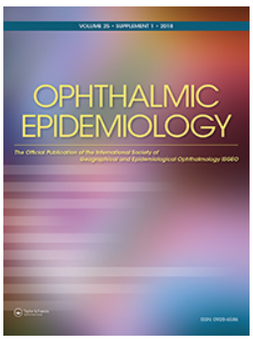

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Prevalence of trachoma in four marakez of Elmenia and Bani Suef Governorates, Egypt

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ABSTRACT

Purpose: In 2015, to determine where interventions are needed to eliminate trachoma as a public health problem from Egypt, we initiated population-based prevalence surveys using the Global Trachoma Mapping Project platform in four suspected-endemic marakez (districts; singular: markaz) of the governorates of Elmenia and Bani Suef.

Methods: In each markaz, 30 households were selected in each of 25 villages. Certified graders examined a total of 3682 children aged 1–9 years in 2993 households, noting the presence or absence of trachomatous inflammation—follicular (TF) and trachomatous inflammation—intense (TI) in each eye. A total of 5582 adults aged ≥15 years living in the same households were examined for trachomatous trichiasis (TT). Household-level access to water and sanitation was recorded.

Results: Three of four marakez had age-adjusted TF prevalence estimates in 1–9-year olds of >10%; the other markaz had a TF prevalence estimate of 5–9.9%. Estimates of the age- and gender-adjusted prevalence of unmanaged TT in adults ranged from 0.7% to 2.3%. Household-level access to water and sanitation was high. (We did not, however, measure use of water or sanitation facilities.)

Conclusions: Each of the four marakez surveyed has trachoma as a public health problem, with a need for implementation of the SAFE (surgery, antibiotics, facial cleanliness, environmental improvement) strategy. Further mapping is also required to determine the need for interventions in other areas of Egypt.

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Trachoma; trichiasis; prevalence; Global Trachoma Mapping Project

Background

With an estimated 89 million residents,[1] Egypt is the most populous country in the Middle East. However, it fares better than some of its neighbours on a variety of health indicators (including deaths from malaria, maternal and infant mortality rates, and prevalence of HIV); neglected tropical diseases such as schistosomiasis, soil-transmitted helminths, and trachoma are endemic.[2,3]

Trachoma's presence in Egypt was documented in the Ebers medical papyrus dating from 1500 BC.[4] During the Napoleonic wars in the early 1800s, troops deployed to Egypt were heavily affected.[5] At the beginning of the twentieth century, in some areas, nearly all young children developed active disease, and more than two-thirds of adults were observed to have trichiasis;[6,7] from 1903 to 1923, seminal work on trachoma was undertaken in Egypt by Arthur Ferguson MacCallan.[8] In the 1970s and 1980s, it was still a widespread problem, including in the capital, Cairo.[9,10] In the mid-1980s, hyperendemic trachoma was seen in two rural communities of Beheira Governorate in the Nile Delta: active trachoma was present in 59% of 3-year olds, while trichiasis and/or

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entropion were seen in children as young as 9 years old and affected a staggering 75% of adult females.[11,12]

In 1999, a population-based survey in the Nile Delta Governorate of Elmenofiya found that 37% of 2–6-year olds had active trachoma, while 6.5% of adults had trichiasis.[13] A 2002 population-based survey of Elmenia Governorate estimated the prevalence of active trachoma in 2–10-year olds to be 42%, and the prevalence of trichiasis in ≥50-year olds to be 6.2%.[14] In 2003, trachoma rapid assessments (TRAs)[15] were undertaken in 15 villages of Elfayoum Governorate. The village-level proportions of 2–10-year-old children observed to have active trachoma ranged from 16% to 85%.[16] A further series of modified TRAs was undertaken in 2010–2011 in 78 villages of four governorates; the proportions of villages in which ≥10% of children examined had the active trachoma sign trachomatous inflammation—follicular (TF)[17] were 6/20 in Elfayoum, 18/20 in Elmenia, 19/20 in Elmenofiya, and 16/18 in Kafr Elsheikh.[18]

Transmission of trachoma's causative agent, *Chlamydia trachomatis*,[19] is thought to be facilitated by a combination of factors including poor sanitation,[11,20] inadequate access to water for face-washing,[21,22] and overcrowding.[23,24] Despite economic improvements across Egypt and the introduction of sewerage to many areas of the Nile Delta in recent decades, trachoma is thought to remain a threat to public health in parts of the country. We sought to collect contemporary data necessary for planning interventions against this disease: specifically, population-based prevalence estimates of TF, trachomatous trichiasis (TT) and access to water and sanitation.[25,26]

Methods

Ethical considerations

Ethics approval was received from the Research Ethics Committee of the London School of Hygiene & Tropical Medicine (reference numbers 6319 and 8355) and the Egypt National Ministry of Health Ethics Committee (20 May 2013). Verbal informed consent was obtained from all adults examined and from the household head on behalf of children in their care.

Study design

We used the principles and protocols of the Global Trachoma Mapping Project (GTMP).[27,28] The survey sample size in each evaluation unit was based on an expected TF prevalence of 10% and a desire to be 95% confident of estimating the true TF prevalence with absolute precision of 3%. The design effect was estimated at 2.65, leading to our sample size estimate of 1019 1–9-year-olds, which was then inflated by 20% to account for partial non-response.[27] We did not calculate a specific sample size for TT, for which prevalences are generally very low, but instead used a household-sampling approach in which a fixed number of households were selected in each cluster, with that number determined by the number of children that we needed to include to generate an adequate sample size for TF.[27]

We undertook population-based surveys in the Governorates of Elmenia and Bani Suef, using the markaz (district; plural: marakez) as the evaluation unit. Due to constraints in availability of personnel, only four surveys could be conducted. Elmenia Governorate was believed (on the basis of recent research[29]) to have a high TT burden; its most northern, most southern, and a central markaz were selected for inclusion. Bani Suef Governorate lies just to the north of Elmenia Governorate. Its most southern markaz was surveyed, based on the understanding that local conditions here were most similar to those in Elmenia. Within each markaz, clusters were selected by creating a list of villages with corresponding village-level population estimates, then systematically sampling from that list with probability proportional to population size.[26] In order to select sufficient households in which $1019 \times 1.2 = 1222$ one-to-nine-year olds would be resident, 25 villages were selected in each markaz, and 30 households were chosen in each selected village. A compact segment sampling technique was employed to select households.[30–35]

Fieldwork

Trachoma grading was undertaken according to the WHO simplified grading scheme,[17] using 2.5× binocular loupes (OptiVISOR, Donegan Optical, Lenexa, KS, USA) and sunlight illumination. Graders and data recorders were trained prior to the surveys and certified according to the standardized training protocols of the GTMP, as described elsewhere.[27] Version 3 of the training system was used.[36]

All consenting residents in the household aged ≥1 year were examined for trichiasis, TF, and trachomatous inflammation—intense (TI). Eyes with trichiasis were considered to have TT if they also had TS, or if the eyelid could not be everted for conjunctival examination by the grader. Participants identified to have trichiasis were asked whether they had been offered surgery or epilation by a health professional. All children identified as having active trachoma (TF and/or TI in one or both eyes) were provided with two tubes of

Table 1. Adults and children resident, examined, absent and refused, by markaz, Global Trachoma Mapping Project, Egypt, 2015.

	Children aged 1–9 years				Adults aged ≥15 years			
Markaz	Enumerated	Examined	Absent	Refused	Enumerated	Examined	Absent	Refused
Abu Quorquas	925	916 (99.0)	6 (0.6)	3 (0.3)	1502	1479 (98.5)	16 (1.1)	6 (0.4)
Deir Mawass	1098	1097 (99.9)	1 (0.1)	0 (0.0)	1458	1400 (96.0)	54 (3.7)	4 (0.3)
Matai	842	837 (99.4)	4 (0.5)	1 (0.1)	1513	1480 (97.8)	14 (0.9)	19 (1.3)
Elfashn	843	832 (98.7)	11 (1.3)	0 (0.0)	1556	1223 (78.6)	299 (19.2)	33 (2.1)
Total	3708	3682 (99.3)	22 (0.6)	4 (0.1)	6029	5582 (92.6)	383 (6.4)	62 (1.0)

1% tetracycline eye ointment and their parents or guardian were instructed on how to use it. Participants with trichiasis were referred for surgery.

Data recording and analysis

Data entry and upload was accomplished via the bespoke Open Data Kit-based GTMP data capture system running on Android smartphones.[27] Data were encrypted during transit and stored in a secure server with only the study investigators having access; cleaning was undertaken by the GTMP data managers (AB and RW). TF data were adjusted at cluster level for the age of those examined, in 1-year age bands. TT data were adjusted at cluster level for age and gender of those examined, in 5-year age bands. Markaz-level estimates were generated by taking the arithmetic mean of the adjusted cluster-level proportions. Confidence intervals for TF and TT prevalence estimates were determined by bootstrapping the adjusted cluster-level proportions of each sign, with replacement, over 10,000 replicates.

Results

Surveys were conducted from 29 November to 25 December 2015 in Abu Quorquas, Deir Mawass and Matai marakez of Elmenia Governorate, and Elfashn markaz of Bani Suef Governorate. Field teams visited a total of 2993 households in 100 clusters across the four marakez. In total, of 3708 1–9-year-old children resident in selected households, 3682 were examined (Table 1).

The estimated age-adjusted markaz-level TF prevalence in 1–9-year olds ranged from 8.4% to 25.3% across the four marakez (Table 2, Figure 1). A total of 134 individuals aged ≥15 years had TT, of whom 46 had bilateral TT. The estimated age- and gender-adjusted prevalence of TT exceeded 1% in each of the four marakez (Table 2, Figure 2). In Elfashn, 14 (64%) of the 22 individuals identified as having TT had been offered surgery or epilation by the health system; corresponding proportions elsewhere were 8/26 (31%, Matai), 17/59 (29%, Deir Mawass), and 7/27 (26%, Abu Quorquas).

Based on these prevalence estimates for TF and TT, applied to 2017 population estimates, for trachoma elimination purposes, >1.7 million people in the four marakez should receive antibiotics, facial cleanliness promotion, and environmental improvement and 8712 people require eyelid surgery to correct TT (Table 3).

Discussion

In the absence of an effective vaccine,[37] the public health approach to preventing trachoma blindness involves reducing *C. trachomatis* transmission intensity by maximising access to water and sanitation and encouraging personal hygiene;[38–40] periodically clearing prevalent infection with antibiotics;[41] and preventing further trachoma-related vision loss in those who already have trichiasis through provision of quality eyelid surgery.[42] These interventions together

Table 2. Prevalence of trachomatous inflammation—follicular (TF) and trachomatous inflammation—intense (TI) in 1–9-year olds, and prevalence of trachomatous trichiasis (TT) in ≥15-year olds, four marakez of Elmenia and Bani Suef Governorates, Global Trachoma Mapping Project, Egypt, 2015.

Markaz	Age-adjusted[a] prevalence of TF in 1–9-year olds (95% CI)	Age-adjusted[a] prevalence of TI in 1–9-year olds (95% CI)	Age- and gender-adjusted[b] prevalence of TT in ≥15-year olds (95% CI)	Age- and gender-adjusted[b] prevalence of unmanaged TT in ≥15-year olds (95% CI)
Abu Quorquas	12.0 (7.5–18.2)	3.5 (1.8–5.5)	1.1 (0.5–1.9)	0.8 (0.4–1.5)
Deir Mawass	25.3 (19.2–32.6)	7.0 (3.8–10.7)	3.1 (1.9–4.6)	2.3 (1.2–3.6)
Matai	8.4 (5.6–10.7)	0.9 (0.2–1.6)	1.2 (0.5–1.9)	0.9 (0.4–1.4)
Elfashn	11.6 (7.3–17.3)	8.0 (4.6–11.8)	1.1 (0.5–1.9)	0.7 (0.2–1.5)

[a]Adjusted for age in 1-year age bands (see text).
[b]Adjusted for gender and age in 5-year age bands (see text).
CI: Confidence interval.

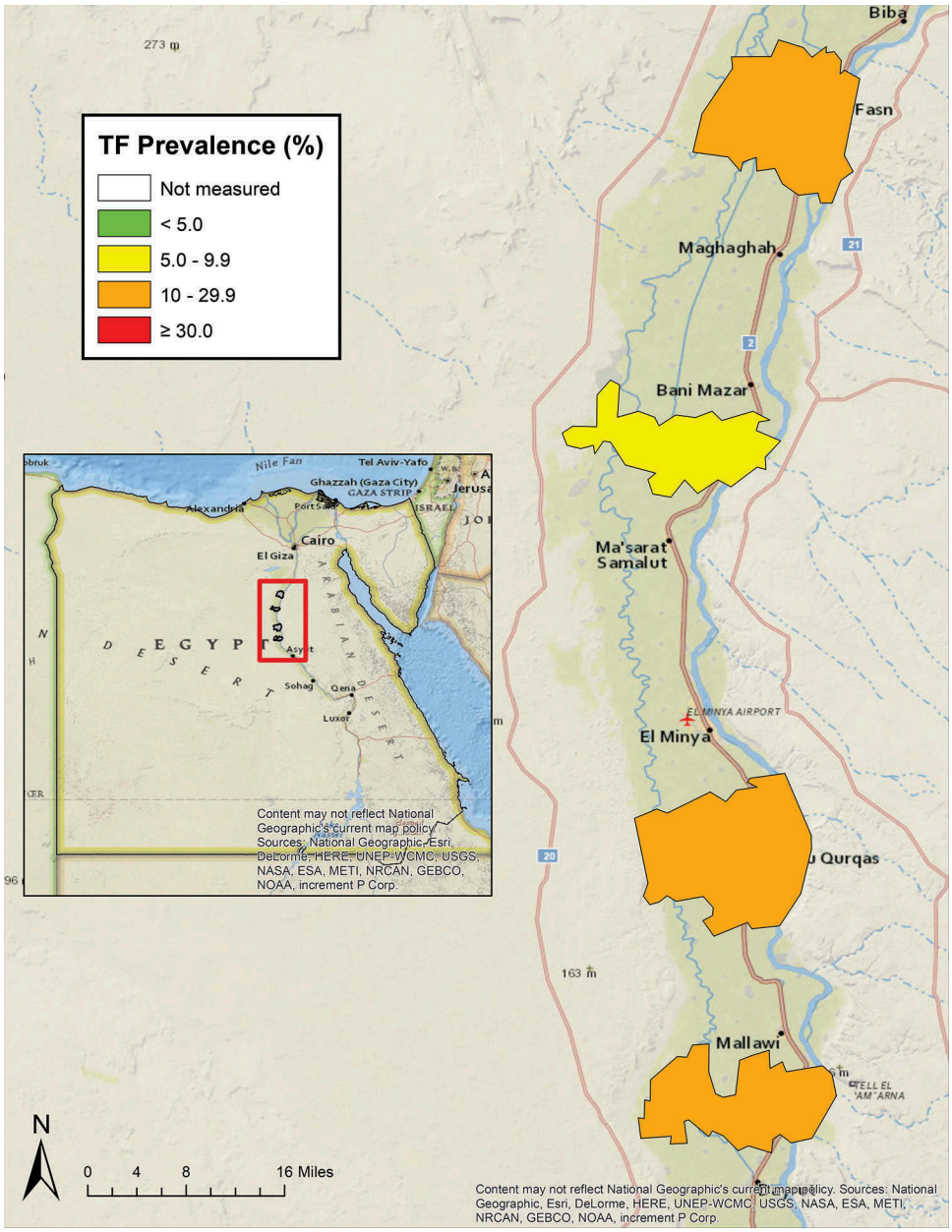

Figure 1. Prevalence of trachomatous inflammation—follicular (TF) in 1–9-year olds, four marakez of Elmenia and Bani Suef Governorates, Global Trachoma Mapping Project, Egypt, 2015.

comprise the "SAFE strategy": surgery, antibiotics, facial cleanliness, environmental improvement.[43] The SAFE strategy works[44,45] and is recommended by the World Health Organization, which leads an Alliance aiming to eliminate trachoma as a public health problem by 2020. SAFE strategy interventions, however, have to compete for prioritization in a crowded public health landscape. Robust prevalence data are required to make the case for funding. Though there are some limitations of our work here—particularly the relatively large size of evaluation units surveyed—we believe that our estimates are of evidence-based metrics, are reproducible, and justify planning for SAFE strategy implementation in the areas surveyed.

In three of four suspected trachoma-endemic marakez of Egypt, we found the TF prevalence to be ≥10%. In Matai, the fourth markaz, TF prevalence was 8.5%. Based on WHO guidelines,[26] Abu Quorquas, Deir Mawass, and Elfashn should be managed with three annual rounds of antibiotic mass drug administration (MDA) plus initiatives to ensure facial cleanliness and improve the environment, before a repeat prevalence survey 6–12 months after the third MDA round. In Matai, one round of MDA, facial cleanliness, and environmental improvement activities are needed before re-survey. In

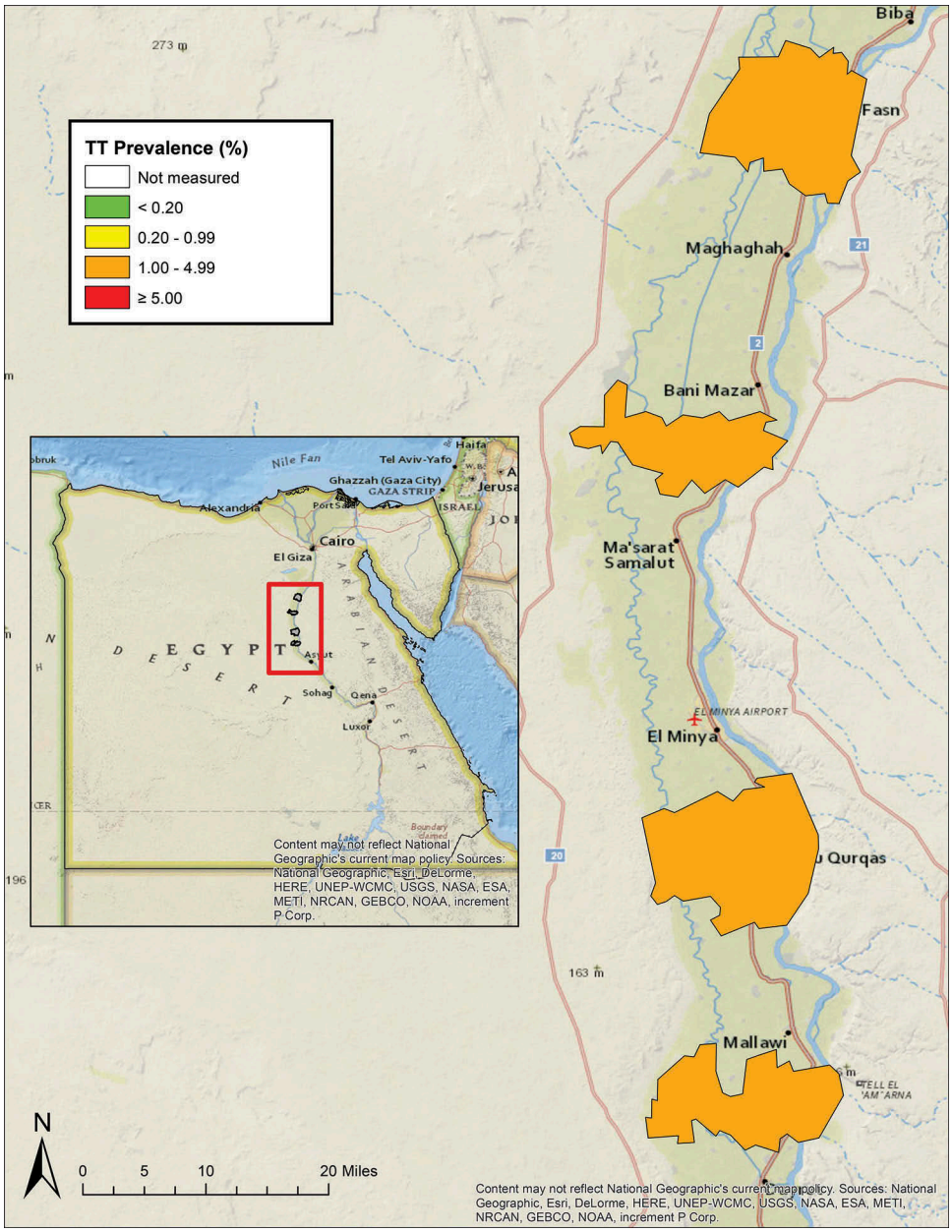

Figure 2. Prevalence of trachomatous trichiasis (TT) in ≥15-year olds, four marakez of Elmenia and Bani Suef Governorates, Global Trachoma Mapping Project, Egypt, 2015.

Table 3. Estimated numbers of people needing surgery (S) for trachomatous trichiasis (TT), antibiotics (A), facial cleanliness (F), and environmental improvement (E) interventions, for trachoma elimination purposes, in four marakez of Elmenia and Bani Suef Governorates, Egypt, 2017.

Markaz	Number of people with TT	Number of people with unmanaged TT	Number of people needing S to achieve the TT elimination threshold	Number of people needing A, F, and E (2017 population estimates)
Abu Quorquas	3590	2611	1958	593,356
Deir Mawass	6505	4826	4407	381,535
Matai	2000	1500	1166	302,978
Elfashn	2598	1653	1181	429,434
Total	14,693	10,590	8712	1707,303

each round, antibiotic coverage of at least 80% of the markaz population is recommended.[46,47] Although WHO guidelines recommend that the A, F, and E components of the SAFE strategy be implemented wherever the TF prevalence exceeds the 5% elimination threshold, it is notable that access to water and sanitation

Table 4. Household access to water and sanitation facilities, four marakez of Elmenia and Bani Suef Governorates, Global Trachoma Mapping Project, Egypt, 2015.

Markaz	Households enumerated (*n*)	Proportion of households (%)		
		With access to an improved water source in the residence/yard	With access to an improved water source within a 30-min round trip	With household-level access to an improved sanitation facility
Abu Quorquas	750	99	100	100
Deir Mawass	748	100	100	100
Matai	747	96	100	100
Elfashn	748	100	100	100

in these four marakez was nearly universal. In each markaz, >95% of households had an improved water source in the residence or yard, and all households visited had access to an improved latrine (Table 4). These levels of access exceed by some margin the access thresholds expected to confer herd protection against trachoma[20,48]—a demonstration of the heterogeneity of environmental correlates of trachoma and the fact that access to sanitation hardware does not necessarily lead to protection from diseases associated with its absence[49]: access may still be inadequate for some population subsets, or facilities may not be used in ways that decrease the risk of *C. trachomatis* transmission. Anecdotally at least, in areas of Egypt in which mains sewerage is not available, people often defaecate where their animals are kept, rather than in household latrines.

The prevalence of unmanaged TT ranged from 0.7% (Elfashn) to 2.3% (Deir Mawass) in the four marakez surveyed here. Elimination of trachoma as a public health problem requires that the prevalence of TT unknown to the health system be reduced to <0.2% in adults.[50] Community-based case identification and provision of quality lid surgery by certified operators[51] is urgently needed in these populations to stem the tide of trachoma-related blindness and visual impairment.

These findings indicate the urgent need to implement the SAFE strategy for trachoma elimination in all four marakez. F and E interventions should incorporate established techniques for achieving sustained behaviour change.[52] Priority should be given to Deir Mawass, where prevalences of both TF and TT were the highest of the four marakez, and the proportion of people with TT who had previously been offered management was the lowest. In all, however, >1.7 million people in these four marakez need services to eliminate trachoma as a public health problem—and it is likely that other markaz in Egypt will also need interventions, a hypothesis that will need to be confirmed or refuted through further population-based surveys.[25,53] It is currently estimated that at least 29 marakez still need to undergo baseline surveys. Of Egypt's international neighbours, only Sudan[23,54] is currently thought to have a public health problem from trachoma, so cross-border issues are not currently believed to be a priority here.

Global progress towards the target of eliminating trachoma as a public health problem has recently gathered pace, with a number of countries now validated by the World Health Organization as having achieved that milestone at national level.[55] Armed with the evidence generated by this series of surveys and those that will follow, Egypt can now proceed to trachoma action planning[56] and engage with relevant stakeholders, starting along the path to national trachoma elimination.

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Appendix

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