World Health Organization Alliance for the Global Elimination of Trachoma by 2020

Second Global Scientific Meeting on Trachomatous Trichiasis

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## Abbreviations

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<tbody>
<tr>
<td>BLTR</td>
<td>bilamellar tarsal rotation</td>
</tr>
<tr>
<td>CO</td>
<td>corneal opacity</td>
</tr>
<tr>
<td>HEAD START</td>
<td>human eyelid analogue device for surgical training and skills reinforcement in trachoma</td>
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<tr>
<td>PLTR</td>
<td>posterior lamellar tarsal rotation</td>
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<tr>
<td>TF</td>
<td>trachomatous inflammation—follicular</td>
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<tr>
<td>TS</td>
<td>trachomatous conjunctival scarring</td>
</tr>
<tr>
<td>TT</td>
<td>trachomatous trichiasis</td>
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<td>WHO</td>
<td>World Health Organization</td>
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1. **Introduction**

1.1 With support from a number of international nongovernmental organizations, the Kilimanjaro Centre for Community Ophthalmology hosted the first Global Scientific Meeting on Trachomatous Trichiasis from 30 January to 1 February 2012 in Moshi, United Republic of Tanzania. That meeting led to the publication of a report [1] as well as to the development of preferred practice materials [2, 3] on surgery for trichiasis. Between February 2012 and November 2015, additional evidence on and experience in the management of trichiasis was accumulated. A second Global Scientific Meeting on Trachomatous Trichiasis was therefore convened from 4–6 November 2015 in Cape Town, South Africa, by the Kilimanjaro Centre for Community Ophthalmology, acting in its capacity as a candidate World Health Organization (WHO) Collaborating Centre for Trachoma, and at WHO’s request.

1.2 The purpose of the meeting was to review published and unpublished data on trichiasis that might help guide those delivering trichiasis services as part of trachoma elimination programmes. The meeting agenda is included as Annex 1. Participants are listed in Annex 2.

1.3 Unpublished data were discussed with the understanding that this would be done “off the record”. Participants signed non-disclosure agreements in relation to those parts of the conversation. In this report, therefore, references are provided to support some, but not all, of the decisions made.

1.4 Even in areas where trachoma is endemic, not all trichiasis is trachomatous (see 12.9, below). Because there is not yet international consensus on how trachomatous trichiasis (TT) and non-trachomatous trichiasis should be differentiated at the level of an individual patient, this document will generally refer to “trichiasis” rather than to “TT”, except where the context requires use of “TT”.

1.5 Neither the recommendations made in this report, nor the standard operating procedures that arise from it to be offered as formal guidance to trachoma elimination programmes, should be considered to limit programmes or surgeons from exercising appropriate judgement tailored to the circumstances of particular environments or particular patients.

1.6 Neither the recommendations made in this report, nor the standard operating procedures that arise from it to be offered as formal guidance to trachoma elimination programmes, should be considered to be final and unchanging. **Guidance should be expected to evolve as the evidence base used to inform that guidance develops.**

2. **Should a TT clamp or a Waddell clamp be used?**

2.1 When conducting bilamellar tarsal rotation (BLTR), it is standard practice [4] to use two haemostats to stabilize the eyelid, and to perform a full-thickness incision in two separate steps. In both steps, the cut is made towards the eyeball. This could potentially result in jagged edges of the wound, or (if it is left unprotected) damage to the eyeball.

2.2 Two instruments are commercially available to resolve these issues: the TT clamp [5] and the Waddell clamp [6]. The TT clamp is included on the TT surgery essential equipment list of the International Agency for the Prevention of Blindness [7]. The TT clamp costs approximately US$ 25; the Waddell clamp costs approximately US$ 64 [8].

2.3 A randomized controlled trial [8] has compared BLTR using standard instrumentation (no clamp; n = 960 people, 1674 eyes) with BLTR using a TT clamp (n = 957 people, 1671 eyes).
Unfavourable outcomes (including post-operative trichiasis, granulomata and eyelid contour abnormalities) were frequent in both groups. Granulomata and mild eyelid contour abnormalities were significantly less common following surgery with the TT clamp. Post-operative trichiasis at 2 years was more frequent following BLTR using a TT clamp (43%) than following BLTR with standard instrumentation (37%), although the difference was not statistically significant. Significantly fewer passes with the blade were made per operation, and surgery was faster (8.6 vs 9.9 minutes from placing the first instrument to tying the last suture, $p = 0.01$) in the TT clamp group. Excessive intra-operative bleeding, post-operative bleeding and division of the eyelid margin all occurred slightly more frequently in the standard instrumentation group. (There are no comparable published data on the Waddell clamp.)

2.4 The use of a clamp (TT clamp or Waddell clamp) during BLTR is recommended. Clamps are believed to protect the eyeball from damage, provide a steady surface on which to make a full thickness cut with a single application of the scalpel, and permit the maintenance of a relatively bloodless surgical field. In order to be able to incise all the way to the end of the lid margin laterally, the largest clamp size that can be used on the patient should be selected. Trichiasis surgery kits, therefore, should include the largest size of either the TT clamp or the Waddell clamp; each surgeon should also have the other two sizes of clamp (ideally two of each size) readily available.

3. Where should the incision be made relative to the eyelid margin?

3.1 The second (2015) edition of Trichiasis surgery for trachoma, published by WHO [4], recommends that when undertaking either BLTR or the Trabut procedure (one of several variants of posterior lamellar tarsal rotation, PLTR), the incision should be placed 3 mm from the eyelid margin [4]. However, the evidence underlying this recommendation is unclear [9].

3.2 Oculoplastic opinion at the meeting was that, for anatomical reasons, the minimum incision height needed to achieve appropriate tarsal rotation is 2.5–3.0 mm.

3.3 In 145 patients from the Partnership for the Rapid Elimination of Trachoma trial cohort [8], at the 1-year post-operative visit, the further the scar on the conjunctival surface was from the eyelid margin, the less likely it was that the eye had post-operative trichiasis; at > 4.5 mm between scar and lid margin, the drop in risk seemed to level off [9]. These data are hypothesis-generating rather than hypothesis-confirming, however, because they are retrospective and observational, rather than being obtained from a prospective, randomized trial. Randomized controlled trial data are required before changing the current recommendation to place incisions 3 mm from the eyelid margin. A trial that will generate relevant data is anticipated to begin in 2016. (No change to current guidance.)

3.5 Incision line measurements and markings should be made before injecting local anaesthetic, because injection of anaesthetic distorts the eyelid tissues.

4. Which procedure should be used?

4.1 The second (2015) edition of Trichiasis surgery for trachoma [4] gives equal prominence to BLTR and the Trabut procedure, and does not identify either as being preferred. Neither the original comparative trials, conducted in 1986 in Oman ($n = 165$ patients, each of whom was randomized to one of five procedures [10]), nor a 1997–1999 randomized trial comparing BLTR and PLTR in Ethiopia ($n = 256$ eyelids of 153 patients [11]), demonstrated a statistically significant difference in the incidence of post-operative trichiasis between patients undergoing BLTR and PLTR, although both
trials were underpowered to detect such a difference. A 1988–1989 trial conducted in Oman ($n = 394$ eyelids of 367 patients) showed a significantly greater risk of post-operative trichiasis in patients who received PLTR than in those who received BLTR [12]. In each of these three trials, however, the variant of PLTR employed differed in technique to the Trabut procedure currently advocated by WHO [4].

4.2 Both programmatic experience and published data [8, 10-18] suggest that the incidence of post-operative trichiasis is unacceptably high, regardless of the procedure used, occurring in 20–40% of patients by 1 year and, in one series, in > 60% of patients by 3 years after surgery [15]. Lower rates can occur, as suggested by a clinical trial comparing the perioperative use of oral azithromycin and topical tetracycline ointment with BLTR in Ethiopia, in which the cumulative incidence of post-operative trichiasis 3 years after surgery was < 15% in both study arms [19].

4.3 Data from a randomized controlled trial were presented at the meeting, the report of which was published [20] between the meeting and the finalization of this report. The trial compared BLTR with the Trabut procedure in Ethiopia. Participating surgeons were already Trabut-experienced; before commencing the trial they were trained and certified [4] in BLTR, allowed to practice for 6 months, then again standardized and certified in both BLTR and the Trabut procedure [20]. A total of 1000 patients were then enrolled and randomized: 499 to the Trabut procedure and 501 to BLTR. Waddell clamps were used for BLTR. The methodologies used allowed an assessment of outcomes masked to randomization status, overcoming the fact that BLTR is associated with a visible scar on the skin of the upper eyelid. The cumulative incidence of post-operative trichiasis by 12 months was 13% in those randomized to the Trabut procedure, and 22% in those randomized to BLTR: an absolute risk difference of 9.5% (95% confidence interval 4.8–14.2%). Although this evidence comes from only one randomized controlled trial, it provides a compelling argument that the Trabut procedure may be superior to BLTR.

4.4 New trichiasis surgeons should be trained to use the Trabut procedure. Surgeons already using BLTR should not be required to change to the Trabut procedure. A randomized controlled trial comparing the Trabut procedure with BLTR should be conducted in an area where surgeons have previously been primarily trained to use BLTR [21]. A trial that will generate relevant data is anticipated to begin in 2016.

5. What is the role of epilation in the management of trichiasis?

5.1 Trichiasis can involve entropion, misdirected eyelashes or metaplastic eyelashes. The clinical phenotype therefore ranges from a single aberrant eyelash touching the eye (without entropion) to the whole eyelid rolled inwards; the eyelashes involved may or may not touch the cornea in the position of primary gaze [22-27]. Operative management is designed to correct entropion. Although many trichiasis patients do not have significant entropion, data suggest that high quality operative management is generally effective in any case [18, 28].

5.2 For a variety of reasons, many patients decline surgery [29-31]. It is important, therefore, that programmes offer a non-surgical alternative to these patients. Many patients initiate epilation themselves [26, 27, 32, 33].

5.3 A randomized controlled non-inferiority trial ($n = 1300$) conducted in Ethiopia [18] compared surgery with epilation for minor trichiasis (≤ 5 eyelashes touching the eyeball). Patients in the epilation group ($n = 650$) were each given two pairs of high-quality, machine-tooled epilation forceps, and they and an accompanying adult with good near vision were trained to use them. Some 2 years after randomization, there was no statistically significant difference in visual acuity or corneal opacity...
between study arms, although the cumulative risk of failure over 2 years was 13.2% in the epilation group and 2.2% in the surgical group (risk difference = 11%), and the mean number of eyelashes touching the eye was significantly greater in the epilation group (0.95) than the surgical group (0.09) \[18\]. Patients in the epilation arm were offered surgery free of charge; 69% declined.

5.4 These patients were followed up 4 years after randomization \[28\] and 88% were traced. Of patients originally randomized to the epilation arm, 33% had had surgery, while 67% were still epilating. Among those who had declined surgery and continued epilating, more than half (54%) were fully controlling their trichiasis, 43% had minor trichiasis and < 3% had progressed to major trichiasis (> 5 eyelashes touching the eyeball), indicating that the progression of minor trichiasis can be effectively mitigated with frequent epilation. Among those who continued epilating, 85% reported that they were happy doing so and 92% had retained at least one of the two pairs of epilation forceps provided at baseline. There were no statistically significant differences in visual acuity or corneal opacity between patients who had continued epilating, those who had been randomized to epilation but eventually had surgery, or in those who had been originally randomized to receive surgery. Of those initially randomized to the surgery arm, 21% had trichiasis at 4 years \[28\].

5.5 Epilation may be offered as a reasonable alternative to surgery in cases in which the patient declines, or has no immediate access to, high-quality surgery. It is ethically important to inform the patient with minor trichiasis about both surgery and epilation, and to discuss the benefits and risks of each procedure so that an informed decision can be made \[34\].

5.6 Patients who choose epilation should be provided with high-quality epilation forceps that have durable frames and rounded tips with non-cutting opposing edges, in a size that enables the instrument to be used comfortably by individuals with fingers of different sizes.

5.7 Patients who choose epilation should be regularly followed up by a service that can provide trichiasis surgery.

6. How should lower eyelid trichiasis be managed?

6.1 Until recently, trichiasis of the lower eyelid was considered relatively rare. However, in one setting in Ethiopia, 11.5% of 4310 eyes (2556 patients) with upper eyelid trichiasis also had lower eyelid trichiasis \[23\]. In the United Republic of Tanzania, in 1673 patients examined 2 years after upper eyelid trichiasis surgery, 318 (11.6%) of 2718 eyes had lower eyelid trichiasis. The likelihood of lower eyelid trichiasis being present at 2 years increased with increasing baseline severity of upper eyelid trichiasis \( (p < 0.0001) \), and independently with the baseline presence of trichiatic eyelashes originating from the nasal aspect of the upper eyelid \( (p = 0.0009) \) \[35\].

6.2 There is no WHO-recommended surgical technique to address lower eyelid trichiasis.

6.3 Lower eyelid trichiasis surgery is not commonly reported. One (to-date unpublished) study among 200 patients indicated a 40% cumulative recurrence of lower eyelid trichiasis 6 months post-operatively.

6.4 More data are needed on lower eyelid trichiasis, including data that will contribute to characterizing its phenotype and likely aetiology. Collection of such data will be encouraged by making standard trichiasis patient tracking systems available to programmes.
More research should be conducted on how best to manage lower eyelid trichiasis. In the meantime, lower eyelid trichiasis should be managed by the most experienced eye specialist available. Between diagnosis and review by that specialist, epilation should be encouraged.

7. **How should post-operative trichiasis be managed?**

7.1 Unfavourable outcomes following trichiasis surgery are common. They include eyelid contour abnormality with or without eyelid closure defect, pyogenic granuloma and recurrent trichiasis. The incidence of these outcomes varies widely between settings [8, 13, 15, 19, 36-42]. Only limited research on how best to manage them has been conducted.

7.2 For various reasons, “recurrent trichiasis” is more inclusively referred to within the term “post-operative trichiasis”.

7.3 Of the unfavourable outcomes listed in 7.1, post-operative trichiasis is a particular problem, the magnitude of which will increase with increasing output of trichiasis surgery programmes in trachoma-endemic countries. Preliminary analysis of population-based data from the Global Trachoma Mapping Project [43] indicates that of individuals found to have trichiasis, 10–75% have already had trichiasis surgery.

7.4 In a (to-date unpublished) ancillary study to the Partnership for the Rapid Elimination of Trachoma surgery trial, 140 eyes with post-operative trichiasis underwent revision surgery by eye nurses and were evaluated 6 months after the revision operation; 42% (n = 59) again had post-operative trichiasis at 6 months. The severity of trichiasis after the revision operation was the same as or worse than the severity after the first operation in 45% of those with post-operative trichiasis after revision surgery. After controlling for operating surgeon, the only significant predictor of post-operative trichiasis after the revision operation was the severity of post-operative trichiasis after the primary operation. The severity of trichiasis at baseline did not predict the likelihood of post-operative trichiasis after revision surgery: 63 (45%) revision surgeries resulted in an eyelid contour abnormality, with half of those being moderate or severe abnormalities; 33 of the 63 eyes with eyelid contour abnormalities (52%) after revision surgery did not have a contour abnormality before revision surgery. This analysis suggests that revision trichiasis surgery often leads to poor outcomes; in some patients the status of the eyelid is worse after, than immediately before, revision surgery.

7.5 Post-operative trichiasis should be managed by the most experienced trichiasis surgeon (see 9.4) or eye specialist\(^1\) available. Between diagnosis and review by that professional, epilation should be encouraged.

7.6 More research is needed on post-operative trichiasis and its management.

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\(^1\) Meeting participants offered widely differing opinions on the optimal term to use here, reflecting geographical differences in the availability of different levels of eye care personnel to cases of post-operative trichiasis. Health ministries in trachoma-endemic Member States should set their own standards in defining who should manage post-operative trichiasis. Recommendation 7.5 is not intended to restrict that process of national standard setting, but rather to acknowledge that management of post-operative trichiasis is technically difficult, and is likely to be handled better by health-care workers with more specific formal technical training and/or greater professional experience.
8. What is the role of mannequin-based training in improving the quality of trichiasis surgery?

8.1 Conventional training of nurses to perform trichiasis surgery is typically conducted as a 2–4 week course. The first week is devoted to classroom training on the anatomy of the eye, recognition of trichiasis, how to perform trichiasis surgery, and generic aspects of surgical practice such as creating and maintaining a sterile field. This is followed by demonstration of surgery by a trainer. Trainees then commence surgical practice on live patients, under the trainer’s supervision. Occasionally, as an intermediate step, trainees will be required to practise suturing on a glove or piece of fruit before operating on live patients, but this is not always the case. Training is considered complete when the trainee is capable of performing surgery independently and has performed the number of surgeries required by the programme.

8.2 Some programmes reportedly ask trainees to improve their trichiasis surgery skills before certification [4], through unsupervised practice in the community. Only surgeons who have been certified according to the protocols described in the second (2015) edition of Trichiasis surgery for trachoma [4] should be allowed to conduct unsupervised practice.

8.3 In modern surgical training in developed countries, simulation is a commonly used tool for acquiring and improving skills. However, surgical simulation is rare in resource-poor settings.

8.4 A mannequin-based training programme known as HEAD START (Human Eyelid Analogue Device for Surgical Training And skills Reinforcement in Trachoma) has been introduced to provide trainees in trichiasis surgery with an opportunity to learn and practise all the major steps of the procedure without risk to patients. HEAD START bridges the gap between didactic, classroom-based learning and training on live patients. The HEAD START system consists of a reusable silicone base shaped like a human head, together with disposable eyelid cartridges. The cartridges are designed to mimic the layers of the eyelid (skin, muscle, tarsus and conjunctiva).

8.5 A recent (to-date unpublished) study compared standard BLTR training versus BLTR training incorporating the use of HEAD START. A total of 22 previously untrained trainees were allocated to standard training and 26 previously untrained trainees to HEAD START. Among the 26 HEAD START trainees, 10 received enhanced HEAD START training in which they were provided with additional practice on HEAD START following the one-on-one training session and before live surgery training. Data collectors recorded the time that anaesthesia was administered, the time the first clamp was placed and the time the last suture was tied. Additionally, they recorded how many times the trainer intervened to correct the trainee’s technique, and whether or not the trainer completely took over to finish the procedure. Trainees who received the HEAD START approach performed their first live patient surgery significantly faster than those with standard training (28 vs 36 minutes; \( p = 0.01 \)) and with half the number of interventions required by the trainer. This trend remained constant throughout the training, with the 20th live surgery performed by HEAD START-trained surgeons remaining significantly faster than those of the standard training trainees. Additionally, first surgeries performed by the enhanced HEAD START group were significantly faster than those performed by the standard HEAD START group (22 vs 29 minutes; \( p = 0.03 \)). In responses to standard questionnaires, both the trainers and the trainees reported that HEAD START was extremely useful in allowing trainees to learn the procedure and build confidence before operating on patients.

8.6 The handmade HEAD START cartridges used to date have been very good, but production is time-intensive and costly; an alternative 3-D cartridge printing production method is now being tested.
8.7 Both new surgeon training and refresher training should include the use of mannequins as part of a comprehensive training package. To facilitate this recommendation, more trained trainers, more mannequins and an adequate supply of eyelid cartridges will all be required. The latest estimates of the trichiasis backlog should be used to predict the likely need for trainers, surgeons, mannequins and cartridges.

8.8 Research to compare the incidence of post-surgical trichiasis in patients operated on by surgeons trained with and without mannequins would be helpful.

9. How should trichiasis surgeon trainees be selected?

9.1 The global backlog of trichiasis is huge but too few ophthalmologists are available in endemic countries to address it. Additionally, most ophthalmologists are located in large cities, while most people with trichiasis are in rural areas. There is evidence that non-ophthalmologist health professionals can be trained to conduct trichiasis surgeries [37, 44]. This practice has been widely adopted [45]. Unfortunately, surgical outcomes vary. A significant part of that variation is attributable to the individual surgeon [39, 41]; thus, how trainees are selected is likely to be important.

9.2 According to the second (2015) edition of Trichiasis surgery for trachoma [4], the criteria for selection of individuals to be trained as trichiasis surgeons include: previous experience with eye examinations; experience in giving injections; knowledge of sterile surgical techniques; excellent vision; and demonstrated manual dexterity. Tests of dexterity include the grooved pegboard test [46] and incision and suturing of orange peel. Further research to determine the set of tests that best predict technical competence [47] in trichiasis surgery would be helpful. Prior to data becoming available, programmes could consider using a mannequin-based screening test as part of the selection process. Such a test might include a one-on-one session with a trainer, in which the trainee is taught to perform surgery on a mannequin while the trainer assesses the trainee’s dexterity and capacity for skill acquisition.

9.3 Technical performance results from a complex interplay of numerous innate abilities in conjunction with subsequent exposures and experiences. Performing periodic tests during training allows the identification of trainees having challenges before they conduct surgeries on live patients.

9.4 Retaining and motivating trained trichiasis surgeons can be problematic [48, 49] for a variety of reasons. “Trichiasis surgeon” is not a specific cadre in the health system of most countries; rather, trichiasis surgery is a skill that doctors, ophthalmic nurses or eye care assistants learn as a complement to their other clinical skills. There is therefore not a clear career path focused on trichiasis surgery. Furthermore, undertaking trichiasis surgery is time- and labour-intensive, so trained trichiasis surgeons need a high level of internal motivation, external incentives, or both, to encourage retention and productivity. When selecting individuals to train as trichiasis surgeons, programmes are encouraged to seek out individuals who are highly motivated to serve in the community. After training, programmes should provide an employment environment that encourages retention and productivity.
10. What is the role of supervision?

10.1 Supervision of health-care delivery in resource-limited settings is a complex managerial intervention, with many cultural, social, behavioural and organizational dimensions. The literature surrounding the impact of supervision on outcomes reflects this complexity [50].

10.2 Although not clear cut, the available evidence suggests that supervision has a positive impact on performance, at least in the short term, and if done well may facilitate health workers’ professional development, improve job satisfaction and increase motivation [51].

10.3 There are few robust data on the relative benefit of supportive supervision compared with that of other approaches to supervision. Supportive supervision focuses on problem-solving to assure quality and meet the needs of patients. The entire team, including the supervisor, accepts responsibility for quality, so attention shifts from identifying poorly performing individuals to strengthening collective skills and processes. There is a belief that supportive supervision reduces barriers between the supervisor and those being supervised, and increases the frequency of supervision, provider ratings of management effectiveness and skill enhancement.

10.4 In a study examining the productivity of trichiasis surgeons, a surgeon’s ability to name his or her supervisor was associated with higher productivity [48]. This could be taken to imply that there is benefit in providing supervision, but the cross-sectional nature of the data limits the conclusions that should be drawn. There is little or no evidence to suggest what the optimal frequency of supervision might be.

10.5 Supervision should be an integral part of trichiasis programmes at all stages, from conception to planning, budgeting, implementation and evaluation. This is best served by developing a standardized approach to supervision within any given national programme and including a budget line for it. As programmes evolve, governments and partners have a shared responsibility to ensure that supervision of surgeons becomes integrated into the general health care or ophthalmic service system.

10.6 Programmes should review the performance of new trichiasis surgeons 3–6 months after certification, and existing trichiasis surgeons’ performance at least annually.

10.5 Every programme should have a system for updating personnel at all levels on new evidence-based preferred practices. New developments should be rapidly incorporated into supervision practices.

11. How should trichiasis patients be followed up post-operatively?

11.1 It is recommended [4] that all operated trichiasis patients are seen on the first post-operative day for eye patch removal and examination of the wound.

11.2 In settings where non-absorbable sutures are used, a follow up visit for suture removal should be scheduled for 8–14 days after surgery. If absorbable sutures are used, the 8–14 day visit is not essential but still advisable to allow the wound to be reviewed.

11.3 It is strongly recommended to follow up all TT patients 6 weeks to 6 months after surgery.

11.4 All patients should be advised to seek care between scheduled visits if complications arise.
11.5 Providing post-operative follow-up of trichiasis patients poses a huge challenge to trachoma elimination programmes. Few settings have effective routine systems in place for surgical follow up. However, in addition to the benefit to patients who have received an operation, active follow up has the benefit of providing the programme with an opportunity to confirm that surgeries took place at all.

11.6 Additional operational research is needed to determine a reasonable minimum percentage of cases to be followed up post-operatively, and who should undertake the follow-up.

12. How should the TT component of “elimination of trachoma as a public health problem” be assessed?

12.1 The definitions for elimination of trachoma as a public health problem were established at the Second Global Scientific Meeting on Trachoma [52] in 2003. The following parameters and assumptions were used when formulating the threshold for TT: (a) a TT prevalence of 1% or above in the population aged ≥ 15 years constitutes a public health problem; (b) ≥ 10 cases per 1000 population aged ≥ 15 years (1%) is equivalent to ≥ 5 cases per 1000 total (all-ages) population (which assumes that TT is not found in those aged < 15 years); and (c) programmes should achieve an 80% relative reduction below the minimum level at which TT constitutes a public health problem. The TT component of the definition of elimination of trachoma as a public health problem was therefore accepted as a prevalence of TT of < 1 case per 1000 total population.

12.2 The Third Global Scientific Meeting on Trachoma [53] recommended that individuals with TT who are “known to the health system” be excluded when determining current TT prevalence. Those “known to the health system” are individuals with post-operative trichiasis, individuals who have refused surgery, and individuals who have not yet received an operation but for whom a surgical date has been set. This refined the TT component of the definition of elimination of trachoma as a public health problem, to: a prevalence of TT unknown to the health system of < 1 case per 1000 total population.

12.3 Because at baseline most national programmes estimate the prevalence of trichiasis in adults aged ≥ 15 years [43], when conducting impact and pre-validation surveillance surveys, it may be simpler and more epidemiologically relevant to again estimate the prevalence of trichiasis in adults aged ≥ 15 years rather than in the all-ages population. For the purposes of clarification, therefore, the TT component of the definition of elimination of trachoma as a public health problem can also be expressed as a prevalence of TT unknown to the health system of < 0.2% in adults aged ≥ 15 years.

12.4 There must also be evidence that the health system is able to identify and manage incident TT cases, using defined strategies, with evidence of appropriate financial resources to implement those strategies [53].

12.5 There are few data on the incidence of TT. Available data are summarized in paragraphs 12.6–12.8.

12.6 A population-based national survey of blindness and low vision was undertaken in the Gambia in 1986. Two ophthalmologists examined 8174 people in 52 communities [54], of whom 639 (7.8%) had trachomatous conjunctival scarring (TS) and/or trichiasis and/or corneal opacity (CO) [55]. A study conducted 12 years later in 1998 attempted to trace all those with cicatricial complications of trachoma in order to observe the natural history of the disease. Of 297 individuals examined who had had TS without trichiasis at baseline, 19 (6.4%; 95% confidence interval 4.0–10.0%) had
developed trichiasis. Ignoring mortality among those who had developed trichiasis, and development of trichiasis in those who had not yet had TS at baseline, this is equivalent to a 12-year cumulative incidence of trichiasis in the whole population of 5 per 1000 (17% of those with TS and/or trichiasis and/or CO at baseline had died by the time of follow-up [55].)

12.7 In 1988 in Kongwa, United Republic of Tanzania, 4898 adult women from 11 villages were examined for signs of trachoma, representing 81% of all adult women resident in those communities. Using the assumptions that the incidence of cicatricial complications of trachoma had been constant in those women’s lifetimes, and that no excess mortality was associated with the presence of trichiasis, the 5-year incidence of trichiasis was modelled to be 0.3% for women aged 15–19 years, increasing to 6.4% for women aged 55–59 years [56]. Empirical longitudinal data from a subset of this sample were subsequently published, showing that of 523 adult women with TS at baseline, 48 (9.2%) had developed trichiasis at follow-up 7 years later: an average incidence of 1.3% per year for that cohort [57]. Of 503 adult women who had not had TS at baseline, 3 (0.6%) had developed trichiasis 7 years later [57].

12.8 In a cohort study on the effect of mass treatment with azithromycin in Rombo District, United Republic of Tanzania, 956 (98%) of 978 residents of the community of Kahe Mpya were examined at baseline [58]; 14 (1.5%) had trichiasis in one or both eyes. All were offered operations, and all accepted. Ten years later, 10 individuals had trichiasis, all but one of whom had been resident in Kahe Mpya (and examined) at baseline. Of the 9 examined at baseline, only one had had trichiasis at baseline, and at 10 years again had (post-operative) trichiasis in the same eye (still without CO); the contralateral eye had neither trichiasis nor CO at either time point. Following two rounds of high coverage mass treatment with azithromycin, ocular Chlamydia trachomatis infection had been suppressed to the point of being undetectable throughout the community 5 years after baseline [59, 60]. These limited data suggest that in populations living in areas where trachoma is meso-endemic, even after highly successful implementation of trachoma elimination activities, trichiasis incidence will drive trichiasis prevalence towards baseline levels for at least a decade without ongoing surgical service provision. It is therefore difficult to recommend the use of surgical output data to evaluate the success or otherwise of meeting trachoma elimination goals.

12.9 Another question involves the definition of “trachomatous trichiasis”. As noted during the 2014 WHO Technical Consultation on Trachoma Surveillance [61], eyelid and eyelash abnormalities other than posterior lamellar scarring from trachoma (e.g. old age, epiblepharon, distichiasis) can cause eyelashes to touch the eye, and there is an underlying level of non-trachomatous trichiasis everywhere, potentially causing misdiagnosis of such conditions as TT in trachoma-endemic areas; the prevalence of non-trachomatous trichiasis is not known for either non-trachoma-endemic areas or trachoma-endemic areas. The distinctions between TT and non-trachomatous trichiasis may be important in the clinical care of individual patients (if the aberrant eyelashes in involutional trichiasis, epiblepharon or distichiasis are not vision-threatening), and important from an epidemiological and public health perspective with respect to (a) planning the need for TT surgery services and (b) their impact on apparent achievement of TT elimination targets. It was recommended at that Consultation that, in impact surveys and pre-validation surveillance surveys, when trichiasis is observed, graders should attempt to evert the eyelid to assess for and record the presence or absence of TS, with the presence of TS, or the inability to evert the lid because of lid tightness, taken to indicate that the trichiasis was TT. This topic was discussed again at the present meeting, which considered that there was insufficient evidence to recommend that TT be formally redefined as the presence of trichiasis (at least one eyelash rubs on the eyeball, or evidence of recent removal of in-turned eyelashes [62]) AND either TS or the inability to evert the eyelid because of lid tightness, in the same eye. Further work is needed to determine the best way to evaluate whether trichiatic eyelashes result from trachoma or another cause. Data collection, including routinely recording the presence or absence of TS in all cases of trichiasis, should continue.
12.10 As the TT backlog diminishes, it becomes extremely difficult to find the remaining individuals with TT in order to reduce the prevalence to < 1 case unknown to the health system per 1000 total population, in each evaluation unit. **Further work to determine the best way to identify cases and estimate the backlog is needed.**

12.11 Because donor funding is unlikely to continue once trachoma elimination goals are reached, it is critical to ensure that robust case detection and management systems are built now to address future TT surgery needs.

13. What is the current global burden of trichiasis?

13.1 The most recent attempts to estimate the global backlog of trichiasis were published in 2009 and 2012. The 2009 estimate [63] was generated through a literature review, supplemented by unpublished data submitted to WHO for the eleventh (2007) meeting of the WHO Alliance for the Global Elimination of Trachoma by 2020 [64], direct enquiries with health ministries, and extrapolation from neighbouring districts (and countries) to districts (and countries) with no data; it calculated the global trichiasis backlog to be 8.2 million people [63]. The 2012 estimate [65] was based on provisional 2011 country reports to WHO, and revised the global total down to 7.3 million people.

13.2 Since December 2012, the Global Trachoma Mapping Project has been undertaking highly standardized population-based prevalence surveys of trachoma [43] across 29 countries. Analyses included adjustment of trichiasis prevalence estimates to try to account for non-random differences between the age and sex distribution of people examined and the age and sex distributions of the underlying populations. The production of these data has prompted an attempt to generate a new, more accurate estimate of the global trichiasis backlog.

13.3 As an extension to this work, efforts have been made to obtain raw data from surveys conducted before, or outside, the Global Trachoma Mapping Project, in order to standardize by age and sex the prevalence estimates that they had generated. Where prevalence data were not available, health ministries have been contacted to try to obtain a better understanding of current national backlog estimates.

13.4 The best estimate of the 2015 global trichiasis backlog is 3.6 million people. Once all the data from the Global Trachoma Mapping Project are finalized and approved, a 2016 update to this figure, along with detailed account of the methodology used to derive it, should be published in a peer-reviewed journal. There is a large decrease from the 2012 estimate to the 2015 one; a considerable proportion of this decrease is due to recent information from China indicating a much lower burden of disease there than previously estimated.

13.5 There was some discussion about the age and sex standardization methodology used by the Global Trachoma Mapping Project, which assumes an even distribution of trichiasis cases within each 5-year age band. In people examined in any given evaluation unit, many such age bands contain no cases. This could lead to instability in the calculations, which might be overcome by using wider age bands. Further work to investigate this is under way.

13.6 Annual updating of the global trichiasis backlog estimate, perhaps as part of the publication on trachoma in the Weekly Epidemiological Record, is recommended.
14. How should case-finding for individuals with trichiasis be conducted?

14.1 Trichiasis surgery uptake is low in many settings [30, 66-68]. Case-finding (that is, identifying people who have trichiasis) is the first step in promoting uptake, and both the sensitivity and the specificity of the case-finding process may affect the efficiency of trichiasis surgery delivery systems overall. Additionally, given that contact with a case-finder may be the first interaction that an individual with trichiasis has with the trachoma elimination programme, the nature of the approach may have a considerable impact on the likelihood that the individual consents to surgery.

14.2 There are few published data on the sensitivity, specificity, efficiency or cost–effectiveness of case-finders. In a community randomized trial in the United Republic of Tanzania, community antibiotic treatment assistants given a half-day training on identifying trichiasis identified more than 5 times as many cases of trichiasis during mass drug administration events, as community treatment assistants receiving the usual training package for antibiotic mass drug administration, which included a 30-minute overview of trichiasis and its recognition. Diagnostic sensitivities of community treatment assistants in the two groups for trichiasis were 31% and 6%, respectively [69].

14.3 In Egypt, there is some evidence that a house-to-house screening and education system can increase trichiasis surgery uptake [70]. Similarly, in Ethiopia, house-to-house screening by “eye ambassadors” with discussion-based counselling of individuals identified as having trichiasis, plus their relatives, seems to increase surgical uptake [71]. Neither of these studies has provided data on the sensitivity or specificity of the screening system.

14.4 Emerging data from several rapidly expanding programmes in Africa suggest that house-to-house case-finding and mass mobilization through radio motivate approximately equal numbers of people with trichiasis to attend trichiasis surgery camps, but by pre-screening, the house-to-house approach results in considerably fewer individuals without trichiasis presenting to camps for review. This improves camp efficiency.

14.5 There is a need for further research to explore how best to identify individuals with trichiasis in areas with high, moderate and low trichiasis prevalence.

15. How should a trichiasis-only survey be conducted?

15.1 There are a number of scenarios in which it may be necessary or desirable for a trachoma elimination programme to estimate the prevalence of trichiasis without simultaneously estimating the prevalence of active trachoma. Examples include:

1. If a baseline survey finds a TF prevalence in children aged 1–9 years of < 5% and a trichiasis prevalence in adults of ≥ 0.2%, an impact survey to again measure the TF prevalence will not usually be indicated, but an impact survey to measure the trichiasis prevalence will be required.

2. If a baseline survey finds a TF prevalence in children aged 1–9 years of ≥ 30% and a trichiasis prevalence in adults of ≥ 0.2%, the district will undergo a minimum of 5 years of intervention before conducting an impact survey to again measure the prevalence of TF. During this intervention period, the programme may wish to re-estimate the trichiasis prevalence.
3. If a surveillance survey finds a TF prevalence in children aged 1–9 years of < 5% and a trichiasis prevalence in adults of ≥ 0.2%, further work to identify and manage patients with trichiasis should be undertaken, and an attempt then made to re-estimate the trichiasis prevalence.

4. If a trichiasis prevalence does not match expectations, and the design or conduct of the survey appears to have been sub-optimal, re-estimation of trichiasis prevalence may be desirable in order to assist with programme planning.

15.2 The provisional design of a population-based trichiasis prevalence survey was discussed. The methodology will be trialled in a number of countries, with oversampling to allow generation of a large dataset for subsequent computer simulations. Simulations will be used iteratively to test and validate the protocol.
## Annex 1. Meeting agenda

### Day 1 (4 November 2015)

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Convener</th>
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<tbody>
<tr>
<td>14:00–14:30</td>
<td>Opening and introductions</td>
<td>Anthony Solomon</td>
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<tr>
<td>14:30–14:45</td>
<td>Agenda, meeting logistics</td>
<td>Paul Courtright</td>
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<tr>
<td>14:45–15:30</td>
<td>Surgical factors and their impact on outcomes</td>
<td>Emily Gower</td>
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<tr>
<td>15:30–15:45</td>
<td>Break</td>
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<tr>
<td>15:45–16:30</td>
<td>Findings from studies comparing BLTR and Trabut</td>
<td>Matthew Burton</td>
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<tr>
<td>16:30–17:15</td>
<td>Evidence for management of lower lid trichiasis</td>
<td>Caleb Mpyet</td>
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### Day 2 (5 November 2015)

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
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<tbody>
<tr>
<td>09:00–09:15</td>
<td>Review of day 1</td>
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<tr>
<td>09:15–10:15</td>
<td>Evidence from studies of epilation</td>
<td>Esmael Habtamu</td>
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<tr>
<td>10:15–10:30</td>
<td>Evidence for the management of post-operative trichiasis</td>
<td>Serge Resnikoff</td>
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<tr>
<td>10:30–10:45</td>
<td>Break</td>
<td></td>
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<tr>
<td>10:45–11:30</td>
<td>Evidence for the management of post-operative trichiasis</td>
<td>Serge Resnikoff</td>
</tr>
<tr>
<td>11:30–12:30</td>
<td>Research on contribution of HEAD START and other simulation devices to surgical outcomes</td>
<td>Emily Gower</td>
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<tr>
<td>12:30–13:15</td>
<td>Surgeon selection</td>
<td>Amir Bedri Kello</td>
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<tr>
<td>13:15–14:15</td>
<td>Lunch</td>
<td></td>
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<tr>
<td>14:15–15:15</td>
<td>Performance improvement and supportive supervision</td>
<td>Chad MacArthur</td>
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<tr>
<td>15:15–15:30</td>
<td>Findings from routine monitoring at 6 months</td>
<td>Caleb Mpyet</td>
</tr>
<tr>
<td>15:30–15:45</td>
<td>Break</td>
<td></td>
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<tr>
<td>15:45–16:30</td>
<td>Findings from routine monitoring at 6 months (continued)</td>
<td>Caleb Mpyet</td>
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### Day 3 (6 November 2015)

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<tr>
<th>Time</th>
<th>Topic</th>
<th>Convener</th>
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<tbody>
<tr>
<td>09:00–09:15</td>
<td>Summary of day 2</td>
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<tr>
<td>09:15–10:30</td>
<td>Elimination thresholds and potential for use of performance data against elimination thresholds</td>
<td>Anthony Solomon</td>
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<tr>
<td>10:30–10:45</td>
<td>Break</td>
<td></td>
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<tr>
<td>10:45–11:30</td>
<td>Review of findings on burden of trichiasis (including age/sex standardization)</td>
<td>Paul Courtright</td>
</tr>
<tr>
<td>11:30–13:00</td>
<td>Experience using &quot;unknown to the health system&quot; and inclusion of TS for TT cases seen during impact assessments</td>
<td>Susan Lewallen</td>
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<tr>
<td>13:00–14:00</td>
<td>Lunch</td>
<td></td>
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<tr>
<td>14:00–14:45</td>
<td>Experience with TT case finding</td>
<td>Michaela Kelly</td>
</tr>
<tr>
<td>14:45–15:30</td>
<td>Findings from TT only survey pilot studies</td>
<td>Rebecca Flueckiger</td>
</tr>
<tr>
<td>15:30–15:45</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>15:45–16:15</td>
<td>Closing, next steps, etc.</td>
<td>Anthony Solomon</td>
</tr>
</tbody>
</table>
Annex 2. List of participants

<table>
<thead>
<tr>
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<th>Affiliation</th>
<th>Email</th>
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<tbody>
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References


WORLD HEALTH ORGANIZATION ALLIANCE FOR THE GLOBAL ELIMINATION OF TRACHOMA BY 2020

SECOND GLOBAL SCIENTIFIC MEETING ON TRACHOMATOUS TRICHIASIS
SCAPE TOWN, 4-6 NOVEMBER 2015