



CLEAN FACES, STRONG EYES!

Trachoma Resource Book



THE UNIVERSITY OF
MELBOURNE



This document was prepared by Mr Joobin Hooshmand, Professor Hugh R. Taylor AC and Emma Stanford.

Indigenous Eye Health Unit
Melbourne School of Population Health
The University of Melbourne.

Acknowledgements

The authors would like to acknowledge the support of our private donors, the Harold Mitchell Foundation, the Ian Potter Foundation, CBM Australia, the Cybec Foundation and the Aspen Foundation.

The authors would also like to thank Meg Torpey, Judy Carrigan, Brooke Sawyer, Dr Andrew Bell, Kath Desmyth, the Katherine West Health Board, Cate Coffey, Paula Sutton, Centre for Disease Control, Department of Health and Families, Northern Territory for their contribution.

The illustrations are by Lily McDonnell. The Goanna is used with permission from the Centre for Eye Research Australia.

Published by the Indigenous Eye Health Unit, Melbourne School of Population Health,
The University of Melbourne.

ISBN 978 0 7340 4171 5
May 2010

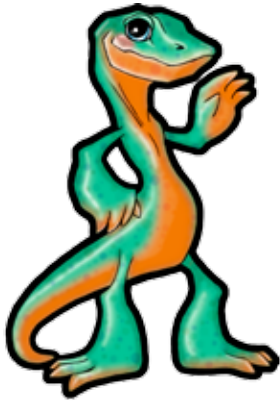


Table of Contents

Introduction.....	2
Abbreviations.....	2
Key resources.....	3
Key materials.....	5
Trachoma Grading Card.....	6
Screening procedure.....	8
Defining the problem.....	9
Who is affected and why?.....	11
Elimination.....	13
Organism/aetiology.....	14
Clinical features, natural history and disease progression.....	15
Transmission.....	16
Screening, diagnosis and grading.....	17
<i>Active trachoma examination</i>	19
<i>Trichiasis screening</i>	20
Differential diagnosis.....	21
Who SAFE strategy.....	23
Surgery.....	24
Antibacterials.....	25
How to treat?.....	26
The treatment of infants.....	28
Facial cleanliness.....	29
Environmental improvement.....	30
Management.....	31
Monitoring and evaluation.....	32
Outcomes.....	33
References.....	34

Introduction

This Trachoma Resource Book forms part of the Trachoma Story Kit developed by the Indigenous Eye Health Unit at The University of Melbourne in close co-operation with the Katherine West Health Board and the Centre for Disease Control, Department of Health and Families, in the Northern Territory. This book includes health promotion material and education material for use in clinics and schools. It is designed as a resource for regional leaders of health services dealing with trachoma and those curious professional staff who want to know more about trachoma and how it spreads and is controlled. This book provides a coherent overview, and for interested readers who want to know even more, it guides them to the next level of data and information.

Trachoma has been a cause of blindness for thousands of years, although it has disappeared from developed areas over the past hundred years. Trachoma continues to occur in developing countries and in areas where personal and community hygiene are poor.

In February 2009 the Australian Government committed to eliminate blinding trachoma from Australian Aboriginal communities. Although trachoma had disappeared from mainstream Australia a hundred years ago, Australia is currently the only developed country in which trachoma persists.

Over the years, an enormous array of material has been developed about trachoma and trachoma control. The purpose of this Trachoma Resource Book is to pull together some of the current key information about trachoma and its control to assist people involved in trachoma control activities. It specifically does not want to re-invent the wheel but, rather, acts as a guide to resource materials and links them together in a coherent story.

We hope this material proves useful and provides practical support for those who will be able to look back in pride and say they successfully eliminated trachoma from Australia.

Abbreviations

CDNA	Communicable Diseases Network Australia
CERA	Centre for Eye Research Australia
CO	Corneal Opacity
HSV	Herpes Simplex Virus
PCR	Polymerase Chain Reaction
SAFE	Surgery, Antibiotics, Facial cleanliness and Environmental improvement
TF	Trachomatis inflammation Follicular
TI	Trachomatis inflammation Intense
TS	Trachomatous Scarring
WHO	World Health Organization



Key Resources

The following key resources supplement the information in this resource book. Rather than re-writing the contents of these resources, a direct reference has been provided under each heading where appropriate and applicable.

For further information please visit www.iehu.unimelb.edu.au

CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾

These guidelines set a minimum best practice approach for the public health management of trachoma in Australia. The guidelines were published by the Communicable Diseases Network Australia (CDNA), Department of Health and Ageing, Australian Government, in March 2006, and can be accessed via the Department of Health and Ageing website at www.health.gov.au

WHO simplified Trachoma grading card⁽²⁾

The Trachoma grading card contains grading instructions, simplified trachoma grading information, and photographs to aid grading and diagnosis. Published by the World Health Organization (WHO), it can be accessed via the WHO website at www.who.int/blindness/causes/trachoma_documents

WHO Achieving community support for trachoma control⁽³⁾

This manual deals with trachoma as 'a community disease' and provides guidelines for achieving community support for trachoma control activities. Published by WHO in 1993, it can be accessed via the WHO website at www.who.int/blindness/causes/trachoma_documents

CERA Trachoma grading self directed learning CD-ROM⁽⁴⁾

This CD-ROM is an excellent way to quickly train a new grader or refresh grading skills and is based on the WHO simplified grading of trachoma. Published by the Centre for Eye Research Australia (CERA) in 2007, it is available from the Centre at The University of Melbourne, Department of Ophthalmology, www.cera.org.au

Trachoma surveillance annual report, 2008: A report by the National Trachoma Surveillance and Reporting Unit⁽⁵⁾

This is the third report of the National Trachoma Surveillance and Reporting Unit. This report compares 2008 data with results from the trachoma screening in 2006 and 2007 conducted in the Northern Territory, South Australia and Western Australia in regions with endemic trachoma. It comments on jurisdictions implementation of the Communicable Diseases Network Australia trachoma guidelines 'minimum best practice approach', and makes recommendations regarding future reporting and management.

CDC Guidelines for management of trachoma in the Northern Territory⁽⁶⁾

This publication is adapted from the CDNA guidelines for the public health management of trachoma in Australia to reflect the unique needs of the Northern Territory. It is published by the Centre for Disease Control (CDC), Department of Health and Families, Northern Territory Government, and is available from CDC, Alice Springs, www.health.nt.gov.au/Centre_for_Disease_Control

Key Resources continued...

[A national framework for delivery of trachoma control programs](#)

This publication was developed by the Office for Aboriginal and Torres Strait Islander Health (OATSIH) as the basis for a call for proposals from jurisdictions with endemic trachoma. It is not yet publicly available at the time of this print. For more information contact OATSIH, Department of Health and Ageing at www.health.gov.au

[WHO Trichiasis surgery for trachoma: The bilamellar tarsal rotation procedure^{\(7\)}](#)

This is an excellent training manual for the bilamellar tarsal rotation operation to correct trichiasis and management of complications of this procedure. Published by WHO in 1993, it can be accessed via the WHO website at www.who.int/blindness/causes/trachoma_documents

[Trachoma: A blinding scourge from the Bronze Age to the twenty-first century^{\(8\)}](#)

This book by HR Taylor is a comprehensive review of trachoma from ancient times through to the present. Published by the Centre for Eye Research Australia in 2008, it is available from the Indigenous Eye Health Unit, Melbourne School of Population Health, The University of Melbourne, at www.iehu.unimelb.edu.au



Key Materials

The following materials are required for examining people for active trachoma and for trachoma grading. The essential items are requisite and the grading is unreliable without them.

Essential equipment

- Binocular loupes (x2.5)
- Disposable Penlight Torch
- Data collection form

Desirable equipment

- Orange stick or applicator stick
- Soap and water or alcohol based hand wash
- Rubbish disposal bags
- Pens
- WHO simplified trachoma grading chart (see page 6 & 7)
- seating (2 chairs are required)

Binocular loupes can be purchased from:

Designs for Vision Pty Ltd
16/1 Horden Place
Camperdown NSW 2050
www.dfv.com.au
Ph: 02 9550 6966
Fax: 02 9550 3853
1800 225 307

McNeils Surgical (NT)
57a Winnellie Rd
Winnellie NT 0820
Ph: 08 8947 4412
Fax: 08 8947 4413
www.mcneilnt.com.au

Device Technologies Australia
8/25 Frenchs Forest Road
Frenchs Forest NSW 2086
www.device.com.au
P: 02 9975 5755
F: 02 9975 5711
1800 429 551

Disposable penlight torches can be purchased from:

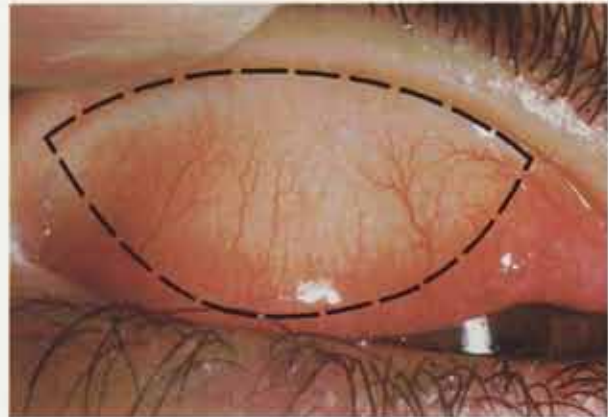
Livingstone International
Medical, Safety, Scientific, Beauty and Educational Supplies
10 Epsom Rd, Rosebery NSW 2018 www.livingstone.com.au
Ph: 02 9313 6111 Fax: 02 9313 6444 1800 780 078

TRACHOMA GRADING CARD

- Each eye must be examined and assessed separately.
- Use binocular loupes (x 2.5) and adequate lighting (either daylight or a torch).
- Signs must be clearly seen in order to be considered present.

The eyelids and cornea are observed first for inturned eyelashes and any corneal opacity. The upper eyelid is then turned over (everted) to examine the conjunctiva over the stiffer part of the upper lid (tarsal conjunctiva).

The normal conjunctiva is pink, smooth, thin and transparent. Over the whole area of the tarsal conjunctiva there are normally large deep-lying blood vessels that run vertically.



Normal tarsal conjunctiva (x 2 magnification). The dotted line shows the area to be examined.

TRACHOMATOUS INFLAMMATION – FOLLICULAR (TF): the presence of five or more follicles in the upper tarsal conjunctiva.

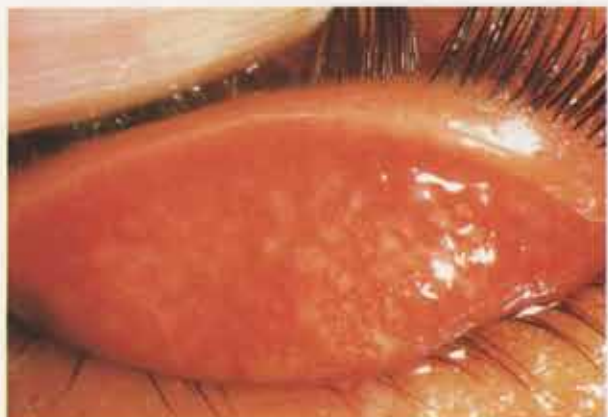
Follicles are round swellings that are paler than the surrounding conjunctiva, appearing white, grey or yellow. Follicles must be at least 0.5mm in diameter, i.e., at least as large as the dots shown below, to be considered.



Trachomatous inflammation – follicular (TF).

TRACHOMATOUS INFLAMMATION – INTENSE (TI): pronounced inflammatory thickening of the tarsal conjunctiva that obscures more than half of the normal deep tarsal vessels.

The tarsal conjunctiva appears red, rough and thickened. There are usually numerous follicles, which may be partially or totally covered by the thickened conjunctiva.



Trachomatous inflammation – follicular and intense (TF + TI).



TRACHOMATOUS SCARRING (TS): the presence of scarring in the tarsal conjunctiva.

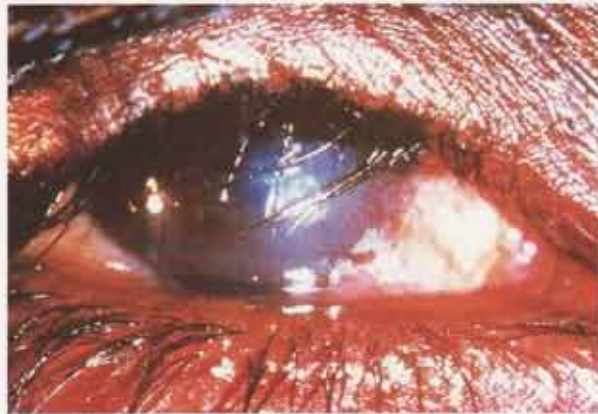
Scars are easily visible as white lines, bands, or sheets in the tarsal conjunctiva. They are glistening and fibrous in appearance. Scarring, especially diffuse fibrosis, may obscure the tarsal blood vessels.



Trachomatous scarring (TS)

TRACHOMATOUS TRICHIASIS (TT): at least one eyelash rubs on the eyeball.

Evidence of recent removal of inturned eyelashes should also be graded as trichiasis.



Trachomatous trichiasis (TT)

CORNEAL OPACITY (CO): easily visible corneal opacity over the pupil.

The pupil margin is blurred viewed through the opacity. Such corneal opacities cause significant visual impairment (less than 6/18 or 0.3 vision), and therefore visual acuity should be measured if possible.



Corneal opacity (CO)



**WORLD HEALTH ORGANIZATION
PREVENTION OF BLINDNESS AND DEAFNESS**



Support from the partners of the WHO Alliance for the Global Elimination of Trachoma is acknowledged.

Screening Procedure

The following is a summary of screening procedure. For further details and illustrations refer to the 'screening, diagnosis and grading' section of this book on pages 17 to 20.

- Each eye must be assessed separately
- Binocular loupes (X2.5) and adequate lighting are essential
- Wash hands with soap and water or alcohol based hand wash, rinse off hand wash
- Signs must be clearly seen for trachoma to be reported as present
- Refer to the WHO simplified trachoma grading card for a coloured pictorial guide to trachoma grading
- Observe and record facial cleanliness (Is there 'sleep', dirt or crusting around the eyes?). Clean face is defined as the absence of dirt or crusting on the cheeks and forehead
- Examine for trichiasis, either in-turned eyelashes or previously removed lashes. To check for this the upper lid needs to be pushed upwards slightly, to expose the lid margins.
- Examine the cornea for opacities (CO)
- Evert the right upper eye lid, examine and record the presence of TF, TI and TS in the area shown
- Evert the left upper eye lid, examine and record the presence of TF, TI and TS in area shown



Defining the Problem

Trachoma is the leading cause of infectious blindness in the world. Endemic in fifty-seven countries, over 500 million people are at risk of being blind by this disease. It is estimated that 6 million people are blind from trachoma. Blindness from trachoma is entirely preventable.

Australia is the only developed nation in the world still to have endemic areas of trachoma. Although trachoma was eradicated from most parts of Australia by the 1930s, it continues to be endemic and a significant public health problem in Aboriginal and Torres Strait Islander populations in many outback communities.

Recent data released by the National Trachoma Surveillance and Reporting Unit (NTSRU) in its 2008 trachoma surveillance report⁽⁷⁾ for 2006 to 2008 indicate a total of 16 regions in the Northern Territory, South Australia and Western Australia conducted trachoma screening. Data were reported for 121 of the 235 Communities At Risk (51%). The Overall prevalence of active trachoma in Aboriginal children aged 1 to 9 years for whom data were reported was 21%. A total of 82 communities (68%) had a prevalence of active trachoma $\geq 5\%$, and this occurred in 10 of the 15 regions (67%).

Table 1: Number of communities screened for trachoma, by trachoma risk, state and territory, 2008

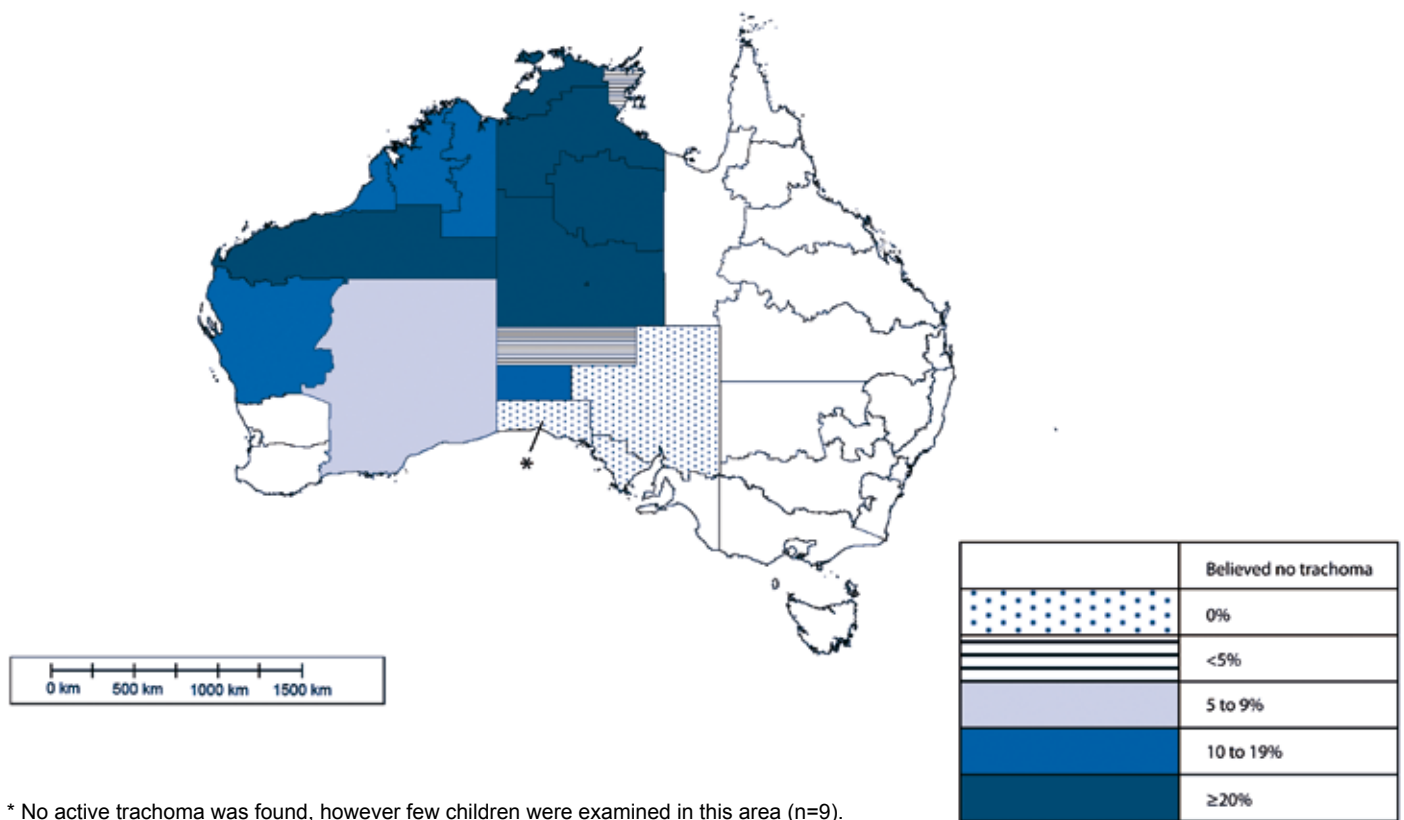
Communities	Number (%) of communities			Total
	Northern Territory	South Australia	Western Australia	
Not At Risk				
Screened	0	0	0	0
Not screened	5 (100%)	0	47 (100%)	52 (100%)
Total Not At Risk	5	0	47	52
At Risk				
Screened with no trachoma found	4 (5%)	7 (10%)	16 (21%)	27 (11%)
Screened with trachoma found	39 (45%)	4 (6%)	51 (67%)	94 (40%)
Reported screened but no data received	19 (22%)	0	2 (3%)	21 (9%)
Not screened	25 (29%)	61 (85%)	7 (9%)	93 (40%)
Total At Risk	87	72	76	235
Total communities	92	72	123	287

Source: Trachoma surveillance report 2008(9), p.10

Defining the Problem continued...

In the 2009 National Indigenous Eye Health Survey⁽⁸⁾ a total of 1694 Indigenous children and 1189 Indigenous adults were examined for trachoma in 30 communities across Australia. Overall rate of active trachoma (TF) in children was 3.8%, ranging from 0.6% in Major Cities to 7.3% in Very Remote areas. In Very Remote areas, 50% of communities had endemic rates (>5%). Overall scarring (TS) occurred in 15.7% of adults, trichiasis (TT) in 1.4% and corneal opacity (CO) in 0.3%. TS was found in all regions and TT in all except the Major Cities and the Inner Regional areas. The highest community rates for TF were 23%, for TS 58%, for TT 14.6% and 3.3% for CO. Trachoma is the third most common cause of blindness in Indigenous adults and causes 9% of blindness.

Figure 1: Map of Australia showing the Prevalence of Active Trachoma (TF) in Indigenous Children (1 - 9 years). [Trachoma Surveillance Annual Report 2008]⁽⁷⁾



Further information:

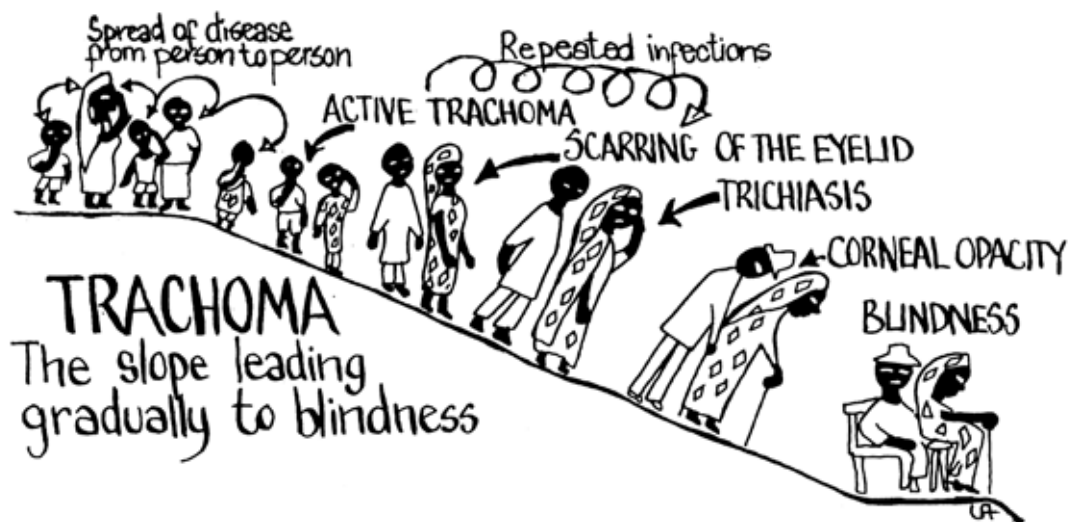
- CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ – Sections 1, 2 & 5



Who is affected and why?

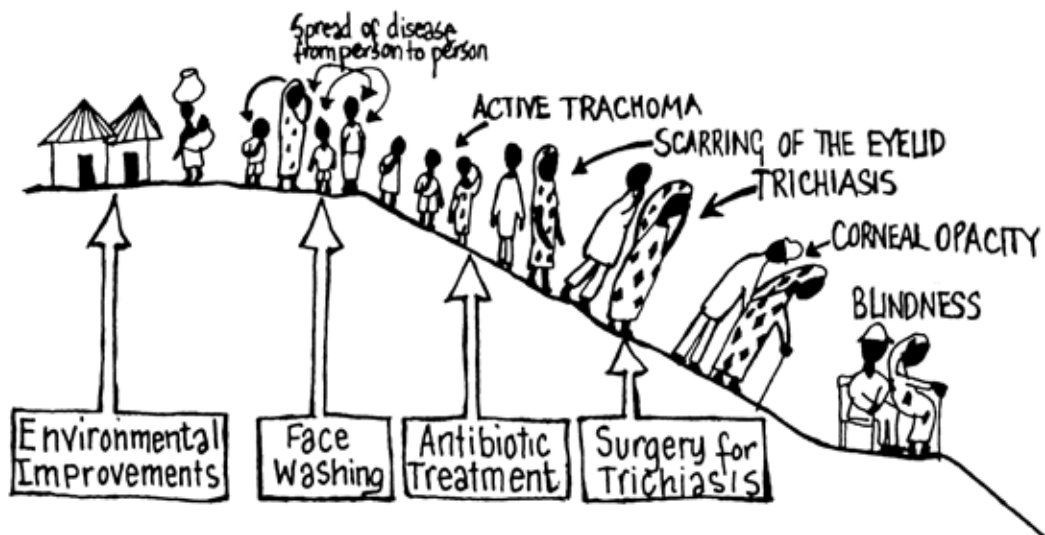
Trachoma occurs in areas where personal and community hygiene is poor. Children are the main reservoirs of infection, as they are frequently and heavily infected. They share infected eye secretions with other children especially their brothers and sisters and this leads to repeated episodes of re-infection. The more often a child is infected the more severe and prolonged the infection and inflammation and the more severe the scarring and damage to the eyelids. The scarred eyelids drag the eyelashes in so they rub on the eye (trichiasis) in older people and this leads to blindness. Active trachoma (TF) is commonly seen in children. Trichiasis (TT) and corneal opacity (CO) are common in adults.

Figure 2: Trachoma, the slope leading gradually to blindness;
(WHO Achieving Community Support for Trachoma Control 1993)



Source: WHO Achieving community support for trachoma control(2), p. 6

Figure 3: Blindness from trachoma can be prevented;



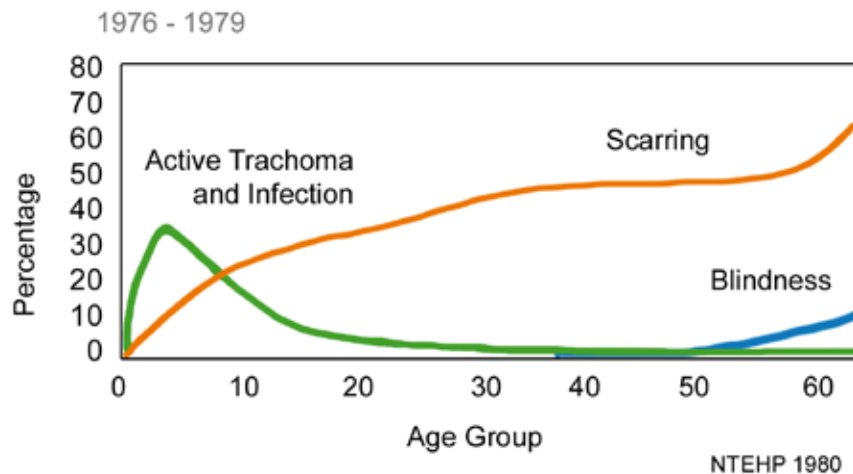
Source: WHO Achieving community support for trachoma control(2), p. 7

Who is affected and why? Continued...

Active trachoma is usually seen in young children and adolescents. The highest rates of active trachoma are usually found in preschool children aged 3 to 5 years. As children grow up and have better hygiene the amount of active trachoma falls. As the prevalence of trachoma falls trachoma becomes more confined to younger children. The longer one has active trachoma and the more severe it is the more scarring one will develop.

Scarring becomes more apparent as the inflammation of active trachoma subsides. With time the scarring contracts and distorts the upper eye lid so trichiasis and blindness develop in later life.

Figure 4: Age-specific prevalence of trachoma in Aboriginal people



Source: Royal College of Ophthalmologists. The National Trachoma and Eye Health Program of the Royal Australian College of Ophthalmologists. Sydney: RACO, 1980



Elimination

Trachoma is preventable and the suffering, adverse developmental outcomes and the productivity losses it causes can be avoided. Advances in treatment, strategic programs (SAFE) and planning have now brought global elimination of this ancient disease within reach.

In line with the Vision 2020 initiative, the World Health Organization has adopted a resolution to eliminate blinding trachoma by the year 2020 to which Australia is a signatory. In 2009, as part of its Improving Eye and Ear Health Services for Indigenous Australians for Better Education and Employment Outcomes initiative, the Australian government has also made the commitment to eliminate trachoma among Indigenous communities across Australia within the next 5 years.

To meet the aim of eliminating blinding trachoma, WHO has set the following benchmarks;⁽⁹⁾

Active Trachoma (TF)

The number of cases of active trachoma (TF) in children between the ages of 1-9 must be reduced to less than 5 percent of the population of children in a community.

Facial Cleanliness

Hygiene promotion, in particular regular face washing, and environmental improvements must be conducted in a community so that, at any given time, 80 percent of the children in the community will have clean faces.

Trachomatous Trichiasis (TT)

The number of people with unoperated trichiasis must be reduced to less than one per 1,000 people. This can be achieved by increasing accessibility to surgery and improving acceptance.

Organism/aetiology

Trachoma is caused by repeated episodes of ocular infection with the organism *Chlamydia trachomatis*, an obligate intracellular Gram-negative bacteria.

In trachoma the infection is predominantly spread by passing infected ocular secretions back and forth between young children. This requires close contact and is facilitated by children having dirty faces, playing together and sharing the same bed. If a child has trachoma, *Chlamydia* can often be found in their nose and nasal secretions and in their respiratory tracts. It is rare for it to be found in the genital tract, although rectal infection has been reported in 7% of children under the age of two.⁽¹⁰⁾

The genital strains of *Chlamydia* that cause sexually transmitted infections are very similar to the trachoma strains and only differ in a very minor way. However the ocular or trachoma strains prefer to infect the eye and the genital strains the genital tract.

As with the ocular strains to become infected with genital *Chlamydia* one needs to have such close contact that the infected secretions are applied directly to the mucosal surface. Genital chlamydial infection is common especially in young sexually active adults. Infected genital secretions can get to the eye easily if the eye is rubbed with a dirty hand. About 1 in 20 of those with genital infection will also have an ocular infection with *Chlamydia*; this infection is called "Inclusion Conjunctivitis". It is usually self-limited and unless there is reinfection it will resolve in one or two months or more quickly with treatment. Inclusion conjunctivitis usually causes follicles that are seen in the lower eye lid (tarsal plate) rather than the upper eye lid as for trachoma.

The diagnosis of trachoma, especially in endemic areas is made on clinical examination. The presence of *Chlamydia* can be confirmed by a number of different laboratory tests such as culture, immuno-fluorescent cytology or nuclear acid amplification testing- such as PCR, although these tests are not recommended for general use. Even the most sensitive test, PCR, is usually negative in children with trachoma. Up to 75% of children who have active trachoma (TF) will be PCR negative and even 25% of those with the most severe inflammation (TI) will still be negative.⁽⁶⁾

Lab tests are so often negative because of the immune basis to the inflammatory tissue reaction seen in trachoma. Trachoma is a form of delayed-type of hypersensitivity and only the occasional exposure to the chlamydial antigens is enough to keep the inflammation going. For example, a given child may be re-infected once or twice a month and be positive for *Chlamydia* for only a few days after that and yet have the clinical signs of active trachoma for the whole time.

Doing PCR properly is complex, time consuming and expensive. Moreover, one still needs to flip the upper lid to collect reliable swabs which must be firmly rubbed against the tarsal conjunctiva 3 times. This hurts and children do not like it. Scrupulous care must be taken to avoid contamination in the field so that everyone who touches the child or collects the swab should be double-gloved. The tests have to be sent to an accredited lab and it often takes weeks for the results to come back.

Further information

- CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ – Sections 2 & 15-page 36 'Genotyping trachoma strains'



Clinical features, natural history and disease progression

Much of the time children with active trachoma will look normal and will not tell you they have trouble with their eyes. They are frequently asymptomatic and sore, red, sticky eyes are often regarded as normal. They may have dirty faces with ocular and nasal discharge or their faces may look clean.

The presence of active trachoma is characterized by redness of the tarsal conjunctiva, discharge, follicles and swelling of the tarsal conjunctivae. Sometimes, especially with secondary bacterial infection they may have lots of pus discharging from their eyes.

Repeated episodes of infection from *Chlamydia trachomatis* lead to long-term inflammation, scarring of the tarsal conjunctivae and distortion of the upper eyelid with in-turning of eyelashes that abrade the surface of the globe. This constant abrasion, in turn, can cause irreversible corneal opacity and blindness.

Older adults with trichiasis often present with irritated watery eyes and if not recognized, referred and operated on, the trichiasis will lead to corneal scarring and blindness.

Further information

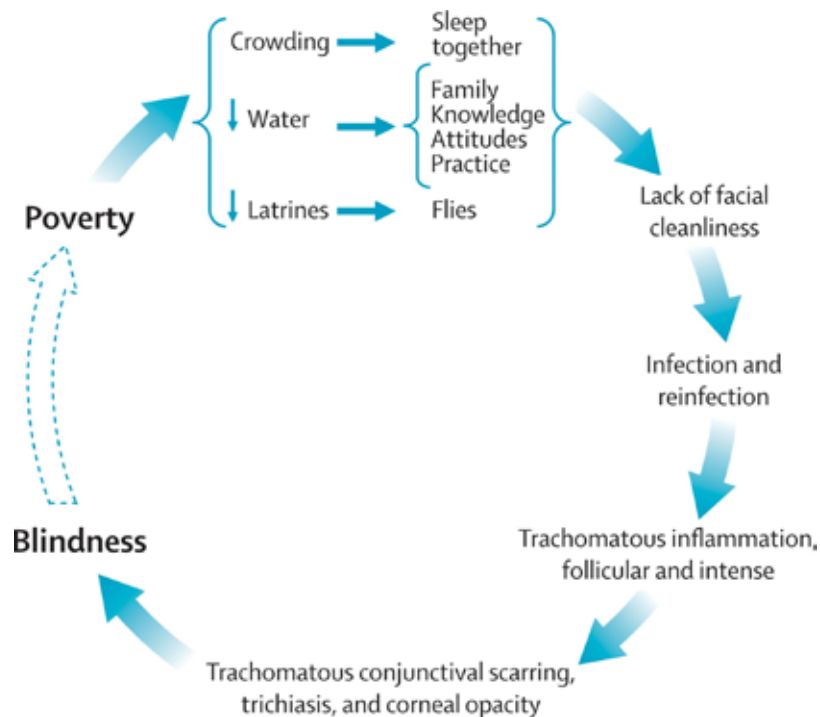
- CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ – Section 2
- WHO trachoma grading card
- WHO Achieving Community Support for Trachoma Control⁽³⁾ – Section 2.1-pages 6-8

Transmission

Children, especially pre-school children, are the major reservoirs of *C. trachomatis*.⁽¹¹⁻¹³⁾ Infection is transmitted by sharing infected ocular secretions through close physical contact (e.g. during play or when sharing a bed), indirect spread of fomites (e.g. shared towels or handkerchiefs) or by eye-seeking flies.

Poor facial cleanliness is the most important risk factor in the transmission of trachoma; particularly amongst children. Cross-sectional studies have repeatedly demonstrated an association between children with unclean faces and trachomatous inflammation.⁽¹⁴⁻¹⁷⁾ Facial cleanliness is important because it is readily modifiable. Children with dirty faces can spread infection to other children with their fingers or clothes, by all sleeping together in one bed. Small eye seeking flies can also spread trachoma.

Figure 5: Interaction of trachoma risk factors



Source: Wright HR, Turner A, Taylor HR Trachoma Lancet 2008; 371: 1945-54

Further information

- CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ – Section 4



Screening, diagnosis and grading

Regular screening and surveillance of trachoma provides important prevalence information, which is useful in management and eradication of trachoma.

Annual screening for active trachoma should be conducted in trachoma endemic communities until active trachoma prevalence in those communities is less than 5% for five consecutive years.

The coverage of screening should be at least 80% of the target group (e.g. children aged five to nine years). Ideally, all pre-school children also need to be screened because the highest prevalence of active trachoma is usually found in pre-school children.

The diagnosis of active trachoma is generally made in asymptomatic children as part of a population-based screening program.

Adults who live in, or come from, trachoma endemic areas should be examined for trachoma scarring and trichiasis as part of routine adult health examination or whenever they present with sore, watery eyes.

The diagnosis of trachoma is generally based on clinical grading using the simplified WHO grading system as outlined below.⁽²⁰⁾

(TF)	<i>Trachomatous inflammation, Follicular</i>	Presence of five or more follicles of >0.5 mm in diameter on the upper tarsal conjunctiva.
(TI)	<i>Trachomatous inflammation, Intense</i>	Presence of pronounced inflammatory thickening of the upper tarsal conjunctiva obscuring more than half of the normal deep tarsal vessels.
(TS)	<i>Trachomatous conjunctival Scarring</i>	Presence of visible scars on the tarsal conjunctiva.
(TT)	<i>Trachomatous Trichiasis</i>	Presence of at least one in-grown eyelash touching the globe, or evidence of epilation (eyelash removal).
(TO)	<i>Corneal Opacity</i>	Presence of corneal opacity blurring part of the pupil margin.

Screening, diagnosis and grading

Each eye should be examined separately. To make sure one remembers to examine both eyes, most people develop the routine of always examining the right eye first. The upper eyelid is everted and examined with the aid of x2.5 loupes and a good light source. Each component of the grading system is individually marked as present or absent. This is important because, for example, a child may have TF, TI and TS, or an older adult may present with TS, TT and CO.

Before each screening, an inter-observer agreement exercise involving a reference grader of proven accuracy ('gold standard') should be conducted. Although such exercises in the field are time consuming and may be logistically difficult, they are the best way to ensure the quality of assessments, accuracy of the diagnosis and the prevalence data collected.⁽²¹⁾

The use of the Trachoma grading self directed learning CD-ROM⁽⁴⁾ is an excellent way to quickly train a new grader or refresh the skills of an experienced grader before starting an annual examination program.

Data on trachoma should be reported to the National Trachoma Reporting and Surveillance Unit through the State or Territory coordinator.

To calculate the coverage of trachoma screening use the following formula:

$$\frac{\text{total number of children < 10 years screened for trachoma}}{\text{total number of children < 10 years who live in the community}} \times 100$$

To calculate the prevalence of active trachoma use the following formula:

$$\frac{\text{number of children < 10 years with trachoma}}{\text{number of children < 10 years screened}} \times 100$$

In areas where trachoma or trichiasis is endemic, adults aged 40-54 years should be screened every 2 years and those 55+ years should be screened annually for trichiasis as a part of a healthy adult check.

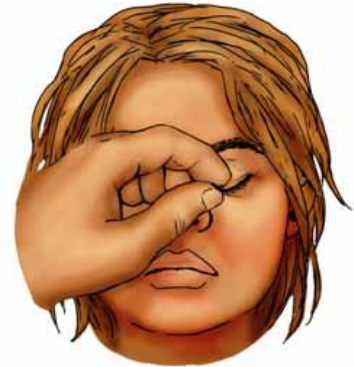


Screening, diagnosis and grading

Figure 6: How to examine for active trachoma

To examine for Active Trachoma (Flip for Follicles)

- Position yourself directly in front of the patient.
- Ask the patient to look down without moving their head.
- Hold lashes between thumb and first finger of your left hand and gently pull the eyelid down.
- Using an applicator or similar instrument or your right thumb gently push down on the eyelid above the lid skin fold and pull the eyelid out and up to evert the eyelid.
- Hold the flipped lid with your left thumb as shown and carefully look for follicles.
- Remember to always use 2.5x loupes and a torch as shown.
- When you have finished gently re-evert the eyelid and ask the patient to blink.



In areas where trachoma or trichiasis is endemic, adults aged 40 to 54 years should be screened every two years and those 55+ years should be screened annually for trichiasis as a part of a healthy adult check. To screen for trichiasis refer to figure 7 below.

Figure 7: The three Ts to screen for trichiasis

To screen for trichiasis, remember the three Ts

- **T**hink about it: check for trichiasis at every old person's check.



- **T**humb: use your thumb to lift the eyelid off the eyeball.



- **T**orch: shine the torch to check for in-turned eyelashes.



Remember, patients with trichiasis must be referred to an ophthalmologist for evaluation for eyelid surgery.

Health services need to ensure that a process is in place for timely surgical referral and treatment of people with trichiasis before they develop corneal opacity and blindness.

Further information

- CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ — Sections 8, second-last paragraph, 11.1–11.4, 11.7, 15, Appendix 1 & 2
- WHO Trachoma grading card
- CERA Trachoma grading self directed learning CD⁽⁴⁾



Differential diagnosis

Table 2:

Differential name	Differentiating signs/symptoms	Differentiating tests
Inclusion conjunctivitis	Generally occurs in adults not living in areas where trachoma is endemic. Often have urethritis/cervicitis (sexually transmitted infection) as well. It may also occur in newborn babies born to mothers with chlamydial genital infection.	PCR testing can be used to identify genital strains of <i>C. trachomatis</i> .
Viral conjunctivitis	A common cause of conjunctival follicles. It can be distinguished from trachoma by an acute history and mucopurulent discharge is more likely. Absence of Herbert's pits or pannus. Both conditions may lead to tarsal conjunctival scarring.	A swab for HSV and adenovirus could be considered.
Bacterial conjunctivitis	Bacterial infection, such as with <i>Moraxella</i> organism, can be a rare cause of follicle formation. Absence of Herbert's pits.	Microscopy, culture and sensitivity testing on a conjunctival swab may reveal a bacterial cause.
Vernal conjunctivitis	As an allergic disorder, patients often have associated with atopy. Symptoms include itchiness, lacrimation, photophobia, foreign body sensation and burning. Absence of Herbert's pits.	Giemsa cytology of conjunctival scraping shows many eosinophils.
Trauma or chemical injury to eye	History of trauma or chemical contact with eye. Absence of Herbert's pits. Both conditions may lead to tarsal conjunctival scarring.	No differentiating tests performed.
Trichiasis due to other chronic inflammatory conditions	Trichiasis can be idiopathic or secondary to a large range of chronic inflammatory diseases such as blepharitis and chronic conjunctivitis. Absence of Herbert's pits. Trachoma more likely in an area where it is endemic.	No differentiating tests performed.
Corneal opacity due to other causes	There are many other causes of corneal opacity. However, when seen in conjunction with trichiasis and other signs of trachoma in a patient who has spent a significant amount of his/her life in a trachoma endemic area, a diagnosis of trachomatous corneal opacity is likely.	No differentiating tests performed.

Pannus and Herbert's pits

Two additional signs are useful in making the differential diagnosis of trachoma. They are not used in the WHO simplified grading, but they are signs that are specific for trachoma. Someone who has these features will definitely have had trachoma previously, although he or she might have no other signs of trachoma now.

Pannus is scarring of the upper part of the cornea adjacent to the limbus (the junction between the cornea and the sclera). It forms while the inflamed and toxic upper tarsal plate covers the upper cornea. Fine blood vessels can sometimes be seen in the pannus. It forms a moon-like crescent that covers the top edge of the cornea.

Herbert's pits are small depressions or gaps left in pannus. During intense active trachoma, follicles can form at the limbus, as well as in the tarsal conjunctiva. Herbert's pits are left by resolving limbal follicles.

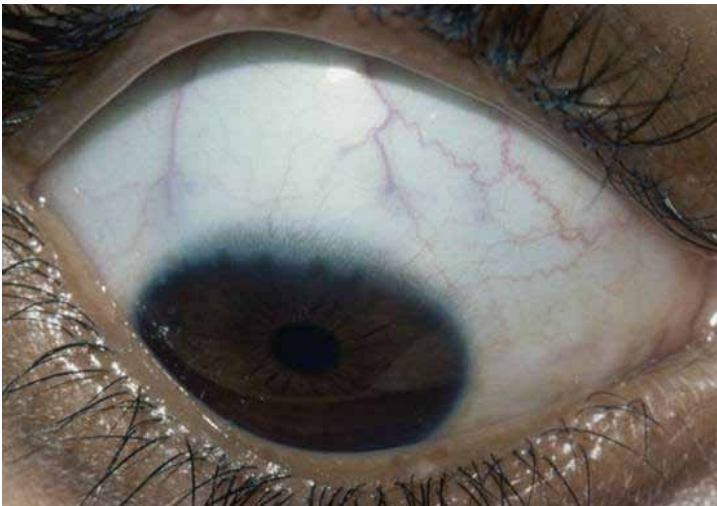


Figure 9: Mild pannus and Herbert's pits (above) and more extensive pannus and pits (below)⁽⁸⁾



WHO SAFE strategy

WHO recommends a multi-faceted intervention strategy for eliminating blinding trachoma. The strategy is known as the SAFE (Surgery, Antibiotics, Facial cleanliness and Environmental improvement) strategy.⁽²¹⁾

Table 3: The SAFE (Surgery, Antibiotics, Facial cleanliness and Environmental improvement) strategy

Component of the strategy	WHO recommendations
Surgery for trichiasis	Bilamellar tarsal rotation procedure for those with trichiasis, regardless of the number or position of eyelashes touching the globe
Antibacterials	Single oral dose of azithromycin (20mg/kg bodyweight; maximum 1g) repeated every 12 months* Mass community treatment or targeted household treatment depending on prevalence
Facial cleanliness	Health promotion to educate community about trachoma, the importance of personal hygiene and practical advice on facial cleanliness
Environmental improvements	Improve overcrowding, water and sanitation facilities

*Note in many hyperendemic areas (prevalence >20%) azithromycin is distributed every six months.

The SAFE strategy is the main action against trachoma recommended by the Alliance for the Global Elimination of Trachoma by 2020 (GET 2020).⁽²²⁾ The aim of this strategy is not to eradicate *C. trachomatis* infection in humans as such, because that is an unrealistic expectation against a bacterium that has stood the test of time. Instead, the aim is to eliminate endemic blinding trachoma by reducing the risk and frequency of transmission through improved hygiene, by reducing infection with antibacterials and by treating trichiasis with surgery to delay the onset of blindness.^(23, 24) Although the acronym SAFE is convenient, it reverses the order of public health importance of the four components.

Further information

- CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ — Section 6

Surgery

All patients with trichiasis must be referred to an ophthalmologist for evaluation for eyelid surgery. The aim of trachoma surgery is to correct the in-turning of eyelashes. To correct trichiasis, WHO recommends the bilamellar tarsal rotation procedure, which is described in the Trichiasis surgery for trachoma: The bilamellar tarsal rotation procedure manual.⁽⁷⁾ Surgical intervention of trichiasis stops the eyelashes from rubbing against the cornea, thereby preventing corneal opacity and subsequent blindness.

Surgery does not always prevent the further development of trichiasis, as the remaining scar tissue may continue to contract and turn other eyelashes inward. Post-operative recurrence is a major problem. With well-done surgery, about 5% of patients will have recurrence at one year. With less well-done surgery, the rates can be much higher.⁽²⁵⁻²⁸⁾ Recurrence may be inevitable because of the progressive nature of the disease and ongoing pathological scarring that may be augmented by changes to the tear film and predisposition to bacterial infection.^(27, 29)

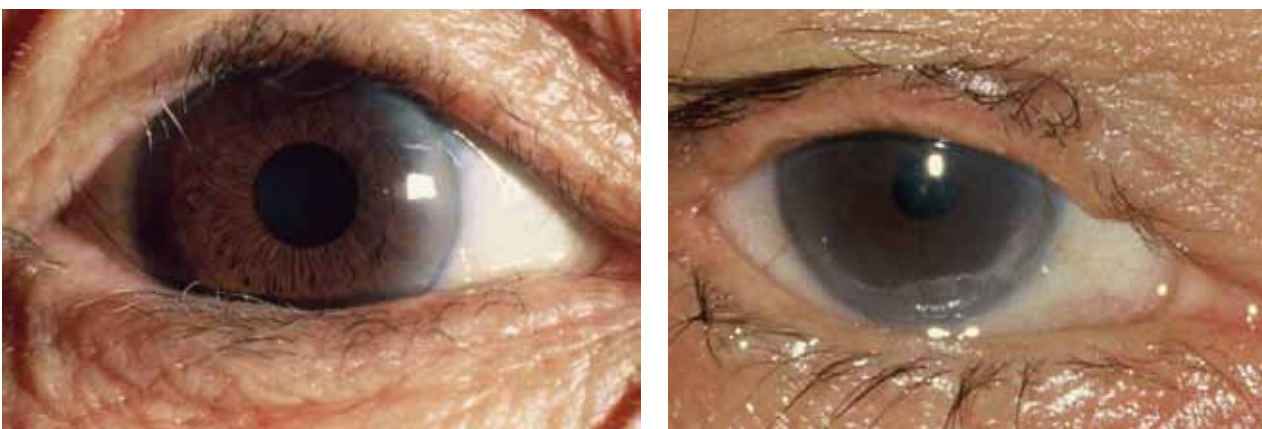
Patients should be actively followed up for possible recurrence and an annual review after surgery is required to detect further trichiasis.

Epilation (removal of eyelashes) is not recommended as a long-term solution, as lashes will regrow. In addition, incomplete removal of broken lashes is dangerous, as the broken lash can act as a bristle and damage the cornea.

Trichiasis surgery is an important arm of the SAFE strategy, not only to reduce the risk of blindness, but to improve quality of life from non-visual symptoms such as photophobia and eye pain.⁽³⁰⁾

Future efforts need to increase the accessibility to surgery and improve surgical acceptance.

Figure 10: Pre-operative trichiasis (left) and the post-operative appearance (right).



Further information

- CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ — Sections 6, 10 & second-last sentence, page 9
- WHO Trichiasis surgery for trachoma: The bilamellar tarsal rotation procedure⁽⁷⁾



Antibacterials

The rationale behind antibacterial treatment is to reduce the prevalence, duration and intensity of active trachoma infection, thereby preventing the development of scarring and blindness.⁽¹⁾

Oral azithromycin is as close to the ideal antibacterial as we will get for mass distribution: it is safe, requires only a single oral dose, treatment is usually repeated every six to 12 months, chlamydia do not develop antibiotic resistance, and cost is not a limiting factor in Australia because azithromycin is available through the PBS as a schedule 100 drug for use in Aboriginal communities.

A single oral dose of azithromycin (20mg/kg body weight; maximum 1g) repeated six to 12 monthly as needed is recommended to reduce the prevalence and intensity of active trachoma infection and in the long term to prevent the development of scarring and blindness.

Azithromycin has a broad spectrum of activity against Gram-positive and some Gram-negative bacteria, including *Chlamydia* spp.⁽³¹⁾ High tissue selectivity with a long tissue half-life makes it suitable for a once-daily administration regimen. In relation to *C. trachomatis* (lifecycle from 48 hours to four–seven days), levels of azithromycin above the 90% minimal inhibitory concentration have been detected after four days in tear samples,^(32, 33) and after 14 days in conjunctival tissue specimens.⁽³²⁾

In addition, it is well tolerated by the elderly (even with mild to moderate renal or hepatic insufficiency), young children⁽³⁴⁾ and pregnant women,⁽³⁵⁾ and has little interaction with other drugs.^(31, 32) Azithromycin is a category B1 drug, which means it is approved to be used in pregnancy. It has replaced both 1% tetracycline eye ointment to both eyes twice daily for six weeks and oral erythromycin four times a day for one week.

Other benefits of azithromycin treatment have been reported to include reductions in common infections such as respiratory, ear and skin infections, diarrhoea and, of course, chlamydial genital tract infections and other sexually transmitted infections.^(36, 37)

Concerns have been raised about the development of bacterial resistance to azithromycin associated with its widespread use. This is actively monitored in Australia by the National Trachoma Surveillance and Reporting Unit and the prevalence of resistance (20%) in *Streptococcus pneumoniae* isolates from trachoma endemic areas is not different from the national rate (23%).

Further information

- CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ — Section 11
- CDC Guidelines for management of trachoma in the Northern Territory⁽⁶⁾ —Section 12.2 & Appendix 2, page 18
- Trachoma surveillance report 2008⁽⁹⁾

How to treat?

The key to treatment is to treat all members of a household (or family) in which one or more child has active trachoma. When the prevalence is sufficiently high, it is logistically much easier to treat all members of the community.

Treating only individuals with a clinically active disease has been shown to miss a significant proportion with *C. trachomatis* infection.⁽³⁸⁻⁴⁰⁾ Targeting treatment to those households positive for the disease⁽⁴¹⁻⁴⁴⁾ is intuitive, as treatment will be directed to the individuals most in need and to whom the disease could be transmitted. This method is also appealing because of the expectation that fewer resources will be used, including antibacterials, and fewer people will be treated unnecessarily, and household-based treatment has been shown to be effective in low-prevalence settings.^(39, 45) However, in high-prevalence settings, this method is less effective than either the mass treatment of children^(45, 46) or community-based mass treatment,⁽⁴⁷⁾ and much less resource efficient as a result of the need for trained personnel to examine every child to be able to identify each and every household with positive cases⁽⁴⁵⁾ and the presence of numerous subclinical infections.⁽⁴⁷⁾ Thus, the choice between mass treatment of all community members or family-based treatment should be based on logistic factors.

Based on evidence from other communities, WHO has recommended that when the prevalence of active trachoma in children exceeds 10%, it is easier to treat the whole community. For Australia, at these prevalences CDNA recommends treating all affected households if household clustering is obvious and otherwise treating the whole community. Below this prevalence, treatment should be given at the household level.

Because trachoma resolves slowly, WHO has recommended that treatment should continue on an annual basis for at least three years and treatment should only stop once the prevalence of active follicular trachoma (TF) in children aged one to nine years is less than 5%.⁽²¹⁾ CDNA recommends that once the prevalence of TF has dropped below 5%, annual screening should be continued for five years before being discontinued.

The use of weight-adjusted dosing of azithromycin for young children (20mg/kg body weight; maximum 1g) requires each child to be weighed. Borrowing from an idea used successfully with the distribution of ivermectin to treat onchocerciasis,⁽⁴⁸⁾ a height-adjusted schedule was also introduced for azithromycin to improve the efficiency and the speed of treatment.⁽⁴⁹⁾ The use of a height-adjusted dose has become the standard method of distribution in many parts of the world because of its ease and speed. For ease of use and comparison, both the weight-adjusted and the height-adjusted dosing for azithromycin are provided in the following tables.



Table 4: Weight-adjusted azithromycin treatment schedule for trachoma(1)

Weight (kg)	Dose	
3 to <6	80mg	2ml ^a
6 to <10	160mg	4ml ^a
10 to <15	240mg	6ml ^a
15 to <20	400mg	10ml ^a
20 to <30	500mg	1 tablet ^b
30 to <40	750mg	1 ½ tablets ^b
40+	1000mg	2 tablets ^b

a. 200mg/5ml suspension

b. 500mg tablet

The height-adjusted azithromycin treatment schedule may be used with the aid of a colour-coded stick or a measuring tape tagged to the wall.

Table 5: Height-adjusted azithromycin treatment schedule for trachoma(modified from 50)

Height (cm)	Dose	
For treatment of children <61cm or <1 year of age refer to weight-adjusted dosing		
61–70	160mg	4ml ^a
70–100	240mg	6ml ^a
100–120	400mg	10ml ^a
120–140	500mg	1 tablet ^b (12.5ml)
140–160	750mg	1 ½ tablets ^b
>160	1000mg	2 tablets ^b

a. 200mg/5ml suspension

b. 500mg tablet

Further information

- CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ — Sections 11.1, 11.6, 11.7, pp. 9, 10, 12 & 19
- CDC Guidelines for management of trachoma in the Northern Territory⁽⁶⁾ — Sections 12.2.4, 12.2.5, 12.2.7, pages III & 18

The treatment of infants

The main burden of *C. trachomatis* is known to be in very young children.^(13, 51, 52) Infants <6 months of age have not been included in many mass treatment strategies on the basis that azithromycin is not widely approved for use in this age group. There are three reasons why this age group should be included in mass azithromycin treatment strategies.

First, infants are a significant source of infection and, in extreme cases, >50% of the community load of *C. trachomatis* may be harboured in children under one year of age.⁽⁵¹⁾ Second, the alternative treatment prescribed, such as tetracycline ointment or oral erythromycin, is not without its own compliance and complication issues.^(53, 54) Third, azithromycin is recognised as safe in young children and is approved for use in children over six months of age.⁽⁵⁵⁾ Azithromycin is also recommended by the National Health and Medical Research Council as the treatment of choice in infants of any age for the prophylaxis of pertussis, as it is better tolerated and is associated with improved compliance compared with erythromycin.⁽⁵⁶⁾ Thus, safety issues need not be grounds to exclude azithromycin for the treatment of children aged <1 year.

Further information

- CDC Guidelines for management of trachoma in the Northern Territory⁽⁶⁾ — Section 12.2.6 & page 19, top section



Facial cleanliness

Facial cleanliness, particularly among children, may be the most important component of the SAFE strategy, as lack of facial cleanliness is seen as ‘the critical, final common pathway for all the environmental risk factors’ of trachoma.⁽⁸⁾ Crowding leads to the increased likelihood of transmission of trachoma through close proximity and thus the transference of bacteria from the infected ocular secretions on a dirty face; poor access to water or, more importantly, the failure to use water appropriately leads to a dirty face; and, finally, garbage disposal and close proximity to animals lead to increased density of flies, which are more likely to land on a dirty face than a clean face and may carry infected ocular secretions to the next child (see Figures 5 on page 13 which show the cycle of trachoma).

Although an important component of the SAFE strategy, facial cleanliness is the one that has received the least attention. In part this may be because it does require a behavioural change, which can be hard to achieve and may need prolonged local involvement, but, in the end, this is what is needed (see 2 and 3 on page 8)

Barriers to facial cleanliness may include;

- lack of access to clean water;
- lack of awareness of the benefits of keeping children’s faces clean;
- time constraints; and
- lack of motivation.

In the Australian context, lack of access to clean water usually means poorly maintained or constructed washing facilities or bathrooms. Broken plumbing, missing taps, slippery floors or missing basins can make it difficult or impossible for children to wash their faces or for others to wash their faces for them. In these circumstances, proper repairs and maintenance are required.

It is important to communicate that one does not need a lot of water to keep children’s faces and hands clean. A couple of handfuls of water — one to wash the eyes and surrounding and the other to wash the hands and the rest of the face — are sufficient. The use of soap, although good, is not necessary. A clean face does not have ocular or nasal discharge, flies, dirt or crusting.

The promotion of facial cleanliness through education, targeting both expectant mothers and young children, may be the key to trachoma elimination, as it will stop the frequent exchange of infected ocular secretions and thus reduce transmission of infection.

Further efforts should be aimed at innovative methods to translate health education and promotion activities into sustainable changes in hygiene behaviour so that, at any given time, 80% of the children in the community will have clean faces. The involvement of everyone who interacts with children is really required. In addition to clinic staff and teachers, the involvement of football coaches, art teachers and swimming pool attendants, for example, is needed, and family and community service workers should be encouraged to promote clean faces as part of a new community norm and reinforce the message in a positive and non-judgmental way.

Further information

- WHO Achieving community support for trachoma control⁽³⁾ — Sections 3.1–3.3, pages 13, 15, 17, 19, 27 & 28 & Section 5.3
- CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ — Section 12

Environmental improvement

The 'E' component of the SAFE strategy covers a very broad category of potential activities, and in some ways is the most difficult component to comprehend and define. Access to clean water supply, adequate sanitation, improved housing and attempts to minimise fly density are all potentially important factors for trachoma control.^(3, 57-59)

Trials have examined fly control and have shown a minor reduction in the prevalence of trachoma in the low endemic area.^(59, 60) However, it is an expensive solution and not sustainable, and fly control was not found to be effective in a hyperendemic area in central Tanzania when it was added to mass antibacterial treatment.⁽⁶¹⁾

In Africa it is common to encourage people to dig pit latrines or to drill bore-holes to improve hygiene and living conditions and also to reduce flies. There is little convincing evidence to support the impact of these specific environmental improvements. With lack of strong evidence for cost-effective strategies, the emphasis should be placed on health education and on situation-specific barriers to achieving facial cleanliness, such as access to water and appropriate use of water for hygiene purposes. The situation is different in Australia.

In Australia attention needs to be directed to the proper maintenance of housing, especially washing facilities and bathrooms, and the development of homemaker skills. Environmental improvements should focus on the barriers to children washing their faces and achieving facial cleanliness. Time and effort should be spent to check household and community washing facilities to ensure they are functional and safe for children to use. Leaky or broken plumbing needs to be repaired and bathrooms properly maintained. The installation of mirrors so children can actually see whether their faces are clean or dirty is another way to help reinforce the message and promote clean faces.

The significance of improved hygiene and environmental improvements should not be diminished by the difficulties in achieving this, as the benefits also include reduced morbidity from other diseases, such as scabies, otitis media, rheumatic fever and gastrointestinal infections, which share similar risk factors.^(60, 62)

Further information

- CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ — Sections 6 & 12



Management

Management of trachoma in Australia is based on the SAFE strategy. The CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ recommend that trachoma control programs should be the responsibility of government-run and regional public health units and should be run at a regional level.

Engagement and partnership with the local community at all levels, including program development, implementation and evaluation, is an essential and critical component of an effective and successful trachoma control program. This can be achieved through genuine collaboration and consultation with Aboriginal Community Controlled Organisations, community representatives, and other key stakeholders and experts.

Further efforts should be aimed at:

- increasing collaboration at national, regional and community levels to ensure comprehensive implementation of all components of the SAFE strategy; and
- establishing and maintaining a health workforce with appropriate knowledge, skills and experience in trachoma control through regular training and support.

Further information

- CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ — pages 8, 20 & Sections 7–9
- CDC Guidelines for management of trachoma in the Northern Territory⁽⁶⁾ — Sections 6 & 13

Monitoring and evaluation

Community-wide monitoring of trachoma should continue in a trachoma endemic community until such time as trachoma is no longer a public health problem in a region. Monitoring and evaluation should include both process indicators and outcome measures.

Monitoring should be carried out in the following areas:

- efficacy of antibiotic treatment through monitoring community prevalence data;
- efficacy of facial cleanliness health promotion materials/activities through monitoring the percentage of children with clean faces;
- monitoring the outcome of surgery for trichiasis patients to assess the success of the surgical procedure;
- post-operative monitoring of trichiasis patients on an annual basis to detect further trichiasis, as surgery does not always prevent trichiasis in the future and the remaining scar tissue may continue to contract and turn other eyelashes inward.

Trachoma control programs have the elimination of blinding trachoma from Australia as their ultimate goal, and thereby contribute to improved health, education, employment and community participation for Aboriginal and Torres Strait Islander peoples.

A number of process and outcome indicators have been developed to evaluate and measure the impact of trachoma control programs in Australia. These indicators include recruitment and training of healthcare workers, antibiotic treatment, clean faces, surveillance, data management and surgical referral.

The prevalence of resistance to the antibiotic azithromycin is a factor monitored by the National Trachoma Surveillance and Reporting Unit.^(63, 64) Over the past three years the rate of resistance to azithromycin of *S. pneumoniae* isolates from trachoma endemic areas is not different from isolates from the rest of Australia.

Further information

- CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ — Sections 10, 11.3 & 13, page 8, point 8
- A national framework for delivery of trachoma control programs



Outcomes

The following Medium and Long term outcomes should be the focus of trachoma control programs in Australia.

Medium term

- A significant reduction in prevalence of TF, TI and TS in the Aboriginal and Torres Strait Islander population aged one to four years, five to nine years and 10 to 14 years.

Long term (five years)

- A significant reduction in prevalence of TT in the Aboriginal and Torres Strait Islander population.
- Elimination of blinding trachoma by achieving the WHO benchmarks for eliminating blinding trachoma as outlined in the 'Elimination' section of this booklet (page 13) (active trachoma (TF) <5% in every community and operable trichiasis (TT) <0.1%).

Further information

- CDNA Guidelines for the public health management of trachoma in Australia⁽¹⁾ — Sections 13
- A national framework for delivery of trachoma control programs

References

1. Communicable Disease Network Australia. Guidelines for the public health management of Trachoma in Australia March 2006.
2. WHO. Trachoma Grading Card.
3. Francis V, Turner V. Achieving Community Support for Trachoma Control. Geneva: World Health Organization 1993. Report No.: WHO/PBL/93.36.
4. Wright HR, McDonnell C, Squire S, Keeffe JE, Taylor HR. Trachoma Grading Self Directed Learning. Melbourne: Centre for Eye Research Australia; 2007.
5. Betty Tellis KF, Jill E Keeffe, Hugh R Taylor. Trachoma Surveillance Annual Report, 2008. A report by the National Trachoma Surveillance and Reporting Unit (NTSRU). Commun Dis Intell. 2009.
6. CDC. Guidelines for Management of Trachoma in the Northern Territory 2008.
7. Reacher M, Foster A, Huber J. Trichiasis Surgery for Trachoma - The Bilamellar Tarsal Rotation Procedure. Geneva: World Health Organization 1993. Report No.: WHO/PBL/93.29.
8. Taylor HR. Trachoma: A Blinding Scourge from the Bronze Age to the Twenty-first Century. Melbourne: Centre for Eye Research Australia; 2008.
9. NTSRU. Trachoma Surveillance Report 2008 in press.
10. Taylor HR, Fox SS, Xie J, Arnold A-L, Keeffe JE. The prevalence and causes of vision loss in Indigenous Australians: The National Indigenous Eye Health Survey. 2009: in preparation.
11. Montgomery M. Sustaining Trachoma Control and Elimination. World Health Organization; 2006.
12. Malaty R, Zaki S, Said ME, Vastine DW, Dawson CR, Schachter J. Extraocular infections in children in areas with endemic trachoma. J Infect Dis. 1981;143:853.
13. Abdou A, Nassirou B, Kadri B, Moussa F, Munoz BE, Opong E, et al. Prevalence and risk factors for trachoma and ocular chlamydia trachomatis infection in Niger. Br J Ophthalmol. [World View]. 2007;91(January):13-7.
14. Courtright P, Sheppard J, Lane S, Sadek A, Schachter J, Dawson CR. Latrine ownership as a protective factor in inflammatory trachoma in Egypt. Br J Ophthalmol. [TRACHOMA]. 1991;75:322-5.
15. Katz J, West KP, Khattri SK, LeClerq SC, Pradhan EK, Thapa MD, et al. Prevalence and risk factors for trachoma in Sarlahi district, Nepal. Br J Ophthalmol. 1996;80(June):1037-41.
16. Schemann J-F, Sacko D, Malvy D, Momo G, Traore L, Bore O, et al. Risk factors for trachoma in Mali. Int J Epidemiol. 2002;31:194-201.
17. Taylor HR, West SK, Mmbaga BBO, Katala SJ, Turner V, Lynch M, et al. Hygiene factors and increased risk of trachoma in Central Tanzania. Arch Ophthalmol. [Epidemiology & Biostatistics]. 1989;107:1821-5.
18. West S, Congdon N, Katala S, Mele L. Facial cleanliness and risk of trachoma in families. Arch Ophthalmol. 1991;109:855-7.
19. West SK, Munoz B, Lynch M, Kayongoya A, Mmbaga BBO, Taylor HR. Risk factors for constant, severe trachoma in pre-school children in Kongwa, Tanzania. Am J Epidemiol. 1996;143:73-8.
20. Thylefors B, Dawson CR, Jones BR, West SK, Taylor HR. A simple system for the assessment of trachoma and its complications. Bull World Health Organ. 1987;65:477-83.
21. Solomon AW, Zondervan M, Kuper H, Buchan JC, Mabey DCW, Foster A. Trachoma Control - A Guide for Programme Managers. WHO, editor. Geneva: World Health Organization; 2006.
22. Mariotti SP, Pararajasegaram R, Resnikoff S. TRACHOMA: LOOKING FORWARD TO GLOBAL ELIMINATION OF TRACHOMA BY 2020 (GET 2020). Am J Trop Med Hyg. 2003 November 1, 2003;69(90051):33-5.
23. Lietman T, Fry A. Can we eliminate Trachoma? Br J Ophthalmol. 2001;85:385-7.
24. Emerson PM, Cairncross S, Bailey RL, Mabey DCW. Review of the evidence base for the 'F' and 'E' components of the SAFE strategy for trachoma control. Tropical Medicine & International Health. 2000;5(8):515-27.
25. Reacher MH, Munoz B, Alghassany A, Daar AS, Elbualy M, Taylor HR. A controlled trial of surgery for trachomatous trichiasis of the upper lid. Arch Ophthalmol. 1992;110:667-74.
26. Bog H, Yorson D, Foster A. Results of community-based eyelid surgery for trichiasis due to trachoma. Br J Ophthalmol. 1993;77:81-3.
27. Zhang H, Kandel RP, Sharma B, Dean D. Risk factors for recurrence of post-operative trichiasis: implications for trachoma blindness prevention. Arch Ophthalmol. 2004;122:511-6.



References

28. West ES, Mkocha H, Munoz B, Mabey D, Foster A, Bailey R, et al. Risk Factors for Postsurgical Trichiasis Recurrence in a Trachoma-Endemic Area. *Invest Ophthalmol Vis Sci.* 2005;46:447-53.
29. Burton MJ, Bowman RJC, Faal H, Aryee EAN, Ikumapayi UN, Alexander NDE, et al. Long term outcome of trichiasis surgery in the Gambia. *Br J Ophthalmol.* 2005;89:575-9.
30. Dhaliwal U, Nagpal G, Bhatia MS. Health-Related Quality of Life in Patients with Trichomatous Trichiasis or Entropion. *Ophthalmic Epidemiol.* 2006;13(No 1 - February):59-66.
31. Hoepelman IM, Schneider MME. Azithromycin: the first of the tissue-selective azalides. *Int J Antimicrob Agents.* 1995;5:145-67.
32. Tabbara KF, El-Asrar AM, Al-Omar O, Choudhury AH, Al-Faisal Z. Single-dose azithromycin in the treatment of trachoma. A randomized, controlled study. *Ophthalmology.* 1996;103:842-6.
33. Karcioğlu ZA, El-Yazigi A, Jabak MH, Choudhury AH, Ahmed WS. Pharmacokinetics of Azithromycin in Trachoma Patients. *Ophthalmology.* 1998;105(4 - April):658-61.
34. Wood N, McIntyre P. Pertussis: review of epidemiology, diagnosis, management and prevention. *Paediatric Respiratory Reviews.* 2008;9(3):201-12.
35. Gray RH, Wabwire-Mangen F, Kigozi G, Sewankambo NK, Serwadda D, Moulton LH, et al. Randomized trial of presumptive sexually transmitted disease therapy during pregnancy in Rakai, Uganda. *American Journal of Obstetrics and Gynecology.* 2001;185(5):1209-17.
36. Shelby-James TM, Leach AJ, Carapetis JR, Currie BJ, Mathews JD. Impact of single dose azithromycin on group A streptococci in the upper respiratory tract and skin of Aboriginal children. *Ped Infect Dis J.* 2002;21(5):375-80.
37. Fry AM, Jha HC, Lietman TM, Chaudhary JSP, Bhatta RC, Elliott J, et al. Adverse and Beneficial Secondary Effects of Mass Treatment with Azithromycin to Eliminate Blindness Due to Trachoma in Nepal. *Clin Infect Dis.* 2002;35(August):395-402.
38. West ES, Munoz B, Mkocha H, Holland MJ, Aguirre A, Solomon AW, et al. Mass treatment and the effect on the load of *Chlamydia trachomatis* infection in a trachoma-hyperendemic Community. *Invest Ophthalmol Vis Sci.* 2005;46:83-7.
39. Burton MJ, Holland MJ, Faal N, Aryee EAN, Alexander NDE, Bah M, et al. Which members of a community need antibiotics to control trachoma? Conjunctival *Chlamydial trachomatis* infection load in Gambian Villages. *Invest Ophthalmol Vis Sci.* 2003;44:4215-22.
40. Bird M, Dawson CR, Schachter JS, Miao Y, Shama A, Osman A, et al. Does the Diagnosis of Trachoma Adequately identify ocular chlamydial Infection in Trachoma-Endemic Areas? *J Infect Dis.* 2003;187(May):1669-73.
41. Tielsch JM, West KP Jr, Katz J, Keyvan-Larijani E, Tizazu T, Schwab L, et al. The epidemiology of trachoma in southern Malawi. *Am J Trop Med Hyg.* [trachoma]. 1988;38:393-9.
42. Taylor HR, Millan-Velasco F, Sommer A. The ecology of trachoma: an epidemiological study of trachoma in Southern Mexico. *Bull World Health Organ.* [trachoma]. 1985;63:559-67.
43. West SK, Rapoza P, Muñoz B, Katala S, Taylor HR. Epidemiology of ocular chlamydial infection in a trachoma-hyperendemic area. *J Infect Dis.* [TRACHOMA]. 1991;163:752-6.
44. Broman AT, Shum K, Munoz B, Duncan DD, West SK. Spatial clustering of ocular chlamydial infection over time following treatment, among households in a village in Tanzania. *Invest Ophthalmol Vis Sci.* 2006;47(No1 January):99-104.
45. Frick KD, Lietman TM, Holm SO, Jha HC, Chaudary JSP, Bhatta RC. Cost-effectiveness of trachoma control measures: comparing targeted household treatment and mass treatment of children. *Bull World Health Organ.* 2001;79(3):201-7.
46. Holm SO, Jha HC, Bhatta RC, Chaudary JSP, Thapa BB, Davis D, et al. Comparison of two azithromycin distribution strategies for controlling trachoma in Nepal. *Bull World Health Organ.* 2001;79(3):194-200.
47. Schemann JF, Guinot C, Traore L, Zefack G, Dembele M, Diallo I, et al. Longitudinal evaluation of three azithromycin distribution strategies for treatment of trachoma in a sub-Saharan African country, Mali. *Acta Tropica.* 2007;101:40-53.
48. Taylor HR, Duke BOL, Muñoz B. The selection of communities for treatment of onchocerciasis with ivermectin. *Trop Med Parasitol.* 1992;43:267-70.

References

49. Basilion EV, Kilima PM, Mecaskey JW. Simplification and improvement of height-based azithromycin treatment for paediatric trachoma. *Trans R Soc Trop Med Hyg.* 2005;99(1):6-12.
50. Schemann J-F. *Le trachome Une maladie de la pauvreté* 2008.
51. Solomon AW, Holland MJ, Burton MJ, West SK, Alexander NDE, Aguirre A, et al. Strategies for control of trachoma: observational study with quantitative PCR. *Lancet.* 2003;362(July):198-204.
52. Taylor HR, Siler JA, Mkocho HA, Muñoz B, West S. The natural history of endemic trachoma: a longitudinal study. *Am J Trop Med Hyg.* 1992;46:552-9.
53. Schachter J, West S, Mabey D, Dawson CR, Bobo L, Bailey R, et al. Azithromycin in control of trachoma. *Lancet.* 1999;354:630-5.
54. Bailey RL, Arullendran P, Whittle HC, Mabey DW. Randomised controlled trial of single-dose azithromycin in treatment of trachoma. *Lancet.* 1993;342:453-6.
55. Pfizer Inc. Zithromax (azithromycin tablets) and (azithromycin for oral suspension) 70-5179-00-4. Product Insert. 2004;70:1-32.
56. Tiwari T, Murphy TV, Moran J, National Immunization Program, CDC. Recommended antimicrobial agents for the treatment and postexposure prophylaxis of pertussis: 2005 CDC Guidelines. *MMWR Recomm Rep.* 2005;54:1-16.
57. Miller K, Pakpour N, Yi E, Melese M, Alemayehu W, Bird M, et al. Pesky trachoma suspect finally caught. *Br J Ophthalmol.* 2004;88:750-1.
58. West S, Lynch M, Turner V, Muñoz B, Rapoza P, Mmbaga BBO, et al. Water availability and trachoma. *Bull World Health Organ.* [trachoma]. 1989;67:71-5.
59. Emerson PM, Lindsay SW, Alexander N, Bah M, Dibba S, Faal HB, et al. Role of flies and provision of latrines in trachoma control: cluster-randomised controlled trial. *Lancet.* 2004 April 3rd;363:1093-8.
60. Emerson P, Lindsay SW, Walraven GEL, Faal H, Bogh C, Lowe K, et al. Effect of fly control on trachoma and diarrhoea. *Lancet.* 1999;353:1401-3.
61. West SK, Emerson PM, Mkocho H, Mchiwa W, Munoz B, Bailey R, et al. Intensive insecticide spraying for fly control after mass antibiotic treatment for trachoma in a hyperendemic setting: a randomised trial. *Lancet.* 2006;368:596-600.
62. Barreto ML, Genser B, Strina A, Teixeira MG, Assis AMO, Rego RF, et al. Effect of city-wide sanitation programme on reduction in rate of childhood diarrhoea in northeast Brazil: assessment by two cohort studies. *The Lancet.* 2007 2007/11/16/;370(9599):1622-8.
63. Tellis B, Keeffe JE, Taylor HR. Surveillance report for active trachoma, 2006: National Trachoma Surveillance and Reporting Unit. *Comm Dis Intell.* 2007;31(4):366-74.
64. Tellis B, Keeffe JE, Taylor HR. Surveillance report for active trachoma, 2007: National Trachoma Surveillance and Reporting Unit. *Comm Dis Intell.* 2008;32:388 -99.



Contact

Professor Hugh R. Taylor AC.
Indigenous Eye Health Unit,
Melbourne School of Population Health,
The University of Melbourne,
Level 5, 207 Bouverie St,
Carlton, Victoria 3053
Website: www.iehu.unimelb.edu.au

Authorised by the Harold Mitchell Chair of Indigenous Eye Health, Melbourne School of Population Health.

Copy right

© Copyright University of Melbourne 2009. Copyright in this publication is owned by the University and no part of it may be reproduced without the permission of the University.

Disclaimer

The University has used its best endeavours to ensure that material contained in this publication was correct at the time of printing. The University gives no warranty and accepts no responsibility for the accuracy or completeness of information and the University reserves the right to make changes without notice at any time in its absolute discretion.

Statement on privacy policy

When dealing with personal or health information about individuals, the University of Melbourne is obliged to comply with the *Information Privacy Act 2000* and the *Health Records Act 2001*.

For further information refer to:
www.unimelb.edu.au/unisec/privacypolicy.htm.

Intellectual Property

For further information refer to:
www.unimelb.edu.au/Statutes

