The Trachoma Vector in Africa: a case study of The Gambia and Ethiopia

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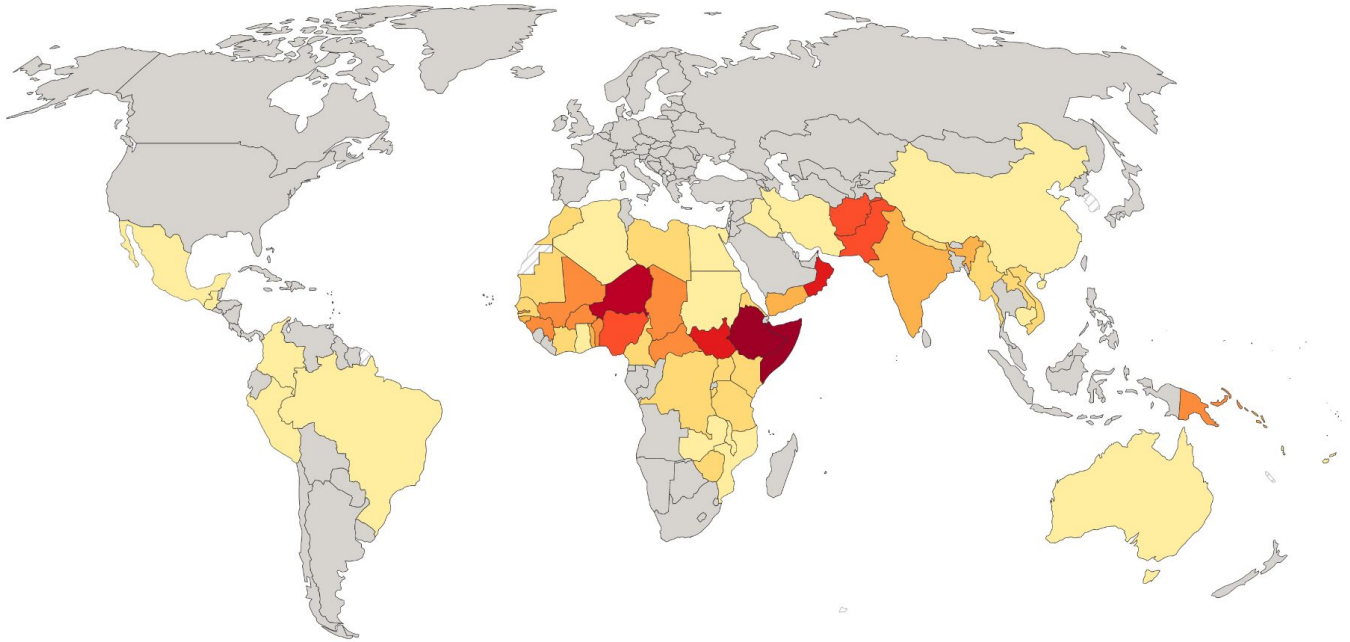
Trachoma

Burden of Disease & Vector

Trachoma prevalence rate, 2019

The prevalence of trachoma in a population measured per 100,000 people. Trachoma is an eye infection by bacterium Chlamydia trachomatis, which can lead to blindness.

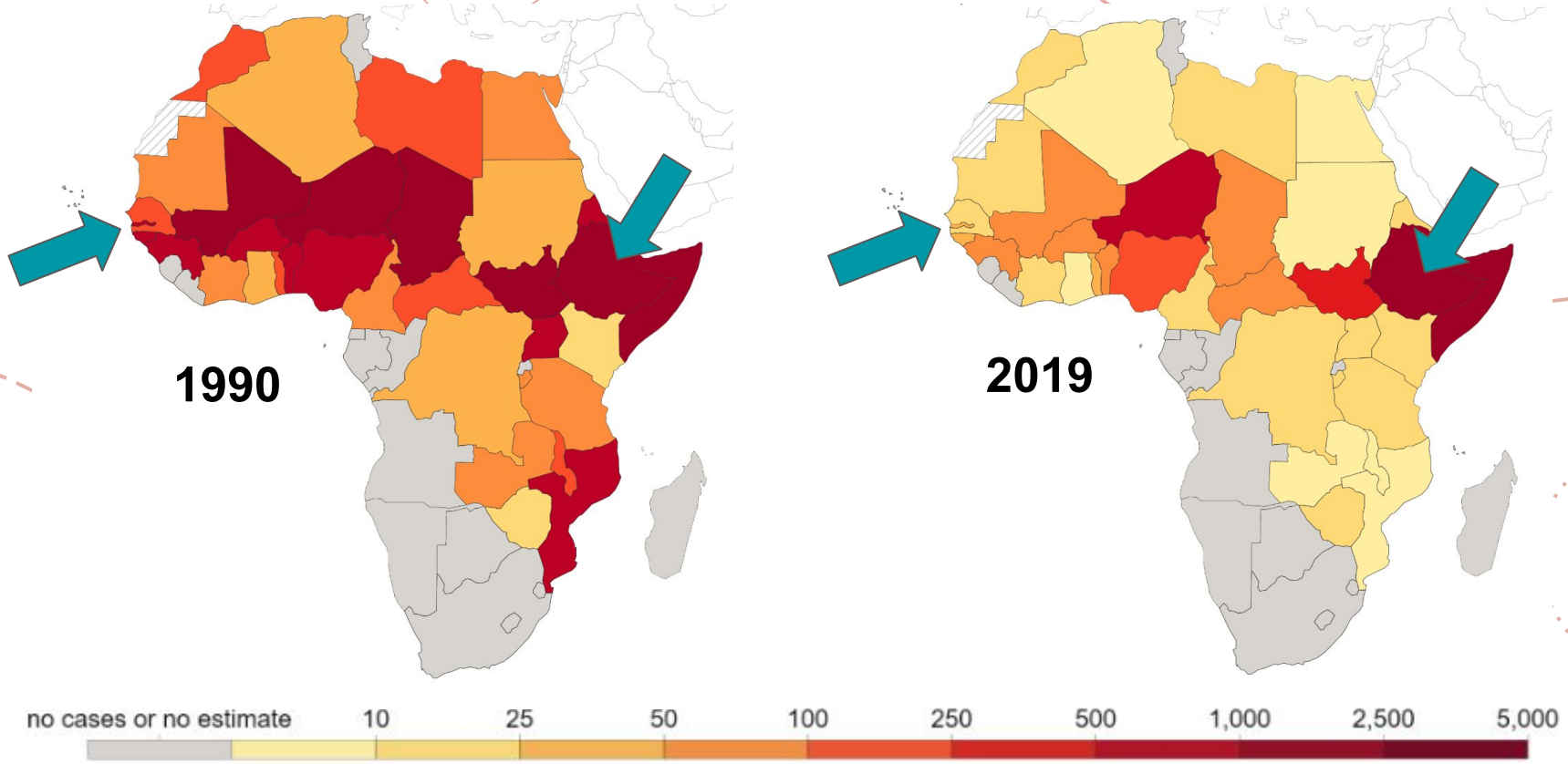
Our World in Data



no cases or no estimate | 10 | 25 | 50 | 100 | 250 | 500 | 1,000 | 2,500 | 5,000

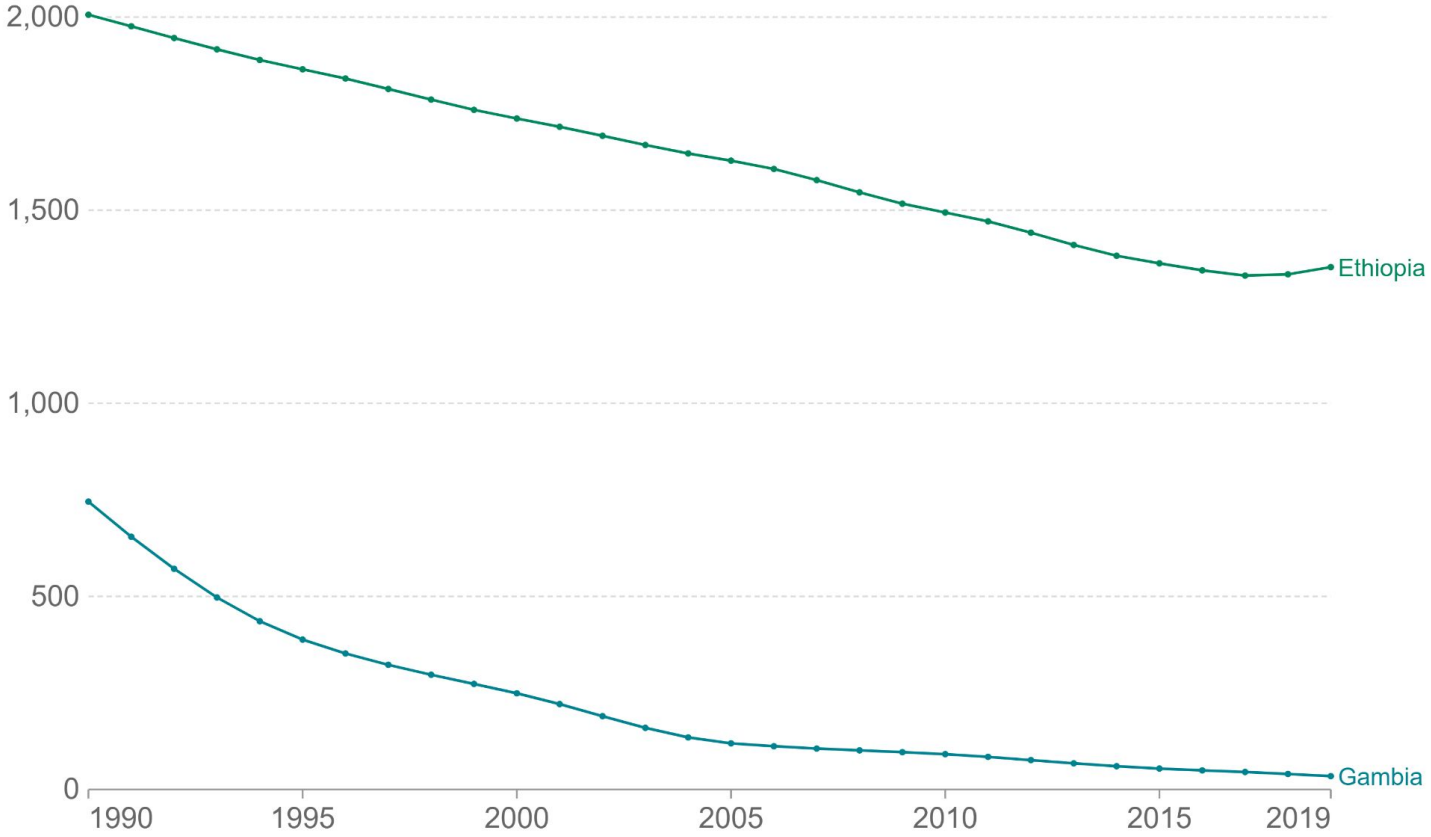
Source: IHME, Global Burden of Disease (2019)

Trachoma Prevalence in Africa



Trachoma prevalence rate, 1990 to 2019

The prevalence of trachoma in a population measured per 100,000 people. Trachoma is an eye infection by bacterium Chlamydia trachomatis, which can lead to blindness.

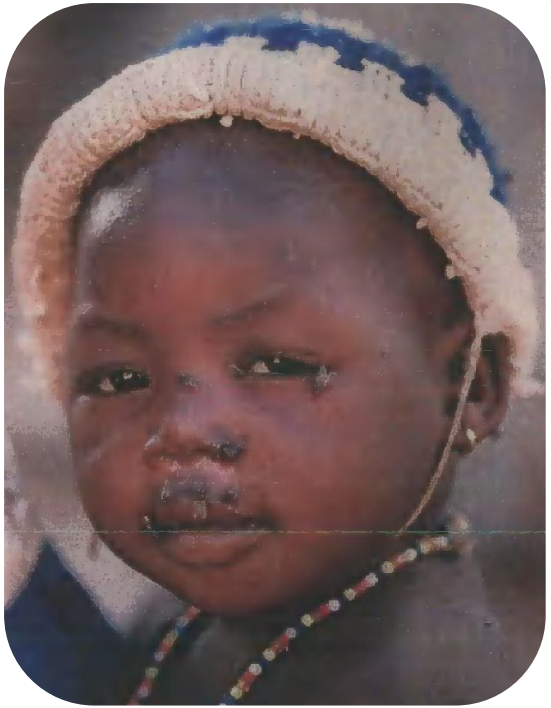


Source: IHME, Global Burden of Disease (2019)

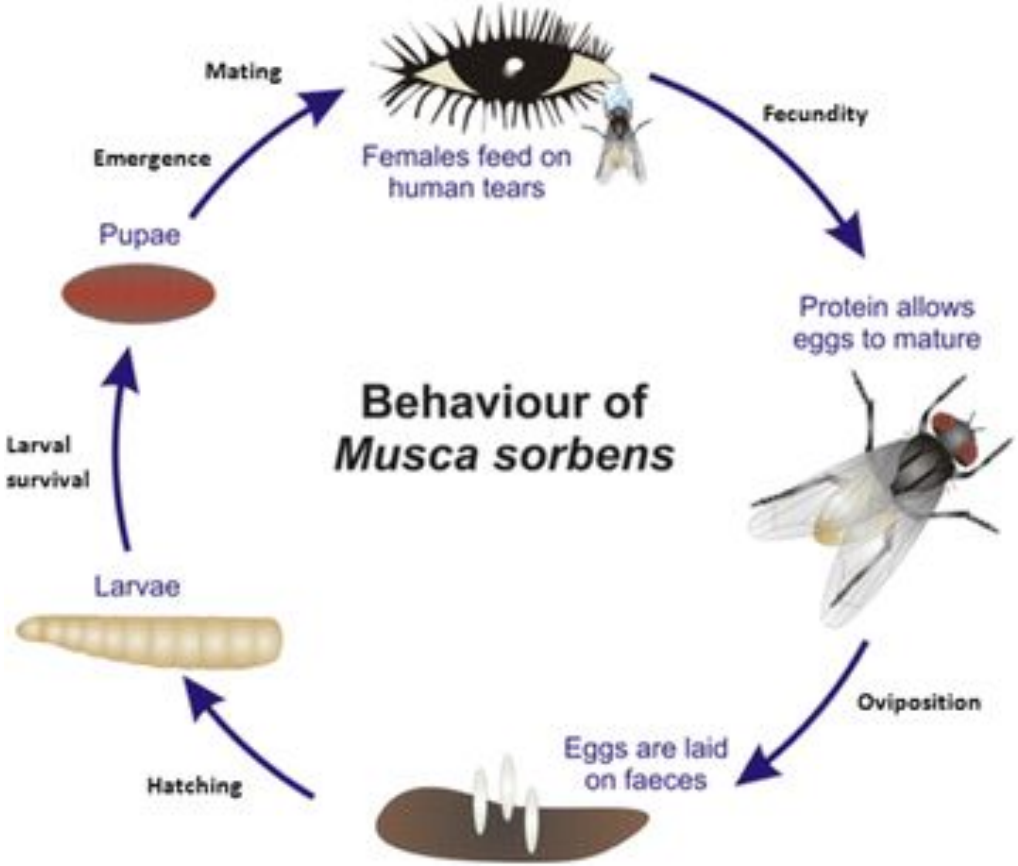
OurWorldInData.org/eradication-of-diseases • CC BY

Populations exposed to and affected by Trachoma

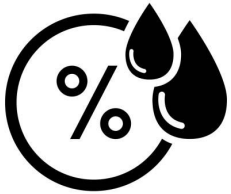
Musca sorbens (Bazaar flies)



Primary Exposure: *M. sorbens*



Climate Change & *M. sorbens*



- Climate effects
- Environmental mediators
- Other insects

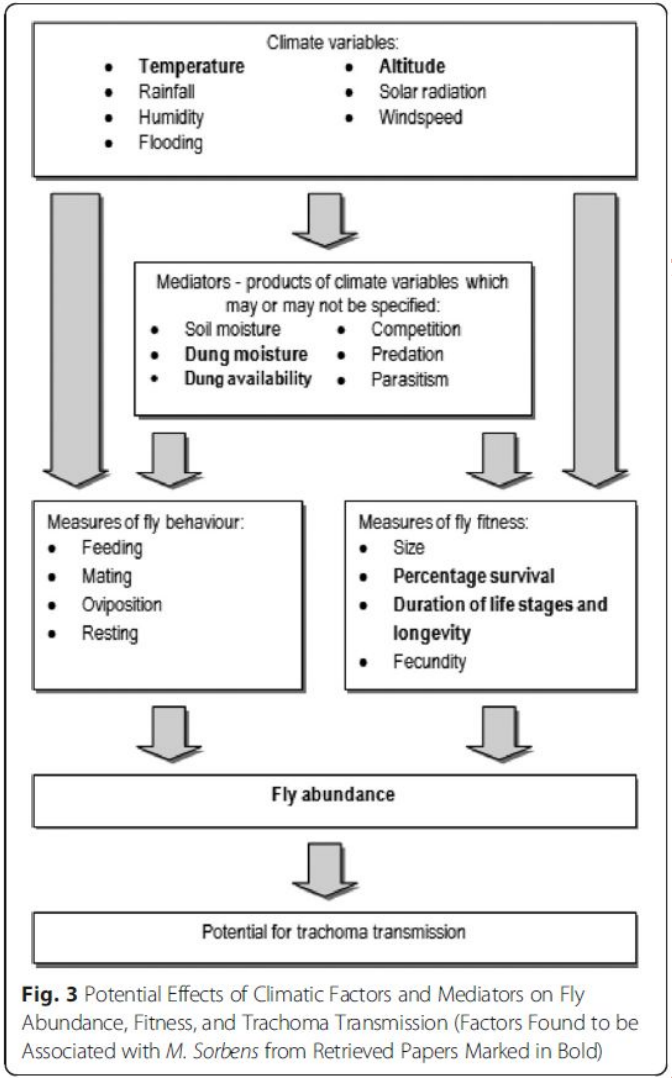


Fig. 3 Potential Effects of Climatic Factors and Mediators on Fly Abundance, Fitness, and Trachoma Transmission (Factors Found to be Associated with *M. Sorbens* from Retrieved Papers Marked in Bold)

The Gambia

The history of control and glimpse into interventions which have lead to the elimination of trachoma as a public health problem

The Gambia

- Officially Republic of The Gambia
- Surrounds the Gambia River
- Population: ~2.35 million
- **2nd country in Africa to have eliminated trachoma as a public health issue**
  - WHO validated in 2021

History of Trachoma Control: Overview

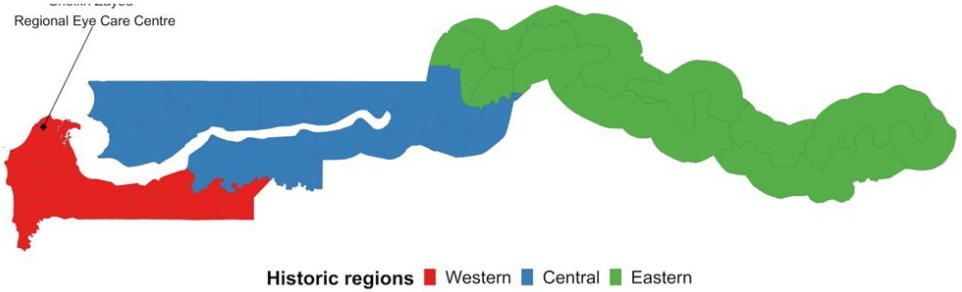
- Fruit of decades of work with the establishment of many partnerships, all working collaboratively to tackle trachoma
  - spanned both private and public sector
  - across different governmental ministries
  - involved the support and efforts of community health workers
- Success now provides a roadmap for other parts of the world

The Gambia's Roadmap:

History of Control: Nationwide Blindness Survey

- Conducted in 1986
- Among the first conducted in Sub-Saharan Africa
- Set the stage for later control efforts

1. Established the baseline prevalence of blindness
2. Identified proportion of blindness attributed to trachoma



Nationwide Blindness Survey: Key Results

- Estimated prevalence of blindness was **0.7%**
- **17%** of blindness attributed to trachoma
- Prevalence of vision loss due to trachoma in women was **0.2%** → **3.5 times higher** than in men of the same age

Table 2 *Age standardised prevalence of visual loss by cause*

	Prevalence in females	*Prevalence in males*	*Prevalence*	
			Ratio	*Difference*
Trachoma	0·20%	0·057%	3·51	0·14%
Cataract	0·94%	0·690%	1·36	0·32%
Uncorrected aphakia	0·15%	0·086%	1·74	0·064%
Other corneal	0·10%	0·057%	1·75	0·043%

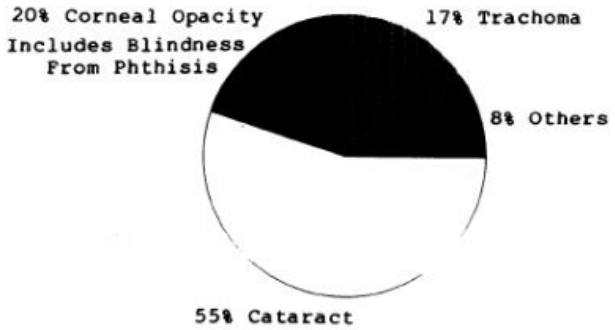


Fig. 4 *Causes of blindness in The Gambia, 1986.*

Faal et al., 1989

History of Control: National Eye Care Programme (NECP)

- Established in June 1986 by the Ministry of Health
  - Exists today → National Eye Health Programme (NEHP)

Overall Goal:
Contribute towards improving the quality of life of the Gambian population by reducing the burden of blindness

- Initially, programme worked independently
  - trained Gambian community volunteers & workers in primary eye care
  - “Nyateros” = “friends of the eye”

History of Control: 2nd Nationwide Blindness Survey

- Conducted in 1996 as follow-up to 1986 survey

Findings:

- Reduction in overall prevalence of blindness; **0.55%** [previously 0.7%]
- **5%** of blindness attributed to trachoma [previously 17%]
- Reduction in trachoma prevalence in children (0–14 yrs); **4.8%** [previously 10.7%]

Attributed to:

- Provision of lid surgery (some!)
- Cohort effect
- Expanding primary healthcare & nyateros
- Improvement in access to water/basic sanitation & hygiene

Dolin et al., 1998

Table 3 Prevalence of active trachoma (TF and/or TI) among children aged 0–14 in the Gambia

Division	*1986 survey prevalence (%)*	*1996 survey prevalence (%)*
Banjul City	2.3	1.9
Western		
Greater Banjul	2.3	4.6
Remainder	14.0	7.8
Lower River	12.3	9.4
North Bank	12.6	6.1
Central River	14.1	4.0
Upper River	5.0	1.2
Total	10.4	4.9

WHO-GET2020 & SAFE Strategy

- In 1996 WHO launched the WHO Alliance for the Global Elimination of Trachoma by the year 2020 (GET2020)

"GET 2020 is a partnership which supports country implementation of the **SAFE strategy** and the strengthening of national capacity through epidemiological assessment, monitoring, surveillance, project evaluation and resource mobilization" - WHO

- **SAFE:** a four-pronged strategy
  - **S**urgery
  - **A**ntibiotics
  - **F**acial Cleanliness
  - **E**nvironmental Improvement

Nationwide Blindness Survey → National Eye Care Program → 2nd Nationwide Blindness Survey → WHO GET2020 → Baseline Mapping → National Trachoma Elimination Plan

NECP- Baseline Mapping + Evolvement

- In 1997 NECP conducted baseline mapping for trachoma
- 1st step of the implementation of GET2020
- NECP now had the strongest evidence on where and who had trachoma

Evolution:

- With WHO as a partner, began to see NECP evolve into a network of numerous partnerships (e.g. Sightsavers, the International Trachoma Initiative (ITI), the Medical Research Council, and the LSHTM)
- Collaborated to draft the National Trachoma Elimination Plan in 2007

International Trachoma Initiative

Sightsavers

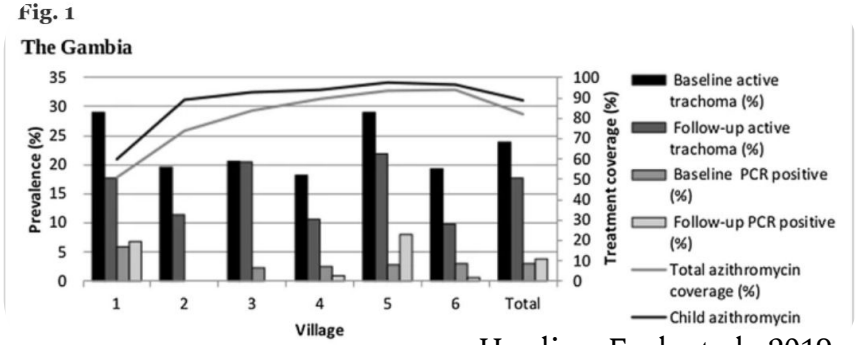
LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

Nationwide Blindness Survey | National Eye Care Program | 2nd Nationwide Blindness Survey | WHO GET2020 | Baseline Mapping | National Trachoma Elimination Plan

MDA: Zithromax (2007-2010)

- Single oral dose of Azithromycin

Impact of a single round of mass drug administration with azithromycin



Harding-Esch et al., 2019

- Children (0–9 years) were examined for clinical signs of trachoma in 6 villages, pre-and one year post-MDA
- **Results:**
  - 1171 children examined at baseline & follow-up
  - Active trachoma prevalence decreased from 23.9% to 17.7%, whereas ocular *C. trachomatis* prevalence increased from 3.0% to 3.8%
    - **Coverage:** Overall treatment coverage with azithromycin was 82.0%. In children aged 0–9 years, coverage was 88.8%

Single round of MDA successful in reducing active trachoma prevalence; no impact on ocular C. trachomatis infection

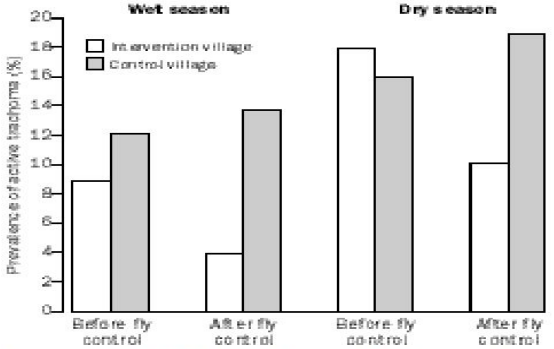
MDA: Strengths & Weaknesses

- **Strengths**
  - Inexpensive
  - Effective → great cost-effectiveness
- **Challenges/Weaknesses**
  - Lack of access to antibiotic treatment for low prevalence districts
    - MDA intervention only administered in districts with prevalence ≥ 10%
    - Screen-and-Treat approach adopted → expensive
      - Considerable personnel, nyateros
    - **Barrier:** funding for Screen-and-Treat
  - Resurgence of active trachoma districts

Vector Control- *Musca sorbens*

- Emerson et al., 1999 established *Musca sorbens* as an important mechanical vector in the transmission of trachoma

WET 1997	WET 1997	DRY 1998	DRY 1998
Sprayed with deltamethrin ~3 months	**Control**	**Sprayed with deltamethrin ~3 months**	**Control**

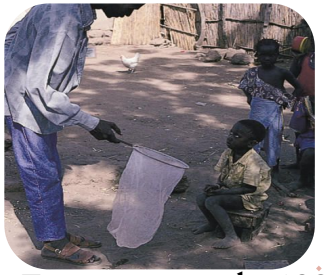


Prevalence of active trachoma before and after fly control in study villages in wet and dry seasons

- Lower trachoma prevalence post spraying (wet and dry)
  - WET: **3.7%** (intervention) vs **13.7%** (control)
  - DRY: **10.0%** (intervention) vs **18.9%** (control)
- **61%** lower community prevalence of active trachoma in the intervention villages

Musca sorbens

- Fly control decreased numbers of muscid flies by ~**75%** in intervention villages
- Reduced fly-eye contact by >**95%**

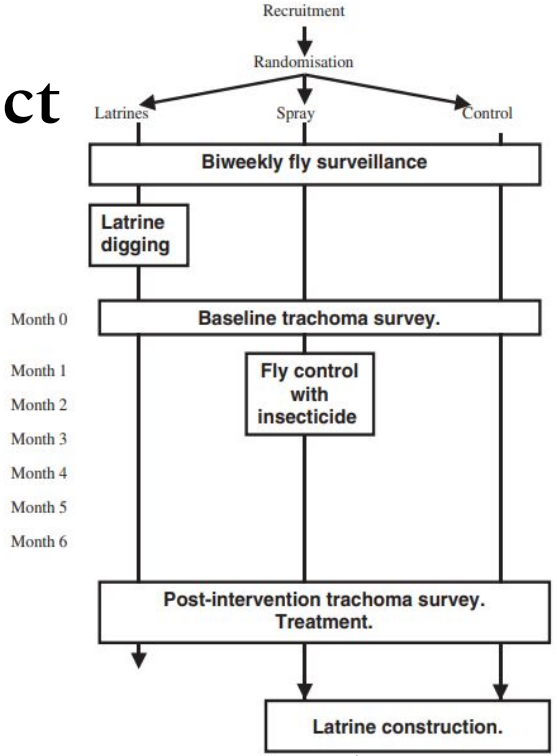


Emerson et al., 1999

Vector Control-The Flies and Eyes Project

- Cluster-randomised intervention trial
  - 7 sets of three village clusters (21 clusters)
  - 2 intervention arms (insecticide spraying, latrine provision) and 1 control arm running concurrently
  - **Coverage**: latrine coverage 100%

- Following completion of intervention trial, all participating villages received pit latrines



Emerson et al., 2002

The Flies and Eyes Project

Design and methods of a cluster-randomised intervention study to confirm the importance of flies as trachoma vectors in The Gambia and to test a sustainable method of fly control using pit latrines

Flies and Eyes - Results

	Musca sorbens		
	Spray	Control	Latrine
Triplet			
1	0·27 (–2·87 to 3·41)	2·32 (–3·22 to 7·86)	0·92 (–2·57 to 4·41)
2	0·61 (–2·73 to 3·95)	2·92 (–2·79 to 8·63)	1·78 (–2·02 to 5·58)
3	0·19 (–0·88 to 1·26)	2·10 (–2·49 to 6·69)	1·23 (–2·35 to 4·81)
4	0·11 (–0·09 to 0·31)	0·50 (–0·09 to 1·09)	0·48 (–0·76 to 1·72)
5	0·06 (–0·94 to 1·06)	1·55 (–1·61 to 4·71)	1·16 (–2·08 to 4·40)
6	0·16 (–1·96 to 2·28)	1·85 (–0·61 to 4·31)	1·85 (–1·90 to 5·60)
7	0·17 (–1·54 to 1·88)	1·95 (–1·36 to 5·26)	1·84 (–2·04 to 5·72)
Mean	0·22 (–0·13 to 0·58)	1·88 (0·42 to 3·35)	1·32 (0·29 to 2·35)

Data are adjusted geometric mean (95% CI) of about 96 fly catches.

Table 3: **Species and geometric mean number of flies caught from the eyes**

Musca sorbens flies:

- Spraying: reduction of **88%**
- Latrines: reduction of **30%**

Trachoma prevalence:

- Spraying: mean reduction of **56%**
- Latrines: mean reduction of **30%**

	Spray			**Control**			**Latrine**		
	Baseline	6 months	Change	Baseline	6 months	Change	Baseline	6 months	Change
Triplet									
1	5·39	4·33	–1·07	2·89	6·27	+3·38	3·57	4·35	+0·78
2	7·46	4·15	–3·31	4·93	5·60	+0·67	3·74	4·61	+0·87
3	11·23	4·16	–7·07	4·04	4·36	+0·33	5·11	2·25	–2·86
4	6·95	1·60	–5·34	8·31	3·66	–4·66	6·20	3·37	–2·83
5	7·26	3·28	–3·98	3·98	2·74	–1·24	9·64	6·53	–3·11
6	3·90	3·89	–0·01	4·43	6·19	+1·76	4·98	1·97	–3·01
7	8·08	4·40	–3·67	6·66	6·30	–0·36	4·21	5·42	+1·21
Mean	7·18	3·69	–3·49	5·03	5·02	–0·02	5·35	4·07	–1·28

Data are number of cases per 100 population.

Table 4: **Age-standardised prevalence of active trachoma for people of all ages**

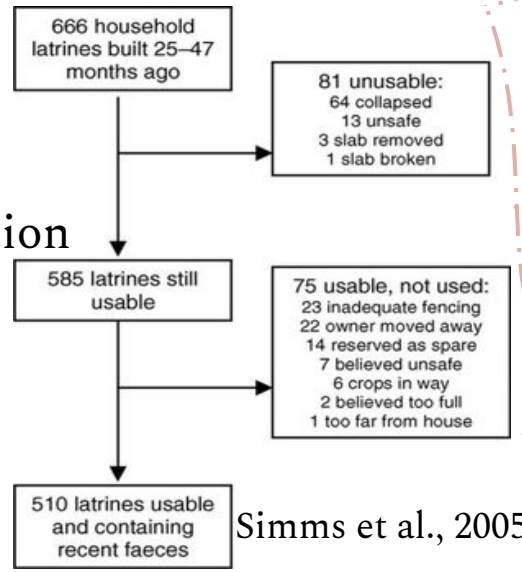
Latrine uptake: **97.1%**

Vector Control: Latrine Provision Sustainability

100% latrine coverage during the intervention + all participating villages given latrines following intervention trial

Sustainability?

- Sustainability and acceptability of latrine provision
- Follow up study → 25-47 months (2-4 yrs) after construction



Simms et al., 2005

Results:

- 510 (**76.6%**) latrines remained in regular use
- 65 (9.8%) temporarily not used
- 91 (13.7%) unusable or abandoned
- **Latrine access risen** from 32% of households (baseline) to **95%** at follow-up

Flies and Eyes VC: Strengths and Weaknesses

Weaknesses:

- Insecticide spraying popular with villagers, but selection pressure→ insecticide resistance
- Pit latrines are temporary by nature
  - Heavy rains → reduce latrine lifespan
- Without support, cost prohibitive

Strengths:

- High latrine uptake (**97.1%**), continued use after 2-4 years
- Spraying reduces other vectors beyond M. sorbens
- Community workers constructed latrines
- Latrine provision: vector control & environmental improvement

Improvement Strategies:

- Mix different insecticides
- Alternative to cement (still needs to be water resistant) → affordability

Barriers:

- Community trust and involvement is critical
- *M. sorbens* not the only route of transmission, contribution varies in time and space

Vector Control - Odor Based Traps

- *Musca sorbens* known to breed in faeces in the environment

Odour based traps to control *M. sorbens*

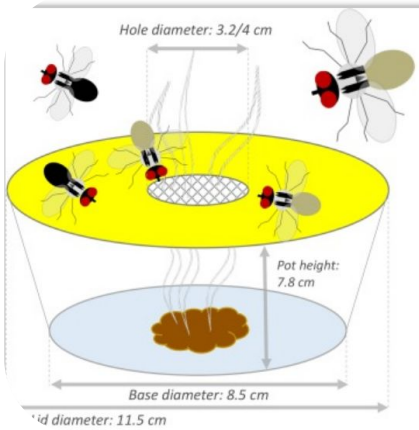
1. Suppress populations to decrease Trachoma prevalence
2. Entomological surveillance + monitoring and evaluating other programmes

Human faeces was the optimum bait

- Identified the compounds (volatiles) resulting in strongest attraction of *M. sorbens*

Before fully deployed, trachoma eliminated as public health problem

Robinson et al., 2021



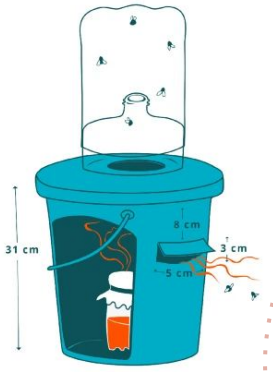
Odor Based Traps - Strengths and Weaknesses

Strengths:

- Effective traps are cheap to construct ($3)
- Increase general household hygiene

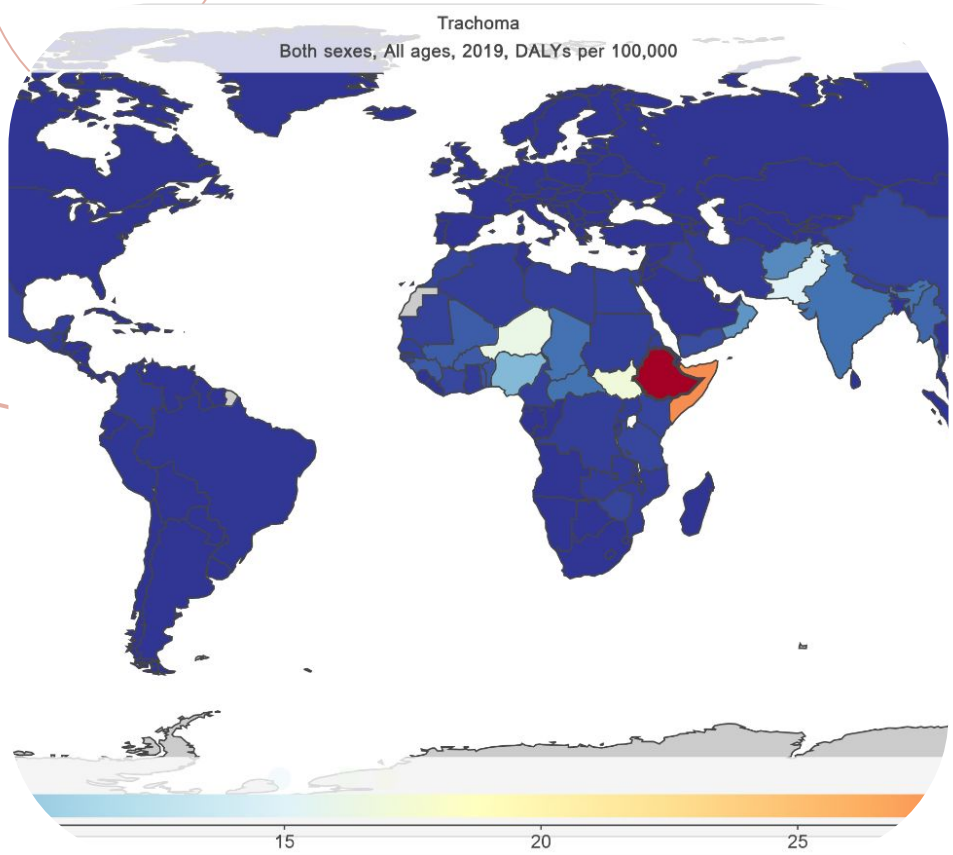
Weaknesses/Challenges:

- Trapping most effective in low vector density
  - Deployed following spraying
- Long research lead time
  - Crafting the ultimate lure only just started
- Coordination of distribution? Switching out bait?



Ethiopia

The history of control and initiatives for elimination



Ethiopia

- Located in East Africa
- Population: roughly 120 million
- **Accounting for 49% of people at risk globally (2020)**

History of Trachoma Control: prior to 2012

NGOs

- Orbis, Amres health Africa, Sight Saver etc…
- MDA (azithromycin, 2001-)

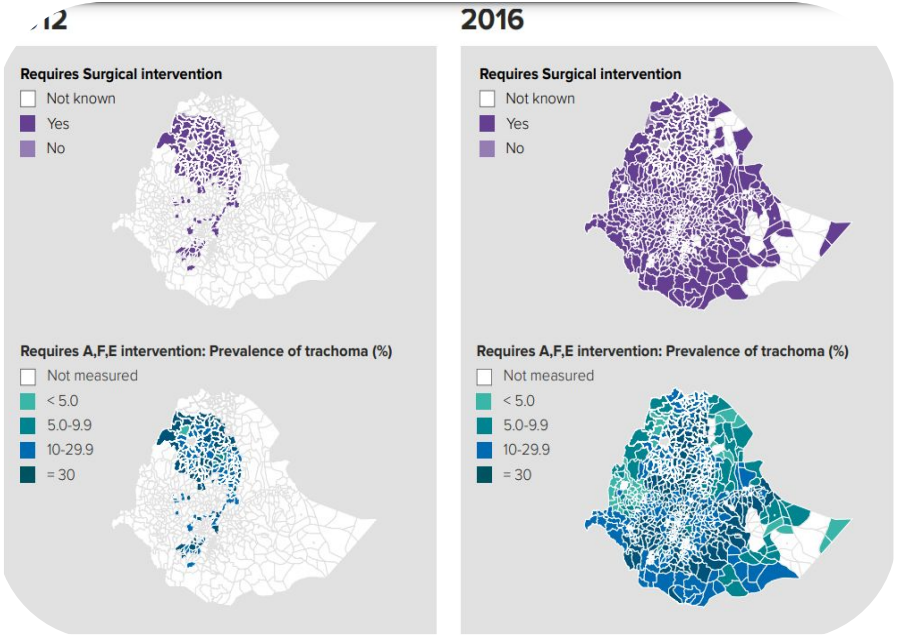
Limitations

- Not comprehensive (only A component)
- Stakeholders acting separately
- Not nationwide
- Lack of information

bet Belachew, aged 7, receiving Zithromax® in the form of oral suspension in the North Mecha Woreda
Region. ETHIOPIA © Brent Stirton / Getty images for the International Trachoma Initiative

History of Trachoma Control: 2012-2019

- First Trachoma Action Plan (2012-)
  - By Ethiopian government
  - Scale up of SAFE strategy
- Global Trachoma Mapping Plan (2012-)
  - Investigation of unknown needs
- One WASH national program (2013)
- Fast Track Initiative (2014-)
  - Training of Eye care workers
  - Mobile surgical teams



Effectiveness: Amhara region

- One of the regions with highest burden of trachoma

Baseline

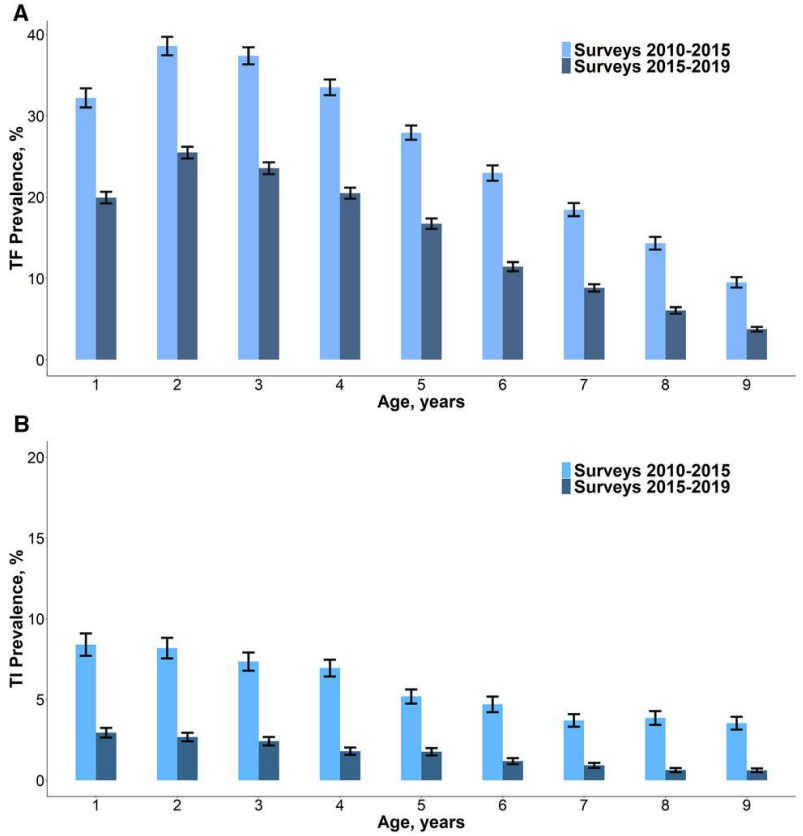
- 94% of districts were endemic (more than 5% prevalence)

Coverage

- Almost 90% coverage of antibiotic distribution
- 61.6% improved water source
- 2.9% improved sanitation

Effectiveness (As of 2019)

- 72% districts reduced prevalence of TF more than 20%
- 28% reached the prevalence less than 5% (elimination as a public health problem)



Looking Ahead: 2019-

- Elimination of blinding trachoma by 2025
  - Prevalence of trachoma among children lower than 5%
  - Lower than 1% among 15 years and older

- Scale up of MDA planned

  Strengths
  - Reach rural areas

  Weaknesses
  - Only MDA is not effective for elimination

Recommendation: Need in scale up of F and E

- Facial Cleanliness
  - Improved access to safe water
  - Education on hygiene and trachoma

- Vector control
  - Pit latrine construction
  - Traps
  - Insecticide spraying
  - Livestock faeces management

Especially in rural areas → close the gap within the country

Recommendation: Possible vector control

- Insecticide treated scarves
  Strengths
  - Reduction of fly-eye contact (35% reduction in a pilot RCT study)
  - Might be less toxic than spraying house

  Weaknesses
  - Children might not want to wear the scarves
  - Not solving the root cause

- Biological control
  - Funghi, mites, beetles

  Strengths
  - No toxic chemicals

  Weaknesses
  - Unknown impact on ecosystem as well as humans

Combination of MDA + Vector Control + Improved Sanitation are Necessary

Questions?

Thank you! :)

Dr. Emerson's TedxEmory talk: Freeing the World from Blindness | Paul Emerson | TEDxEmory - YouTube

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