-Assisted Areas in Nigeria, Uganda, Ethiopia, and Collaborative Programs in Latin America (OEPA) and Sudan

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL	% UTG	% ALL RBP TX
NIGERIA	***UTG=**	**6,719,870**			**UTG (villages)=**	**8,161**									
Treatments	0	0	0	0	0	207,546	1,127,278	1,259,564	1,156,955	1,462,235	821,048	561,413	**6,596,039**	98%	35%
Villages treated	0	0	0	0	0	135	1,065	1,349	1,529	2,302	1,089	688	**8,157**	100%	22%
UGANDA	***UTG=**	**340,940**			**UTG (villages)=**	**562**									
Treatments	0	-	0	0	103,261	0	100,650	0	0	0	97,374	0	**301,285**	88%	2%
Villages treated	0	-	0	0	131	0	225	0	0	0	206	0	**562**	100%	1%
UGANDA ELIMINA	****UTG(2)=**	**3,929,164**			**UTG (villages)=**	**3,753**									
Treatments	0	-	0	92,211	453,531	796,087	165,286	0	116,761	167,427	1,318,622	115,486	**3,225,411**	82%	17%
Villages treated	0	-	0	265	834	2,307	67	0	203	284	3,077	142	**3,704**	99%	10%
OEPA	****UTG(2)=**	**15,714**			**UTG (villages)=**	**138**									
Treatments	0	0	0	0	0	6,496	0	0	0	0	0	7,116	**13,612**	87%	0%
Villages treated	0	0	0	0	127	0	0	0	0	0	0	135	**135**	98%	0%
OEPA	****UTG(4)=**	**49,211**			**UTG (villages)=**	**277**									
Treatments	0	0	9,632	0	0	10,045	0	0	9,757	0	0	10,444	**39,878**	81%	0%
Villages treated	0	0	239	0	0	250	0	0	244	0	0	252	**252**	91%	1%
ETHIOPIA	***UTG=**	**1,944,692**			**UTG (villages)=**	**9,845**									
Treatments	0	0	0	0	0	0	88,583	635,676	0	277,726	143,321	771,717	**1,917,023**	99%	10%
Villages treated	0	0	0	0	0	0	4,341	0	0	763	363	4,378	**9,845**	100%	26%
ETHIOPIA ELIMIN	***UTG(2)=**	**6,780,882**			**UTG (villages)=**	**14,756**									
Treatments	0	0	0	0	0	0	1,617,725	2,229,622	0	537,802	0	2,225,460	**6,610,609**	97%	0%
Villages treated	0	0	0	0	0	0	4,789	0	0	2,962	0	7,005	**14,756**	100%	0%
SUDAN	****ATO=**	**19,723**			**UTG (villages)=**	**19**									
Treatments	0	0	0	0	0	0	0	0	0	0	0	21,197	**21,197**	107%	0%
Villages treated	0	0	0	0	0	0	0	0	0	0	0	19	**19**	100%	0%
SUDAN ELIMINAT	****UTG(2)=**	**204,862**			**UTG (villages)=**	**153**									
Treatments	0	0	0	0	0	59,754	73,872	0	0	0	0	130,227	**263,853**	129%	1%
Villages treated	0	0	0	0	0	0	153	0	0	0	0	0	**153**	100%	0%
TOTALS	***UTG=**	**20,005,058**			**UTG (villages)=**	**37,664**									
Treatments	**0**	**0**	**9,632**	**92,211**	**556,792**	**1,079,928**	**3,173,394**	**4,124,862**	**1,283,473**	**2,445,190**	**2,380,365**	**3,843,060**	**18,988,907**	**95%**	
Villages treated	**0**	**0**	**239**	**265**	**1,092**	**2,692**	**5,851**	**1,349**	**1,976**	**3,349**	**4,735**	**5,614**	**37,583**	**100%**	

Cumulative RBP-assisted treatments (1996 - 2013) = 191,247,812

2013 Mass Treatments	18,988,907
2013 Passive Treatments	4,274
2013 TOTAL TREATMENTS	**18,993,181**

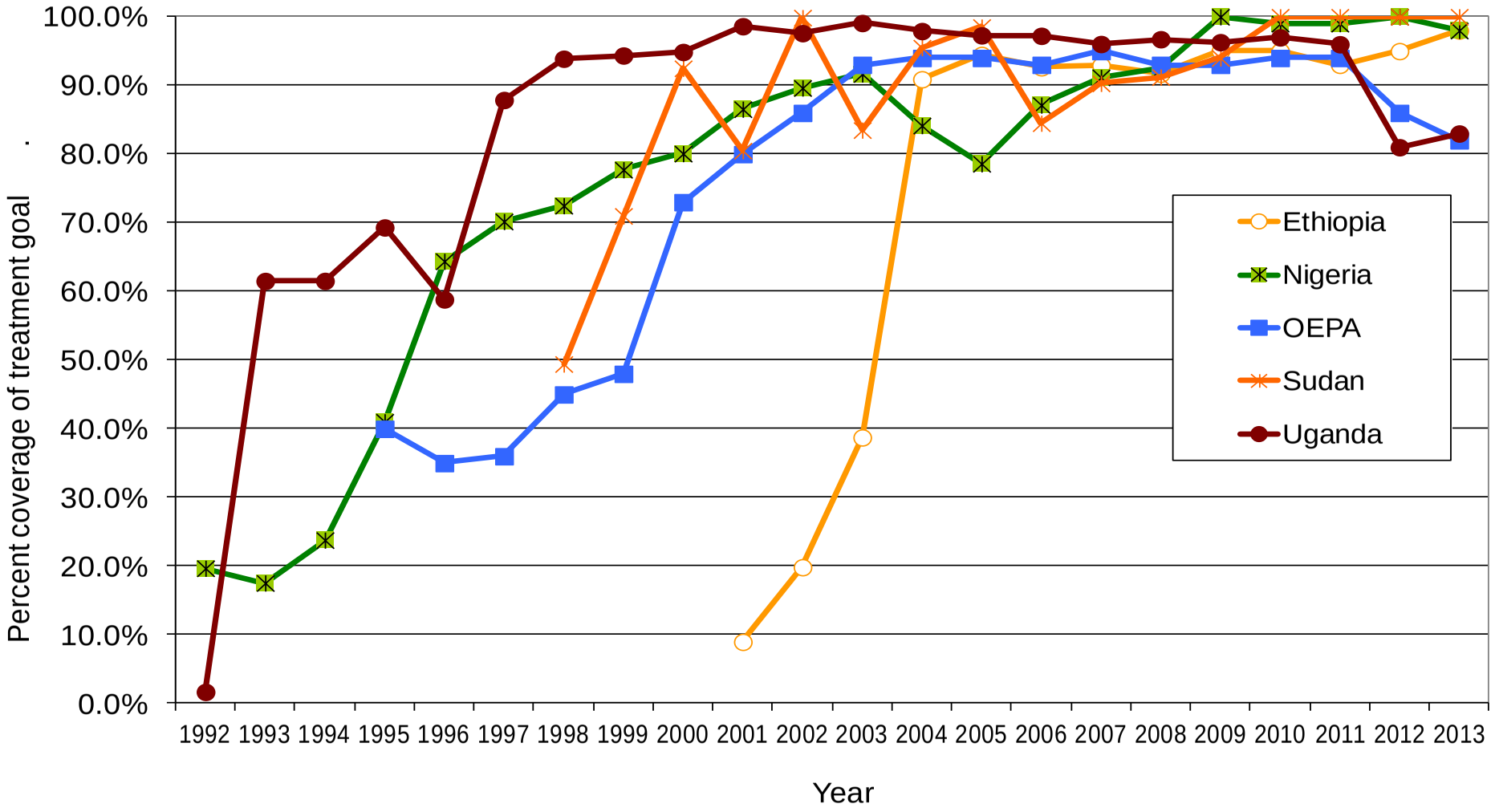
***UTG**: Ultimate Treatment Goal (all the treatment-eligible population in a program area, i.e. healthy persons >5 years of age)

OEPA's **UTG(2) and UTG(4) are the Ultimate Treatment Goal times 2 or 4, since OEPA treatments are semiannual or quarterly

****ATO**: Annual Treatment Objective: used in this case because population is unknown

Figure 2

River Blindness Program: Treatment coverage (eligible population) by project: UTG, UTG(2) or UTG(4) 1992 – 2013*



* 1992 – 1995 treatments were provided by River Blindness Foundation.

Figure 3

RBEP-assisted Programs: Ivermectin Treatments 1996 – 2013

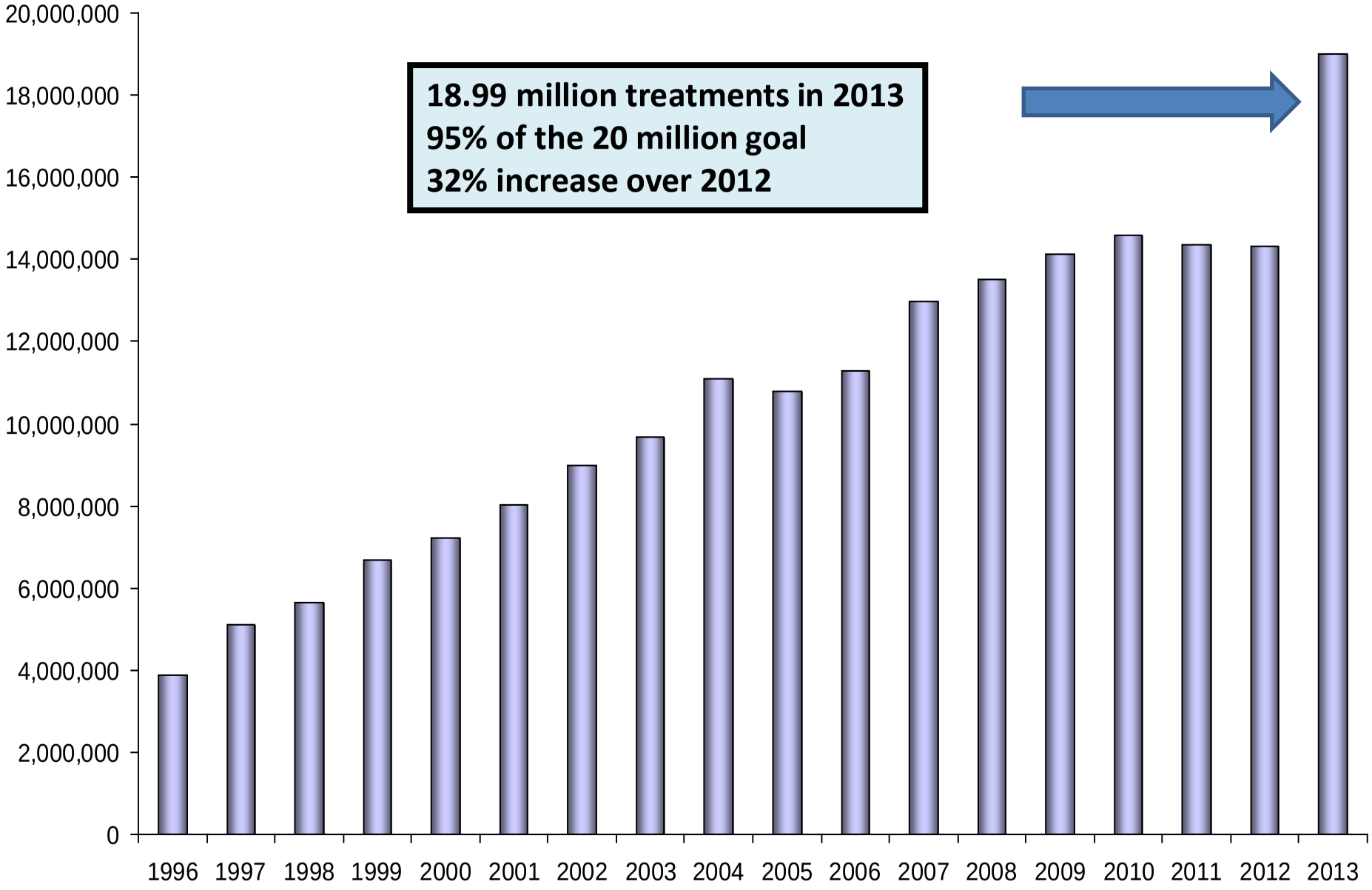


Figure 4

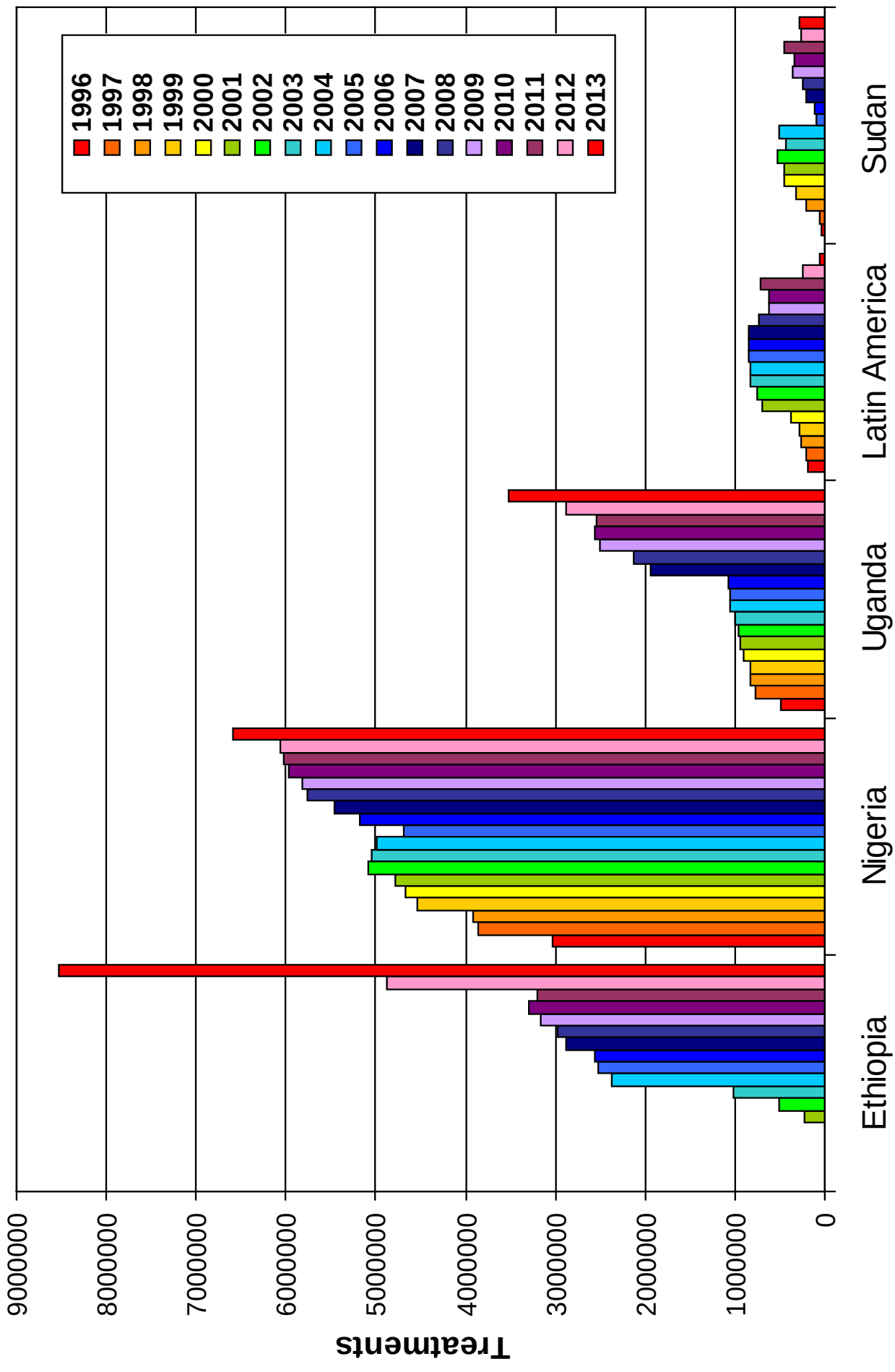
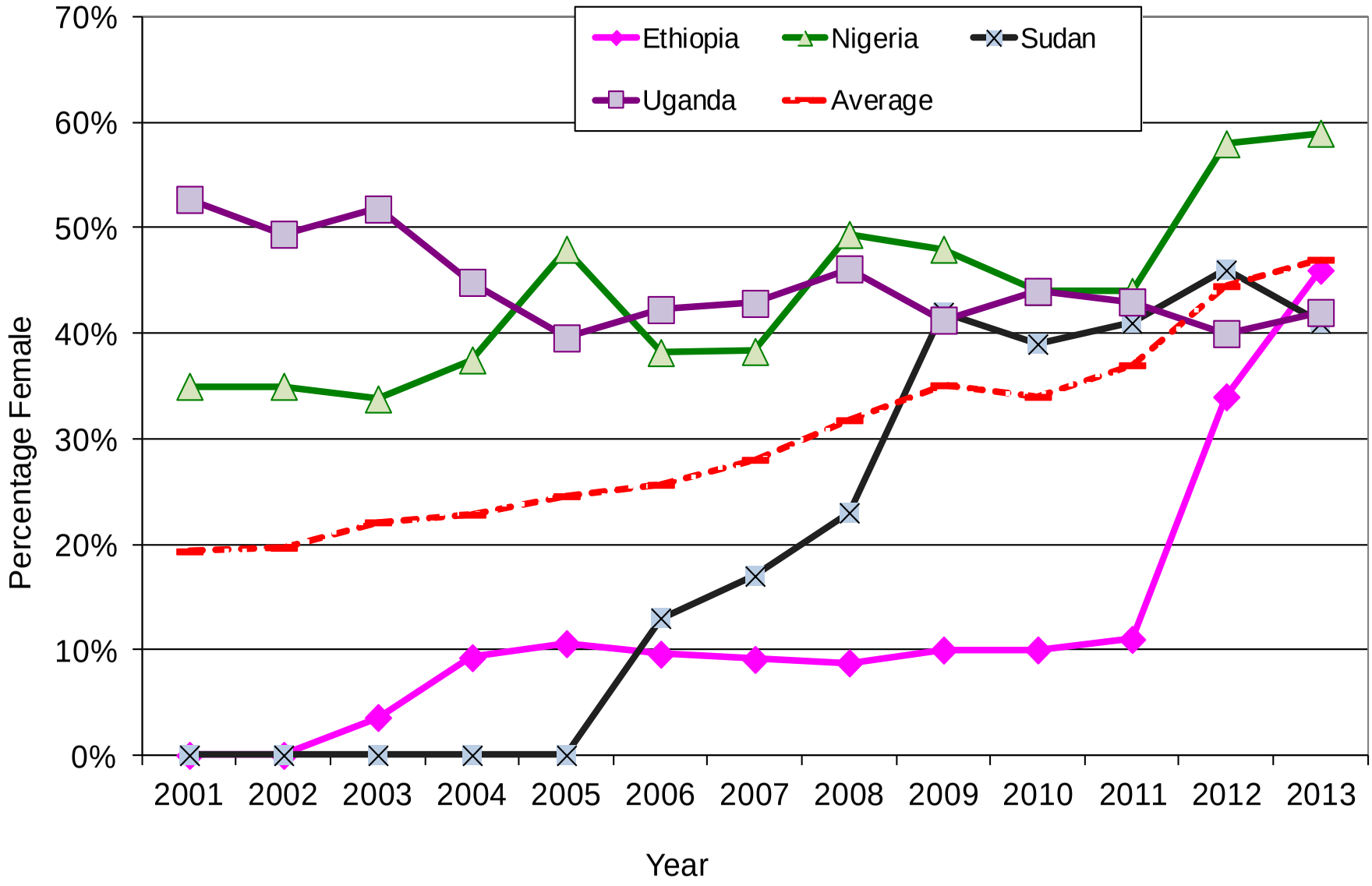

Carter Center-Assisted Programs:
1996 – 2013 Mectizan® Treatments by Program
Treatments
0
1000000
2000000
3000000
4000000
5000000
6000000
7000000
8000000
9000000
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Ethiopia
Nigeria
Uganda
Latin America
Sudan

Figure 5

Increasing Percentage of Female Community Distributors in Carter Center-assisted River Blindness Programs in Africa: 2001 – 2013



ONCHOCERCIASIS ELIMINATION PROGRAM FOR THE AMERICAS (OEPA)

Summary

As of 2013, *O. volvulus* transmission was interrupted or eliminated in 11 of the 13 foci in the Americas, and in 4 of the 6 endemic countries. Colombia became the first country ever verified as having eliminated onchocerciasis by WHO. A total of 64,010 Mectizan® treatments were given in 2013, all in the 'Yanomami Area' shared by Brazil and Venezuela (Frontispiece F), which is the very last active transmission zone for onchocerciasis in the Americas and the only area that will be under treatment in 2014.

BACKGROUND

The Onchocerciasis Elimination Program for the Americas (OEPA) is a Carter Center-led program that serves as the vanguard of the regional initiative working to eliminate both morbidity and transmission of onchocerciasis from the Americas through distribution of Mectizan® every 6 months, and in some areas every 3 months, in all affected communities of the 13 endemic areas of the Americas region. Mass Drug Administration (MDA) aims at reaching ≥85% coverage of the population eligible for treatment. In addition to The Carter Center, the OEPA coalition includes ministries of health (MOHs) of the 6 countries with onchocerciasis in the Americas (Brazil, Colombia, Ecuador, Guatemala, Mexico, and Venezuela), the Lions Clubs International Foundation (LCIF) and local Lions Clubs, the Bill & Melinda Gates Foundation, Pan American Health Organization/World Health Organization (PAHO/WHO), Merck and the Mectizan® Donation Program (MDP), the United States Agency for International Development (USAID), the U.S. Centers for Disease Control and Prevention (CDC), and several U.S. and Latin American universities. A Program Coordinating Committee (PCC) serves as the steering committee for Carter Center OEPA staff, which are based in Guatemala City, Guatemala. Technical and financial assistance to the 6 countries flows through the OEPA office.

The OEPA initiative was launched by the River Blindness Foundation in 1993 in response to the 1991 Resolution XIV of the 35th PAHO Assembly that called for the elimination of onchocerciasis morbidity from the Americas by the year 2007. The Carter Center assumed administrative responsibilities for OEPA in 1996. In 2008, PAHO renewed the call to eliminate onchocerciasis (Resolution CD48.R12) throughout the region. A subsequent 2009 PAHO Resolution (CD49.R19), calling for the elimination or drastic reduction of 12 neglected infectious diseases of poverty in the Americas by 2015, includes onchocerciasis as an elimination target.

In 2001, the WHO established a set of guidelines to assist onchocerciasis programs to determine whether interruption of transmission had occurred and MDA with Mectizan® could be stopped. The process is shown diagrammatically in Frontispiece Figure E and involves three key points depicted by the three vertical arrows: 1) Suppression of transmission, when infective stage larvae are no longer introduced into the human population by the vectors (Annual Transmission Potential [ATP] is at or near zero), but the parasite population maintains the ability to recover if interventions are withdrawn; 2)

Interruption of transmission, when the parasite population is thought to be unable to recover and ivermectin treatment can be halted; and 3) Elimination of transmission and the parasite, after a post-treatment surveillance (PTS) period of at least 3 years, confirms no return of transmission in the absence of treatment or other interventions. Once all country foci reach the elimination stage, final country verification can be considered by an independent international team meeting under the auspices of the WHO.

The primary strategy for eliminating onchocerciasis from the Americas is ivermectin MDA every 3-6 months, with health education and community mobilization, in all affected communities of the 13 endemic foci in the six affected countries. MDA aims to achieve at least 85% coverage of the population at risk and eligible for treatment. MDA has decreased by over 95% in the Americas since its peach in 2005 under this elimination strategy, as transmission in the region has been broken focus by focus (Figure O1)

In May 2013, the progress toward elimination of onchocerciasis from the Americans (over the period 1993-2012) was published in the CDC's Morbidity and Mortality Weekly Report (MMWR) (62: 405-408). That article noted that the OEPA program is distinguished by the substantial proportion (39.5%) of its costs (totaling approximately $147.8 million since 1991) that was contributed by the six countries themselves (Figure O2). This was supplemented by the critical support from external partners.

COLOMBIA AS FIRST COUNTRY IN THE WORLD TO BE VERIFIED BY WHO FREE OF RIVER BLINDNESS

In June 2012, OEPA's steering committee (the Program Coordinating Committee--PCC) meeting in Guatemala agreed that evidence showed onchocerciasis had been eliminated from Colombia. On October 27, 2012, Colombia filed a formal application to the World Health Organization (WHO) for independent verification of elimination. In response to Colombia's request, a WHO-led team of international experts visited the country from November 5 – 9, 2012 to extensively review the program and the data supporting onchocerciasis elimination. On April 5, 2013, based on the internal review of the verification team's report at WHO headquarters in Geneva, Director-General Margaret Chan issued an official WHO letter of verification of elimination of onchocerciasis to the Government of Colombia.

In Bogotá, Colombian President Juan Manuel Santos accepted the WHO certificate (Frontispiece Figure G) during a Pan American Health Organization-sponsored celebration of the achievement on July 29, 2013. President Santos and former U.S. President Jimmy Carter both made remarks during the ceremony (Frontispiece G). Also in attendance were community residents from the formerly endemic area in Caucá State; Colombian Minister of Health and Social Protection, Dr. Alejandro Gaviria Uribe; former U.S. First Lady Rosalynn Carter; and representatives from Colombia's National Institute of Health, The Carter Center, Merck/MSD, the Lions Clubs International

Foundation, the Lions Clubs of Colombia, the U.S. Agency for International Development (USAID), the Bill & Melinda Gates Foundation, and other partners.

Colombia eliminated river blindness using the twice per year Mectizan® mass treatment strategy in the affected area over the course of 17 years. Community volunteers, leaders, and promoters played a major role in sustaining the health education and excellent drug coverage that resulted in the elimination of the infection. Mectizan® treatments were stopped in 2008, and elimination was declared after three years of post-treatment surveillance needed to assure that transmission of the parasite did not recur after MDA was stopped.

Colombia is the first country in the Americas to eliminate river blindness and is the first country in the world to be granted verification of elimination of river blindness by the WHO. The Colombia time line in relation to the other endemic countries in the Americas are described in Figure O3). Further details about Colombia's success can be seen in the September, 2013 edition of WHO's Weekly Epidemiological Record (88:381-385.) Colombia's achievements, and the overall success of the OEPA initiative in the Americas, have encouraged reorientation of onchocerciasis goals in Africa from morbidity control to transmission elimination.

OTHER COUNTRY UPDATES

Ecuador. The single focus of onchocerciasis in Ecuador includes 119 communities (42 hyperendemic, 23 mesoendemic, and 54 hypoendemic) distributed among three river valleys in the Province of Esmeraldas. Although Ecuador's population at risk for onchocerciasis was relatively small (25,863), this focus had the highest prevalence of microfilariae in the skin at baseline and included the most efficient vector of the 13 American foci. Ecuador completed 23 MDA semiannual rounds of at least 85% coverage with dramatic impact on *O. volvulus* mf prevalence in skin and eyes of the afflicted population (Figure O4). Transmission was documented to have been interrupted in 2009 and the MOH (on PCC recommendation) halted MDA in 2010. Post treatment surveillance was completed successfully in 2012. In 2013, Ecuador requested verification of elimination of onchocerciasis from the WHO.

At the initiation of the OEPA program in 1993, the Esmeraldas Focus of Ecuador was considered one of the greatest challenges in the region to proving that transmission of onchocerciasis could be interrupted using a strategy of twice per year ivermectin MDA. This was due to the fact that Ecuador's main vector, *S. exiguum*, is highly efficient and comparable to those in Africa. Details of the initial success of the Ecuador MDA program were reported in the WHO WER in 2009 [85(33): 321-7]. The 23rd annual Inter-American Conference on Onchocerciasis (IACO 2013) was held in Quito, Ecuador in November, 2013 to celebrate the occasion of Ecuador's filing its formal request to PAHO/WHO for verification of elimination (see below).

Guatemala

Onchocerciasis transmission has been eliminated in three of the four foci of Guatemala (Santa Rosa, Huehuetenango and Escuintla foci). In the fourth focus (Central Focus), transmission was interrupted and MDA halted in 2011; PTS will be completed in 2014. If the 2014 evaluations there are negative, Guatemala could apply for verification of elimination from WHO in 2015 (Figure O3).

Mexico

Onchocerciasis transmission has been eliminated in two of the three foci of Mexico (Oaxaca and North Chiapas foci) and interrupted the South Chiapas Focus (the second largest in the Americas). South Chiapas will complete PTS in 2014; if the completed evaluations are negative, Mexico could apply for verification from WHO in 2015 (Figure O3).

Venezuela/Brazil

A total of 26,715 indigenous Yanomami people live deep in the Amazon rainforest in the final active transmission zone in the Americas. Two national foci, the Venezuelan South Focus and the Brazilian Amazonas Focus, comprise the Yanomami Area, a contiguous transmission zone that straddles the international border. Major challenges in this area include high endemicity, difficult access, insecurity in some areas and incomplete community inventories, with new highly endemic communities being discovered every year. Selected communities having the highest infection prevalence (of microfilariae in skin) have been targeted to receive four-times-per-year (quarterly) treatment in an effort to hasten the elimination of the disease. The number of persons targeted for this quarterly strategy has increased each year, and consistent 85% coverage is yet to be attained (Figure O5). In 2013, a total of 12,168 persons were eligible for the four-times-per-year treatment approach, of which 79% were treated during the first round, 81% during the second, 81% during the third, and 83% during the fourth. In 2014, a total of 13,532 individuals are being targeted for quarterly treatment. In 2013, a total of 7,857 persons, resident in less highly endemic communities, were eligible to receive the standard twice-per-year treatment approach in the Yanomami Area, of which 83% were treated during the first round, and 91% during the second. In 2014, a total of 8,514 individuals should be treated twice per year. The latest epidemiological evaluations conducted in the Venezuelan South focus show that microfilariae infection prevalence has dropped from 27.6% in 2008 to 7.8% in 2013. Epidemiological evaluations conducted at the Brazilian Amazonas focus show the prevalence dropped from 14.7% in 2007 to 4% in 2012.

Brazil has no other foci for onchocerciasis. Venezuela has a total of three foci, but the other two foci have stopped MDA, and are currently undergoing PTS: the Northcentral focus (will complete PTS in 2014) and Northeast focus (will complete PTS in 2015).

THE ANNUAL INTER-AMERICAN CONFERENCE ON ONCHOCERCIASIS (IACO'13) AND THE PROGRAM COORDINATING COMMITTEE (PCC):

Over eighty persons attended the 23rd annual Inter-American Conference on Onchocerciasis (IACO) in Quito, Ecuador, November 21 – 22, 2013. The theme of the meeting was "Success in Ecuador, Challenges in the Amazon." IACO was convened by the Ecuadorian MOH, The Carter Center's OEPA, and PAHO, with support from CDC and USAID. Country directors attended from the six endemic countries (Brazil, Colombia, Ecuador, Guatemala, Mexico and Venezuela). Steadfast partners, the Lions Clubs, were represented at IACO by two members of their Quito Central Lions Club: Mr. Ramiro Peña, President, and Mrs. Margarita Garrido de Peña, Director of the Women's Committee.

Mectizan® twice per year has been effective in eliminating the disease from Ecuador, as in Colombia. In his opening remarks to IACO 2013, Dr. Francisco Vallejo, Undersecretary of the Ecuadorian MOH, commended this achievement. In July, 2013, Ecuador formally submitted a request to WHO for verification of onchocerciasis elimination.

About twenty local program workers from Esmeraldas, the formerly endemic area of Ecuador, attended the meeting. Meeting attendees congratulated the Esmeraldas team for its tireless work to eliminate onchocerciasis, which also causes intense itching, skin disease, and blindness. Also present were key early pioneers in the Ecuadorian battle against onchocerciasis, which was launched in the late 1970's by Drs. Ronald Guderian, Mariella Anselmi, Angel Guevara, Philip Cooper, Martin Ruppenthal, and Roberto Proaño.

During the June, 2013 PCC meeting in Guatemala, Chairman Dr. Ed Cupp stepped down and was succeeded by Dr. Frank Richards, Director of The Carter Center's RBEP. Dr. Cupp was honored for his long service by IACO'13 in Quito.

2014 RECOMMENDATIONS FOR THE CARTER CENTER RBEP, OEPA

Obtain the highest level of political support from Venezuela and Brazil for the elimination of onchocerciasis from the Yanomami Area, including a plan of operations and the ability to work across the borders.

Help establish an MOU between the two countries for cross-border teams. These teams would work not just on onchocerciasis but other health issues as well.

Establish cross-border collaboration and launching of bi-national implementation teams operating out of a base at Surucucú in Brazil, where infrastructure is greatest and where OEPA can contract aerial transportation.

Collaborate with PAHO to work as a partner in the above efforts.

Detect any unidentified communities as soon as possible. There is a particularly urgent need to arrange a fixed wing or helicopter 'fly over' photography exercise to verify by ground truth all 149 potential community 'remote sensing signature' coordinates that have been identified by Dr. Unnasch's project .

Implement immediate four-times-per-year treatment, prioritizing hyperendemic areas. High treatment coverage (>85%) in each round should be considered essential. In newly identified villages, the program will report the year treatment was launched, the number of rounds with any treatment coverage, the number of rounds with>85% treatment coverage, and the number of consecutive rounds of >85% coverage.

Mexico and Guatemala: Complete final PTS entomological evaluations in Southern Chiapas focus, Mexico, and Central Focus, Guatemala. Complete country dossiers for submission to WHO for verification of elimination, and assist in the planning of WHO verification visits in 2015. Continue health education in the foci where transmission has been eliminated.

Assist Ecuador to prepare for the visit by the WHO verification team in 2014.

Continue to invite all countries to IACO regardless of elimination verification status.

Encourage Lions to support attendance of a Lions representative from each of the six countries to IACO.

General

Submit drug applications to WHO and MDP as early as possible, and no later than August of the year before the drug is needed. This is especially important as TCC/RBEP moves to twice per year treatments in many assisted areas. OEPA should continue to work with federal agencies in Brazil and Venezuela to facilitate appropriate

documentation and clearance for all medications. Because drug requests are made well before treatment activities are done, treatment denominators will require adjustment during the treatment year. Keep headquarters copied on all related correspondence.

Through national mechanisms, monitor government and partner financial contributions for elimination efforts in RBEP-assisted areas.

Carter Center program staff must complete or renew the Emory IRB certification if they are to be involved with research programs.

Treatment Objectives for onchocerciasis for 2014:
UTG(2): 16,882
UTG(4): 54,176

Figure O1

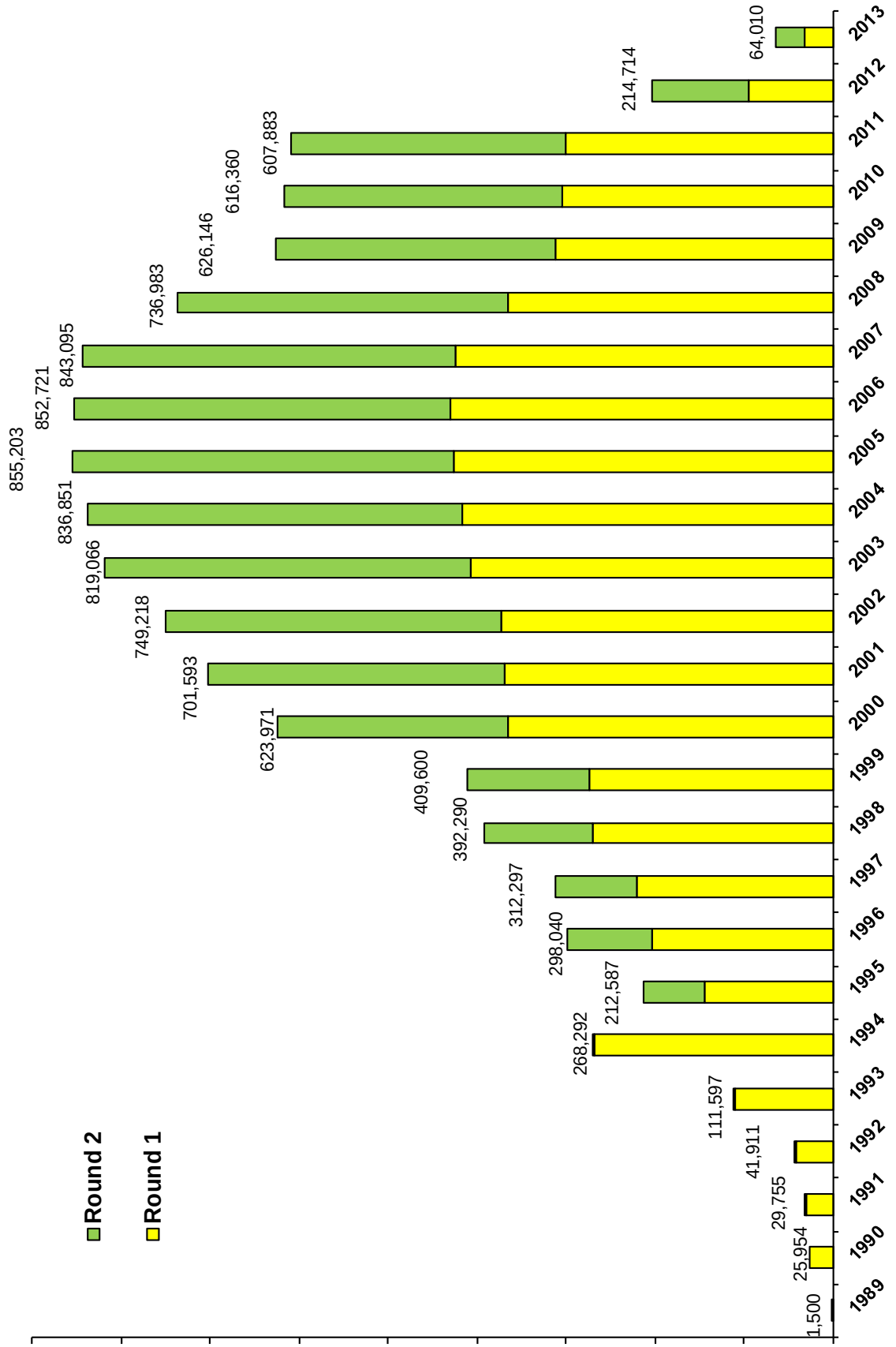

OEPA-History of Ivermectin Treatment in the Americas
Round 2
Round 1
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
1,500
25,954
29,755
41,911
111,597
268,292
212,587
298,040
312,297
392,290
409,600
623,971
701,593
749,218
819,066
836,851
855,203
852,721
843,095
736,983
626,146
616,360
607,883
214,714
64,010
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013

Figure O2

Summary of Financial Contributions to the OEPA Regional Initiative (in millions of US $)

SOURCE	1991/2013	%
Countries (counterpart funding from MOH´s)	58.38	39.49%
MERCK/MDP (in kind)	55.01	37.21%
The Carter Center and its generous donors: *BMGF, LCIF, IDB, Merck/MDP, USAID, CDC/USAID and Other Donors	33.35	22.56%
RIVER BLINDNESS FOUNDATION (seed money)	1	0.68%
PAHO/WHO (IACO contributions 1997-2003 and verification process 2012-2013)	0.09	0.06%
Total	**147.83**	**100%**

*Abbreviations include: Bill & Melinda Gates Foundation, Lions Clubs International Foundation, Inter-American Development Bank, Mectizan Donation Program, U.S. Agency for International Development, Centers for Disease Control and Prevention

Figure O3

Change in Prevalence of *O. volvulus* microfilariae in Skin (Mf) and in the anterior chamber of the eye (MfAC) in Sentinel Villages of Ecuador (1991-2008)

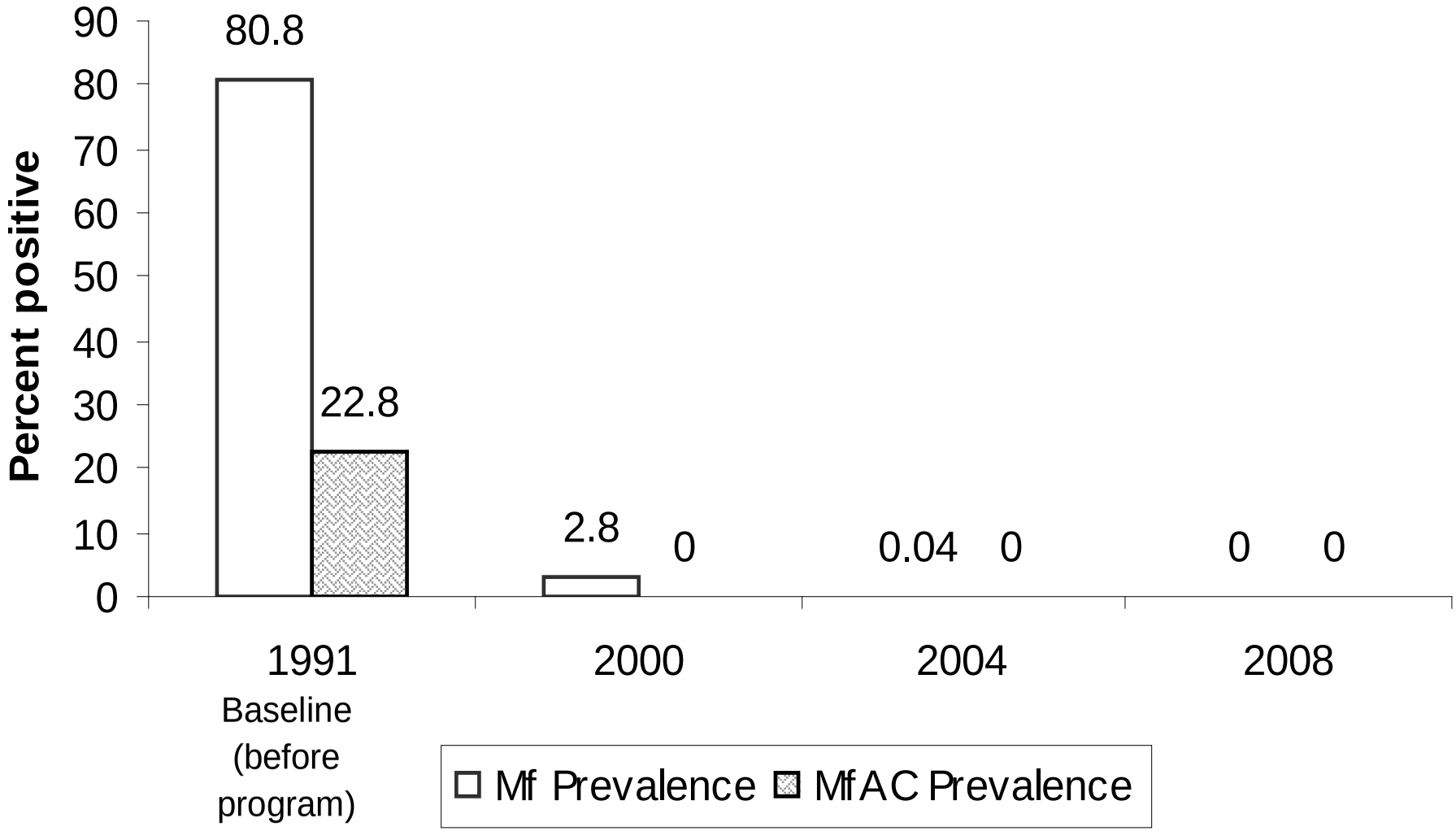


Figure O4

Countries' Timeline for Verification of Disease Elimination

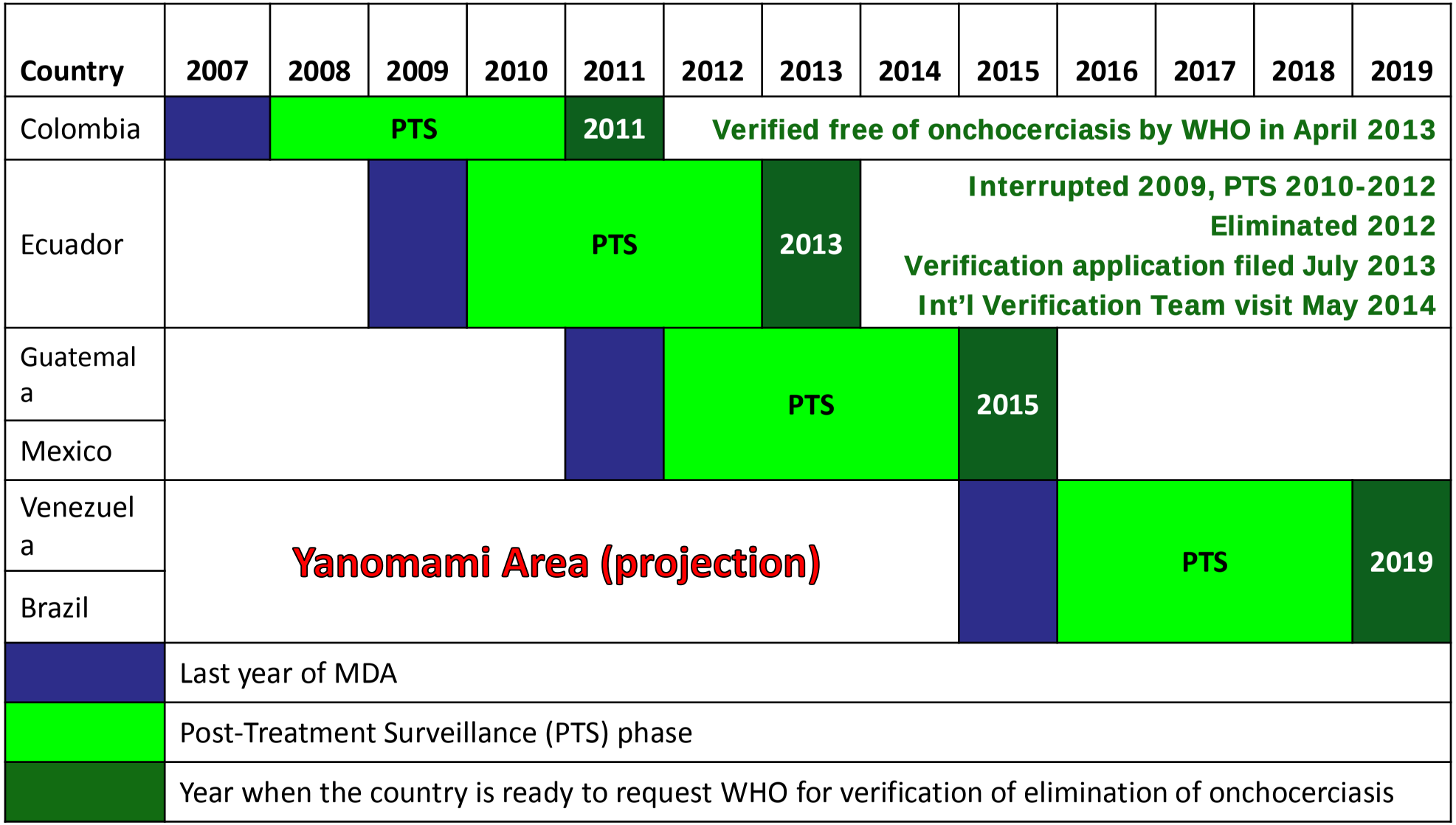
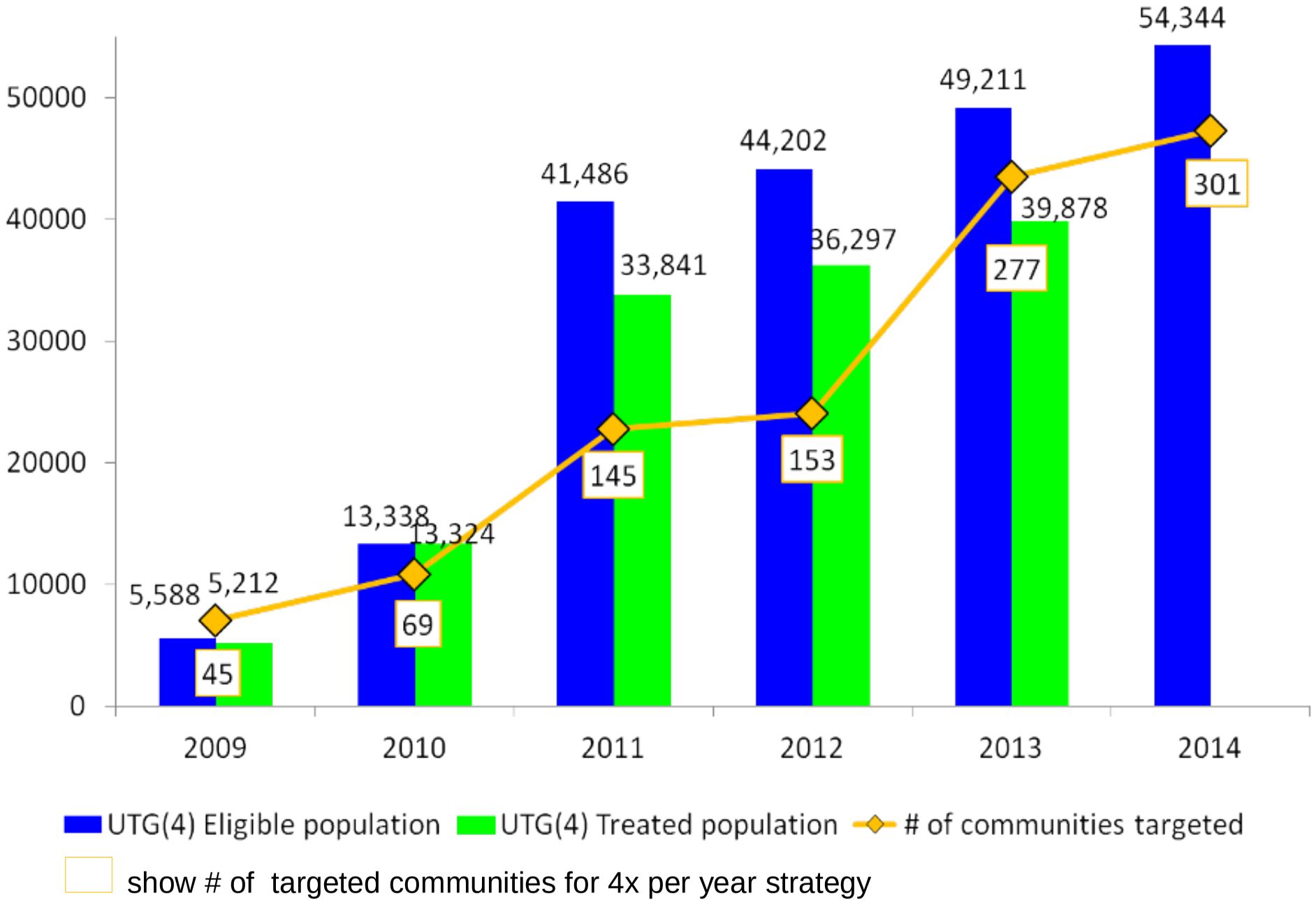


Figure O5

Trend for the UTG(4) target and treatments in the Yanomami Area 2009-2013 (with 2014 target)



UGANDA

Summary

Since the launching of its onchocerciasis elimination program in 2007, Uganda has interrupted transmission of onchocerciasis in nine of the 18 foci (Frontispiece Figure H and I). The nine foci where onchocerciasis transmission has been interrupted include: 1. the Victoria focus (eliminated by vector control in the 1970s); 2. Wadelai in 2010; 3. Mt. Elgon and 4. Itwara in 2011; 5. Mpamba-Nkusi, 6. Imaramagambo, and 7. Maracha-Terego in 2012; and 8. Kashoya-Kitomi and 9. Wambabya-Rwamarongo in 2013. This translates into about 1.77 million treatments for onchocerciasis no longer being required in Uganda.

As lymphatic filariasis (LF) is not endemic in Kashoya-Kitomi and Wambabya-Rwamarongo, mass treatment with ivermectin will be stopped in 2014 and the foci moved to the three-year Post Treatment Surveillance (PTS) phase. The populations in Kashoya-Kitomi and Wambabya-Rwamarongo will receive health education in preparation for these changes.

In 2014, information on parasitology, serology, and entomology from two more foci (Nyamugasani and Obongi in western and northwestern Uganda, respectively) will be reviewed with respect to the Uganda guidelines to determine if interventions could be halted there.

The biggest challenges are in northern Uganda, where MDA programs must be oriented to a community-directed approach. This is especially true in the Mid North focus, an area that until recently, was largely inaccessible due to insecurity. The President of Uganda, His Excellency Yoweri Museveni, launched semi-annual treatment with ivermectin in the Mid North focus in May 2012. He also authorized an estimated US$500,000 in government funding for 2012 entomological surveys and aerial spraying of insecticide for vector control in that focus. Since then, ground larviciding has been applied.

Background: Onchocerciasis affects 36 of the 112 districts in Uganda. The first Ugandan onchocerciasis transmission zone ('focus') to successfully eliminate the disease was Victoria, which claimed victory in the 1970s following a vector control campaign based on DDT spraying of rivers that liberated 3 million people from the threat of the disease. Onchocerciasis control using annual mass treatment with Mectizan® began in 1991. The original Ministry of Health ivermectin program enjoyed financial support from The River Blindness Foundation (RBF), CBM, and Sightsavers. In 1996, The Carter Center (TCC) assumed the activities of RBF. In 1997, the African Program for Onchocerciasis Control (APOC) began supporting some Ugandan efforts and introduced the community-directed approach to Mectizan® distribution. APOC also supported successful vector elimination efforts in two foci (Itwara and Mpamba-Nkusi) that used ground larviciding with temephos (Abate®) together with annual Mectizan® distribution. In 2006, The Carter Center helped launch semi-annual treatments (every

six months) to eliminate onchocerciasis from the Wadelai focus, with support from Merck (funding being administered through the NGDO Coalition for Onchocerciasis Control). Wadelai's success was confirmed in 2010, but annual treatment had to continue as the entire Nebbi district is also endemic for LF. The Uganda Ministry of Health (MOH) was emboldened by these APOC and Lions-Carter Center-assisted elimination successes, and announced a nationwide elimination policy in 2007 that was to be based on twice-per-year treatment (where necessary) and (where feasible) vector elimination/control (using ground-based larviciding), in addition to health education in the affected communities. The new flexible elimination policy, which aims for nationwide elimination of onchocerciasis by the year 2020, was immediately applauded and supported technically and financially by the Lions-Carter Center partnership and Sightsavers.

Currently, onchocerciasis elimination in Uganda is supported by The Carter Center, the United States Agency for International Development (USAID) ENVISION project led by RTI International, and Sightsavers, under the coordination of the Ministry of Health. The Carter Center River Blindness Elimination Program (RBEP) assists in 36 (94%) of the onchocerciasis endemic districts: Bushenyi, Kabale, Kanungu, Kasese, Kisoro, Rubirizi, Buhweju, Kamwenge, Ibanda, and Mitooma (in southwest Uganda); Bulisa, Hoima, Kabarole, Kibaale, Kyenjonjo, and Masindi (in western Uganda); Adjumani, Arua, Koboko, Yumbe, Maracha, Moyo, Nebbi, Yumbe, and Zombo (in the West Nile region bordering the Democratic Republic of the Congo); Amuru, Gulu, Kitgum, Lamwo, Lira, Nwoya, Oyam and Pader districts (in the Mid North focus); and Bududa, Manafua, Mbale, and Sironko (in the Mount Elgon focus in the east, bordering Kenya). In Koboko and Yumbe districts, the assistance has been mainly in mapping, parasitological, entomological and serological assessments. Since 2007, The Carter Center has supported technical services, vector elimination activities and some community-directed treatment with ivermectin (CDTI) activities in Bulisa, Kibaale, Hoima, and Masindi, in partnership with Sightsavers, which operationally supports these districts. The Carter Center has also supported technical services in the districts of Kabarole and Kyenjojo in Itwara focus. Ivermectin distribution through CDTI in West Nile focus is supported by APOC and the Ministry of Health of Uganda. A few other districts continue to receive some level of support from APOC.

Lions have supported the Uganda effort through the Lions Clubs International Foundation (LCIF) SightFirst program for many years. LCIF's most recent grant began in August 2013. Ugandan Lions Clubs are very active participants in and advocates for the Carter Center-assisted river blindness control and elimination activities, including engaging and mobilizing members of parliament and other government officials. The Carter Center's Country Representative in Uganda, Ms. Peace Habomugisha, is a Lions Club member.

Uganda laboratory activity: In support of the elimination effort, The Carter Center has continued to fund equipment and reagents for the MOH laboratory that provides state-of-the-art diagnostic support to the elimination program. The laboratory is located at the MOH Vector Control Division in Kampala and provides polymerase chain reaction (PCR) testing for black flies and skin snips, and serologic enzyme-linked immunosorbent assay (ELISA) testing for OV16 antibodies. Technical backup and reference lab support is provided by Dr. Tom Unnasch's laboratory at the University of South Florida in Tampa, FL. In 2013, the Uganda laboratory analyzed 6,433 blood spots for OV16 antibodies. Since its launching, the Uganda lab has analyzed 45,877 OV16 specimens, and as a result has the greatest operational experience using this test of any lab in the world.

Expert advisory committee for national onchocerciasis elimination: To ensure that the elimination decisions are supported with the best scientific and technical advice, the Uganda MOH established the Ugandan Onchocerciasis Elimination Expert Advisory Committee (UOEEAC), which is chaired by Dr. Tom Unnasch (University of South Florida). The UOEEAC meetings are supported financially by The Carter Center. UOEEAC responsibilities are to: 1. review programmatic activity reports from each elimination-targeted focus in Uganda annually; 2. advise the MOH on focus-specific monitoring and evaluation activities, and recommend halting of interventions when appropriate in accord with international and national guidelines; and 3. make any other recommendations to the MOH on activities needed to reach the national 2020 elimination goal. In addition to MOH representatives and institutional representatives from The Carter Center, Sightsavers, and APOC, the UOEEAC includes several members-at-large who are recognized for their international expertise in onchocerciasis: Dr. Unnasch (chair), Dr. Edridah Tukahebwa (Acting Assistant Commissioner of National Disease Control, MOH), Professor Rolf Garms (Bernhard-Nocht Institute), Dr. Frank Walsh (former director of entomology of the WHO Onchocerciasis Control Program). The national coordinator for the onchocerciasis elimination program of the Ministry of Health is the committee's secretary, assisted by The Carter Center country representative (Ms. Peace Habomugisha) serves with the national coordinator (Mr. Tom Lakwo) as a co-secretaries. The World Health Organization (WHO) Uganda representative attends these meetings as an observer, to avoid any conflict of interest since WHO will likely coordinate future verification of the elimination activities. NTD representatives, the Uganda LF coordinator, local Lions, Mectizan Donation Program representatives, RTI/ENVISION, and other donors and technical bodies also attend as observers.

At its sixth session (August 6-8, 2013) the UOEEAC concluded that onchocerciasis transmission had been interrupted in Kashoya-Kitomi and Wambabya-Rwamarongo foci. The UOEEAC recommended that the MOH halt all interventions in these foci and move them to the post-treatment surveillance (PTS) phase (Frontispiece Figure E). The UOEEAC also noted that suppression of transmission may have already taken place in Bwindi focus, Nyamugasani focus, Obongi focus and West Nile focus, but additional epidemiological information was needed to determine if transmission interruption had been met according to WHO/MOH guidelines.

Treatments: The Carter Center assisted about 88% of its treatment target of 4,270,104 in 2013. Treatments in the MOH/APOC-assisted areas of West Nile focus were unavailable, and therefore it was not possible to estimate the national treatments during 2013 (Figure U1).

The Uganda program continues to expand semiannual treatments (Frontispiece Figure I). The Ultimate Treatment Goal (UTG) for Carter Center- assisted areas using a control strategy, with an annual ivermectin treatment target of just 340,940 in 2013 (Figure U2). The 2013 coverage of the UTG was 88.4% (301,285 treatments provided). In the areas targeted for elimination where the strategy was semiannual treatment, the 2013 UTG(2) was 3,929,164 (Figure U3), and the program provided 3,225,411 treatments, 82% of that target. In total, the Uganda RBEP assisted in a total of 3,526,696 mass treatments in 2013 (as well as 4,650 passive and visitor treatments). This was a 23% increase over 2012 treatment numbers, an indication of improvement in Mid North focus treatments. The Uganda RBEP reached 100% of 562 villages targeted for control; for villages targeted for semi-annual treatment, 97% (3,753) were reached in round one and 99% in round two. Yet, Uganda provided treatments in all the 4,315 targeted villages, although about 1% to 3% may have received only one round of treatment instead of two. The program needs to continue improving its implementation process in order to overcome challenges still being experienced in expansion areas of the Mid North focus. With the exception of Adjumani district (which is under the control strategy), all other Carter Center-assisted areas, due to well-established infrastructure, attained more than 90% coverage of the UTG. In Adjumani, UTG district treatment coverage was low (74%) due to refugees returning to the Republic of South Sudan before they could be treated by the Ugandan program.

Training and Health Education: Uganda trained or retrained 23,377 Community-Directed Distributors (CDDs) and 8,458 Community-Directed Health Supervisors (CDHSs) in 2012. Fewer CDDs and CDHSs were trained than in 2012 because the emphasis was only on communities and districts that had not satisfactorily trained as planned during the previous year. Of those trained in 2013, 41% of the CDDs and 34% of the CDHSs were female. The current ratio of CDDs to population served is 1 CDD to 120 persons served, and the supervisor-to-CDD ratio was 1:3.

Financial Contribution: Figure U4 shows APOC, Carter Center/LCIF/ENVISION, and government (district and national) financial contributions to onchocerciasis control/elimination in areas assisted by the RBEP. Starting in 2007, The Carter Center dramatically increased its funding with the launching of the new national elimination policy; APOC support remained relatively stable (US $137,743), and at levels comparable to 2011 (US $157,476) and 2012 (US $119,324). The national government contribution increased from US $9,053 in 2012 to US $24,932 in 2013. The support from government in 2012 was largely from central government for vector control in Mid-North focus. Central government did not continue this level of assistance in 2013.

Sustainability and Integration: The RBEP-assisted CDTI program actively co-implements with the national lymphatic filariasis elimination effort, which reached 198,024 persons in Adjumani and Moyo districts, 85% of its target for combination ivermectin and albendazole treatments in 2013. Adjumani reached just 74% of its target due to refugees returning to the Republic of South Sudan. Moyo reached 99% of its target.

Co-implementation with the Vitamin A Supplementation Program for young children (6-59 months) was only done in Kabale district. In the first round, 5,080 children were treated at 90% treatment coverage; and in the second round 3,220 children were treated, at 57% coverage. The low coverage was due to an inadequate supply of Vitamin A. The chronic shortage of Vitamin A did not allow extension of treatment to other districts.

2014 RECOMMENDATIONS FOR THE CARTER CENTER RBEP, UGANDA

Expand twice-per-year treatment to Moyo and Adjumani districts currently under Madi onchocerciasis focus.

Focus on CDTI activities in the Mid North onchocerciasis focus particularly in Lamwo, Kitgum and Pader districts, with the aim of improving community involvement, and treatment coverage (at least 90% of UTG) in each treatment cycle every year. A special presentation on this focus will be requested at the next program review.

Provide financial and administrative support for the 2014 UOEEAC meeting.

Work closely with the MOH NTD program in order to promote effective and efficient LF and Oncho co-implementation where the two diseases are co-endemic.

General

Encourage WHO/APOC and the concerned Ministries of Health (DRC and RSS) to evaluate and treat cross border foci in a coordinated manner.

Undertake treatment coverage questionnaire surveys that provide 95% confidence intervals.

Submit drug applications to WHO and MDP as early as possible, and no later than August of the year before the drug is needed. This is especially important as TCC/RBEP moves to twice-per-year treatments in many assisted areas. Work with federal agencies to facilitate appropriate documentation and clearance for all medications. Because drug requests are made well before treatment activities are done, treatment denominators will require adjustment during the treatment year. Keep headquarters copied on all related correspondence.

Seek to increase training, supervision, involvement of kinship groups, and gender balance among CDDs and community supervisors. Work toward a target ratio of at least 1 CDD: 100 people and 1 community supervisor: 5 CDDs.

Through national mechanisms, monitor government and partner financial contributions for elimination efforts in RBEP-assisted areas.

Seek more Lions participation to help maintain program visibility and support wherever possible.

Carter Center program staff must complete or renew the Emory IRB certification if they are to be involved with research programs.

Treatment Objective for onchocerciasis for 2014:

Semiannual UTG (2)	**4,086,008**
Annual UTG (confirmed)	**40,787**

Training Objective for 2014:

CDDs:	**22,094**
Community Supervisors:	**7,858**

Figure U1

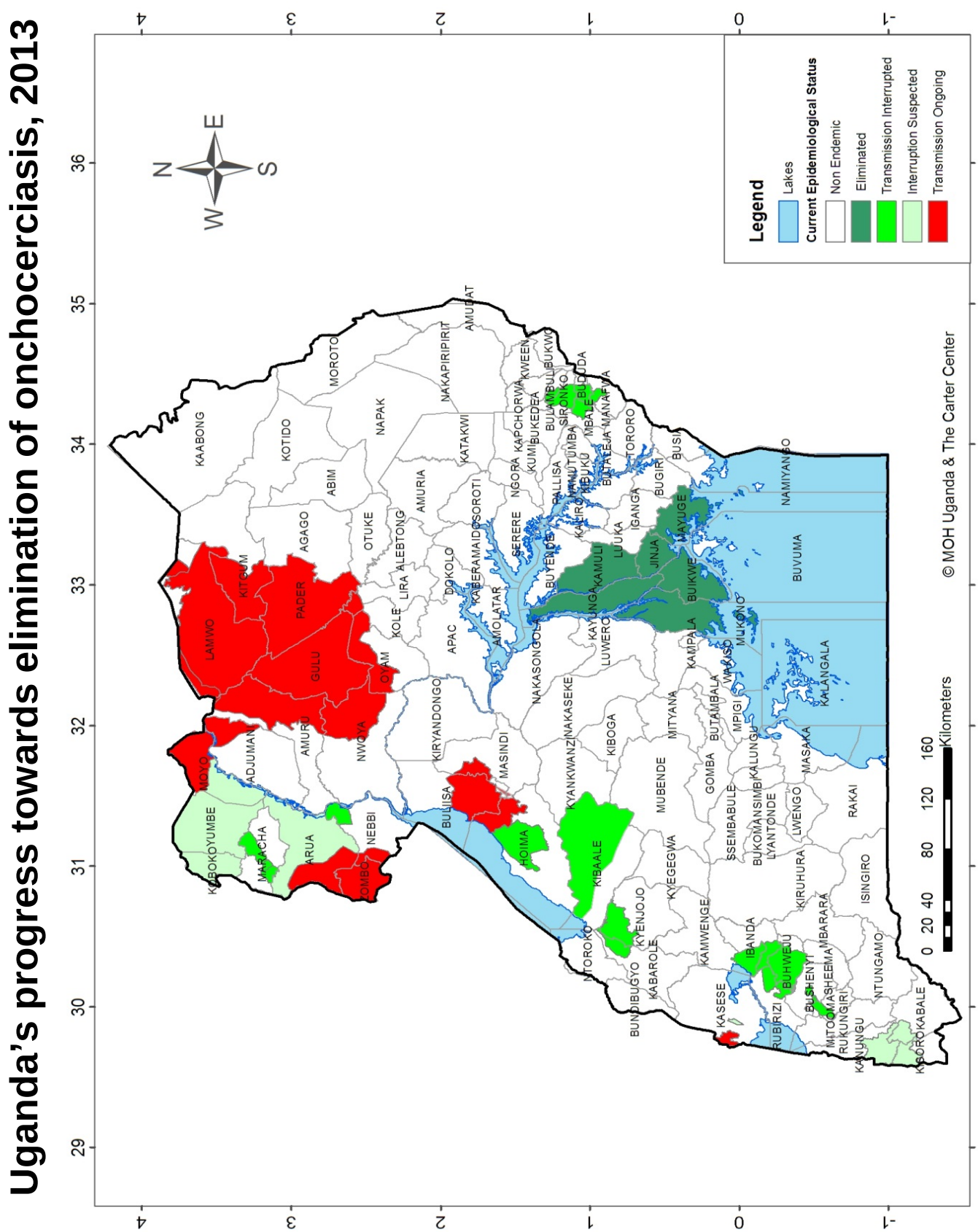
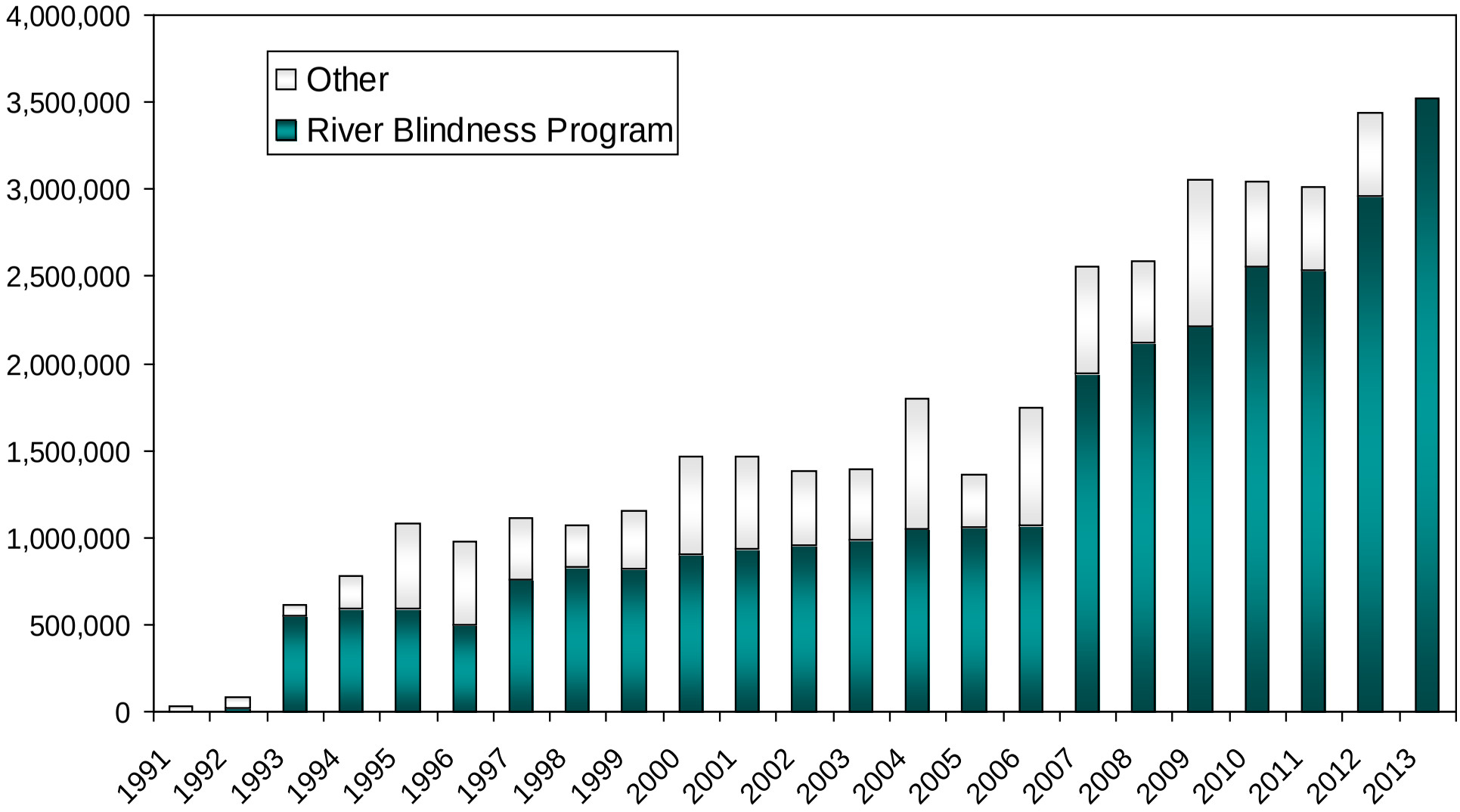

Uganda's progress towards elimination of onchocerciasis, 2013
Legend
Lakes
Current Epidemiological Status
Non Endemic
Eliminated
Transmission Interrupted
Interruption Suspected
Transmission Ongoing
N
S
E
W
0 20 40 80 120 160
Kilometers
© MOH Uganda & The Carter Center
KAABONG
KOTIDO
MOROTO
NAPAK
NAKAPIRIPIRIT
AMUDAT
ABIM
AGAGO
OTUKE
AMURIA
KATAKWI
KAPCHORWA
KWEEN
BUKWO
BUDUDA
BULAMBULI
SIRONKO
MBALE
MANAFWA
KITGUM
PADER
LAMWO
GULU
OYAM
KOLE
LIRA
ALEBTONG
DOKOLO
SOROTI
KUMI
BUKEDEA
PALLISA
KALIRO
KIBUKU
BUTALEJA
TORORO
BUSIA
BUGIRI
IGANGA
JINJA
MAYUGE
NAMIYANGO
BUVUMA
KAMULI
LUUKA
KAYUNGA
BUIKWE
MUKONO
KAMPALA
WAKISO
LUWERO
NAKASONGOLA
APAC
AMOLATAR
KABERAMAIDO
SERERE
NGORA
BUYENDE
MOYO
ADJUMANI
AMURU
NWOYA
KIRYANDONGO
MASINDI
BULISA
KIBOGA
NAKASEKE
KYANKWANZI
MITYANA
MUBENDE
BUTAMBALA
GOMBA
MPIGI
KALUNGU
KALANGALA
KOBOKOYUMBE
MARACHA
ARUA
NEBBI
KOMBO
HOIMA
KIBAALE
KYEGEGWA
SSEMBABULE
BUKOMANSIMBI
LYANTONDE
MASAKA
LWENGO
RAKAI
KYENJOJO
KABAROLE
KAMWENGE
IBANDA
KIRUHURA
ISINGIRO
BUNDIBUGYO
KASESE
RUBIRIZI
BUHWEJU
BUSHENYI
MBARARA
NTUNGAMO
MITOOMA
RUKUNGIRI
KANUNGU
KISORO
KABALE

Figure U2

Uganda: Carter Center-Assisted Treatments and Total Mectizan® RB Treatments Provided, 1991-2013



* Treatments in 1992-1995 assisted by River Blindness Foundation. National numbers are provisional and incomplete for 2013 figure.

Figure U3

Uganda: 2013 Treatment Coverage in Annual Treatment Areas

Name of of District	Total Population (Projection)	Population treated cumulative	Ultimate Tx Goal (UTG)	Total Population TX %	% Tx cov. of UTG	Active villages cumulative	Active villages UTG	Active villages % for UTG
Adjumani	156,340	97,374	130,866	62.3%	74.4%	206	206	100%
Kasese	130,071	103,261	108,242	79.4%	95.4%	131	131	100%
Moyo	125,135	100,650	101,832	80.4%	98.8%	225	225	100%
Total	**411,546**	**301,285**	**340,940**	**73.2%**	**88.4%**	**562**	**562**	**100%**

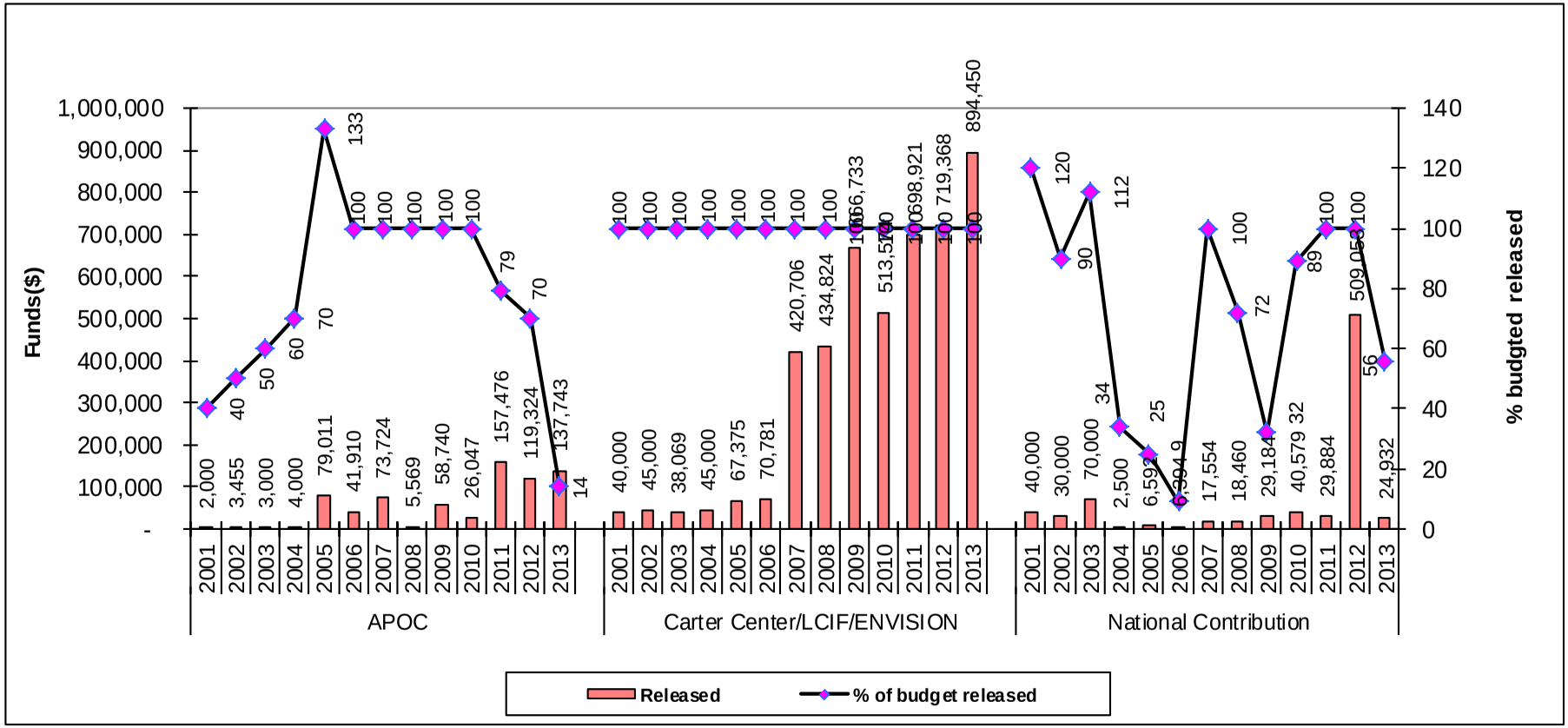
Figure U4

Uganda: 2013 Treatments Coverage in Semiannual Treatment Areas

Focus	Total Popn (Projection)	Population Treated		Population Treated Cumulative	UTG 1	UTG 2	% Coverage of UTG 1		% Coverage of UTG 2	Active Villages Cumulative		Active Villages UTG	Active Villages % UTG	
		Rd 1	Rd 2	Rds 1 & 2		Rds 1 & 2	Rd 1	Rd 2	Rds 1 & 2	Rd 1	Rd 2		Rd 1	Rd 2
Kashoya	209,275	164,619	165,357	329,976	172,166	344,332	96%	96%	96%	385	385	385	100%	100%
Bwindi	122,436	93,078	94,851	187,929	98,641	197,282	94%	96%	95%	208	208	208	100%	100%
Nyagak	540,018	407,745	419,039	826,784	447,728	895,456	91%	94%	92%	1,118	1,118	1,118	100%	100%
Wambabya	75,733	55,517	57,938	113,455	62,654	125,308	89%	92%	91%	70	70	70	100%	100%
Budongo	150,195	110,530	115,774	226,304	123,758	247,516	89%	94%	91%	184	184	184	100%	100%
Mid-North (post-conflict)	1,286,119	675,626	865,337	1,540,963	1,059,635	2,119,270	64%	82%	73%	1,659	1,739	1,788	93%	97%
TOTAL	**2,383,776**	**1,507,115**	**1,718,296**	**3,225,411**	**1,964,582**	**3,929,164**	**77%**	**87%**	**82%**	**3,624**	**3,704**	**3,753**	**97%**	**99%**

Figure U5

Uganda: Financial Contributions in US Dollars (2001-2013)



The APOC and government contributions are reported by our Carter Center country representatives based on their best possible determinations from information available in country through the National Onchocerciasis Task Force and other local sources. Capital equipment replacement provided by APOC and government salaries are not considered.

Figure U6

Uganda: Where Onchocerciasis has been interrupted or is suspected interrupted

ID No.	Focus	Vector	District	# MDA annual rounds	# of MDA semi annual rounds	Total Pop	Planned Annual Txs 2013	Planned Semi Annual Txs 2013	Status of Transmission
2	Wadelai	*S.neavei*	Nebbi	15	8	21,068	42,137		Interupted (2012)
4	Itwara	*S. neavei*	Kabarole	20	2	35,216	35,216		Interupted (2012)
			Kyenjojo	20	2	73,269	73,269		Interupted (2012)
5	Mt. Elgon	*S.neavei*	Manafwa	15	8	43,496	86,992		Interupted (2012)
			Mbale	15	8	53,832	107,665		Interupted (2012)
			Sironko	15	8	81,815	163,630		Interupted (2012)
			Bududa	15	8	173,142	346,284		Interupted (2012)
3	Mpamba-Nkusi	*S. neavei*	Kibale	17	8	203,859	407,719		Interupted (2013)
6	Imaramagambo	*S.neavei*	Bushenyi	18	0	109,458	109,458		Interupted (2013)
11	Maracha-Terego	*S.neavei/S.damnosum*	Maracha-Terego	19	0	182,469	182,469		Interupted (2013)
8	Wambabya-Rwamarongo	*S. neavei*	Hoima	16	13	75,733	125,308		Interrupted (2014)
7	Kashoya-Kitomi*	*S.neavei*	Buhweju	16	13	60,255		99,024	Interrupted (2014)
			Rubirizi	16	13	77,250		127,352	Interrupted (2014)
			Ibanda	16	13	26,144		43,610	Interrupted (2014)
			Kamwenge	18	13	45,626		74,346	Interrupted (2014)
15	Nyamugasani	*S. kilibanum*	Kasese	19	0	10,664	9,603		Interruption Suspected
10	Bwindi	*S.neavei/ S. damnosum*	Kabale	15	13	29,428		46,900	Interruption Suspected
			Kanungu	15	13	56,735		91,874	Interruption Suspected
			Kisoro	15	13	36,273		58,508	Interruption Suspected
13	Obongi / Moyo	*S.neavei/ S. damnosum*	Moyo	19	0	37,392	30,778		Interruption Suspected
17	West Nile	*S.neavei/ S. damnosum*	Yumbe	19	0	286,615	229,292		Interruption Suspected
			Koboko	19	0	167,076	133,661		Interruption Suspected
			Arua	19	0	138,063	134,696		Interruption Suspected

Light Green = Transmission Interrupted

Greyish Green = Interruption Suspected

SUDAN

Summary

Sudan has three known river blindness foci: Abu Hamad (River Nile state), Radom (South Darfur state), and Galabat (Gedarif state) (Figure S1). In 2013 the Abu Hamad focus 2013 was in its second year of post treatment surveillance (PTS). Health education to Abu Hamad communities was provided. A major evaluation is planned for 2014; if there is no disease recrudescence, onchocerciasis can be declared eliminated in Abu Hamad area. Mectizan^{R} treatments continued in the other two transmission zones of the country (Radom and Galabat).

Background:

In December 2006, the Government of Sudan (GOS) changed its onchocerciasis goals from control to elimination, concentrating initially on the isolated desert focus of Abu Hamad in River Nile state and then in Galabat in Gedarif State in 2011 (Figure S2). The RBEP, with Lions SightFirst support, has principally worked on these elimination efforts in Abu Hamad and Galabat foci. Successful interruption of transmission was declared in Abu Hamad in 2012, and semi-annual treatment with Mectizan® ceased. Semi-annual treatment continues in Galabat.

The strategy in Radom focus of South Darfur remains a control strategy, as the area still experiences insecurity. The disease's geographical reach and the total affected population has never been determined since insecurity prevents mapping from being carried out safely (Figure S1).

Treatments: A total of 285,050 treatments were delivered by the Sudan program in 2013 in Galabat and Radom. In Galabat focus (which includes an area called Ghorisha), 133,626 treatments were given in round one (131% treatment coverage), and 130,227 in round two (127% coverage). Treatment of more than 100% relates to the influx of farm labor from outside the area during the treatment periods. In Radom, 21,197 annual treatments were delivered. Due to civil conflict, a proper census of the affected population in Radom has not been performed to date, so an ultimate treatment goal cannot be determined. Accordingly, an annual treatment objective (ATO) based on the Mectizan® drug order request is used as the denominator. Details of treatments are provided in Figure S3.

Training and Health Education: During 2013, the program trained a total of 1,143 community-directed distributors (CDDs) of whom 41% were female. This is 44% more CDDs more than were trained during 2012 (792). All trained CDDs were from Galabat focus (Figure S4).

Mectizan®: During 2013, 644,000 tablets were distributed in the Galabat and Radom foci with an average of 2.3 tablets per person (the tablet ratio per treatment is low due to many children in the program). No severe adverse effects were reported. The program

began in 2013 with a balance of 594,000 tablets.

Sustainability and Integration: In late 2007, the program began focusing on involving kinship/family groups in all foci in mobilization and health education, selection and training of CDDs, and distribution of Mectizan®. This policy has improved training figures and has reportedly also reduced demand for monetary incentives.

2014 RECOMMENDATIONS FOR THE CARTER CENTER RBEP, SUDAN

Abu Hamad

Assist post-treatment surveillance evaluations in Abu Hamad in FY15 (September 1, 2014-August 31, 2015).

Galabat Focus in Gedarif State

Conduct surveys on the border of Ethiopia (in Metema) and Sudan (in Galabat) in order to ascertain if cross-border transmission of river blindness occurs.

General

Encourage WHO/APOC and the concerned Ministries of Health to evaluate and treat cross-border foci in a coordinated manner; this especially relates to the Metema Galabat area.

Submit drug applications to WHO and MDP as early as possible, and no later than August of the year before the drug is needed. Work with federal agencies to facilitate appropriate documentation and clearance for all medications. Because drug requests are made well before treatment activities are done, treatment denominators will require adjustment during the treatment year. Keep Carter Center headquarters copied on all related correspondence.

Seek to increase training, supervision, involvement of kinship groups, and gender balance among CDDs and community supervisors. Work toward a target ratio of at least 1 CDD: 100 people and 1 community supervisor: 5 CDDs.

Treatment Objective for onchocerciasis for 2014:
Semiannual UTG(2): 246,179
Annual UTG: 22,055

Figure S1

Map of Sudan Onchocerciasis Program Areas

Figure S2

Sudan: Number of Carter Center-assisted Mectizan® treatments delivered from 2007 to 2013 in Galabat focus, Gedarif State

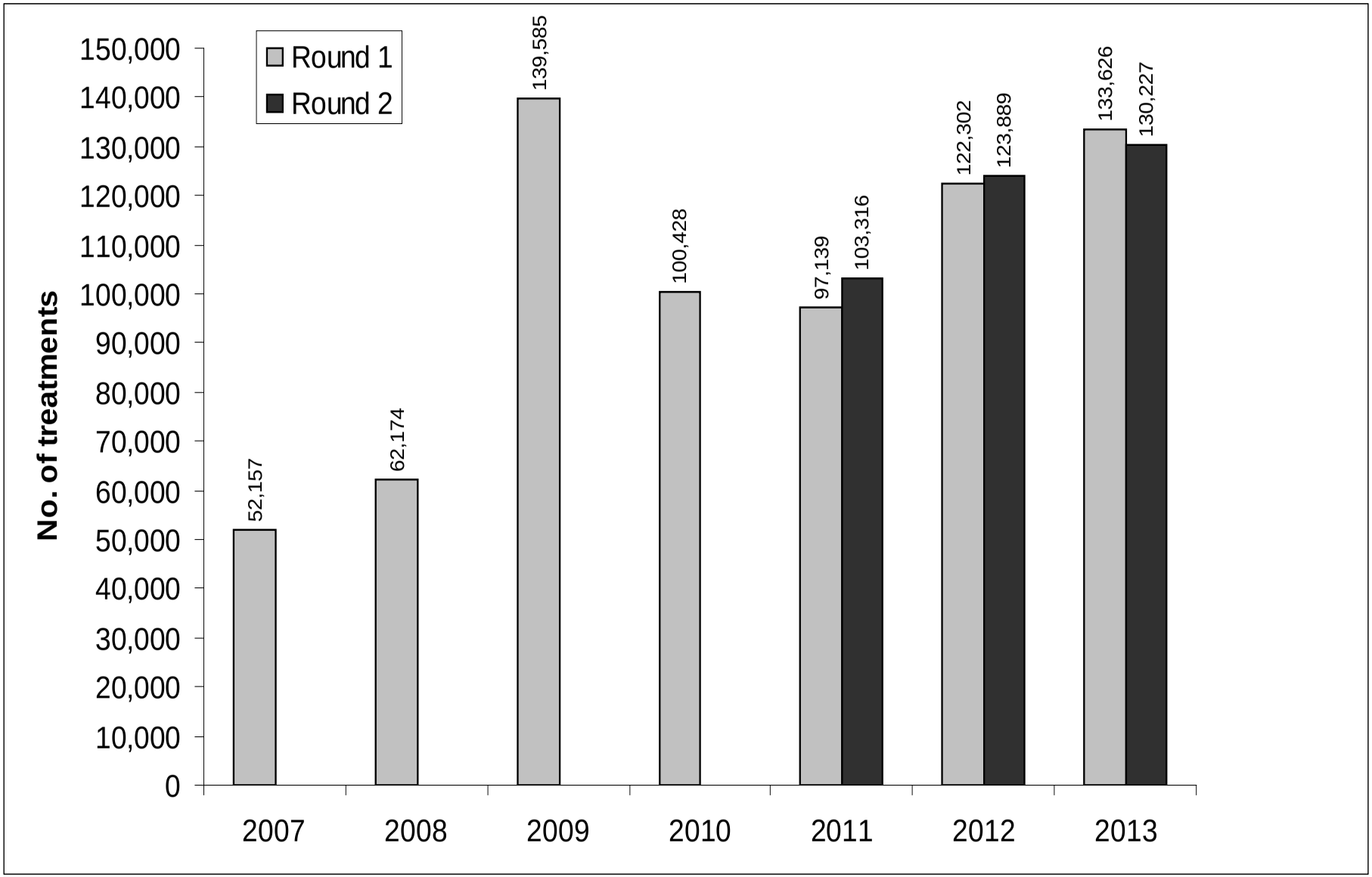


Figure S3

Sudan: 2013 Treatment Coverage

Strategy	State	Focus	Total Population	UTG 1	Treated in Round 1	% UTG Treated Round 1	Treated in Round 2	% UTG Treated Round 2	Total Treatments	Total Treatment Target	% UTG 2	Active Villages Treated 2013
Elimination	Gedarif	Galabat	77,270	65,680	87,234	133%	84,529	129%	171,763	131,360	131%	130
		Galabat (Ghorisha)	43,236	36,751	46,392	126%	45,698	124%	92,090	73,502	125%	23
	Subtotal		120,506	102,431	133,626	130%	130,227	127%	263,853	204,862	129%	153
Control	Southern Darfur	Radom	23,203	19,723	21,160	107%	-	0%	21,160	19,723	0%	19
	Passive		-	-	37	0%	-	0%	37	-	0%	0
	Subtotal		23,203	19,723	21,197	107%	-	0%	21,197	19,723	107%	19
	Grand Total		**143,709**	**122,154**	**154,823**	**127%**	**130,227**	**107%**	**285,050**	**224,585**	**127%**	**172**

Note: Treatment Coverage exceeds 100% due to influx of people from outside the area.

Figure S4

Number of CDDs Trained in Galabat Focus by Gender

Trained in 2012 and 2013

Galabat focus	2012					2013				
	Total CDDs	Male CDDs	% Male	Female CDDs	% Female	Total CDDs	Male CDDs	% Male	Female CDDs	% Female
Galabat	554	292	52.7	262	47.3	824	510	61.9	314	38.1
Ghorisha	238	137	57.6	101	42.4	319	170	53.3	149	46.7
Total	**792**	**429**	**54.2**	**363**	**45.8**	**1143**	**680**	**59.5**	**463**	**40.5**

NIGERIA

Summary

In 2013, 6,596,039 Mectizan® mass treatments (with health education) for onchocerciasis were distributed in Nigeria with assistance from the Carter Center's (TCC's) River Blindness Elimination Program (RBEP) (Figures N1 and N2). Also in 2013, the Federal Ministry of Health (FMOH) of Nigeria released a new master plan for neglected tropical diseases (NTDs) that included a new national policy of onchocerciasis elimination by 2020. Under this new plan, RBEP will seek to play an expanded role in elimination activities related to river blindness (RB) in the 9 states it assists in Nigeria: Abia, Anambra, Delta, Ebonyi, Edo, Enugu, Imo, Nasarawa, and Plateau (Figure N1). In 2013, more than 3 million treatments for Lymphatic Filariasis (LF) were stopped in Plateau and Nasarawa after the two states passed transmission assessments surveys (TAS) in 2012. The same year, TCC assisted in providing 2,173,411 praziquantel treatments (with health education) for schistosomiasis in the four assisted states (Delta, Edo, Nasarawa and Plateau). A limited number of STH treatments with albendazole were possible in both Plateau and Nasarawa, resulting in a total of 721,989 treatments with albendazole. TCC will take advantage of its new partnership with the USAID's ENVISION project led by RTI International program to expand the fight against NTDs, and especially to help eliminate LF in the southeast [Abia, Anambra, Delta, Ebonyi, Edo, Enugu, and Imo are collectively referred to in this document as 'southeast']. A major mapping exercise completed in 2013 resulted in the establishment of ambitious treatment goals for LF, schistosomiasis and soil transmitted helminthiasis (STH) for 2014. The Center has worked closely with the FMOH in efforts to coordinate LF and malaria activities, co-sponsoring a national meeting on LF and malaria integration in 2012. In June 2013, the FMOH released Guidelines for Malaria-LF co-implementation, formally outlining their goals of coordinating these efforts. Support from GSK is helping to coordinate malaria and LF co-implementation through a 2013-16 grant that focuses on Plateau state.

Background: Nigeria is the most endemic country in the world for onchocerciasis, with as much as 40% of the global population at risk. The National Onchocerciasis Control Program (NOCP) is the largest Mectizan® distribution program in the world, reporting between 20-35 million treatments per year (Figure N2). Annual treatments assisted by TCC typically represent 20-30% of the total treatments in Nigeria.

RBEP in Nigeria is headquartered in Jos, Plateau state, with supporting sub-offices in Benin City, Enugu, Lagos, and Owerri. TCC RBEP enjoyed LCIF support from 1999 to 2008, and core APOC support from 2000 to 2005. It also enjoys support from the Sir Emeka Offor Foundation starting in 2013.

Treatments: In 2013, the TCC-assisted RBEP program in Nigeria provided health education and Mectizan® treatments to 6,596,039 persons (Figure N3), 98% of the UTG.

TCC's Nigeria program had approximately 18.1 million Mectizan® tablets available for 2013, and the average number of Mectizan® tablets per person treated was 2.8. There were 229,058 Mectizan® tablets remaining at the end of 2013.

No severe adverse events (SAEs) were reported as a result of Mectizan® treatments in RBEP-assisted states in Nigeria in 2013. Particularly close monitoring for adverse reactions is carried out in the southeast because of the presence of *Loa loa* in that part of the country. *Loa loa* parasites release large numbers of microfilariae into the blood stream that are killed by Mectizan®. Death of *Loa loa* microfilariae after treatment can, in rare cases, provoke SAEs.

TCC-assisted treatments for LF, schistosomiasis and STH are discussed in the Integrated Programs sections that follow.

Training and Health Education: In the 9 states assisted by TCC there were 96,782 professional and lay health personnel involved in Mectizan® distribution in 2013: 71,883 CDDs; 16,680 community supervisors; and 8,219 health workers. Training or retraining was conducted for 58,545 CDDs; 9,878 supervisors; and 8,219 health workers. The ratio of CDDs to population was 1 CDD per 117, slightly exceeding the goal of 1:100. Just over 59% of CDDs were female. Supervision of CDDs in the southeast has been challenging, and more CSs are needed if CDD numbers are to be further expanded. Overall in the program, each CS oversees approximately 6 CDDs (ratio of 1:4).

Financial Contribution: TCC-assisted RBEP in Nigeria received APOC core funding from 1998-2003. Since then, funding was received through special APOC initiatives (Figure N4). In addition, GSK provided financial support for LF in Nigeria starting in 1998 and continuing through their current grant (2013-16) that aims to increase LLIN ownership and use in Plateau state. The Nigeria RBEP-assisted areas have had chronically insufficient government contributions at national, state and local levels. The increase in funding by TCC (2008-10) was due to two grants from the Bill & Melinda Gates Foundation (BMGF) to RBEP for integrated NTD research ("Proof of Concept for Integrated Health Interventions in Nigeria" and "*Loa loa* Paralyzes LF MDA in Central Africa: Integration of LF and Malaria Programs Can Resurrect a Continental Initiative"). These grants (and their research associated field costs) ended in 2011, with an associated decrease in TCC funding to the program. In 2013, a generous grant from the USAID's ENVISION project led by RTI International USAID's ENVISION project led by RTI International helped to support the RBEP in all nine TCC-assisted states, plus mass drug administration (MDA) for schistosomiasis and STH in Plateau and Nasarawa. In addition, this funding also supported surveys in all 9 states where NTD mapping had not previously been done.

Monetary community-level support for the program in 2013 declined compared to 2012: 3,983 villages (1,740 from the southeast and 2,243 from Plateau and Nasarawa or 48.8% of all at-risk villages receiving mass RB treatment) supported their CDDs with direct monetary support. Total village-level contributions equaled approximately 3.5 million Naira (21,217 USD at 163 Naira to the dollar). This contribution was a 53%

decrease from 2012 village level contributions, and averaged to 2.43 USD/CDD/year in those villages that supported their CDDs (average 3.64 USD in the southeast and 1.27 USD in Plateau and Nasarawa).

There were no local government area (LGA)-level or state contributions in Plateau or Nasarawa in 2013. In the southeast states, LGA and state contributions declined again. LGA contributions totaled approximately 1.55 million Naira (9,509 USD), a 55% decrease from 2012. State-level contributions were only provided only in Delta state and totaled approximately 110,000 Naira (675 USD). Government monetary contributions described here do not include the core salary costs of the Ministry of Health (MOH) personnel working in the program.

The Integrated Programs in Nigeria: TCC-assisted program in Nigeria pioneered the concept of integrated mass treatment for RB, LF and schistosomiasis in which the logistics of a MDA program are shared across several programs. The integrated program began in 1999 with integrated RB and urinary schistosomiasis interventions, expanding to include LF MDA in 2000, trachoma in 2001, and malaria in 2003. Background information on RB, LF and schistosomiasis is provided in Annex 6. The central platform of the integrated program was an infrastructure and logistical system to deliver annual community-based mass Mectizan® and albendazole treatment for LF to all at risk in the Plateau and Nasarawa area. The effort demonstrated a dramatic and effective intervention coverage scale-up of statewide interventions for schistosomiasis (in 2008), trachoma (in 2010), and malaria (in 2010). The LF treatment combination also is highly effective against several soil transmitted helminths (STH). The Gates Foundation grant ("Proof of Concept for Integrated Health Intervention in Nigeria") demonstrated that integration results in broader services, lower costs, and higher efficiency among disease programs that use similar strategies. In particular, where needed, praziquantel treatments given simultaneously with LF as 'triple drug administration' (ivermectin, albendazole, and praziquantel) are safe, and have enormous savings (40%) compared with giving two separate treatment rounds (ivermectin and albendazole separated from praziquantel) (Evans et al. 2011).

Lymphatic Filariasis: The goal of the LF program in Plateau and Nasarawa states is to demonstrate that LF transmission can be interrupted with annual combination MDA consisting of Mectizan® and albendazole, with health education in a highly endemic area of tropical Africa. An in-depth history of the effort was published by Richards et al. (2011). When the program began, LF was widespread in Plateau and Nasarawa states, and mass treatment and health education was required in all cities and villages in the 30 LGAs. MDA started in 2000 and achieved scale in 2003 (Figure N6). In 2008, a survey for LF prevalence in the 30 LGAs comprising the 2-state area showed that 10 LGAs had achieved the elimination threshold (based on LF antigenemia prevalence) (King et al. 2012). Five of those LGAs were onchocerciasis-endemic, and treatment for that condition continued; in the other five LGAs MDA for LF was halted. In 2012, using the newly released WHO Treatment Assessment Survey (TAS), TCC and its MOH partners conducted LF antigenemia testing in children ages 6-7 years in four Evaluation Units (EU), using school-based cluster surveys drawn from the remaining 20 LGAs in Plateau

and Nasarawa. A total of 7,131 children were tested in 173 schools: approximately 43 schools per EU; only 24 children were positive (8, 3, 10 and 3 in EUs1-4, respectively). The results of this survey showed that transmission of LF had been interrupted. The FMOH declared that MDA for LF could be halted and, in 2012, the last treatments for LF were given and, in 2013, a period of post treatment surveillance started.

In 2014, plans for a re-evaluation of the five LGAs identified in 2008 as eligible for stopping LF MDA are planned. In addition, with proposed support from the USAID's ENVISION project led by RTI International USAID's ENVISION project led by RTI International, an expansion of LF MDA is planned. The program will begin scaling up to achieve full coverage of the seven TCC-assisted states in the southeast by 2015. In 2014, this will be a 72% increase in LF treatments over 2012 (Figure N6).

Fighting Malaria and Lymphatic Filariasis with LLIN: In Nigeria, LF is transmitted by *Anopheles* mosquitoes, the same mosquito that transmits malaria. LLINs are one of the most important prevention tools for malaria and also are useful as an adjunct to MDA in the LF elimination program. Between 2009 and 2013, all nine TCC-supported states received LLINs as part of the nationwide mass distribution of nets that aimed to provide two nets to every household. TCC has assisted with the distribution of 9.5 million LLINs in Nigeria since 2004.

In Plateau and Nasarawa, rates of LF infected mosquitoes have been determined by dissection since the launching of the program (Richards 2011). By the end of 2011, the year after LLINs had been distributed; the number of infected mosquitoes fell to 0% for the first time ever. It is very likely that the effect of the LLINs was synergistic with MDA and helped to interrupt LF transmission completely. Similar results have been seen in the southeast as the key measurement outcome of the BMGF funded study "*Loa loa* Paralyzes LF MDA in Central Africa: Integration of LF and Malaria Programs Can Resurrect a Continental initiative" The results of this study have been published (Richards et al., *American Journal of Tropical Medicine and Hygiene* 2013)

TCC cosponsored a national meeting for malaria and LF in Abuja (March 27-28, 2012) together with the FMOH. The purpose of the meeting was to explore opportunities for co-implemented programs to address both malaria and LF, focusing on areas of programmatic synergy. This meeting was fundamental in formalizing the FMOH policy for LF and malaria coimplementation, the guidelines for which were published in 2013.

GSK is supporting a three-year grant to the malaria and LF program in Plateau state, Nigeria. The project aim to increase both LLIN ownership and use in Plateau state in order to maximize the potential effects of LLIN distribution on malaria transmission and to prevent recrudescence of LF.

Schistosomiasis/STH Control:

TCC assists schistosomiasis control in four states (Plateau, Nasarawa, Edo and Delta) and, in 2013, 2,173,411 praziquantel treatments were provided. TCC continued to enjoy support for schistosomiasis work from the Izumi Foundation in Edo and Delta states and the USAID's ENVISION project led by RTI International in Plateau and Nasarawa. The majority of the praziquantel used was donated through the World Health Organization (WHO) by Merck KGaA (E-Merck), Germany. A total of 1,698,595 treatments were given in Plateau and Nasarawa, 90% of the treatment goal (Figure N7) and a total of 474,816 treatments were given in Edo and Delta, exceeding the annual treatment objective (ATO) of 416,610 by nearly 14%. This has been attributed to migration.

Between 2009 and 2012, TDA processes were used to deliver 80% or more of TCC assisted praziquantel treatments in Nigeria. TDA did not take place in 2013 since albendazole treatments were stopped in Plateau and Nasarawa states due to the successful termination of LF MDA. Praziquantel was provided with Mectizan® in an integrated schistosomiasis RB MDA program.

In Plateau and Nasarawa states, where treatment is provided for both intestinal and urinary schistosomiasis, treatment was offered to all school-aged children. In Edo and Delta states, where only urinary schistosomiasis was targeted in 2013, adults and children were treated in communities with urinary schistosomiasis prevalence greater than 50%, and school children alone were targeted where prevalence exceeded 10%, in accordance with WHO guidelines.

In 2013, with support from the USAID's ENVISION project led by RTI International, surveys for both urinary and intestinal schistosomiasis, as well as STH, were conducted in all TCC-assisted states. Over 100,000 fecal and urine specimens were examined during these surveys. Preliminary results showed that schistosomiasis prevalence was over the MDA treatment thresholds in 6 of the 9 TCC assisted states and STH required MDA programs in every TCC assisted state (Frontispiece Figure J). Based on these results, TCC was able to secure sufficient albendazole from the FMOH to treat 721,989 children for STH in Plateau and Nasarawa.

In 2014, 2.3 million treatments for schistosomiasis are projected for Ebonyi, Enugu, Plateau, and Nasarawa states, thanks to the generous support from the Izumi Foundation and the USAID's ENVISION project led by RTI International (Figure N7). In a dramatic scale up, TCC has proposed to USAID/RTI ENVISION to support 8.6 million STH treatments in 2014 (Figure N8).

2014 RECOMMENDATIONS FOR THE CARTER CENTER RBEP, NIGERIA

Scale up capacity of Jos lab to serve as a national NTD support lab.

Complete “community census” to ensure that all existing communities are known in the states we support.

Lymphatic Filariasis/Malaria:
New LF MAL FMOH guidelines: Work to scale up and operationalize guidelines in TCC assisted areas, especially with regard to LLIN use, care and resupply.

Complete LF PTS in five LGAs in Plateau and Nasarawa where MDA was halted in 2009 and that were not assessed during the 2012 TAS.

Help scale up LF MDA in SE Nigeria as resources permit, using guidelines appropriate for *Loa loa* areas.

Onchocerciasis:
Work with federal and state ministries of health in defining and implementing standards for elimination of RB. Encourage FMOH to form an onchocerciasis elimination committee.

Ask the onchocerciasis elimination committee, or other responsible FMOH body, to convene a meeting to discuss what additional information is needed to allow stopping MDA for RB in Plateau and Nasarawa. If necessary, collect such additional information in 2014. Publish results from 2009 surveys as soon as possible.

Launch twice per year treatment on the Edo-Ondo border in 2014.

Seek required funding to augment onchocerciasis activities in the seven states assisted in the southeast.

Determine and map the limits of onchocerciasis in all hypoendemic LGAs. Map *Loa loa* in untreated LGAs using the blood smears to confirm RAPLOA results to determine where Mectizan MDA can be administered for hypoendemic onchocerciasis or for LF. Determine where onchocerciasis transmission is active through PCR testing of black fly vectors (deployment of new black fly traps) and OV16 surveys.

Schistosomiasis/STH:
Produce final report for the USAID/RTI ENVISION -supported integrated mapping for schisto, STH, trachoma, and *L. loa,* which took place in TCC assisted states in 2013.

Assist in providing praziquantel and albendazole to school-age children based on mapping results and WHO guidelines, where resources permit. Work with FMOH to operationalize the WHO guidelines.

General

Encourage FMOH, WHO/APOC and partner NGDOs to evaluate and treat state cross border foci in a coordinated manner. This is especially important in Plateau, Nasarawa and Edo states in 2014.

Undertake treatment coverage questionnaire surveys that provide 95% confidence intervals. The surveys could be based on either USAID/RTI ENVISION or trachoma coverage survey models.

Submit drug applications to WHO and MDP as early as possible, and no later than August of the year before the drug is needed. This is especially important as TCC/RBEP moves to twice per year treatments in many assisted areas. Work with federal agencies to facilitate appropriate documentation and clearance for all medications. Because drug requests are made well before treatment activities are done, treatment denominators will require adjustment during the treatment year. Keep headquarters copied on all related correspondence.

Seek to increase training, supervision, involvement of kinship groups, and gender balance among CDDs and community supervisors. Work toward a target ratio of at least 1 CDD: 100 people and 1 community supervisor: 5 CDDs.

Through national mechanisms, monitor government and partner financial contributions for elimination efforts in RBEP-assisted areas.

Seek more Lions participation to help maintain program visibility and support wherever possible.

TCC program staff must complete or renew the Emory IRB certification if they are to be involved with research programs.

Plateau and Nasarawa States 2014 Objectives:

Treatment Objectives:

River Blindness:	**1,817,362**
Schistosomiasis:	**1,720,089**
STH:	**1,720,089**

Training Objectives:

River Blindness:	
CDDs:	**7,950**
Community Supervisors:	**768**
Health Workers:	**429**

Schistosomiasis and Soil Transmitted Helminths:

CDDs:	**15,301**
Community Supervisors:	**1,920**
Health Workers:	**1,062**
Teachers:	**1,831**

Southeast States 2014 Objectives:

Treatments Objectives:

River Blindness UTG:	**5,749,468**
LF UTG:	**11,311,894**
STH UTG:	**6,970,583**
Schistosomiasis:	**1,190,027**

River Blindness:

CDDs:	**66,543**
Community Supervisors:	**15,948**
Health Workers:	**8,255**
Teachers:	**16,637**

Lymphatic Filariasis:

CDDs:	**29,546**
Community Supervisors:	**7,087**
Health Workers:	**4,130**

Schistosomiasis:

CDDs:	**16,369**
Community Supervisors:	**6,543**
Health Workers:	**1,543**

Soil Transmitted Helminths

CDDs:	**26,637**
Community Supervisors:	**7,489**
Health Workers:	**3,872**

Figure N1

Nigeria: Carter Center-Assisted States

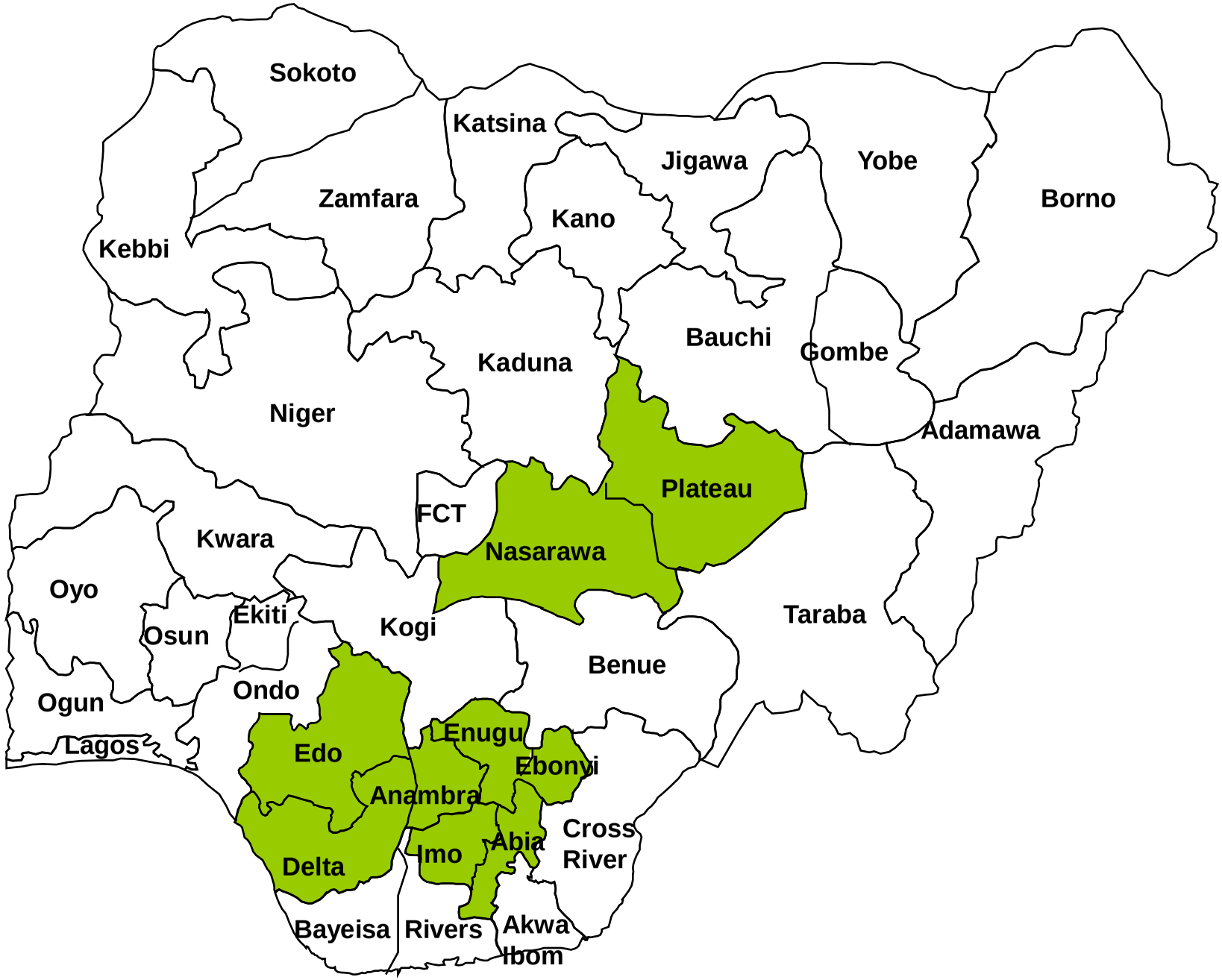
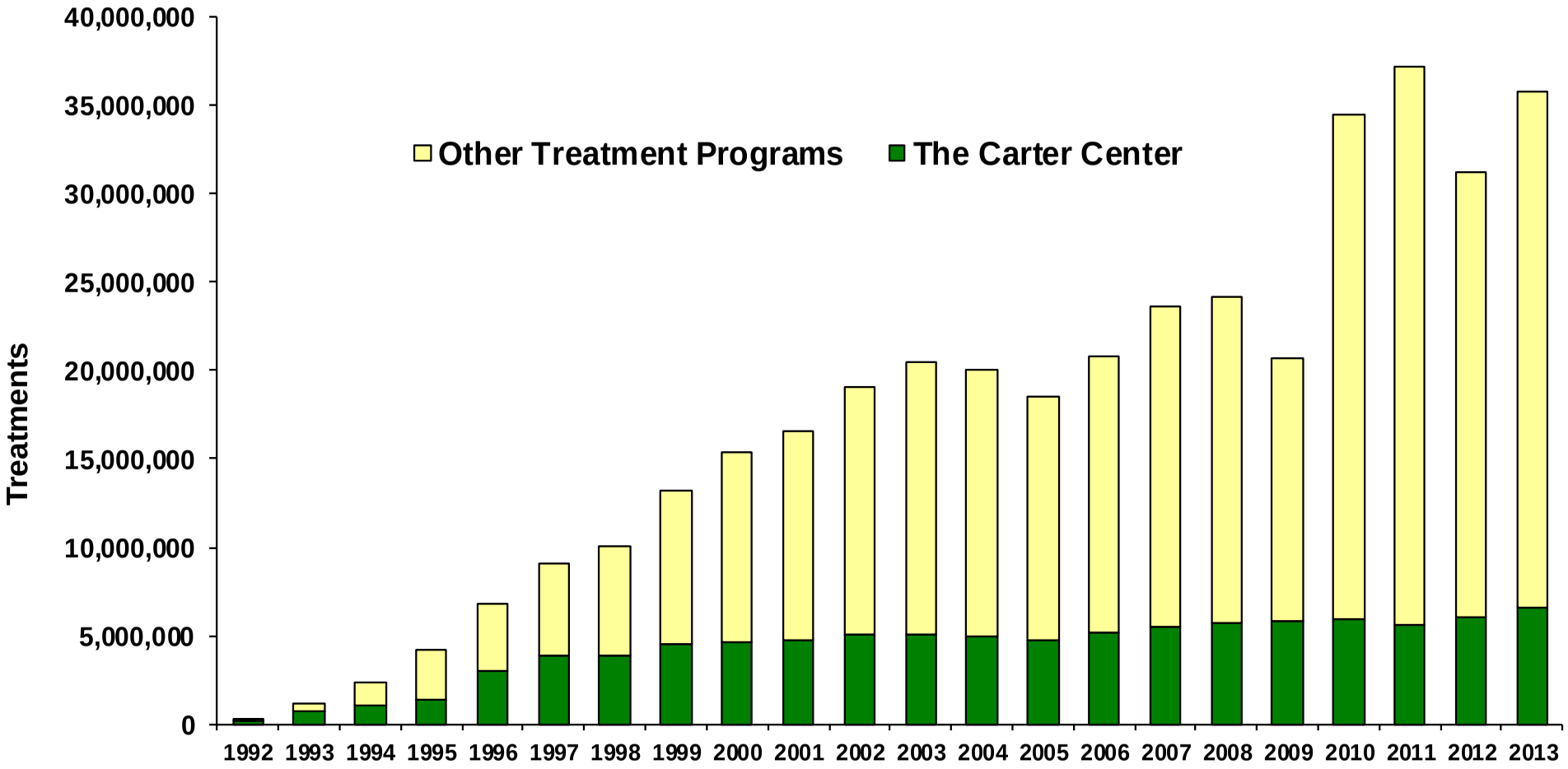


Figure N2

Nigeria: Carter Center-Assisted Treatments and Total Mectizan® Treatments Provided 1992-2013*



* Treatments in TCC areas from 1992-1995 were assisted by RBF. The 2013 national figure is provisional.

Figure N3

Nigeria: Carter Center-Assisted Areas
2013 River Blindness Mass Treatments*

Name of State	No. of LGAs	Popn treated cumulative	Ultimate TX Goal (UTG)	% UTG treated	Total Popn	% of total popn treated	Active villages cumulative	Active villages UTG/ATO	Active villages % for UTG
ENUGU	17	856,166	847,940	101%	1,051,446	81%	1,410	1,410	100%
ANAMBRA	16	630,511	628,351	100%	779,155	81%	1,062	1,062	100%
EBONYI	10	529,293	528,239	100%	655,016	81%	973	973	100%
EDO	12	1,145,785	1,123,594	102%	1,393,257	82%	824	824	100%
DELTA	9	529,472	531,931	100%	659,594	80%	470	470	100%
IMO	18	751,301	752,741	100%	933,399	80%	1,853	1,853	100%
ABIA	12	426,718	439,570	97%	545,067	78%	684	684	100%
PLATEAU	5	631,269	769,979	82%	952,474	66%	292	296	99%
NASARAWA	7	1,095,524	1,097,525	100%	1,371,906	80%	589	589	100%
TOTAL	**106**	**6,596,039**	**6,719,870**	**98%**	**8,341,314**	**79%**	**8,157**	**8,161**	**100%**

* There were no passive treatments reported in 2013.

Figure N4

Nigeria: 2013 Soil Transmitted Helminthiasis and Schistosomiasis Treatments

Soil Transmitted Helminthiasis

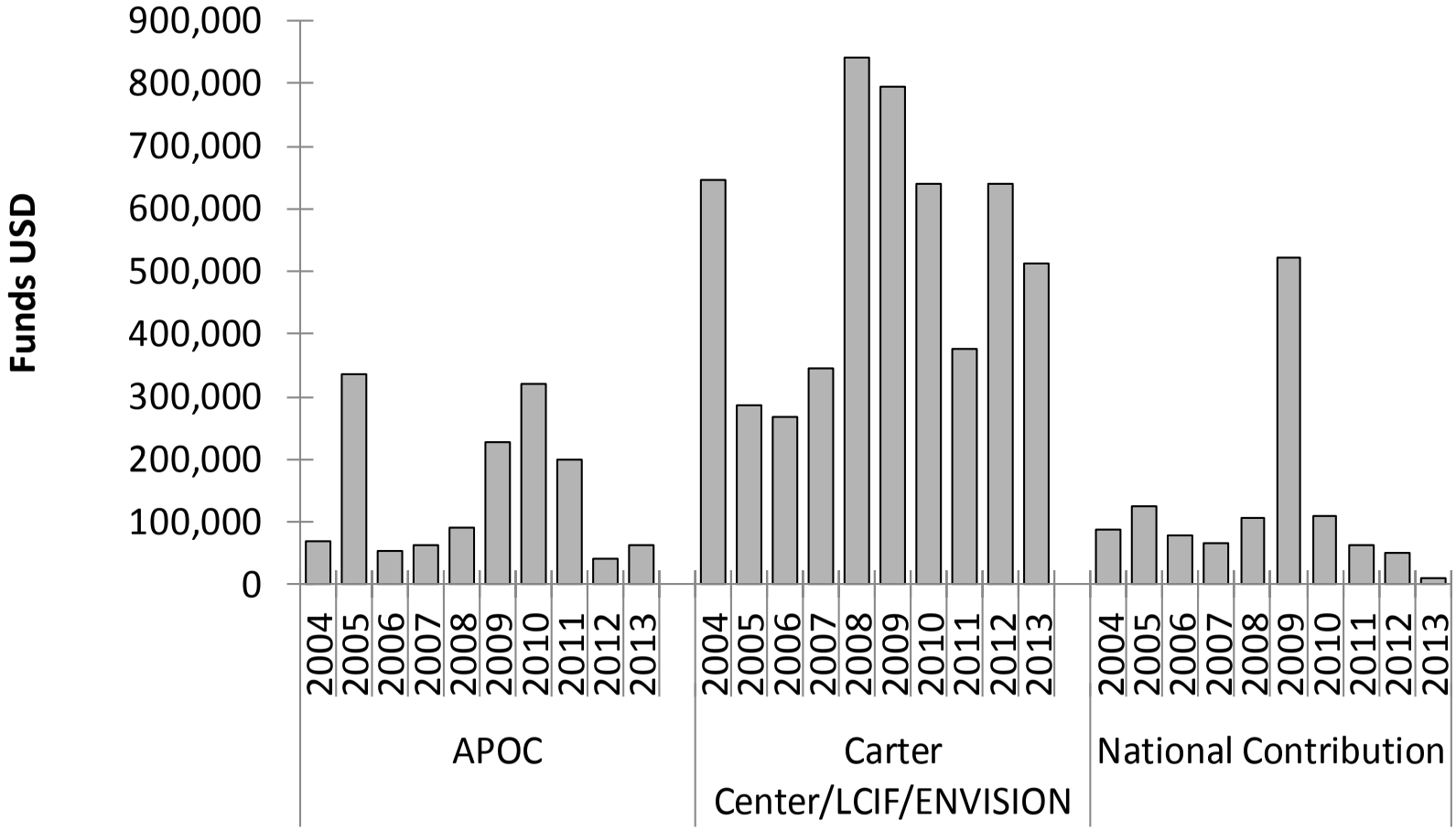
Name of State	No. of Local Gov't Areas (LGAs)	Popn treated cumulative	Annual Treatment Objective (ATO)/UTG	%ATO/UTG Treated	Cumulative Villages Treated	Villages UTG	Villages % of UTG
Plateau	3	240,239	261,735	92%	614	637	96%
Nasarawa	8	481,750	530,665	91%	704	718	98%
Total	**11**	**721,989**	**792,400**	**91%**	**1,318**	**1,355**	**97%**

Schistosomiasis Treatments

State	No. of Local Gov't Areas (LGAs)	Popn treated cumulative	Annual Treatment Objective (ATO)/UTG	%ATO/UTG Treated	Cumulative Villages Treated	Villages UTG	Villages % of UTG
Edo	12	226,003	197,685	114%	117	117	100%
Delta	9	248,813	218,925	114%	180	180	100%
Plateau	17	1,090,544	1,187,830	92%	2,565	2,577	100%
Nasarawa	13	608,051	696,891	87%	1,050	1,061	99%
Total	**51**	**2,173,411**	**2,301,331**	**94%**	**3,912**	**3,935**	**99%**

Figure N5

Financial Contribution by Individual Partners in US Dollars (2004-2013)



The APOC and government contributions are reported by our Carter Center country representatives based on their best possible determinations from information available in country through the National Onchocerciasis Task Force and other local sources. Capital equipment replacement provided by APOC and government salaries are not considered.

Figure N6

Nigeria: Scale-Up of Lymphatic Filariasis Treatments Integrated with River Blindness Treatments, and 2014 goal

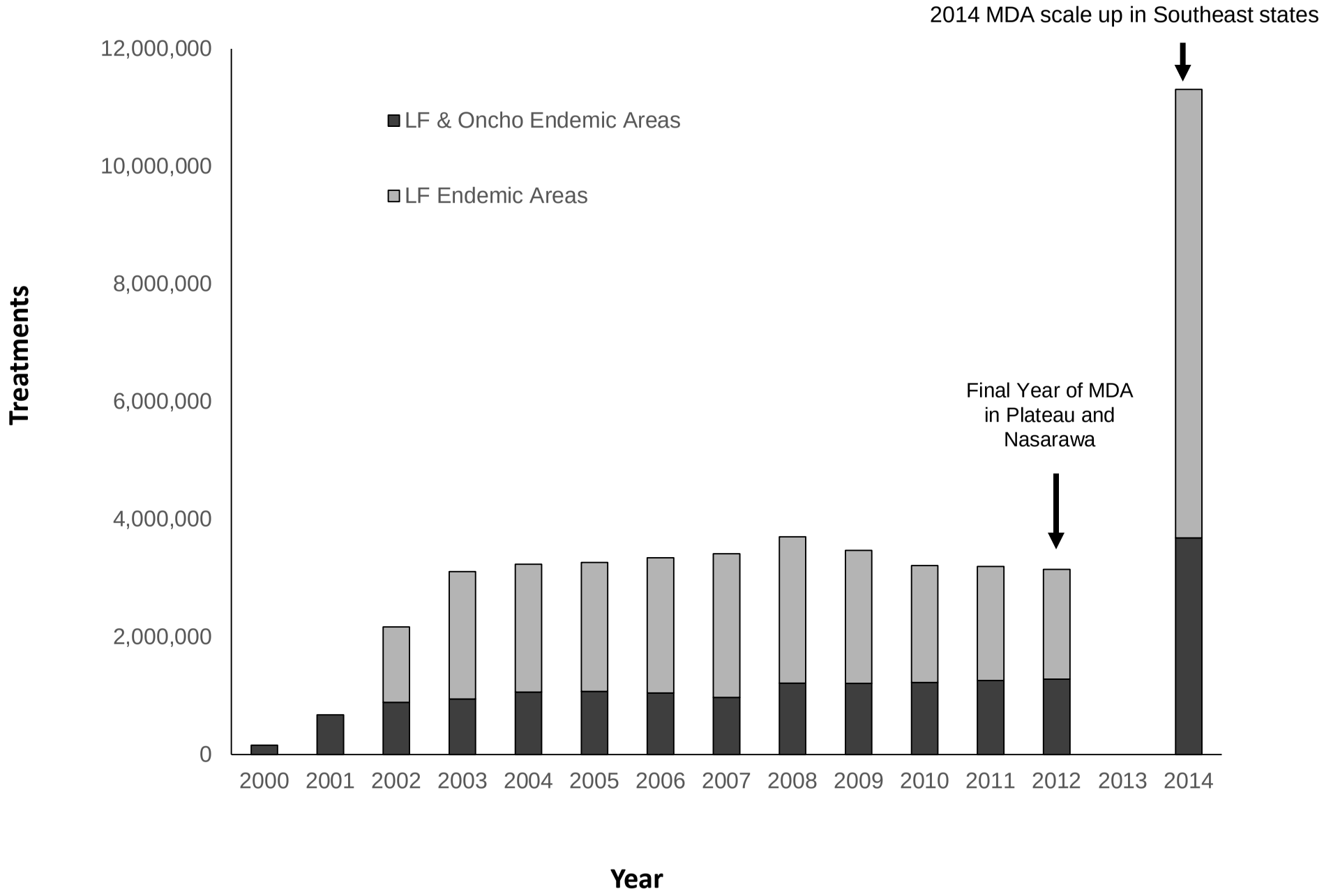


Figure N7

Scale up of Schistosomiasis Treatments in Nigeria, and 2014 goal

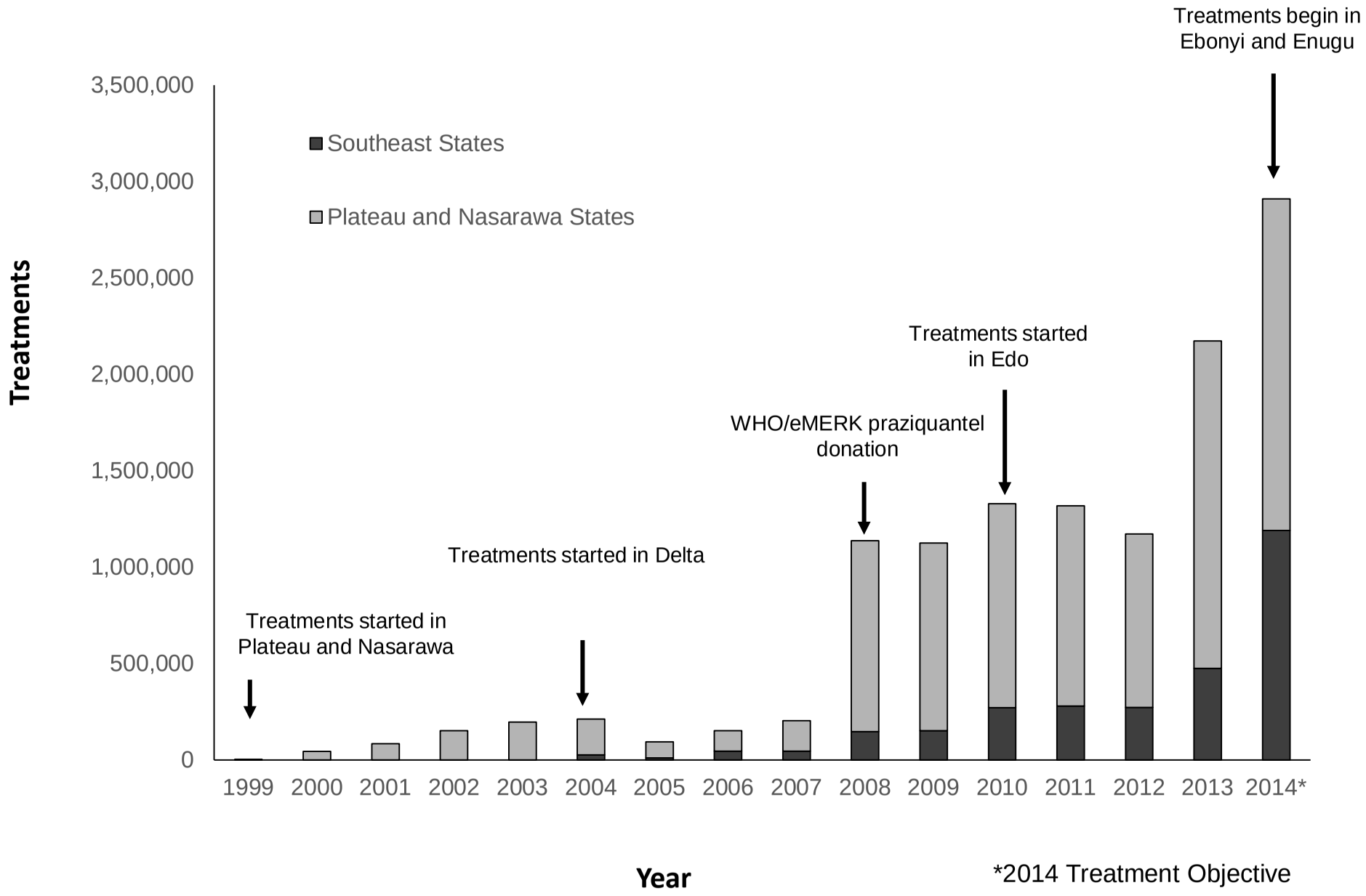
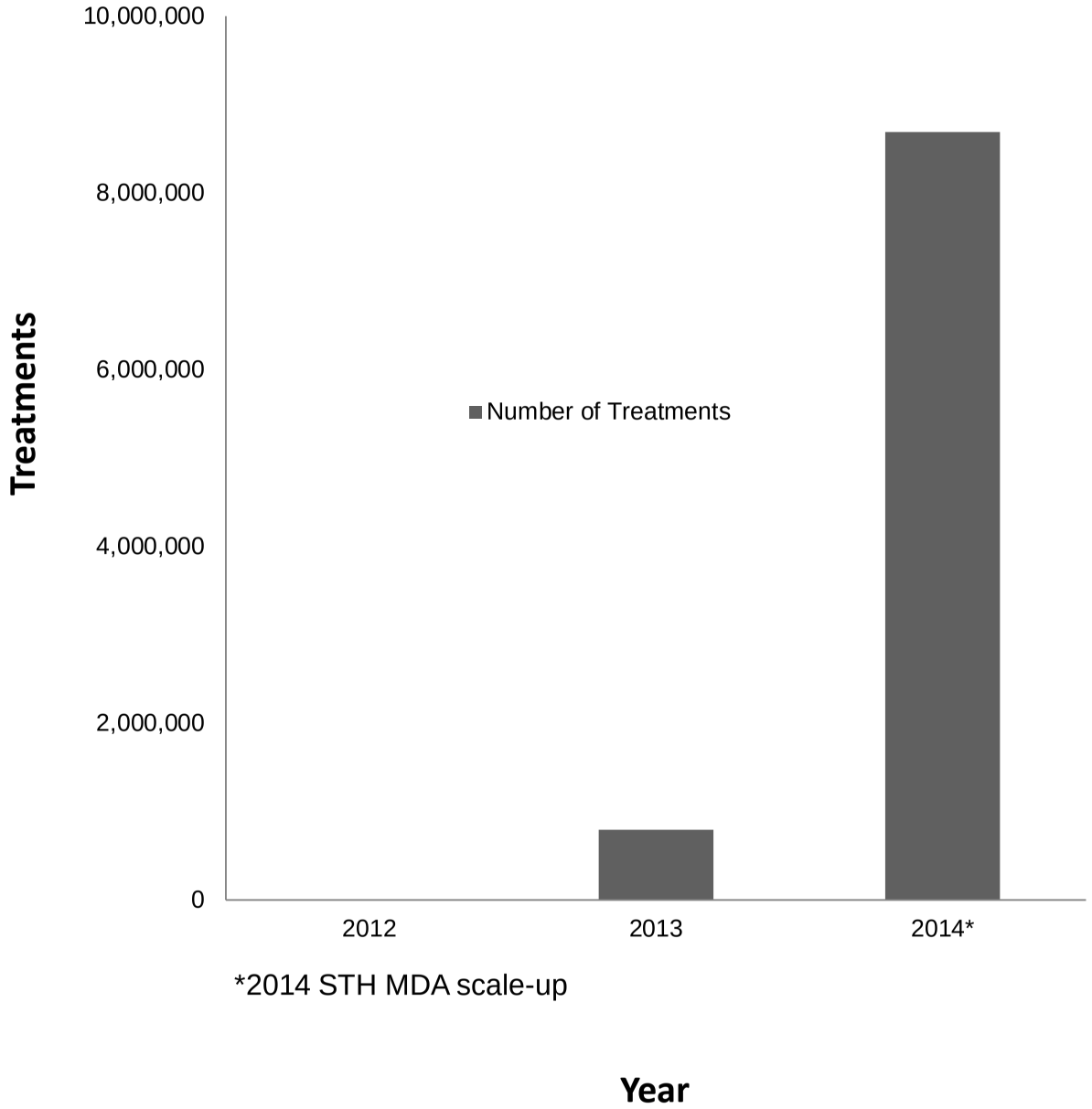


Figure N8

Soil Transmitted Helminthiasis Treatments, 2012, 2013, and 2014 goals



ETHIOPIA

Summary

In 2012 the Federal Ministry of Health (FMOH) of Ethiopia released a new master plan for NTDs that included a change in policy from RB control to RB elimination. As part of this policy change, in 2012 with support from Lions and other partners, The Carter Center assisted the MOH to provide almost 4.9 million treatments; a 50% expansion over treatments assisted in 2011. The increase was due to the launching of semi-annual treatments in new, previously unrecognized hyper, meso, and hypoendemic areas bordering old CDTI zones. In 2013, semi-annual treatments were launched in old CDTI zones that had previously received annual dose of ivermectin, but where transmission interruption had not been accomplished. About 8.5 million treatments were delivered in 2013, representing 3.6 million more treatments than were delivered in 2012, and an increase of 75% (Frontispiece Figure K). During 2013, the new Carter Center –supported molecular laboratory in Ethiopia was renovated, equipped, and the training of lab personnel at the University of Florida was completed. The lab should become operational in October 2014.

There was no geographic expansion of LF treatments in 2013, just the natural annual population growth in Carter Center-assisted zones, raising treatments from 711,701 in 2012 to 775,537 in 2013**.** LF treatment expansion will require the completion of Ethiopia mapping activities yet to be conducted by the FMOH with support from other partners.

Background: Ethiopia is the second most populous country in Africa with a population of about 94 million. Onchocerciasis was first reported in southwestern regions in 1939, while the northwestern part of the country was recognized to be endemic in the 1970s. The National Onchocerciasis Task Force (NOTF) was established in 2000, and the African Program for Onchocerciasis Control (APOC) began supporting Rapid Epidemiological Mapping of Onchocerciasis (REMO) in Ethiopia in 2001. This mapping identified and targeted 10 areas where the overall prevalence of onchocerciasis was estimated to be more than 40% (≥20% nodule rate) and thus eligible for APOC's community-directed treatment with ivermectin (CDTI) projects. The Carter Center, Lions Clubs International Foundation, and local Lions Clubs partnered with the FMOH and APOC in 8 of these 10 projects, beginning with Kaffa and Sheka zones in 2001. Since then, the River Blindness Elimination Program has expanded to include Bench-Maji, North Gondar, Illubabor, Jimma, Metekel and Gambella (Figure E1).

In 2013, The Lions Clubs International Foundation provided renewed financial support to the Ethiopia effort, which contributed to the 2013 geographic expansion of semi-annual treatments with ivermectin through the river blindness elimination program. Members of Lions Clubs District 411-A play an important role in both The River Blindness and Trachoma Control Programs in the Lions-Carter Center SightFirst project areas of Ethiopia. Ethiopian Lions participate actively in the annual retreat of Carter Center Ethiopian staff, and The Carter

Center's Country Representative in Ethiopia, Dr. Zerihun Tadesse, is a Lions Club member. The Honorable Dr. World Laureate Tebebe Y. Berhan attended the 2013 Program Review in Atlanta, representing the Lions Clubs of Ethiopia. Expanded elimination activities require additional financial support, and The Carter Center is grateful for the generous support of the Alwaleed Bin Talal Foundation and other partners to this effort.

Expansion of Semi-annual treatments: In 2013, The Carter Center-assisted RB program consolidated semi-annual treatments which were started in 2012 in the newly identified woredas of Illubabor, Jimma and North Gondar zones. Semi-annual treatments were also expanded into Kaffa, Sheka and Bench-Maji zones, where annual doses of Mectizan® for 10 or more years has failed to interrupt transmission of onchocerciasis. (Figures E1 and E2).

Treatments: During 2013, a total of 1,917,023 people received annual treatments, while 6,610,609 treatments were given semi-annually, thus the total number of treatments provided in 2013 was 8,527,632, reaching a total of 5,335,133 eligible people. As a result of this treatment expansion, Ethiopia became the largest RBEP-assisted treatment program. Annual treatments were delivered in 9,845 communities and semi-annual treatments in 14,756, covering a total of 24,601 communities. Annual treatments covered 98.6% of UTG and semi-annual reached 97.5% of the UTG, with geographic coverage at 100% of targeted villages (Figures E2 and E3). Carter Center-assisted treatments represented 84% of all treatments given in Ethiopia in 2013 (Figure E4), up from 76% in 2012.

Mectizan®: The Carter Center-assisted RB program received 25,965,000 tablets in 2013 (compared to 14,587,000 tablets in 2012), and had a balance of 1,324,682 carried forward from 2012. Through the course of the year, 23,723,528 tablets were distributed, with 40,019 (0.15%) damaged; the program reported no expired tablets. The average number of tablets per treatment was 2.8. The balance at year's end was 3,526,135 tablets.

Training and Health Education: Training was provided to 87,636 community-directed distributors (CDDs) in 2013 (Figure E5); this was a 26% increase over 2012 due to the incorporation of 25,821 new CDDs, mainly in Kaffa, Sheka and Bench Maji zones, where the program changed from annual to semi-annual treatments. The percent of female CDDs showed another substantial increase, from 34% in 2012 to 46% in 2013 (Figure E6). With the exception of Metekel and Gambella, other zones (Bench Maji, Jima, Kaffa, Illubabor, North Gondar, and Sheka) were below 1 CDD per 100 population. Generally, the ratio of CDDs per population improved from 1 CDD per 85 population in 2012 to 1 CDD per 70 population in 2013.

A total of 12,012 community supervisors were trained in 2013, overseeing an average of 7 CDDs each, versus 9 CDDs per supervisor in 2012. These ratios have been improving annually. Community supervisors who are women decreased in 2013 to 32% from 64% in 2012. This is because health extension workers, who are all women, were removed from the category of (volunteer) community supervisors because they are

government-employed workers. Therefore, 32% of the female supervisors now constitute a true category of community supervisors who are not government employees. The change is one of accounting since all health extension workers remain active in the program.

Health education was provided in all 24,601 targeted communities in 2013.

Financial Contribution: Although CDTI is being implemented through government health care delivery structures, key funding in 2013 came from the Lions Clubs International Foundation, the Alwaleed Bin Talal Foundation, and individual donors to The Carter Center. The five-year core funding from APOC ended for Lions-Carter Center-assisted RB programs in 2009, although APOC funding increased temporarily in 2011 for mapping activities in the new areas that were first treated in 2012. Government investment in the program dramatically improved in 2013 (Figure E7).

Lymphatic Filariasis (LF): The LF program in Ethiopia began in 2008 with the support of GSK to conduct surveys for LF in zones receiving support from TCC for onchocerciasis. LF was found to be co-endemic with onchocerciasis in several woredas and, in 2009, GSK supported a pilot project to build LF treatments on the existing RB program in Gambella region, providing roughly 75,000 treatments. In 2012, with further support from GSK, treatments expanded to woredas in Bench Maji, Metekel, and North Gondar, increasing the UTG nearly 10 fold. In 2013, a total of 775,537 LF treatments were given, for 96% of the UTG of 809,556. As the RB program expands into new areas, co-endemicity with LF needs to be determined to adjust treatment regimens to include albendazole.

Other Integration: The Carter Center's malaria program assistance operated at the grassroots level through CDDs in parts of Jimma and Illubabor zones (Oromia region), Bench Maji, Sheka, and Keffa zones (SNNPR region), Metekel zone (Beneshangul-Gumuz region), North Gondar zone (Amhara region) and part of Gambella region. In North Gondar, the integrated program also delivers Carter Center-assisted trachoma control activities. Malaria prevention activities are now included in integrated CDD training courses. CDDs are trained to provide health education messages related to the use and care of long-lasting insecticide-treated bed nets (LLINs) during their MDA activities.

2014 RECOMMENDATIONS FOR THE CARTER CENTER RBEP, ETHIOPIA

Onchocerciasis

Continue twice per year treatments in active onchocerciasis transmission zones to break transmission as soon as possible.

Initiate preparation for launching twice per year treatment in 2015 in the proposed expansion zones of Awi, East and West Gojjam, Dawuro and Konta, and any new expansion woredas of zones already under treatment.

Conduct impact assessments in the old CDTI areas of Jimma, and Illubabor zones currently under treatment. Conduct baseline surveys in new expansion zones, as well as in previously untreated areas listed above.

As resources allow, continue mapping of the eastern extent of river blindness in Ethiopia.

Collect blood spots and black flies from multiple areas, including Metema, and test these materials for OV16 antibody studies and PCR in new lab in 2014.

Provide financial and administrative support for the first meeting of the national onchocerciasis committee in September 2014.

Conduct surveys on the border of Ethiopia (in Metema) and Sudan (in Galabat) in order to ascertain if cross border transmission of river blindness exists.

Lymphatic Filariasis

Publish results of sentinel villages work demonstrating LF infection (nocturnal microfilaremia) rates of up to 11% in areas treated for years with ivermectin for onchocerciasis (these results are of great international interest).

Review FMOH LF mapping results (being conducted with assistance from Liverpool's CNTD program) for TCC-assisted areas. If necessary, complete LF mapping and establish LF sentinel villages in all newly identified RB expansion areas mentioned above. Add albendazole to Mectizan where TCC assists, and where RB and LF are co-endemic.

Conduct Transmission Assessment Survey in Gambella.

General

Encourage WHO/APOC and the concerned Ministries of Health to evaluate and treat cross border foci in a coordinated manner; this especially relates to the Metema (Ethiopia) and Galabat (Sudan) areas.

Undertake treatment coverage questionnaire surveys that provide 95% confidence intervals.

Submit drug applications to WHO and MDP as early as possible, and no later than August of the year before the drug is needed. This is especially important as TCC/RBEP moves to twice per year treatments in many assisted areas. Work with federal agencies to facilitate appropriate documentation and clearance for all medications. Because drug requests are made well before treatment activities are done, treatment denominators will require adjustment during the treatment year. Keep headquarters copied on all related correspondence.

Increase training, supervision, involvement of kinship groups, and gender balance among CDDs and community supervisors. Work toward a target ratio of at least 1 CDD: 100 people and 1 community supervisor: 5 CDDs.

Through national mechanisms, monitor government and partner financial contributions for elimination efforts in RBEP-assisted areas.

Seek more Lions participation to help maintain program visibility and support wherever possible.

Carter Center program staff must complete or renew the Emory IRB certification if they are to be involved with research programs.

Treatment Objectives for onchocerciasis for 2014:
Semiannual UTG(2): 9,279,342
Annual UTG: 2,001,088

Treatment Objectives for Lymphatic Filariasis for 2014: 919,040

Training Objective for 2014:
CDDs: 106,685
Community Supervisors: 21,748
Health Workers: 6,294

Figure E1

Ethiopia: Carter Center-Assisted CDTI Projects

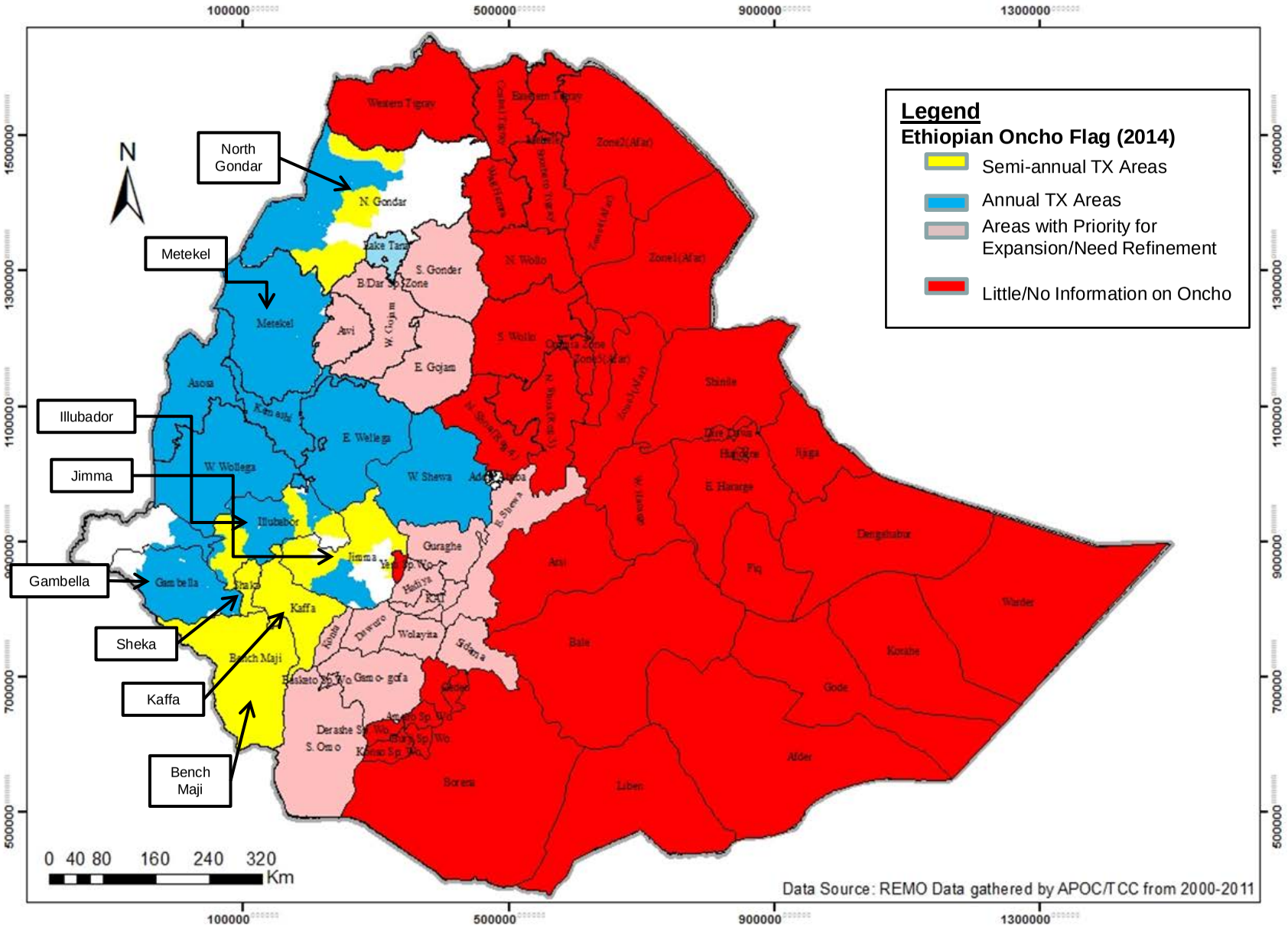


Figure E2

Ethiopia: 2013 Carter Center-Assisted
Semi-Annual River Blindness Treatments

Zone	Total Population	Ultimate Tx Goal (2) [UTG (2)]	Popn Treated Cumulative 1st round	Popn Treated Cumulative 2nd round	Popn Treated Cumulative for both rounds	Popn TX % of UTG (2) for 2013	Active villages Cumulative for 2013		Active villages UTG for 2013	Active villages % for UTG 2013	
							1st Round	2nd Round		1st Round	2nd Round
Kaffa	1,043,750	1,753,500	847,078	863,570	1,710,648	97.6	2,776	2,776	2,776	100	100
Sheka	226,869	381,140	185,687	179,211	364,898	95.7	650	650	650	100	100
Bench-Maji	736,767	1,237,769	592,881	624,120	1,217,001	98.3	1,363	1,363	1,363	100	100
North Gondar	213,730	359,066	175,409	178,184	353,593	98.5	527	527	527	100	100
Illubabor	465,254	781,627	362,393	376,616	739,009	94.5	2,435	2,435	2,435	100	100
Jimma	1,349,869	2,661,352	1,086,573	1,138,887	2,225,460	98.1	6,986	7,005	7,005	99.7	100
Total	**4,036,239**	**6,780,882**	**3,250,021**	**3,360,588**	**6,610,609**	**97.5**	**14,737**	**14,756**	**14,756**	**99.9**	**100**

Figure E3

Ethiopia: 2013 Carter Center-Assisted <u>Annual</u> River Blindness Treatments

Zone	Total Popn	Ultimate TX Goal (UTG)	Popn Treated Cumulative	Total Popn TX %	Popn TX % of UTG	Active villages treated cumulative	Active villages UTG	% of active villages covered
N. Gondar	334,190	280,720	277,726	83.1	98.9	763	763	100
Illubabor	772,506	648,905	635,676	82.3	98	3,980	3,980	100
Jimma	916,197	769,605	771,717	84.2	100.3	4,378	4,378	100
Metekel	174,739	146,781	143,321	82	97.6	363	363	100
Gambella	117,477	98,681	88,583	75.4	89.8	361	361	100
TOTAL	**2,315,109**	**1,944,692**	**1,917,023**	**82.8**	**98.6**	**9,845**	**9,845**	**100**

Figure E4

Ethiopia: Carter Center-Assisted Mectizan® Treatments as Percentage of Total Treatments Provided, 2001-2013

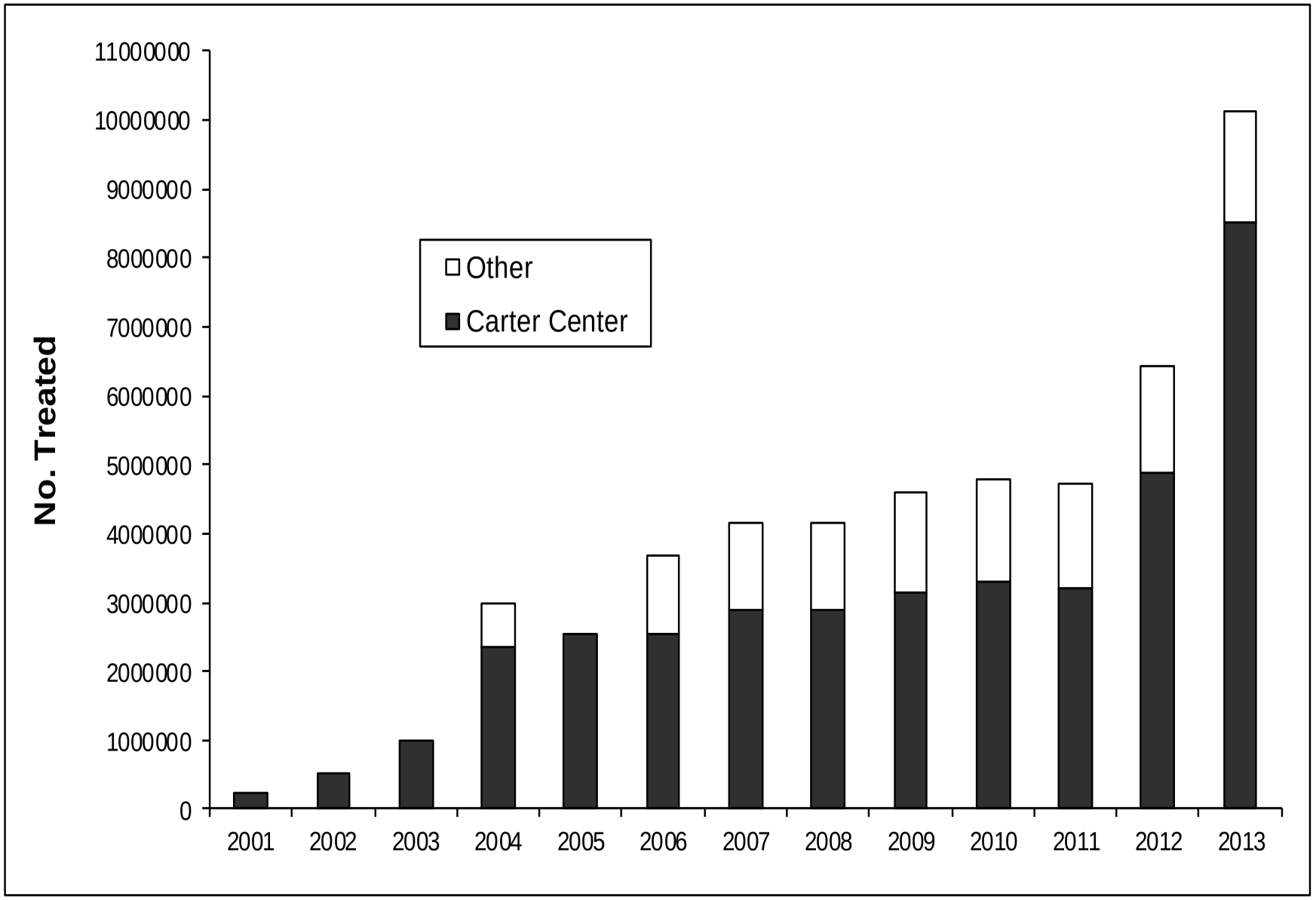


Figure E5

Ethiopia: Community Directed Distributors (CDDs) and Community Supervisors (CSs) Trained (2004 - 2013)

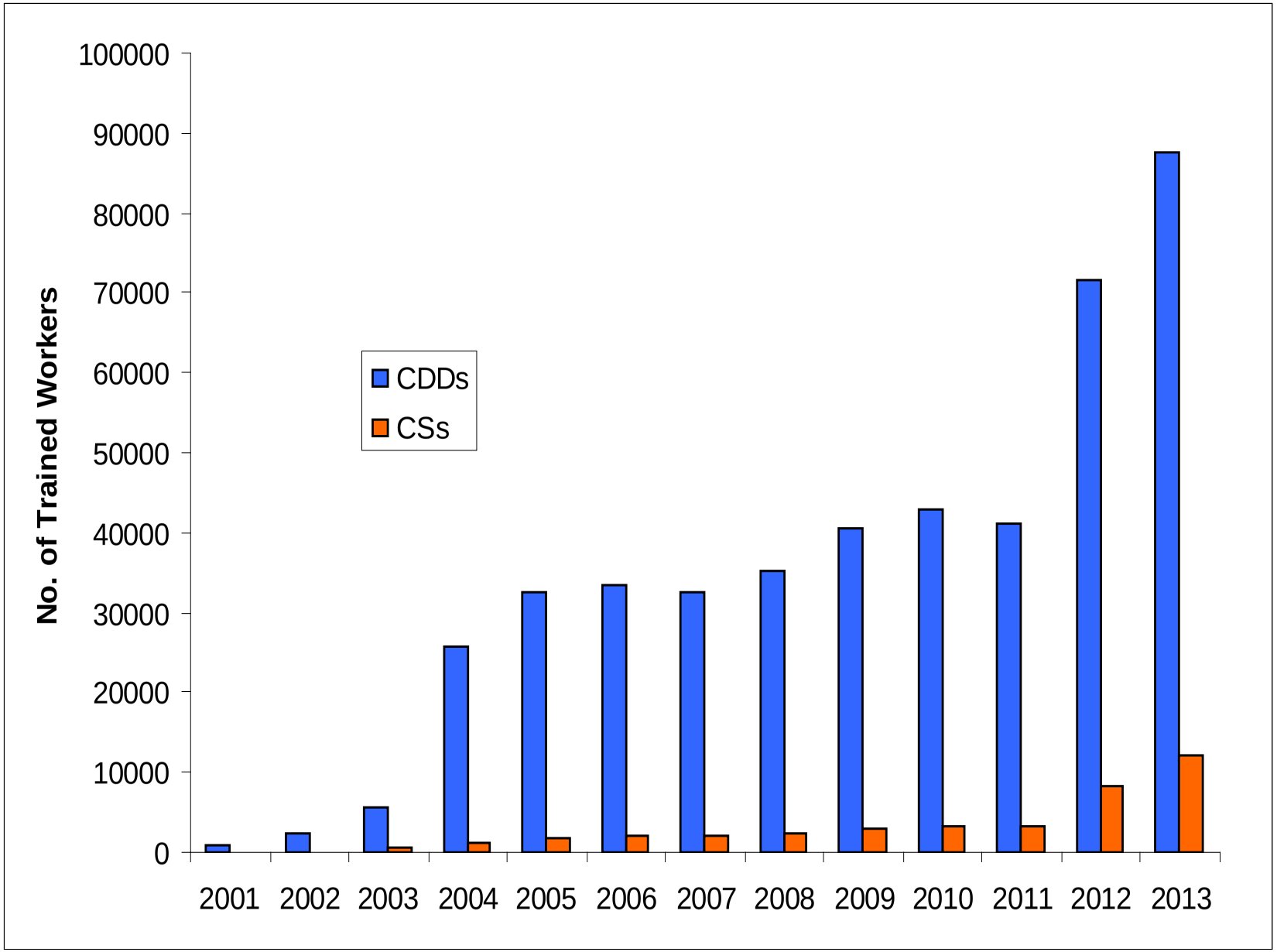


Figure E6

Ethiopia: Training of CDDs: 2001-2013 and percentage female

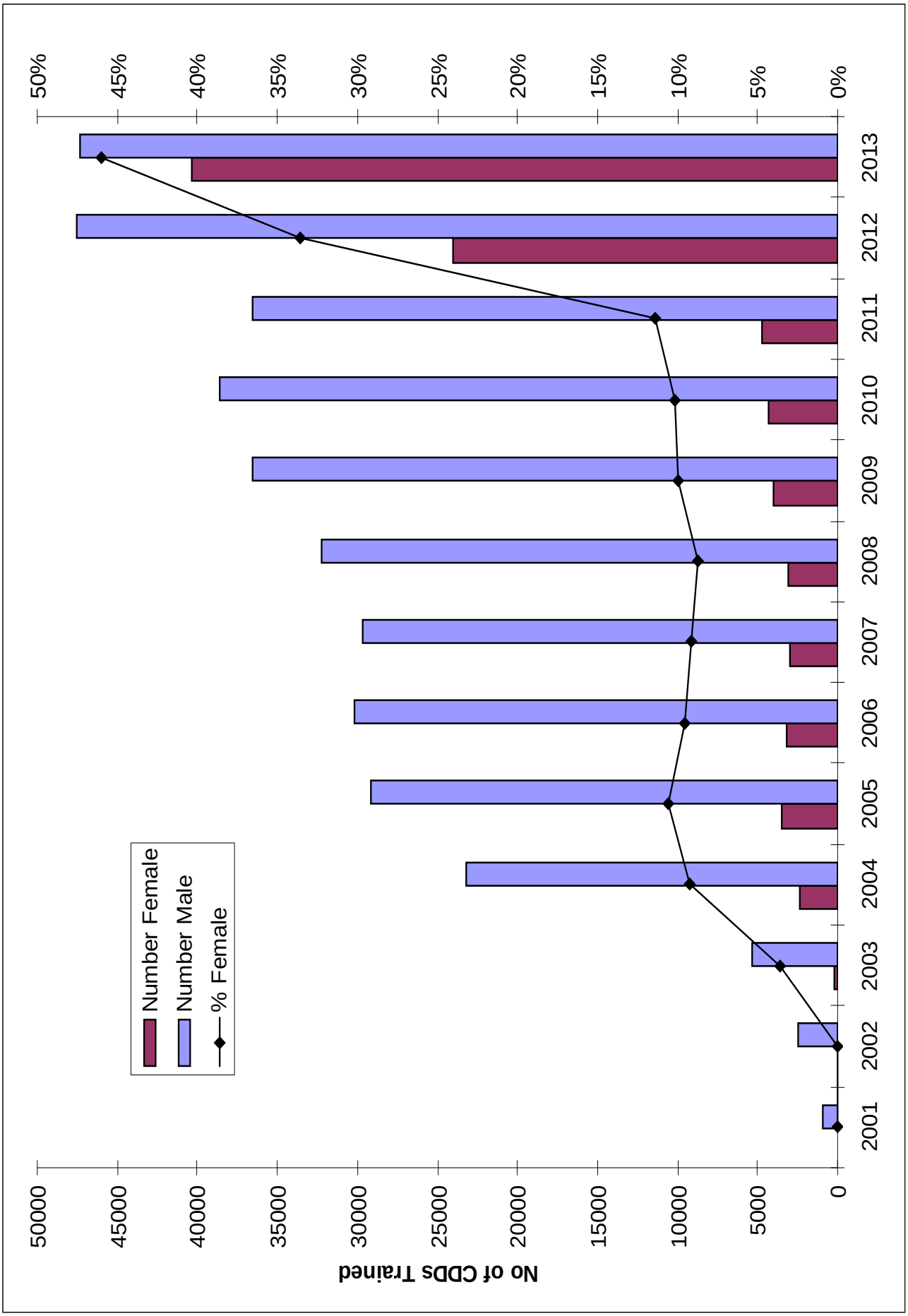
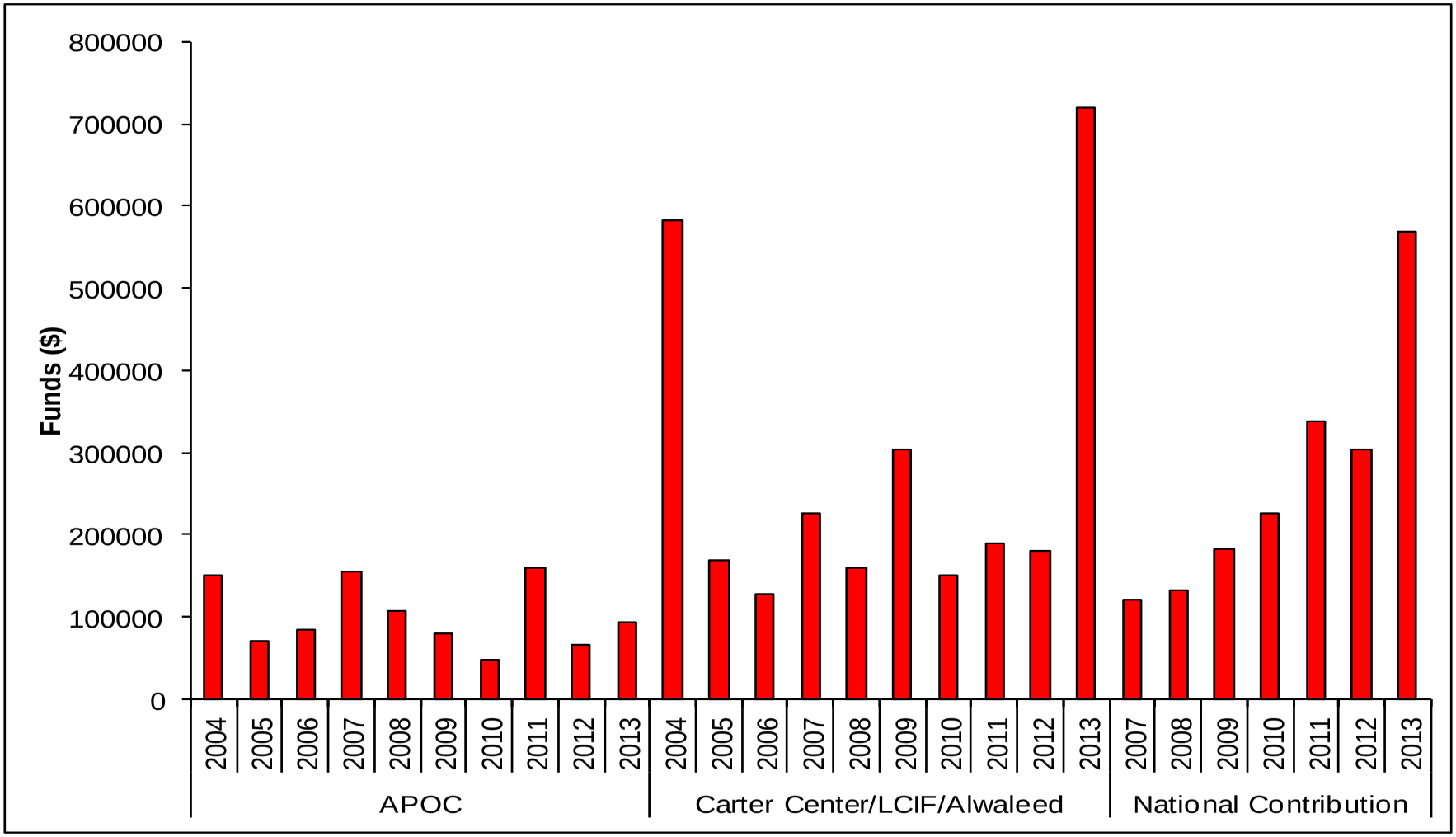


Figure E7

Ethiopia: Financial Contribution by different Partners 2001-2013



The APOC and government contributions are reported by our Carter Center country representatives based on their best possible determinations from information available in country through the National Onchocerciasis Task Force and other local sources. Capital equipment replacement provided by APOC and government salaries are not considered.

ACRONYMS

APOC	African Program for Onchocerciasis Control
arvs	at-risk villages (villages requiring community-wide active mass therapy)
ATO	Annual Treatment Objective
ATP	Annual Transmission Potential
BCC	Behavior Change Communication
CBM	Christoffel Blindenmission
CDC	Centers for Disease Control and Prevention
CDD	Community Directed Distributors
CDHS	Community-Directed Health Supervisors
CDTI	Community-Directed Treatment with Ivermectin
CPA	Comprehensive Peace Agreement
CS	Community Supervisors
DDT	Dichlorodiphenyltrichloroethane
DEC	Diethylcarbamazine
DNA	Deoxyribonucleic Acid
DPDM	Division of Parasitic Diseases and Malaria
earp	eligible at-risk population
ELISA	enzyme-linked immunosorbent assay
FMOH	Federal Ministry of Health
FUNASA	National Health Foundation
GOS	Government of Sudan
GOSS	Government of South Sudan
GSK	GlaxoSmithKline
HE	Health Education
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
IACO	InterAmerican Conference on Onchocerciasis
IEC	Information, Education, and Communication
IRB	Institutional Review Board
JAF	Joint Action Forum
KGaA	E-Merck
LCIF	Lions Clubs International Foundation
LF	Lymphatic Filariasis
LGA	local government areas
LLIN	Long Lasting Insecticidal (bed) Net
MDA	Mass Drug Administration
MDP	Mectizan® Donation Program
MEC	Mectizan® Expert Committee
Mectizan®	Ivermectin (Merck & Co., Inc., product name)
MMWR	CDC's Morbidity and Mortality Weekly Report
MOH	Ministry of Health
MOU	Memorandum of Understanding
NGDO	Non-Governmental Development Organization
NOCP	National Onchocerciasis Control Program
NOTF	National Onchocerciasis Task Force

NTDs	Neglected Tropical Diseases
OCP	Onchocerciasis Control Program of West Africa
OEPA	Onchocerciasis Elimination Program for the Americas
PAHO	Pan American Health Organization
PBD	Department of Prevention of Blindness and Deafness
PCC	Program Coordinating Committee of OEPA
PCR	Polymerase Chain Reaction
PTS	Post-Treatment Surveillance
RB	River Blindness
RBF	River Blindness Foundation
RBP	River Blindness Program of The Carter Center
REMO	Rapid Epidemiological Mapping of Onchocerciasis
RTI	Research Triangle Institute
SAC	School Age Children
SAE	Severe Adverse Events
SH	*Schistosomiasis haematobium* (urinary schistosomiasis)
SM	*Schistosomiasis mansoni*
STAG	Strategic and Technical Advisory Group
STH	Soil Transmitted Helminths
TAS	Treatment Assessment Survey
TCC	Technical Consultative Committee of APOC
TDA	Triple Drug Administration
TDR	Tropical Disease Research
UNICEF	United Nations Children's Emergency Fund
UOEEAC	Ugandan Onchocerciasis Elimination Expert Advisory Committee
USAID	United States Agency for International Development
UTG	Ultimate Treatment Goal
WER	Weekly Epidemiolgical Record
WHO	World Health Organization

ANNEX 1: A History of the River Blindness Campaign at the Carter Center

Human onchocerciasis, caused by the parasite *Onchocerca volvulus*, is an infection characterized by chronic skin and eye lesions. Onchocerciasis is transmitted by small black flies of the genus *Simulium* that breed in rapidly flowing rivers and streams. Due to the high disease rates near rivers, onchocerciasis has been called "river blindness." The adult parasites develop in humans, and reside in non-painful nodules, measuring about one to two centimeters in diameter. These nodules have the consistency and dimensions of cooked lima beans and often can be easily felt under the skin. The parasites are thin male and female worms that measure up to 12 inches in length and have a lifespan of five to 15 years. Female worms, which are four to five times longer than males, release embryonic stage offspring called microfilariae that emerge from the nodules. The microfilariae swarm under the skin, causing itching and rashes, and can enter the eyes, where they cause inflammation and ocular damage. The transmission cycle is propagated when microfilariae are picked up, metamorphose into infectious larvae and are transmitted to another person when the infectious black flies return to bite humans once more. The World Health Organization (WHO) estimates that approximately 123 million people live in endemic areas (and are therefore at risk of infection) in 38 endemic countries, 30 of which are in Africa. Approximately 770,000 persons are blinded or severely visually impaired as a result of the infection. Most of those infected (99 percent) are African. Annual mass treatment with the oral tablets of a medicine called ivermectin (Mectizan®), donated by Merck, prevents eye and skin disease by killing the microfilariae. Unfortunately, ivermectin is not curative, as it does not kill the adult *O. volvulus* (although it does reduce the worms' lifespan). Annual treatment does reduce transmission of the parasite by lowering the amount of microfilariae available to black flies. Twice-per-year treatment (e.g. every six months) is more certain to interrupt transmission of the disease if treatment coverage is high, as this keeps microfilariae levels (and, thus, fly infection rates) extremely low throughout the year. In some situations, four-times-per-year treatment is required (every three months) to push transmission below a critical threshold at which point worm populations cannot be sustained. Twice- or four-times-per-year mass drug administration (MDA) also increases the death rate of the adult worms so that MDA could theoretically be stopped after 6.5 years (with six monthly treatment) or 5 years (with quarterly treatment).

MDA with Mectizan® in community-wide 'Preventive Chemotherapy' (PCT) programs is the main global strategy for the control and elimination of onchocerciasis. It has largely replaced vector control, which was the sole strategy for onchocerciasis control before Merck began donating Mectizan® in 1987. Vector control approaches have always focused on "larviciding," meaning putting chemicals into streams to kill the aquatic stages of the black flies, rather than attacking the adult-stage black flies that emerge from rivers to bite humans. The large World Bank/World Health Organization partnership known as the Onchocerciasis Control Program of West Africa (OCP) used helicopters and fixed-wing aircraft to deliver larvicides for many years; that program closed in 2003. Larviciding on a smaller scale, administered by ground-based field

teams (hence, known as “ground larviciding”), is done as a supplement to Mectizan® treatment as part of the Uganda elimination program and in certain other African country programs.

The Carter Center and its River Blindness Elimination Program: In 1987, Dr. Roy Vagelos (then CEO of Merck), approached Dr. William Foege (then executive director of The Carter Center), for assistance in organizing the global distribution of Mectizan®. Shortly thereafter, in 1988, the Mectizan® Expert Committee (MEC) and the Mectizan Donation Program (MDP) were created and housed at the Atlanta-based Task Force for Child Survival and Development (now called the Task Force for Global Health), an independent partner of The Carter Center, with Dr. Foege as Chair. The global initiative has grown to one that now enables approximately 140 million treatments for river blindness per year, and it has cumulatively provided over one billion treatments valued at more than $4.2 billion U.S. dollars during the 25 years that it has been in existence. The donation is widely considered a model of public-private partnership that demonstrates how industry, international organizations, donors, national Ministries of Health (MOHs) and affected communities can successfully work together toward solving a major health problem. The MDP has spawned other public-private partnerships based on large drug donations and mass treatment programs to fight what are collectively known as the neglected tropical diseases (NTDs). Many of these programs are based at the Task Force for Global Health (www.taskforce.org).

In 1996, The Carter Center expanded its role within the coalition fighting river blindness by acquiring most of the operations of the River Blindness Foundation (RBF), a Houston-based organization founded in 1990 by John and Rebecca Moores. The River Blindness Program (now River Blindness Elimination Program) was established at The Carter Center to assume the field activities of the RBF. The programs assumed in 1996 were active in parts of five African countries: Ethiopia, Nigeria, Cameroon, Sudan and Uganda, as well as the Onchocerciasis Elimination Program for the Americas (OEPA). OEPA has coordinated activities to completely eliminate river blindness transmission and infection in all six endemic countries in the Americas (Brazil, Colombia, Ecuador, Guatemala, Mexico, and Venezuela).

Shortly after assuming the field activities of the RBF in 1997, The Carter Center’s RBP expanded to northern and southern Sudan (now Sudan and South Sudan) with support from the Lions Clubs International Foundation (LCIF), as part of the Carter Center's peace initiative and Guinea worm disease eradication efforts. In 1999, as part of the expanded Lions-Carter Center Sight First Initiative, The Carter Center accepted an invitation to assist onchocerciasis control activities in Ethiopia. Mectizan® treatments and health education (HE) began there in 2001. The Comprehensive Peace Agreement (CPA) in Sudan, signed in January 2005 thanks in part to the active involvement of President Carter, put an end to the decades-long civil war and created the Government of South Sudan (GOSS). The Lions-Carter Center RBP ceased its support of river blindness control activities in GOSS areas of the country shortly after the CPA was signed, when the African Program for Onchocerciasis Control (APOC) and CBM signed an agreement to support and establish five Community-Directed

Treatment with Ivermectin (CDTI) projects in GOSS areas that overlapped areas historically assisted by RBP. In 2011 the Republic of South Sudan was formed after a referendum in the south overwhelmingly called for partition; North Sudan is now referred to as simply 'Sudan'. In 2011, RBP ceased its work in Cameroon.

Sudan, Uganda, Ethiopia and Nigeria launched elimination strategies in 2006, 2007, 2012 and 2013, respectively. All four countries formally invited The Carter Center to participate in their elimination efforts. In Sudan, the elimination strategy targets the Abu Hamad focus on the River Nile and the Galabat focus in Gedarif State, and a twice-per-year treatment approach has been used. In 2011, the Sudan Ministry of Health determined that transmission had been interrupted in Abu Hamad, and thus that focus is now under post-treatment surveillance. In Uganda, the strategy is to phase in a countrywide flexible policy of elimination that includes not only twice-per-year treatment, but also vector elimination or targeted vector control where feasible through larviciding of breeding sites in fast-running rivers and streams. In Ethiopia and Nigeria, national programs are now phasing in treatment of hypoendemic areas (ivermectin-naïve areas) and twice-per-year treatments in areas that had been receiving annual treatments under a control strategy. Nigeria is currently evaluating the ability to treat river blindness with other drugs in areas that are co-endemic for *Loa loa* (and thus ivermectin may not be safe to distribute).

In 2012, The Carter Center's River Blindness Program obtained the Board of Trustees' approval to implement an eight-year plan to interrupt river blindness transmission everywhere we assist by 2020, in accord with the goals of the governments of the countries RBP assists. In early 2013, just prior to its Program Review, RBP was granted permission by the Board of Trustees to change its name to the River Blindness ***Elimination*** Program (RBEP) to reflect this paradigm shift everywhere The Carter Center assists. Programmatically, activities were unchanged in the Americas and Uganda (where an elimination strategy was already being implemented) but enhanced in Nigeria and Ethiopia. The primary aim of the RBEP is to help Ministries of Health and residents of affected communities to establish and/or sustain optimal Mectizan® distribution and related health education activities and to monitor the progress toward elimination of onchocerciasis.

Integration: Whenever possible, RBEP works to integrate (or "co-implement") MDA activities for onchocerciasis, schistosomiasis, lymphatic filariasis, soil-transmitted helminths, and trachoma. Vitamin A supplementation for young children and insecticide-treated net distribution are also a part of our integrated efforts, which are undertaken within Carter Center-assisted river blindness-endemic areas, at the request of MOHs and to the extent that our funding allows.

Partnerships: The Carter Center works through partnerships, with our primary partners being the Ministries of Health (MOHs) and their national onchocerciasis programs. The Carter Center assists programs that are executed within and through the existing primary health care system, with the aim to strengthen those systems. The Carter Center and MOH staff work closely with district and frontline health workers

and the afflicted rural communities. RBEP does not establish parallel systems to the MOH; RBEP provides financial and technical assistance, information, education, and communication (IEC), and behavior change communication (BCC). The primary principle is that the local people themselves must be empowered to be full partners in the program and in the drug delivery process. As mentioned above, The Carter Center has had a long partnership with Lions Clubs and the Lions' SightFirst Initiative, supported by the Lions Clubs International Foundation, in addition to long standing relationships with Merck and the Division of Parasitic Diseases and Malaria (DPDM) at the U.S. Centers for Disease Control & Prevention (CDC). The Carter Center also works closely with the Task Force for Global Health, which houses the Mectizan Donation Program. More recently, the U.S. Agency for International Development (USAID) and Research Triangle Institute (RTI) have become important partners as well.

Partners in the African Programs: In Africa, the main Carter Center RBEP partners are the MOHs in host countries (Ethiopia, Nigeria, Sudan, and Uganda). The African Program for Onchocerciasis Control (APOC), which is executed by WHO and funded through a trust fund housed at The World Bank, is another important partner of The Carter Center (see Annex 7). APOC was launched in 1995 (with President Carter presiding), and aims to establish country-sustained river blindness treatment programs with a "community-directed" approach throughout highly endemic onchocerciasis areas in Africa. Carter Center disease control experts Dr. Donald Hopkins, Dr. Frank Richards, and Dr. Moses Katabarwa have all served on the Technical Consultative Committee of APOC. Dr. Richards also serves on the Strategic and Technical Advisory Group (STAG) to WHO's NTD Department and the Executive Group of the Global Alliance to Eliminate Lymphatic Filariasis (GAELF).

In 2011 APOC changed its focus from river blindness control to elimination in Africa. The Carter Center applauds and supports the APOC paradigm shift, having been long engaged in demonstrating the feasibility of onchocerciasis elimination in Africa. RBEP will continue to play a leadership role in demonstrating an approach to African onchocerciasis elimination that involves reorienting programs away from the control mode toward a more rigorous elimination mode that implies expanded, intensified, and flexible interventions against onchocerciasis, as well as better mapping, monitoring and evaluation. The RBEP mantra is "Elimination cannot be achieved by business as usual."

The Carter Center also works with other non-governmental development organizations (NGDOs) through an NGDO Coalition that includes, among others, CBM, Helen Keller International, Interchurch Medical Assistance, LCIF, the Mectizan Donation Program, Sightsavers, and the U.S. Committee for UNICEF. Dr. Frank Richards currently serves as Chair of this NGDO Coalition, which in 2013 renamed itself "the NGDO Coalition for Onchocerciasis Elimination," as a statement of solidarity with APOC's new orientation.

Since 2012/2013, USAID has been a significant partner of The Carter Center's RBEP, providing funding for the Americas Program (OEPA) as well as the Nigeria and Uganda programs (through the ENVISION Project led by RTI) In Nigeria, the ENVISION project

helps fund Carter Center activities targets onchocerciasis as well as lymphatic filariasis, schistosomiasis, soil transmitted helminthiasis, and trachoma.

Partners in the Americas Programs: The Carter Center provides the administrative framework for OEPA. Headquartered in Guatemala, OEPA is the technical and coordinating body of a multinational, multi-agency coalition working for the elimination of all onchocerciasis morbidity and transmission from the Americas. Through OEPA, The Carter Center partners with the national programs and MOHs of all six endemic or formerly endemic countries of the Americas (Brazil, Colombia[1], Ecuador[2], Guatemala, Mexico, and Venezuela). Regional technical and programmatic goals are developed by a Program Coordinating Committee (PCC), which is convened by OEPA and has representation from key members of the initiative. Dr. Ed Cupp stepped down as chair of the PCC in 2012, after years of invaluable service; Dr. Frank Richards was elected the new PCC chair in 2013. The Carter Center works with LCIF, PAHO, CDC, and several U.S. and Latin American universities. In 2003, The Carter Center's RBP received its first support from the Bill & Melinda Gates Foundation for OEPA through a matching grant mechanism that drew additional funding from LCIF, Merck, and more than 70 other donors. In 2012, OEPA began receiving major support from USAID.

[1] In 2013, Colombia received formal verification of river blindness elimination from the World Health Organization.

[2] In 2013, Ecuador filed for verification as well, and an international verification team visited mid-2014.

Timeline of The Carter Center in River Blindness Elimination

- **1996:** The Carter Center assumed activities of the River Blindness Foundation and began assisting RB programs in the Americas, Nigeria, Cameroon, Sudan and Uganda. Ethiopia started in 2001.
- **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 the launching of the OEPA initiative (Bull PAHO).
- **2000:** OEPA needed a 'definition of success' endorsed by WHO; with a push from President Carter, WHO agreed to hold an important meeting to establish certification criteria for onchocerciasis elimination (WHO 2001). These guidelines remain a key milestone and are used by OEPA and the Uganda program. Richards, writing in *Lancet*, notes the importance of the LF program in advancing the RB elimination agenda.
- **2002:** Carter Center and WHO (with Gates Foundation support) co-hosted the Conference on RB Eradicability that concluded RB can be eliminated in the Americas but not yet throughout Africa with current tools (ivermectin alone). The challenge was 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. (Dadzie 2003)
- **2003:** Richards coauthors a paper on mass treatment decision making in *Loa loa* areas where onchocerciasis occurs. (Addis 2003)
- **2005:** Paper published by Hopkins, Richards, and Katabarwa ("Whither Onchocerciasis Control in Africa?") challenges 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)
- **2006:** TCC agrees to assist North Sudan in elimination efforts in the Abu Hamad focus on the River Nile. (Higazi 2011, 2013)
- **2007:** TCC's ITFDE reviews RB eradicability and notes evidence that ivermectin alone may interrupt transmission in Africa, but that the challenge of *Loa loa* is not resolved. (WHO 2007). TCC/RBP agrees to assist Uganda in its new goal of national RB elimination.
- **2009:** A key WHO/TDR study by Diawara (2009) that was conducted in Senegal and Mali with Gates Foundation support (derived as an outcome of the 2001 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 staff) reports that RB programs in Nigeria would collapse without external support, questioning the 'sustainability' theory.
- **2010:** TCC reports considerable success in RB elimination efforts in the Americas (series of *Weekly Epidemiological Record* articles) and parts of Africa. However, Katabarwa (TCC/RBP staff) notes a need to expand treatment into the so-called hypoendemic areas excluded by APOC's treatment-targeting 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.

- **2011:** TCC's International Task Force for Disease Eradication 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 (*Weekly Epidemiological Record* 2011). An expert committee (with Frank Richards 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 APOCs goal, and asks donors to extend the APOC program's end-date from 2015 to 2025.
- **2012:** Sudan announces interruption of transmission in Abu Hamad focus (Higazi 2013). TCC's River Blindness Program obtained Board of Trustees' approval for an eight-year plan to interrupt RB transmission everywhere we assist, by 2020. WHO sends verification team to Colombia to determine if the country has eliminated onchocerciasis.
- **2013:** The name of TCC's River Blindness Program was changed to The Carter Center's River Blindness Elimination Program (RBEP) 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.
- **2014:** WHO sends verification team to Ecuador to determine if the country has eliminated onchocerciasis. ITFDE reviews RB/LF in Africa again. Published in WER.

ANNEX 2: The Carter Center RBEP Reporting Processes and Research Agenda

At-risk Villages (arvs): An epidemiological mapping exercise was a prerequisite to identifying at-risk villages (arvs) for mass Mectizan® treatment programs. The assessment techniques used in the mapping exercise in Africa varied from those used in the Americas. An overview of the two approaches follows.

In much of Africa, a staged village sampling scheme called Rapid Epidemiological Mapping of Onchocerciasis (REMO) was executed with assistance from WHO to define endemic "zones" that should capture most or all villages having onchocercal nodule rates ≥20 percent in adults (which roughly corresponds to a microfilariae in skin prevalence ≥40 percent) 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 percent. 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, the survey villages are visited by field teams and a convenience sample of 30-50 adults are examined (by palpation) for characteristic onchocercal nodules. The mean nodule prevalence for each village sample is mapped (often using geographic information systems) and the map is used to define endemic zones called 'community directed treatment with ivermectin (CDTI) treatment zones.' These zones typically are defined by sample villages having nodule prevalence of ≥20 percent. All villages within the CDTI treatment zone are offered mass Mectizan® treatment annually. This approach is modified for areas where the parasite *Loa loa* exists. The approach of REMO excludes some areas from CDTI, where there may be onchocerciasis but nodules rates are under 20 percent (the so-called "hypoendemic areas"). As the policy shifts from control to elimination, the role of hypoendemic areas in *Onchocerca volvulus* transmission is being critically re-examined. The River Blindness Elimination Program (RBEP) contributes to this area of investigation in our assisted areas (see Katabarwa, *Trop Med Int Health*. 2010; 15:645-52). Based on evidence we have collected, we firmly believe that transmission occurs in some hypoendemic areas and that they must therefore be promptly reassessed and if necessary treated with CDTI under the elimination approach.

In the Americas, the goal is to eliminate both morbidity and transmission from *O. volvulus* and, as a result, all villages where transmission can occur are considered "at-risk" and are offered mass Mectizan® treatment activities every three or six months. Thus, a "broader net" is cast for mass treatment where elimination is the goal and the concept of excluding hypoendemic villages does not exist. For the Americas, where the endemic foci are characteristically smaller and more defined than Africa, every village in known or suspected endemic areas has a rapid epidemiological assessment of 50 adults, who have both nodule examinations and superficial skin biopsies to identify *O. volvulus* microfilaria in skin. Villages in which one or more persons are positive (sample prevalence ≥2 percent) are considered "at-risk" and are recommended for the mass treatment campaign. Thus, the cutoff prevalence for treatment was much

lower for the Americas compared to Africa until recently when elimination in Africa became the focus.

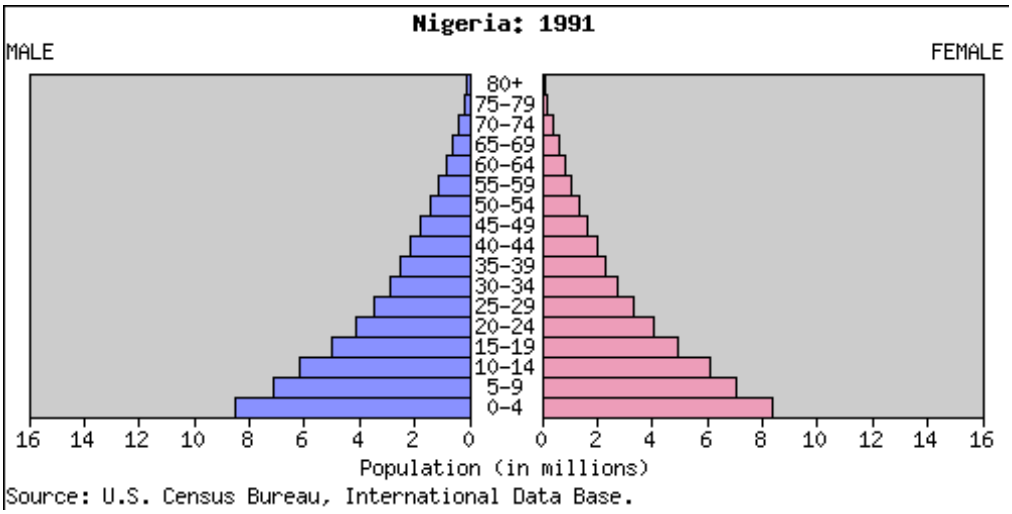
Data Reporting: The Carter Center program offices report monthly to The Carter Center headquarters in Atlanta. These reports include: 1) numbers of villages and persons treated during the previous month (reporting of treatments are updated quarterly for the Americas); 2) the status of the Mectizan® tablet 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 treatment data that are reported originate from village level records prepared during mass treatment activities carried out by village distributors and/or national Ministry of Health (MOH) personnel. The accuracy of these reports is routinely confirmed with random spot checks performed primarily by MOH personnel, supplemented by a standardized monitoring questionnaire administered by The Carter Center and MOH staff. Summary reports of numbers of villages and persons treated are compiled at the district level and forwarded (whenever possible through MOH surveillance and reporting channels) to both headquarters of the national onchocerciasis programs and the national Carter Center offices. In the Americas, the MOHs in the six countries report treatments quarterly to the OEPA office in Guatemala City, which then provides a combined regional report to The Carter Center and to the Program Coordination Committee (PCC), InterAmerican Conference on Onchocerciasis (IACO) and the Pan American Health Organization (PAHO)/World Health Organization (WHO) in its regular meetings; OEPA updates are provided in WHO's annual *Weekly Epidemiological Record (WER)* articles (See Annex 8). African MOHs report their annual results directly to WHO and APOC, which has recently begun publishing its results in the WER as well.

The data from monthly reports are supplemented with additional information at the annual Carter Center River Blindness Program Review held during the first quarter of the following year. At these reviews, all Carter Center program directors and other partners convene to finalize treatment figures for the previous year and establish new treatment objectives for the coming year. Data on Mectizan® treatments provided by other programs/partners operating in other parts of the countries where The Carter Center assists also are discussed (if these data are available), as well as results from research initiatives. The Carter Center reports its final annual treatment figures to the Mectizan Donation Program (MDP), Merck, and the NGDO Onchocerciasis Coordination office at the WHO, Geneva.

RBEP Treatment Indices: Treatments are reported as numbers of persons and number of at-risk villages (arvs) treated for the month by district, focus, region, state or zone, depending on the geographical stratification of the country. Cumulative treatment figures for the year are compared to the Annual Treatment Objectives (ATOs) or Ultimate Treatment Goals (UTGs). The decision on whether to use ATOs or UTGs is based on projections of program capacity. Mature programs that sufficiently reach all targeted communities within their entire program area are said to be at "full geographic coverage," and use the UTG index as their coverage denominator (see

below). UTG figures typically increase by about five percent annually to account for normal population growth.

The eligible populations of at-risk villages (arvs) targeted for active mass distribution receive community-wide Mectizan® treatment. The eligible at-risk population (earp) includes all persons living in arvs who are eligible to receive Mectizan® (i.e., 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 (treatment may be given one week or more after parturition) and therefore all adult women are included in the UTG calculation. In practice, the UTG is established by arv census from the most recent treatment rounds. The UTG is expected to be the same figure used in the annual request for tablets submitted to the Mectizan Donation Program. APOC and LF elimination use total population as their treatment denominator, so RBEP routinely reports both coverage of eligible population (UTG) and coverage of total population ("therapeutic coverage") to satisfy those program's 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 8-10% less than UTG (eligible) population coverage, in accord with population pyramids in areas being served, where 8 percent of the population is under 5 years of age and thus ineligible for Mectizan® treatment (see example below, Nigeria).



The UTG(2) and UTG(4) denominators are used by elimination programs where semiannual or quarterly treatments are delivered: the values are twice or four times the UTG, and represent treatments delivered, not persons treated. Full coverage in control programs is defined as 90 percent achievement of the UTG established for active mass treatment. Full coverage for elimination programs is 90 percent of the UTG(2) in African projects, or 85 percent of the UTG(2) or UTG(4) for OEPA. The differences in full coverage thresholds result from different recommendations by the African and American expert steering committees. Passive treatments are Mectizan® treatments for

onchocerciasis provided through health care units located in hypoendemic communities (where estimated onchocerciasis nodule prevalence is under 20 percent) in the control program strategy. As the program transitions to the elimination paradigm, hypoendemic villages are beginning to receive mass treatment and the passive treatment strategy is no longer applicable.

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Annex 5: Agenda

Eighteenth Annual Carter Center River Blindness Elimination Program Review Agenda
Monday March 3 – Wednesday March 5, 2014
The Carter Center, Atlanta, GA

Day 1: Monday March 3, 2014

8:00	*Shuttle pickup at hotel*	
8:30 – 9:00	*Continental breakfast*	
9:00 – 9:15 9:15 – 9:45	Welcome and ITFDE meeting summary Overview and Introduction	Dr. Donald Hopkins Dr. Frank Richards
Morning session chair: Dr. Mauricio Sauerbrey		
9:45 – 10:15 10:15 – 10:30	Nigeria: Plateau and Nasarawa States: treatment/net dist activities *Discussion*	Dr. Abel Eigege
10:30 – 11:00	*Coffee Break and Group Photo*	
11:00 – 11:20 **11:20 – 11:30**	**New LF impact survey in Plateau and Nasarawa states, Nigeria** ***Discussion***	**Dr. Greg Noland**
11:30 – 12:00 12:00 – 12:15	Nigeria: Integration and community ownership *Discussion*	Dr. Emmanuel Miri
12:15 – 12:25 12:25 – 12:35	STH and schistosomiasis mapping results in TCC-assisted areas in Nigeria *Discussion*	Dr. Darin Evans
12:35 – 2:00	*Lunch*	
Afternoon session chair: Ms. Peace Habomugisha		
2:00 – 2:10 2:10 – 2:20	Nigeria's new integrated ML/LF policy *Discussion*	Dr. Bridget Okoeguale
2:20 – 2:55 2:55 – 3:10	Nigeria: TCC-assisted Southeast States: treatment activities *Discussion*	Dr. Emmanuel Emukah
3:10 – 3:20 3:20 – 3:30	Loa loa mapping: impact on treatment strategies *Discussion*	Dr. Darin Evans
3:30 – 3:50 3:50 – 4:00	Modeling for LF transmission interruption with LLIN *Discussion*	Dr. Edwin Michael
4:00 – 4:30	*Coffee Break*	
4:30 – 5:00 5:00 – 5:15	Twice per year treatments and new WHO Joint Application *Discussion*	Mectizan Donation Program
5:15 – 5:25 5:25 – 5:35	USAID/RTI: Required branding and manuscript review policies *Discussion*	Ms. Sarah Bartlett
5:35	*Session Adjourned*	

Day 2: Tuesday March 4, 2014

8:00	*Shuttle pickup at hotel*	
8:30 – 9:00	*Continental breakfast*	
Morning session chair: Dr. Nabil Aziz		
9:00 – 10:00	**OEPA presentation: Overview, 2013 treatments, Post Treatment Surveillance (PTS), and Venezuela and Brazil update**	**Dr. Mauricio Sauerbrey**
10:00 – 10:05	**Comments on coordination between Venezuela and Brazil**	**Dr. Luis Castellanos**
10:05 – 10:35	***Discussion***	
10:35 – 11:00	*Coffee Break*	
11:00 – 11:30	Uganda treatments	Ms. Peace Habomugisha
11:30 – 11:45	*Discussion*	
11:45 – 12:15	**Uganda onchocerciasis elimination update**	**Dr. Thomson Lakwo**
12:15 – 12:30	**Discussion**	
12:30 – 2:00	*Lunch*	
Afternoon session chair: Dr. Zerihun Tadesse		
2:00 – 2:20	New WHO River Blindness guidelines	Dr. Mark Eberhard
2:20 – 2:30	*Discussion*	
2:30 – 3:00	OEPA: Innovative approaches	Dr. Mauricio Sauerbrey
3:00 – 3:15	*Discussion*	
3:15 – 3:35	OV-16 and new statistics	Dr. Thomas Unnasch
3:35 – 3:45	*Discussion*	
3:45 – 4:15	*Coffee Break*	
4:15 – 4:45	Uganda: integration and community ownership	Ms. Peace Habomugisha
4:45 – 5:00	*Discussion*	
5:00 – 5:20	Entomology of RB on the border of Uganda and South Sudan	Dr. Rory Post
5:20 – 5:30	*Discussion*	
5:30	*Session Adjourned*	
5:30 – 7:00	*Reception: The Carter Center Library & Museum*	
7:00	*Shuttle departs for hotel*	

Day 3: Wednesday March 5, 2014

8:00	*Shuttle pickup at hotel*	
8:30 – 9:00	*Continental breakfast*	
Morning session chair: Dr. Emmanuel Miri		
9:00 – 9:30 9:30 – 9:45	Ethiopia treatments *Discussion*	Dr. Zerihun Tadesse
9:45 – 10:05 10:05 – 10:15	Promoting CDI and intensifying mass treatment for disease elimination in Ethiopia *Discussion*	Dr. Moses Katabarwa
10:15 –10:45 10:45 – 11:00	**Ethiopia update on RB and LF elimination** ***Discussion***	**Mr. Aseged Taye**
11:00 – 11:30	*Coffee Break*	
11:30 –12:00 **12:00 – 12:15**	Ethiopia integration and community ownership *Discussion*	Dr. Zerihun Tadesse
12:15 – 12:35 12:35 – 12:45	Elimination surveillance by CDC *Discussion*	Dr. Vita Cama and Dr. Paul Cantey
12:45 – 2:15	*Lunch*	
Afternoon session chair: Dr. Frank Richards		
2:15 – 2:45 2:45 – 3:00	Sudan treatments and post treatment surveillance surveys *Discussion*	Dr. Kamal Osman/ Dr. Nabil Aziz
3:00 – 3:10 3:10 – 3:20 3:20 – 3:30	Presentations on the border between Galabat (Sudan) and Matema (Ethiopia) *Discussion*	Dr. Isam Zaroug and Mr. Aseged Taye
3:30 – 4:00	*Coffee Break*	
4:00 – 4:20 4:20 – 4:30	Modeling for RB transmission interruption *Discussion*	Dr. Edwin Michael
4:30 – 5:30	**Summary and closure of the Seventeenth Session**	Dr. Donald Hopkins Dr. Frank Richards
5:30	*2013 Carter Center River Blindness Program Review Adjourned*	

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 dysfunction, often leading to poor drainage of lymphatic fluid. Clinical consequences include collection of lymph that results in swelling of limbs and genital organs (lymphoedema and "elephantiasis"), and painful recurrent bacterial infections ('attacks' of acute adenolymphangitis). The female worms release microfilariae, which are tiny embryonic worms that circulate in blood at night, when the mosquito vectors bite. Microfilariae are picked up by mosquitoes, develop over several days into infectious larvae, and are then able to be transmitted to another person when the mosquitoes bite again. Microfilariae are killed by annual single-dose combination therapy, with either Mectizan® (donated by Merck) and albendazole (donated by GlaxoSmithKline), or diethylcarbamazine (DEC) and albendazole (in areas where there is no onchocerciasis and/or *Loa loa* infection). Annual mass drug administration (MDA) prevents mosquitoes from becoming infected, and when given for a period of time (estimated to be five to six years), can interrupt transmission of *W. bancrofti* (which has no animal reservoir). In 2013, the WHO issued a 'provisional strategy' for *Loa loa* areas that includes the dual approach of MDA monotherapy with albendazole, together with long lasting insecticidal (bed) nets (LLIN).

Nigerians suffer in disproportionate numbers from LF. Disease mapping of the country is nearly complete, and confirms that Nigeria is third globally behind India and Indonesia in the human suffering from this parasite. With 704 out of 774 LGAs of 36 States and the Federal Capital Territory mapped, 541 LGAs (77%) are endemic and an estimated 106 million Nigerians are at risk. The Carter Center, working with the Federal Ministry of Health (FMOH) of Nigeria and with the state and local government ministries in Plateau and Nasarawa states, has assisted in establishing an LF elimination program in Plateau and Nasarawa states. The effort is based on a strategy of health education (HE) and annual drug combination therapy with albendazole and Mectizan®. The manufacturers of the drugs have global donation programs for LF: GlaxoSmithKline (GSK) donates albendazole and Merck donates Mectizan®. After years of high treatment coverage, LF has been eliminated in the two states, and they are now under post treatment surveillance for five years. Through a grant from the Bill & Melinda Gates Foundation, The Carter Center also conducted field research on the use of LLINs alone to combat LF in Imo and Ebonyi states, which are areas where LF MDA is not currently possible due to the presence of *Loa loa*. Results show LLINs have had significant impact on mosquito infection (Richards et al., *American Journal of Tropical Medicine and Hygiene* 2013, in press). Thanks to the Global Fund Round 8, LLINs have now been mass distributed for malaria prevention, two per household, in the majority of Nigeria; this supplements HE and drug combination therapy as one more way to fight LF. The national programs are actively involved in The Carter Center-assisted program, and The Carter Center has assisted (in differing degrees) in the mass distribution of LLINs in all nine states where we work. Due in part to strong Carter Center advocacy, Nigeria launched its FMOH Guidelines for Malaria-Lymphatic

Filariasis Co-implementation in Nigeria in June 2013. We feel this opportunity for synergy should not be missed.

The LF program in Ethiopia was launched in 2008, starting with LF surveys for antigenemia conducted in several zones in western Ethiopia in areas where MDA for RB was ongoing (results reported in Shiferaw et al.) Lymphatic filariasis in western Ethiopia with special emphasis on prevalence of *Wuchereria bancrofti* antigenaemia in and around onchocerciasis endemic areas (*Transactions Royal Society Tropical Medicine and Hygiene* 2011). With GSK support, The Carter Center assisted in the launching of a Ministry of Health LF elimination pilot program in 2009 that provided roughly 75,000 treatments annually. Now the program is delivering more than 10 times that each year. Additional mapping is required in Ethiopia. The Carter Center has assisted (in differing degrees) in the mass distribution of LLINs for malaria in several Regions of Ethiopia. These LLINs are undoubtedly impacting LF transmission.

ANNEX 7: The Schistosomiasis/Soil Transmitted Helminthiasis Control Program

SCHISTOSOMES

Schistosomiasis is acquired from contact with infected fresh water. Cercariae, released from infected snails, penetrate the skin and develop into adult worms that reside in venules of the intestines (*Schistosoma mansoni*) or bladder and genitals (*S. haematobium*). Female worms lay thousands of eggs that exit the body in feces or urine. If the eggs gain access to fresh water, they hatch and release miracidae, which swim in search of certain types of snails that they penetrate and infect. In the snails, the miracidiae transform and multiply, releasing cercariae, thus continuing the lifecycle. Disease from schistosomiasis comes from the inflammation caused by the eggs deposited into human tissues by the female worms. These eggs cause inflammation, organ damage, bleeding, and anemia. School-aged children (ages five to 14) are the most heavily affected by schistosomiasis and act as the main disseminators of this infection through their urination and defecation in or near fresh water. MDA with the safe and effective oral medicine praziquantel can significantly reduce schistosomiasis morbidity. Praziquantel kills the adult worms and so prevents the eggs from accumulating in tissues. Until 2007, praziquantel was not routinely donated in large amounts to control programs by the pharmaceutical companies (as are Mectizan® and albendazole) and had to be purchased at approximately U.S. $0.20 per child treated. In April 2007, the pharmaceutical company Merck KGaA (E-Merck) announced a 200 million tablet, 10-year donation of praziquantel to the World Health Organization for schistosomiasis control. By 2011, the company's donation had grown to about 25 million tablets per year. In January 2012, Merck KGaA went further: it pledged to increase its praziquantel donation program tenfold, to 250 million tablets per year.

Nigerians suffer in disproportionate numbers from schistosomiasis; an estimated 20 million Nigerians (the highest for any country) need to be treated with praziquantel every one to three years. The Carter Center's Schistosomiasis Control Program currently operates only in Nigeria, in Plateau, Nasarawa, Delta and Edo states (see maps in Nigeria section). The strategy is similar to the RBEP and LF programs: HE and mass annual treatments with safe and effective oral drugs – in this case praziquantel. Until 2007, praziquantel was not routinely donated to the program, although in past years, The Carter Center received limited gifts of praziquantel from pharmaceutical companies including: Bayer AG; Medochemie, Ltd.; and most recently, Shin Poong Pharmaceutical Company, Ltd. The Carter Center purchased the remainder with funds raised from other donors. The aforementioned WHO donation removed the hurdle of the price of praziquantel (approximately U.S. $0.20 per treatment) which restricted the growth of the schistosomiasis program in the past. Other donors to the schistosomiasis program include USAID/RTI ENVISION and the Izumi Foundation.

The strategy in Plateau and Nasarawa is to treat all the estimated one million school-aged children. Treatment in Plateau and Nasarawa addresses coendemic intestinal *Schistosoma mansoni* (SM), in addition to urinary schistosomiasis (*Schistosoma*

haematobium or SH). The change in approach was decided upon after a Carter Center-supported study, in collaboration with Emory University School of Medicine, concluded that the costs of the village-by-village diagnosis of SH and SM would be greater than those of the presumptive treatment of the school-age children (SAC) in all villages. Until improved and less expensive rapid diagnostic methods for SM become available, the least costly approach to the overall problem of schistosomiasis in this part of Nigeria would therefore be widespread mass drug distributions, without screening for at-risk populations.

In Edo and Delta states, where only urinary schistosomiasis has been targeted, adults and children have been treated in communities with urinary schistosomiasis prevalence greater than 50%, and school children alone have been targeted where prevalence exceeded 10%, in accordance with WHO guidelines. However, with new funding from ENVISION, these states will now address intestinal schistosomiasis as well, and the southeast program will begin working in Ebonyi and Enugu states as well.

SOIL TRANSMITTED HELMINTHS

Soil Transmitted Helminthiasis (STH) is caused by a group of intestinal worms that infect humans and are among the most common infections worldwide. The causal agents in humans are the following intestinal lumen dwelling nematodes: *Ascaris lumbricoides* (roundworm), *Trichuris trichiura* (whipworm), or *Ancylostoma duodenale*, and *Necator americanus* (hookworms). While the outwardly visible signs of STH infection are limited, the developmental effects on children can be severe.

Transmission of soil transmitted helminths occurs through feces. Eggs from the adult females are passed into the environment in feces, where they become infective within days (hookworm and whipworm) or weeks (roundworm). Once in the environment, infective eggs are passed either by ingestion of fecally contaminated food or water (*Ascaris* and *Trichuris*) or through penetration of skin by larvae (*Ancylostoma* and *Necator*). The infective eggs of the whipworm hatch, mature, mate, and lay eggs in the intestines within 70-90 days. Both the roundworm, once hatched, and hookworm will migrate through the circulatory system until they reach the lungs. From there, they pass through the trachea and mouth where they are ingested. They then mature, mate, and release eggs within 6-8 weeks.

Heavy infections result in blood loss leading to increased risk of anemia and hypoproteinemia which, in children, can lead to poor physical and developmental growth causing stunting and decreased mental acuity. In adults, this may reduce productivity. In some cases, pulmonary complications can occur caused by the migration of roundworm or hookworm larvae through the lungs and in the case of *Ascaris,* bowel obstructions can occasionally lead to death.

Nigeria ranks second in the world after India in the estimated number of children at risk of infection with more than 43.5 million school aged children requiring preventive chemotherapy and less than 5 million receiving treatment annually. The drugs albendazole and mebendazole can reduce the intensity of infection, thereby controlling morbidity; ivermectin is likewise effective against *Ascaris*. Although adults may suffer

from infection, the current WHO recommended strategy calls for treatment of school-aged-children only, either once or twice per year. In 2013, a large scale survey to identify STH found that treatable levels of infections exist in all nine states currently assisted by TCC. That same year, a surplus of albendazole within Nigeria allowed for treatment of nearly 800,000 children in Plateau and Nasarawa. Future plans to scale up treatment in all nine states by 2015 are underway thanks to support from USAID through the ENVISION program.

ANNEX 8: Monitoring Sustainability and Costs after Withdrawal of Core Funding by the African Program for Onchocerciasis Control (APOC)

The African Program for Onchocerciasis Control (APOC) administers a large World Bank trust fund for onchocerciasis, which provides major, core support for African onchocerciasis projects during their first five years. The Carter Center's River Blindness Program (RBP) and its national partners enjoyed APOC Trust Fund support for delivery of Mectizan® for 18 Carter Center-assisted river blindness projects in Africa, until each completed the five-year cycle between 2002 and 2008 (Table A). Several RBP projects continue to receive support for special initiatives, but no longer receive regular APOC funding for implementation (field) activities such as community mobilization, health education, supervision, monitoring, data collection, and reporting. While these fundamental tasks required for sustaining Mectizan® treatment programs should be the responsibility of the government, RBP has, in general, observed insufficient national funding needed to sustain the original APOC projects, although government support trended upward in 2009.

Table A: APOC funding for The Carter Center assisted CDTI projects

COUNTRY	Project	First year with APOC (JAF, definitive)	5th year APOC core funding ended
Nigeria	Imo/Abia	1998 Sept	2003 Oct
Nigeria	Enugu/Ebonyi/Anambra	1998 Sept	2003 Oct
Nigeria	Edo/Delta	1999 June	2004 Nov
Nigeria	Plateau/Nasarawa	1998 April	2003 May
Cameroon	North Province	1998 Nov	2003 Oct
Cameroon	West Province	2001 Jan	2006 June
Sudan	Northern	1997 May	2003
Uganda	Kasese/Kisoro	1997 May	2002 July
Uganda	Mbale/Kabale	1998 Sept	2003 Oct
Uganda	Kanungu/Nebbi	1998 Dec	2004 June/July
Uganda	Moyo/Gulu/Apac/Adjumani	1999 Aug	2005 Feb
Ethiopia	Illubabor Zone	2004 June	2008 Nov
Ethiopia	Jimma Zone	2004 June	2008 Nov
Ethiopia	Kaffa/Sheka Zones	2000 Aug	2005 Oct
Ethiopia	Bench Maji Zone	2002 Oct	2007 Mar
Ethiopia	North Gondar Zone	2002 Oct	2008 Mar
Ethiopia	Metekel Zone*	2004 Aug	2008 Aug
Ethiopia	Gambella Zone*	2004 Sept	2008 Sept
* APOC began funding in 2004. Carter Center became an NGDO partner in 2005.			

The RBP has made it one of its basic monitoring tasks to collect and refine government and Carter Center funding figures, along with additional funds provided through APOC. Monitoring trends for increased funding is especially important to determine if countries

are filling the “post-APOC” funding gap. The post-APOC gap is defined as budget shortfalls in key areas arising since the withdrawal of core APOC support for distribution activities. The RBP is monitoring Ultimate Treatment Goal (UTG) coverage by post-APOC treatment year as well, and has not observed a decline in treatments in the post-APOC period. However, when RBP has temporarily withdrawn its support, also, we have observed programmatic decline in either treatments (see Rakers et al, *Lancet* 2009) or in programmatic activities such as training, health education or treatment reporting. The ultimate goal for control programs is to see Mectizan® delivery handed over to the full fiscal responsibility of the national, state, and local governments. However, in the new elimination paradigm that has been embraced by APOC and its partners for Africa, the ultimate goal will be to safely stop administering Mectizan®; sustainability as an ultimate goal will no longer be required.

ANNEX 9: Publications by Year Authored or Coauthored by RBEP Personnel

Katabarwa M, Lakwo T, Habomugisha P, et al. Transmission of *Onchocerca volvulus* by Simulium neavei in Mount Elgon Focus of Eastern Uganda Has Been Interrupted. *Am J Trop Med Hyg.* 2014 Jun 4:90(6):1159-66. doi: 10.4269/ajtmh.13-0501.

Katabarwa M, Richards F. Twice-yearly ivermectin for onchocerciasis: the time is now. *Lancet Infect Dis.* 2014 May:14(5):373-4. doi: 10.1016/S1473-3099(14)70732-7.

Katabarwa MN, Endeshaw T, Taye A, et al. The disappearance of onchocerciasis without intervention in Tigray Region in Northwest Ethiopia. *Pathog Glob Health.* 2014 Apr:108(3):123. doi: 10.1179/2047772414Z.000000000198.

Zarroug IM, Elaagip AH, Abuelmaali SA, et al. The impact of Merowe Dam on *Simulium hamedense* vector of onchocerciasis in Abu Hamed focus - Northern Sudan. *Parasit Vectors.* 2014 Apr 4:7:168. doi: 10.1186/1756-3305-7-168.

Anonymous. Meeting of the International Task Force for Disease Eradication January 2014 (Elimination of onchocerciasis and lymphatic filariasis in Africa) *Wkly Epidemiol Rec* 2014: 89: 153-5

Oguttu D, Byamukama E, Katholi CR, et al. Serosurveillance to monitor onchocerciasis elimination: the Ugandan experience. *Am J Trop Med Hyg.* 2014 Feb:90(2):339-45. Epub 2013

Eigege A, Kal A, Miri E, et al. Long-lasting insecticidal nets are synergistic with mass drug administration for interruption of lymphatic filariasis transmission in Nigeria. *PLoS Negl Trop Dis*. 2013 Oct 31:7(10):e2508. eCollection 2013.

Progress towards eliminating onchocerciasis in the WHO Region of the Americas: verification by WHO of elimination of transmission in Colombia. *Wkly Epidemiol Rec.* 2013 Sep 6:88(36):381-5. English, French.

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Progress toward elimination of onchocerciasis in the Americas - 1993-2012.Centers for Disease Control and Prevention (CDC). *MMWR Morb Mortal Wkly Rep.* 2013 May 24:62(20):405-8.

Higazi TB, Zarroug IM, Mohamed HA, et al. Interruption of Onchocerca volvulus transmission in the Abu Hamed focus, Sudan. *Am J Trop Med Hyg.* 2013 Jul:89(1):51-7. Epub 2013 May 20.

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Lakwo TL, Garms R, Rubaale T, et al. The disappearance of onchocerciasis from the Itwara focus, western Uganda after elimination of the vector Simulium neavei and 19 years of annual ivermectin treatments. *Acta Trop*. Jun 2013:126(3): 218-21. Epub 2013 Feb 28.

Evans DS, King JD, Eigege A, et al. Assessing the WHO 50% prevalence threshold in school-aged children as indication for treatment of urogenital schistosomiasis in adults in central Nigeria. *Am J Trop Med Hyg.* Mar 2013:88(3): 441-5. Epub 2013 Feb 4.

Katabarwa MN, Walsh F, Habomugisha P, et al. Transmission of onchocerciasis in Wadelai focus of northwestern Uganda has been interrupted and the disease eliminated.
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Am J Trop Med Hyg. Aug 2012: 87(2): 272-80.

Program Coordinating Committee and OEPA staff. Guide to detecting a potential recrudescence of onchocerciasis during the post treatment surveillance period: the American paradigm. *Research and Reports in Tropical Medicine.* 2012: 3: 21–33.

Emukah E, Gutman J, Eguagie J,et al. Urine heme dipsticks are useful in monitoring the impact of praziquantel treatment on *Schistosoma haematobium* in sentinel communities of Delta State, Nigeria. *Acta Tropica.* Apr 2012: 122(1): 126-31.

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Cupp EW, Sauerbrey M, Richards F. Elimination of Human Onchocerciasis: History of Progress and Current Feasibility Using Ivermectin (Mectizan®) Monotherapy. *Acta Tropica.* 2010 (Supplement on NTDs).

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