GUIDE TO TRACHOMA CONTROL

in programmes for the prevention of blindness

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INTRODUCTION

Trachoma is estimated to affect approximately 500 million people, most of them in rural communities of the developing world, especially the arid areas of the tropical and subtropical zones. There are at least 2 million blind from trachoma, and a much larger number has suffered partial loss of vision. In many communities with endemic trachoma, avoidable blindness and partial visual loss caused by infections, malnutrition and cataract impose severe constraints on economic and social development.

Trachoma can be controlled, and the ensuing harvest of blindness and visual loss prevented by the appropriate application of relatively simple and inexpensive measures. It is therefore a matter of urgency that communities with uncontrolled blinding trachoma should be identified so that appropriate control measures can be implemented. Such communities are likely to be found in countries with blindness rates that are above the range of 0.5–1 %, and especially where more than 1–2 % of the population are blind from all causes.

In recent years, blindness that is preventable and easily curable has been recognized as a public health problem that should be combated. The need for blindness prevention has led to a renewal of interest in trachoma and associated infections, which are still the most important cause of preventable blindness in the world.

The Twenty-eighth World Health Assembly in 1975, in a resolution on the prevention of blindness (WHA28.54), requested the Director-General of WHO “to encourage Member countries to develop national programmes for the prevention of blindness especially aimed at the control of trachoma, xerophthalmia, onchocerciasis and other causes and to introduce adequate measures for the early detection and treatment of other potentially blinding conditions such as cataract and glaucoma”.

Trachoma is the most readily preventable cause of blindness and it commonly co-exists with other major causes of avoidable blindness in neglected rural communities. Trachoma control programmes must be aimed primarily at those severely affected communities where the disease leads to blindness. In the planning and implementation of control
programmes, consideration must be given to the simultaneous introduction of other specific measures for dealing with all causes of avoidable blindness. In recent years, there have been substantial increases in knowledge about the causative agent of trachoma and about the epidemiological patterns that determine the intensity of inflammation and the gravity of the disease. This new information has led to a clearer definition of the risk for the individual and for the community and has made it possible to distinguish communities with “blinding trachoma” from those with “non-blinding trachoma”. These developments, together with the new emphasis on trachoma control as a component of the WHO programme for the prevention of blindness, made it necessary to revise the WHO publication, Field Methods for the Control of Trachoma, which appeared in 1973.

This new field guide presents simple and effective methods that are suitable for widespread implementation in underserved communities with blinding trachoma. The guide stresses the importance of maximum participation of the people themselves in the promotion of health care for the prevention and cure of blinding trachoma. This approach aims at making the best possible use of the available but limited resources and is in accord with the definition of health objectives and the reorientation of health activities, as set out in the Declaration of Alma-Ata on Primary Health Care.

This guide outlines the basic principles for the organization of trachoma control programmes. It summarizes present knowledge on the epidemiological and clinical aspects of the disease and describes the most commonly used approach to large-scale treatment of trachoma through control of transmission of infection, and the more intensive treatment of individual cases. It also contains recommendations on training activities, health education, evaluation of results and monitoring of programmes. The basic methods described here can be suitably adapted to local conditions, and should enable trachoma control programmes to be put into operation swiftly and effectively.

* * *

We wish to dedicate this volume to the memory of our late colleague, Dr Mario Tarizzo, who died in November 1980 shortly after the completion of the manuscript for this volume. Dr Tarizzo carried out substantial and significant laboratory studies on the agent of trachoma, particularly during his years at the Institute of Ophthalmology in Tunis. He then became increasingly involved in the problems of trachoma control and its public health aspects. In recent years, he was responsible for the establishment and management of the Prevention of Blindness programme in WHO.

Chandler R. Dawson
Barrie R. Jones
1. DEFINITION OF TRACHOMA AND RELATED INFECTIONS

The word *trachoma* is derived from the Greek words for “rough” and “swelling”, which describe the appearance of the tarsal conjunctiva. Trachoma is thus a chronic inflammation of the conjunctiva (the mucous lining covering the inside of the eyelid and the surface of the eyeball) and of the cornea (the transparent window of the eye). The specific etiological agent is *Chlamydia trachomatis*, but other pathogenic microorganisms often contribute to the disease process. During the communicable, inflammatory phase, the disease is characterized by the presence of distinctive granules (follicles) amidst intense diffuse infiltration and papillary hypertrophy in the conjunctiva and by the growth of blood vessels over the cornea.

Trachomatous inflammation may undergo spontaneous resolution, or may progress to conjunctival scarring which can cause inward deviation of the eyelashes (trichiasis) or of the lid margin (entropion). The turned-in eyelashes may abrade the cornea and make it opaque or ulcerated. Thus in milder cases, trachoma may heal without permanent visual loss, but in severely affected cases it may lead to gross and crippling damage to the cornea. At the end of the disease process, therefore, the visual acuity may range from normal vision to total blindness.

Chlamydial infections of the eye

Although the chlamydiaceae closely resemble bacteria and are sensitive to the action of antimicrobial drugs, they reproduce only within living animal cells. The species *Chlamydia trachomatis* includes the agents of trachoma, inclusion conjunctivitis, and lymphogranuloma venereum. Ocular chlamydial infections occur in two epidemiologically different situations, with different significances for the affected communities. The first is the classical, potentially blinding disease (spread from eye to eye by transfer of ocular
discharges), which is best defined as hyperendemic (or endemic) trachoma. It is caused by *Chlamydia trachomatis*, almost invariably serotypes A, B or C.

The second is infection of the eye by sexually transmitted *C. trachomatis* (serotypes D, E, F, G, H, I, J or K), which produces an eye disease that is often indistinguishable from the inflammatory phase of hyperendemic trachoma. Milder cases of this eye disease are usually called inclusion conjunctivitis, but the term “paratrichoma” can conveniently be applied to the whole spectrum of eye infections due to the sexually transmitted chlamydial serotypes. The prevalence of paratrichoma reflects the level of sexual promiscuity, and thus far has been identified mainly in urban and industrialized communities. Paratrichoma rarely progresses to cause permanent visual damage and, in the communities studied, does not constitute a significant cause of blindness.

According to the present taxonomic nomenclature, the agents of lymphogranuloma venereum are classified as *C. trachomatis* serotypes L1, L2 and L3, which have different biological properties from serotypes A to K.

For these reasons, “blinding hyperendemic trachoma” is not synonymous with the clinical definition of “trachoma” as applied to single cases, which would include some cases of paratrichoma; nor is it synonymous with “infection of the eye by *C. trachomatis*” for that may include paratrichoma and lymphogranuloma. Furthermore, chlamydiae are not the only microorganisms involved in the pathogenesis of blinding hyperendemic trachoma.

**Pathways to blindness in communities with endemic trachoma**

Communities with trachoma of blinding severity usually suffer from annual or biennial epidemics of bacterial conjunctivitis (epidemic acute ophthalmia). These are seasonal epidemics clearly associated with vastly increased numbers of eye-seeking flies. Isolated cases of mucopurulent conjunctivitis serve as foci of origin for the seasonal epidemics of bacterial ophthalmia. Owing to this combination of factors the milder non-blinding trachoma in a community escalates into severe potentially blinding trachoma. Furthermore, during these seasonal epidemics, suppurative corneal ulceration is common and constitutes an acute pathway to bilateral blindness—in addition to the chronic trachomatous pathway to blindness from chronic infections and abrasive damage to the cornea.

Because these two pathways to blindness co-exist and are determined by the same environmental and behavioural factors, action must be focused on both pathways. Hyperendemic trachoma is a potentially blinding complex of recurring chronic and acute infections with *C. trachomatis* and other pathogenic microorganisms, notably bacteria. It usually occurs in communities with poor personal hygiene and inadequate community
sanitation, where there are close person-to-person contacts and short birth intervals, where the environment favours the multiplication of eye-seeking flies, and where there is a reservoir of ocular infection due to *C. trachomatis*.

Infections by *C. trachomatis* and other ocular pathogens interact synergistically to enhance the risk of damage to eyesight. It is this multifactorial complex that should be the target of trachoma control programmes.

The introduction of trachoma control activities should be seen as a way to make simple eye care available at the peripheral level in underserved rural and urban communities. The presence of other blinding or potentially blinding conditions must be taken into account. In countries with a substantial number of cases of remediable blindness from cataract, there should be an effort to make cataract surgery available either by referral to existing eye services or through mobile units. This has the broad but immediately appealing objective of eliminating avoidable blindness, i.e., blindness that can be either prevented or remedied with appropriate action based on existing or potentially available resources.
2. CLINICAL ASPECTS

 Symptoms

 The onset of trachoma is often inapparent or gradual and, in children, may not be noticed by the parents. In mild cases the patient experiences slight ocular discomfort, some watering of the eye, minimal sensitivity to light, the sensation of having a foreign body in the eye, and a little purulent discharge in the morning. In severe cases with marked involvement of the cornea, the photophobia and watering are much more marked and may cause children to avoid the light whenever possible. Unless there is an associated bacterial infection, trachoma does not cause a copious purulent discharge. In severe grades of chronic trachomatous inflammation, the symptoms are often far milder than would be expected from the clinical findings.

 Patients with trichiasis and entropion experience constant pain and discomfort from the inturned eyelashes that abrade the cornea, and they often seek temporary relief by plucking out the lashes. Corneal ulceration that develops as a complication of the inturned eyelashes produces severe pain and marked photophobia.

 Clinical signs

 Conjunctiva and lids

 In the early stages, trachoma appears as a follicular conjunctivitis, with papillary hypertrophy and inflammatory infiltration involving the whole conjunctiva and most characteristically the upper tarsal conjunctiva.

 Conjunctival follicles are elevated granules with avascular centres that may be yellowish to grey-white or translucent. They vary from 0.2 to 2 mm in diameter. Histologically, they consist of lymphoid tissue with germinal centres.

 Papillary hypertrophy, which is characterized by vascular engorgement and inflammatory infiltration, occurs where the conjunctiva is tightly
bound down to the underlying tarsal plate. At first there is an engorgement of the smaller vessels, which appear as red dots on the tarsal surface of the conjunctiva. This is accompanied by conjunctival thickening due to infiltration, which obscures the deeper vessels that run vertically in the upper tarsus (see colour plates, Fig. 8 and 11); in severe cases these vessels may be completely hidden. In cases of atopic (or allergic) conjunctivitis, the papillary hypertrophy typically progresses to the formation of “giant” or “cobblestone papillae” that are polyp-like, confluent masses of conjunctiva.

As trachoma progresses, cicatrization of the conjunctiva appears as fine linear and small stellate scars in mild cases and as broader confluent or synechial scars in more severe cases (colour plates, Fig. 5, 9–12). Although scarring commonly progresses during the resolution of conjunctival inflammation, some cases with marked conjunctival scarring may continue to have severe, active disease with follicles and infiltration for many years.

The major, potentially blinding sequelae of trachoma are distortion of the lids (particularly the upper lid), trichiasis (misdirection of the lashes), and entropion (inward deformation of the lid margin) (colour plates, Fig. 1–3). The abrasion of the cornea by eyelashes, especially when aggravated by even a minor foreign-body injury or by deficiency in tear secretion, frequently results in corneal ulceration, followed by scarring and visual loss. Inadequate wetting of the cornea (tear-deficiency syndrome) and stenosis of the lacrimal outflow ducts are other late complications in patients with severe scarring. Following severe and deep trachomatous conjunctival inflammatory disease in the upper fornix, fibrosis of Müller’s muscle may lead to defects in lid closure, which may be aggravated by notching of the lid margin or by deficient tear secretion. These gross disorders of the normal protective mechanisms predispose to traumatic and secondary infective damage to the cornea.

**Cornea**

Corneal lesions in trachoma include punctate and diffuse epithelial keratopathy with punctate erosions of the epithelium, small cellular infiltrates of the corneal epithelium and anterior stroma, superficial neovascularization (vascular pannus), shallow peripheral ulcers, swelling of the limbus (corneal-scleral border), and the formation of lymphoid follicles at the limbus which resolve, leaving characteristic depressions (Herbert’s pits). Typically, the epithelial keratitis of trachoma occurs more commonly in the upper half of the cornea, although it is not limited to this area. Inflammatory infiltrates of the cornea range in size from lesions so small that they can be seen only with a slit lamp to large trachoma pustules. The trachoma pannus consists of a superficial fibrovascular membrane extending over the surface of the cornea from the limbus. In the active stages, there is diffuse and focal infiltration between and beyond the newly
formed vessels; this infiltration resolves, leaving varying degrees of opacity due to scarring. The opacity is usually more marked on the superior cornea, although it is present all around the limbus and may extend across the cornea (Fig. 2).

In addition to the specific trachomatous involvement of the cornea, there is a high prevalence of other corneal disorders in trachoma endemic populations. Superficial corneal scars in association with the corneal vascularization are very common even in children and may be the result of trauma, infection or malnutrition. Bacterial ulcers of the cornea, initiated by damage caused by trichiasis, entropion, foreign bodies or other injuries, are frequent in communities with blinding trachoma, especially at times of epidemic acuteophthalmia.

**Intensity of inflammation**

The upper tarsal conjunctiva has been selected as a convenient index of trachomatous inflammation in the eye as a whole. A classification of inflammatory disease in individual cases has been developed that is based on the scoring of lymphoid follicles (F) and papillary hypertrophy (P). These scores are a slight modification of those put forward by Dawson et al. (11). This intensity scale consists of four categories: severe, moderate, mild, and trivial (insignificant) or absent, as follows:

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Follicles</th>
<th>Papillae</th>
<th>Key sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe</td>
<td>F₃ (or F₂ or F₁)¹</td>
<td>P₁</td>
<td>P₁ (Fig. 8, 11)</td>
</tr>
<tr>
<td>Moderate</td>
<td>F₂</td>
<td>P₁</td>
<td>F₂ (Fig. 7, 12)</td>
</tr>
<tr>
<td>Mild</td>
<td>F₁</td>
<td>P₀, P₁ or P₂</td>
<td>F₂ (Fig. 6, 9)</td>
</tr>
<tr>
<td>Trivial (insignificant) or absent</td>
<td>F₀ or F₁</td>
<td>P₀, P₁ or P₂</td>
<td>F₀ or F₁ (Fig. 4, 5, 10)</td>
</tr>
</tbody>
</table>

For scoring follicles, the upper tarsal conjunctival surface is divided into three approximately equal zones. These zones are defined by two imaginary lines which, as viewed on the everted tarsal surface, are approximately parallel with the upper tarsal border and curve upward towards their lateral extremities (see Figure 1). Zone 1 includes the entire upper tarsal border and adjacent tarsal surface; zone 2 occupies the area between zones 1 and 3 and extends to the lateral quarters of the lid margin; zone 3 includes the tarsal conjunctiva adjacent to the central half of the lid margin and, at its centre, covers just less than half the vertical extent of the tarsal surface.

¹ The follicles may be obscured by severe papillary hypertrophy and diffuse infiltration (P₂).
The scores for upper tarsal follicles (F) are:

- $F_0$: No follicles (Fig. 4 and 10).
- $F_1$: Follicles present, but no more than 5 in zones 2 and 3 together (Fig. 5).
- $F_2$: More than 5 follicles in zones 2 and 3 together, but less than 5 in zone 3 (Fig. 6 and 9).
- $F_3$: Five or more follicles in each of the three zones (Fig. 7, 8, 11 and 12).

The scores for upper tarsal papillary hypertrophy and diffuse infiltration (P) are:

- $P_0$: Absent: normal appearance (Fig. 4, 10).
- $P_1$: Minimal: individual vascular tufts (papillae) prominent, but deep subconjunctival vessels on the tarsus not obscured (Fig. 5, 6).
- $P_2$: Moderate: more prominent papillae, and normal vessels appear hazy, even when seen by the naked eye (Fig. 7, 9, 12).
- $P_3$: Pronounced: conjunctiva thickened and opaque, normal vessels on the tarsus are hidden over more than half of the surface (Fig. 8, 11).

**Potentially disabling and disabling lesions**

The *potentially disabling, irreversible lesions* are (1) distortion of the eyelids due to conjunctival scarring ($C_3$), and (2) trichiasis and/or
entropion (T/E). Previously, trichiasis and/or entropion were recorded as conjunctival scarring, grade 4 ($C_4$). To emphasize disabling lesions and to provide a more direct indication of the risk, it is useful to record trichiasis/entropion separately from conjunctival scarring.

The *disabling lesion* is severe central corneal scarring with gross visual loss ($CC_3$) (see Fig. 3).

The scores for these irreversible lesions, as given below, represent a slight modification of those originally proposed by Dawson et al. (11).

**Conjunctival scarring (C):**

$C_0$: No scarring on the conjunctiva (Fig. 4, 6–8).

$C_1$: Mild: fine scattered scars on the upper tarsal conjunctiva, or scars on other parts of the conjunctiva (Fig. 5).

$C_2$: Moderate: more severe scarring but without shortening or distortion of the upper tarsus (Fig. 9, 11).

$C_3$: Severe: scarring with distortion of the upper tarsus (Fig. 10, 12).

**Trichiasis and/or entropion (T/E):**

$T/E_0$: No trichiasis or entropion.

$T/E_1$: Lashes deviated towards the eye but not touching the globe (Fig. 1).

$T/E_2$: Lashes touching the globe but not rubbing on the cornea (Fig. 2).

$T/E_3$: Lashes constantly rubbing on the cornea (Fig. 3).

**Corneal scarring (CC):**

$CC_0$: Absent

$CC_1$: Minimal scarring or opacity but not involving the visual axis, and with clear central cornea (Fig. 2).

$CC_2$: Moderate scarring or opacity involving the visual axis, with the pupillary margin visible through the opacity.

$CC_3$: Severe central scarring or opacity with the pupillary margin not visible through the opacity (Fig. 3).

**Blinding and non-blinding trachoma**

A community with *blinding trachoma* can be recognized by the presence of persons with severe visual loss due to corneal opacity and a substantial prevalence of potentially disabling trachomatous lesions, particularly trichiasis/entropion. These irreversible changes appear as the long-term outcome of prolonged or recurrent inflammatory disease of moderate or
Fig. 1  
Lashes deviated towards the eye but not touching the globe.

Fig. 2  
T/E₁  
CC₁  
Lashes touching the globe but not rubbing on the cornea. Upper limbal pannus.

Fig. 3  
T/E₁  
CC₁  

**KEY:**  
T/E: Trichiasis/entropion.  
F: Follicles.  
P: Papillae and infiltration.  
C: Conjunctival scarring.  
CC: Corneal opacity.

Intensity of inflammation: trivial. Upper limbal pannus.

Intensity of inflammation: mild.
Fig. 7  \(F_1 P_1 C_0\)

Intensity of inflammation: moderate. Pannus and Herbert's pits at upper limbus.

Fig. 8  \(F_1 P_1 C_0\)

Intensity of inflammation: severe.

Fig. 9  \(F_1 P_2 C_2\)

Intensity of inflammation: mild. Moderate scarring without distortion of the upper lid.
Intensity of inflammation: insignificant. Severe scarring with distortion of the upper tarsus. Meibomian gland orifices appear misplaced because of "conjunctivalization" of the lid margin, caused by entropion.

Intensity of inflammation: severe. Moderate scarring without distortion in a six-year-old child. Treatment started shortly thereafter (see Fig. 12).

Same case as Fig. 11, 45 days later, following a 3-week course of topical tetracycline. The early "conjunctivalization" of the lid margin indicates a high risk of progressive entropion.
severe intensity. *Communities with non-blinding trachoma* may have a low prevalence of potentially blinding lesions, and do not have a substantial prevalence of trachomatous visual loss.

In communities with active, blinding trachoma, chlamydial infection is always present but other ocular microbial pathogens appear to contribute significantly to the intensity of trachoma and to the lesions that impair vision. From the public health point of view, trachoma is important as a cause of preventable blindness. The failure to distinguish communities with blinding trachoma from those where it is present but not blinding leads to confusion in determining priorities and in selecting areas for control programmes.

**Classification of trachoma by stages (after MacCallan)**

Trachoma cases are usually classified in four stages, originally described by MacCallan (13). This classification, based only on conjunctival findings, describes the evolution of the disease, but does not have prognostic value.

- **Tr I** *Trachoma stage I*: Trachoma at onset.
  - Immature follicles present on the upper tarsal conjunctiva. Early corneal changes are usually present.
- **Tr II** *Trachoma stage II*: Established or florid trachoma.
  - Presence of well-developed mature soft follicles with papillary hypertrophy and diffuse infiltration. Associated corneal findings may include pannus and infiltrates extending from the upper limbus and limbal follicles of Herbert's pits.
- **Tr III** *Trachoma stage III*: Cicatrising trachoma.
  - Conjunctival scarring is present with some of the conjunctival signs of stages I or II.
- **Tr IV** *Trachoma stage IV*: Cicatrising or healed trachoma.
  - Inflammatory signs in the conjunctiva have resolved but scar tissue remains. The disease is no longer infectious, although further changes in the scars may follow.

The term “trachoma dubium” has been used to indicate cases that were thought to be early trachoma but lacking sufficient signs to make the diagnosis.

“Mature” follicles have been defined as “soft”, “necrotic”, “liable to rupture under light pressure”, and “leaves a conjunctival scar”. In practice these definitions are difficult to apply so that, in field surveys, observers frequently differ in the classification of individual cases as Tr I or Tr II. In mild cases, it is often difficult to differentiate Tr I and Tr III from Tr IV, i.e., to distinguish mild active disease from inactive disease. This may lead to
variation in the classification of cases by stages by different observers, but these mild cases do not represent significant degrees of activity in terms of infectivity for others or risk of loss of vision.

Furthermore, the MacCallan classification does not identify the varying degrees of inflammation or the cases with (or at risk of developing) visually disabling lesions. For this reason it is necessary to evaluate endemic trachoma in terms of communities with blinding or with non-blinding trachoma. This evaluation is based on the presence of severe signs of follicular, papillary and diffuse inflammatory reaction (i.e., the intensity of inflammatory disease), conjunctival scarring, trichiasis/entropion, and corneal scarring, as described above.

**Diagnosis of trachoma**

*Diagnosis in the field*

When there is uncertainty concerning the presence or absence of trachoma in a given community or area, it is essential to use strict diagnostic criteria that are unlikely to yield false positive interpretations. For this purpose, individual cases must have at least two of the following signs:

1. Follicles on the upper tarsal conjunctiva.
2. Limbal follicles or their sequelae, Herbert’s pits.
3. Typical conjunctival scarring.
4. Vascular pannus most marked at the superior limbus.

Herbert’s pits are the only clinical sign unique to trachoma, but they do not occur in every case. Their presence is sufficient indication of previous trachoma.

On the other hand, once the presence of endemic trachoma has been established, it is desirable to use more sensitive but slightly less specific criteria for diagnosis; in surveys to measure endemicity, the presence of one of the above signs in individual cases is sufficient.

*Differential diagnosis*

There are a number of conditions that may pose a problem in differential diagnosis of individual cases. The forms of chronic follicular conjunctivitis, other than those caused by chlamydial infection or chronic bacterial infection (which merge in endemic trachoma), are:

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1 These differ from the criteria recommended in the third report of the WHO Expert Committee on Trachoma (15) in that limbal follicles and Herbert’s pits have been removed from the same category as tarsal follicles and have replaced the less specific sign of epithelial keratitis.
1. Folliculosis
2. "Toxic" follicular conjunctivitis induced by:
   (a) molluscum contagiosum
   (b) topically applied drugs
   (c) eye cosmetics
3. Bacterial: caused by *Moraxella* species and other bacteria
4. Axenfeld's chronic follicular conjunctivitis
5. Chronic follicular keratoconjunctivitis of Thygeson
6. Parinaud's oculoglandular syndrome.

These conditions are either rare or present little risk to vision.

Cases of vernal catarrh occur occasionally among children in trachomatous communities. These cases are frequently diagnosed as active trachoma because of their marked papillary hypertrophy. In communities with a high level of active trachoma requiring chemotherapy, the inclusion of these cases among those to be treated is advisable because they also often have trachoma. Chemotherapy should not be withheld because of uncertainty in diagnosing active trachoma in the presence of vernal catarrh. On the other hand, the chronic progression of trachoma under inappropriate steroid treatment given for erroneously diagnosed vernal disease is a common event in some areas, and should be avoided.

Role of laboratory tests

Laboratory tests are not essential in trachoma control programmes. However, they may be used for a number of reasons: to support the clinical diagnosis of the disease in individual cases; to measure the prevalence of the infection in a community where trachoma is endemic (i.e., to estimate the "force" of infection); to monitor individuals or communities for the effect of therapy; to estimate the total exposure of a population to chlamydial infection; to monitor for shifts in serotypes in a given population which might indicate influx of the agent from outside the community or possible transmission from a genital reservoir.

Laboratory procedures to detect the presence of chlamydiae in trachoma cases include:

- microscopic examination of Giemsa- or immunofluorescent-stained conjunctival smears;
- isolation by inoculation of specimens into special tissue culture systems or into the yolk sac of embryonated eggs;
- detection of specific antibodies by microimmunofluorescence (micro-IF), complement fixation or other tests.

These procedures are described in the *Guide to the Laboratory Diagnosis of Trachoma*, published by WHO in 1975 (17). A further simplification of tissue culture methods for use in the field was described subsequently (14).
Bacterial studies should be an integral part of the laboratory evaluation of individuals or communities with trachoma. The more important ocular bacterial pathogens include *Haemophilus* sp., pneumococcus, *Neisseria* sp., *Moraxella* sp. and *Staphylococcus aureus*; other pathogens such as Gram-negative rods and beta-streptococci are less frequent. The most commonly used method to detect bacterial pathogens in trachomatous populations is the examination of Gram- or Giemsa-stained conjunctival smears. However, appropriate culture techniques such as isolation on blood agar may be more sensitive and specific.
3. EPIDEMIOLOGY

Worldwide distribution

Trachoma has a worldwide distribution. At present, blinding trachoma is a major public health problem in various parts of a geographical area extending from North Africa and the sub-Saharan region, through the Middle East, to the drier regions of the Indian subcontinent and south-east Asia. Pockets of blinding trachoma exist in Latin America, Australasia and the Pacific islands. Non-blinding trachoma is present in these same areas as well as in a much broader region that includes most of the drier subtropical and tropical countries.

Historical evidence suggests that trachoma was, in the past, prevalent and severe in many countries, including parts of Europe, North America and northern Asia. It apparently regressed and disappeared with the improved living standards that followed industrialization and economic development.

Community patterns

Control programmes introduced in the last few decades further contributed to the disappearance of trachoma as a public health problem in many countries. Under the living conditions prevailing in the developed countries and in the better-off urban communities of developing countries, trachoma is rarely transmitted, even to younger family members; if the disease is acquired, it is mild. In persons with healed trachoma, however, there may be a recurrence of active disease associated with a number of factors, such as old age, allergic conjunctivitis, or the administration of topical corticosteroids; but these cases do not present a significant public health risk.

Within a community there may be striking differences, between families, in the prevalence and severity of the disease. These variations appear to be intimately related to environmental and behavioural factors.
There also appears to be a direct relationship between age of the patient and prevalence of the disease, in the sense that the more prevalent and more severe the disease, the younger the age of onset and the age of peak prevalence of active inflammatory disease. In the most heavily affected communities, most children are infected by the age of 1 or 2 years and, starting at age 5 years, the prevalence of active disease declines steadily even though some adults may continue to have signs of active disease. Because the age-specific rates of trachoma are so high in children and they constitute such a large proportion of the population in hyperendemic areas, children with active disease are the chief reservoir in the community. Where the disease is less prevalent and less severe, pockets of blinding trachoma may still persist, with active inflammatory disease affecting individuals in different age groups, both children and adults. Female family members who are exposed to infected young children in the household may have a higher rate of active trachoma and develop complications (trichiasis/entropion) more frequently. Chronically infected older children and adults may also be a source of infection for children in the household.

Blinding lesions are the outcome of earlier inflammatory disease of severe or moderate intensity. They are generally observed in adults but may occur in younger persons as a result of very severe inflammatory disease.

In less severely affected communities two patterns may occur. In one, relatively few families may be affected by severe blinding disease; although the total reservoir of the infectious agent is limited within the community, the affected families continue to have individuals who are at risk of developing blindness. In the second pattern, the onset of manifest disease occurs later and the disease itself is progressively milder so that it rarely, if ever, leads to visual loss, although a substantial portion of the population may be affected.

Evolution of the disease in individuals in endemic areas

In the absence of specific treatment, the intensity of trachoma in any particular child appears to be relatively stable, and the intensity of disease in any one individual is apparently determined by environmental factors operating especially within the family or household group.

Children who develop trachoma of severe or moderate intensity at an early age are especially likely to develop conjunctival scarring of a degree sufficient to turn the eyelids inward. Trichiasis or entropion evolves in older persons because the scarring continues to distort the lids, even after the infection has cleared.

The corneal vascularization associated with active trachoma only rarely involves the visual axis and seldom affects vision severely. Cases with central vascularization and dense corneal scarring appear to have suffered from an additional disease process, usually corneal ulceration due to a variety of associated causes including trauma, infections, or malnutrition.
Visual loss from trachoma may occur in young adults in affected communities, but it is more common in older age groups. With decrease in the tear function resulting from ageing or conjunctival scarring, adults with potentially blinding lesions are more subject to breakdown of the corneal epithelium and to corneal ulceration.

Microbiology

Endemic trachoma has always been associated with infection by serotypes A, B, or C of *Chlamydia trachomatis*, as confirmed by microbiological studies whenever they have been carried out. More than one of these serotypes can occur in the same community. In regions with blinding trachoma, however, bacterial infections also play an important role in the evolution of the disease. *Haemophilus influenzae* causes a mild, mucopurulent conjunctivitis; *H. aegyptius* causes a more severe purulent conjunctivitis. In some regions, a gonococcus-like *Neisseria* may cause small outbreaks of hyperacute conjunctivitis with marked discharge which occasionally progresses to corneal ulceration. Rarely *Neisseria meningitidis* causes a similar eye infection. Pneumococci cause a purulent conjunctivitis and are found more frequently during the cold winter months. *Moraxella* sp. and *Staphylococcus aureus* are found more commonly on the lid margins; they cause chronic blepharitis and chronic conjunctivitis in some individuals; they may be associated with corneal involvement but less commonly cause corneal ulceration.

In subtropical areas of the northern hemisphere with endemic trachoma, seasonal epidemics of purulent bacterial conjunctivitis begin in the spring, reach a peak in the autumn months, and decrease rapidly with the onset of cooler weather. These epidemics are most frequently associated with *H. aegyptius*.

There is a very clear, direct relationship between the intensity of active inflammatory disease and the amount of *Chlamydia trachomatis* present, as shown by laboratory tests. This is also the case with associated bacterial pathogens. Thus, the intensity of inflammation correlates with the potential for transmission of *C. trachomatis* and bacterial pathogens. There is no evidence that bacterial infection affects the multiplication of chlamydiae, although associated bacterial pathogens enhance the inflammation in both the cornea and the conjunctiva.

Mechanism of transmission

It has long been known that trachoma is associated with poverty and that economic development appears to eliminate or reduce the severity of the disease. Transmission of the disease is by direct or indirect contact with infected material (hands, clothing, towels, etc.). It is difficult to identify
with certainty the environmental and behavioural features of greatest importance but among them are the presence of young children in the household, crowding, and the unavailability of safe water for household use. All these factors, together with inadequate disposal of human and animal waste, contribute to an increase in the fly population and lead to a condition described as “ocular promiscuity... the frequent, unrestricted, and indiscriminate mixing of ocular contacts or of ocular discharges” (12).

The flies which cluster on children’s eyes and feed on ocular discharges are usually, in North Africa and the Middle East, the larger Musca species. It has been shown that ocular discharges are transferred to the eyes of other children in the same family within 15 to 30 minutes. Flies taken from the faces of infected children harbour the ocular bacterial pathogens as well as coliform bacilli. In North America, the smaller Hippelates species (eye gnats) appeared to have had a similar role. Flies may thus act as a passive vector, carrying chlamydial and ocular bacterial pathogens from one child to another in an affected community.
4. ORGANIZATION OF TRACHOMA CONTROL PROGRAMMES

The primary objective of public health programmes for the control of trachoma is the prevention of blindness caused by it. This goal implies that a trachoma control programme should be designed and implemented as an integral part of activities that are aimed at controlling blindness from other major causes as well and should not necessarily be limited to a single category of disease. Such programmes should essentially be based on the resources of the country (possibly with initial international cooperation) and should evolve into stable community-based efforts to deliver and promote eye health care in communities that are most in need. Once control of blinding trachoma has been achieved, provision must be made to maintain surveillance to detect the occurrence of cases with severe, potentially blinding trachoma.

Programmes to control trachoma should include the following elements:

1. Assessment of the problem and establishment of priorities.
2. Allocation of resources.
3. Chemotherapeutic intervention.
4. Surgical intervention to correct lid deformities.
5. Training and utilization of local health aides and other non-specialized health workers.
6. Health education and community participation.

These are described below.

Assessment to establish priorities

Assessment surveys are necessary to determine the magnitude of the problem and the geographical distribution of trachoma and other causes of blindness within the region or country. These surveys should follow the
basic principles set forth in *Methods of Assessment of Avoidable Blindness* (10).

Preliminary prevalence surveys should identify the **communities with blinding trachoma**, which can be recognized by the presence of persons with severe visual loss due to corneal opacity and by a high prevalence of inflammatory disease of severe and moderate intensity and trichiasis and entropion.

An inventory of the available and potential health resources should be made so that programmes to control trachoma and avoidable blindness are integrated, from the start, with the local health services and involve primary health workers to the greatest possible extent.

**Allocation of resources**

The selection of target populations is a critical step in trachoma control programmes. The needs of each community change continuously and must be reviewed at regular intervals. Antibiotic treatment and economic development may substantially and rapidly reduce the prevalence of the inflammatory disease. On the other hand, in communities with a substantial amount of potentially disabling scarring, new cases of trichiasis/entropion will continue to appear, so that continuing surveillance will be necessary for many years after active inflammatory trachoma has been controlled; in such communities surgical programmes may have to be continued long after the need for mass antibiotic treatment has ceased.

**Antibiotic treatment**

Sulfonamides, tetracyclines, erythromycin and its derivatives, certain other macrolides, and rifampicin are known to be effective in the treatment of active trachoma. At present, topical tetracyclines (as eye ointments or suspensions) are the generally recommended preparations for large-scale treatment of trachoma. However, the route of application, choice of drug, and schedule of administration are the subjects of active and continuing investigation.

Trachoma control programmes have been based essentially on the mass application of locally applied antibiotics. Initially the application of intensive large-scale chemotherapy should reduce the reservoir of *Chlamydia* in the population and this should be followed by intermittent, family-based self-treatment to control further eye-to-eye transmission. Such family-based self-treatment with topically applied antibiotic depends on the easy local availability of effective drug preparations at low cost, and on vigorous health education by local health workers.
Surgical correction of trichiasis and/or entropion

The correction of lid deformities has an immediate impact on preventing blindness. In areas with a high prevalence of trichiasis, mobile surgical teams are highly effective in carrying out these simple procedures in affected communities. Surgical programmes may still be required where active trachoma is no longer a problem but where the previously acquired trachomatous scarring among older age groups continues to evolve and to cause further lid deformities and visual loss.

Preparatory assessment is important for surgical programmes, since only communities with a high prevalence of trichiasis/entropion need be visited by mobile surgical teams. Sporadic cases could be better treated by referral to a local centre or regional eye hospital. Because new cases of potentially blinding deformity of the lids may continue to appear in the older population, surveillance and screening for trichiasis and entropion may have to be maintained for many years.

Local health aides

The actual application of antibiotics to the eye is often carried out by local persons with little, if any, formal training in health work. The role of such auxiliary personnel may be expanded in several ways: they can distribute ointment to households; during their visit, they can treat children and instruct mothers or older children on how to treat young children; they can screen for trichiasis; they can be trained to differentiate simple infections of the lids and conjunctiva from corneal ulcers and other acute conditions which should receive immediate, definitive treatment. The selection of village health workers should be determined by cultural and other local factors. Their training should be short and simple and should be carried out in the community, since there may be a high rate of replacement or turnover among these workers. There is also a need for continuing supervision and assessment of their work.

Health education and community participation

In the long run, most of the antibiotic treatment must be carried out by the affected population itself. To do this, the people need to have an understanding of the disease and the measures that can be taken against it. In antibiotic treatment programmes, mothers of young children are the prime target for health education, because they must be responsible for treating their children. Provision of water, reduction of crowding, identification and control of breeding sites of eye-seeking flies, and improvement of personal hygiene should be actively encouraged and assisted, in order to reduce the transmission of eye infections.
Evaluation of intervention programmes

Trachoma control programmes must be evaluated at frequent intervals. The effect of intervention can be judged by changes in the age-specific rates of active trachoma of severe and moderate intensity and in the prevalence of trichiasis and entropion.

4.1 Sampling Methods

Introduction

The first step in determining the need for a trachoma control programme is to gather the available knowledge about the prevalence of trachoma and blindness and to identify the communities and areas that are most affected. Such information may be available from: (1) hospital, clinic and eye-camp records; (2) schools and institutions for the blind and blind registers; (3) health and social insurance records; (4) information from local physicians, social and public health workers, community leaders and other; (5) previous health surveys; (6) national and regional censuses; (7) discussions with ophthalmologists to identify communities with high needs for eyelid operations.

However, the communities with the most severe blinding trachoma are likely to be those that have the least contact with the health services. Thus clinic-based opinions, based on outpatient and health service data, tend to underestimate the extent and importance of trachoma.

Surveys

Rapid surveys of schoolchildren for the intensity of trachomatous inflammation are valuable in identifying areas with a high prevalence. It should be borne in mind that children attending schools in underserved communities may come largely from a privileged section that has a markedly lower risk of severe eye disease than the community as a whole. Thus data from school surveys are of limited value because they tend to underestimate the prevalence of trachoma of severe and moderate intensity in a community.

Once the regions or communities that are thought to have the highest prevalence of trachoma and blindness have been tentatively identified, there is a need for data obtained by sound epidemiological methods to establish the priorities, to plan regional interventions, to monitor activities, and to evaluate results. Such information can be provided by a population-based survey.

Population-based sample surveys

Once a decision has been made on the population from which data are to be collected, the sample size depends on the disease prevalence considered
to be significant for control programmes. For example, a prevalence of more than 5% severe and moderate trachoma in children under 10 years might be considered an indication for mass chemotherapy in that community; a trichiasis/entropion rate of more than 1% with corneal scarring in 2-5% of adults may indicate a need for intervention by mobile surgical teams. The expected prevalence of the least common condition of interest determines the size of the sample required.

To select a sample, a decision must be made on the smallest population unit for which an estimate is needed. This is often the smallest administrative unit used as a basis for the delivery of health services. It must then be decided if estimates are needed for age-specific, age- and sex-specific, or age- and ethnic-specific groups within this unit. Other factors that are useful and often essential to the design of the survey are:

1. accessibility of various groups to be included, e.g., seasonal employment patterns and ethnic or socioeconomic clustering;
2. climate, geography and topography that may influence the choice of season and duration of the survey;
3. transport and communication systems;
4. availability of census data, maps, registration systems and other surveys (e.g., census, family planning, agricultural development programmes).

With this information, the geographical administrative structure of the region under consideration is subdivided into the smallest units for which preliminary demographic information is available in a more or less uniform fashion. These well-recognized administrative divisions are the primary (first-stage) sampling units (PSU). Urban areas may stand alone or may include some rural territory but should always be dealt with separately from the rural population.

A useful procedure to follow in selecting a sample consists in:

1. Definition of homogeneous subgroups or subpopulations (strata) that are relevant to the conditions considered. These strata should distinguish between urban and rural zones, major economic regions, ethnic differences, major climate-altitude zones, and zones of different disease prevalence. Strata should not cross the major political boundaries such as province borders.
2. The primary sampling units should be grouped into strata within the lowest level of the administrative organization for which estimates are to be made. Within each stratum, the PSUs should be listed in order of the size of their population. The largest cities should be treated as individual strata and smaller cities should be grouped within urban strata.
3. PSUs for the sample can be selected from the list at regular intervals if a random start is taken. If the initial choice of PSUs is geographically concentrated, a few selected units may be replaced (using a randomizing procedure) to achieve improved distribution.
(4) In rural areas, the villages (or equivalent settlements) in each PSU should be listed by whatever size measures are available, and their location identified on a map. A systematic selection of villages is then carried out.

(5) Before the arrival of the examination team, the survey team should visit each selected site and list all members of each household according to place of residence. The survey team should contact village leaders and take other steps to encourage cooperation before the actual listing takes place.

(6) Since about 200 to 400 persons can be examined each day, all the inhabitants of villages with less than 300 people should be examined. In larger villages, the number examined should be limited to 300 or less and the duration of each visit to one or at most two days.

(7) Urban areas can be divided into geographical areas, roughly equivalent to rural PSUs (usually 2000 households or 10,000 persons is a useful target size). Within these strata, clusters of 40 households or 200 to 300 persons may be examined.

Sample size considerations

The size of the sample selected depends on the standard level of prevalence of the condition considered to be important, e.g., 5% trachoma of severe and moderate intensity in children under 10 years or 1% trichiasis/entropion in the entire population. For example, if the standard prevalence is 1%, and a 5% chance of error is acceptable, the power of the test procedure to detect a level of 2% prevalence is 0.85 if 1000 persons are included in the sample, and 0.97 if 2000 are included. The power of the test is the likelihood of detecting a prevalence rate at least as large as the minimum rate (in this case, 1%) when the true rate in the general population is estimated from the survey (in this case, 2%).

The estimates obtained apply to the entire general population from which the sample is taken, as long as that population is homogeneous or constitutes a single stratum. In surveys for trachoma, such estimates are usually applied to different strata; for example, the rural population would be considered separately from town populations and estimates of trachoma intensity would be considered separately for children and adults within the rural population. The size of the general population or stratum does not affect the accuracy of the estimated prevalence, but the size of the sample actually examined is of critical importance.

Quality control and reducing errors

Any differences between the estimates obtained from sample observations and the actual value for a selected population may be termed the error. The part of the error which is due to observing only a portion of the selected population sample is called the sampling error, and the rest is nonsampling error which is due to a variety of processes. These nonsampling errors can be reduced by:
(1) ensuring that all persons in the sample are examined and no one is included who does not belong to the sample (coverage errors);
(2) reducing the errors in observation and recording by having well defined descriptions of each sign and code to be recorded, by obtaining agreement on coding between examiners, and by accurate recording of observations;
(3) ensuring that no errors are made when transferring data for processing or computation.

At the end of each day’s field activities, supervisory personnel should examine all data forms for completeness, legibility and consistency. If necessary, some individuals may have to be recalled for re-examination. A simple tabulation of each day’s results should be done to monitor progress and to detect unusual events.

4.2 Examination Procedures under Field Conditions

Surveys for trachoma in endemic regions should include the assessment of vision and the determination of other common blinding conditions, when such data have not already been obtained prior to the trachoma survey.

Examination team

The examiner can be any medically trained individual (health aide, nurse, general physician or ophthalmologist) who has received special training in the diagnosis of the eye disorders that are to be recorded by the survey. Another health worker should test the visual acuity. At least one or two assistants must prepare a household register that includes the name of every person living in the household, their ages and sex, and must indicate the individuals actually examined.

It is essential to have correct physical identification of the place of residence of each household with the entry in the register (by numbering the houses, by having a sketch map of the village, or by other means).

Provision should also be made to administer basic treatment for common eye problems. The team should therefore include local health personnel who can continue to carry out treatment and prevention activities after the survey team’s visit.

It is also desirable to examine and treat separately all persons who present spontaneously with eye complaints. The findings on these self-referred cases (who are not in the sample) may be useful for identifying the occurrence of other problems, but they should be recorded separately.

Examination site

When possible, the examination (except, perhaps, the visual acuity testing) should be done in a shaded place or a partially darkened room or...
hall. If the examinations are conducted outside, it may be advantageous to utilize direct sunlight when making observations with the naked eye or loupe. However, uniformity of background illumination may be better ensured when examinations are made indoors.

Testing visual acuity

Visual acuity testing should be carried out with sizes of test letters or figures (optotypes) that correspond to the acuity level considered as low vision or blindness, as shown in Table 1.

Table 1. Notation for visual acuity

<table>
<thead>
<tr>
<th>Categories of visual impairment</th>
<th>Visual acuity with best correctiona</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Decimal notation</td>
<td>Snellen notationb</td>
</tr>
<tr>
<td></td>
<td>At 6 m</td>
<td>At 1 m</td>
</tr>
<tr>
<td>Low vision</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>&lt; 0.3</td>
<td>&lt; 6/18</td>
</tr>
<tr>
<td>2</td>
<td>&lt; 0.1</td>
<td>&lt; 6/60</td>
</tr>
<tr>
<td>3</td>
<td>&lt; 0.06</td>
<td>&lt; 1/20</td>
</tr>
<tr>
<td>Blindness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>&lt; 0.02</td>
<td>&lt; 1/50</td>
</tr>
<tr>
<td>5</td>
<td>No light perception</td>
<td></td>
</tr>
</tbody>
</table>

*a Each subject should be assigned to a category according to the visual acuity in the better eye.

b The numerator in the Snellen notation is the distance at which the test is performed.

The kinds of optotypes used (e.g., Snellen letters, Landolt rings, tumbling “E”s, or others) should be understood by those in the region where the testing will be done. For convenience in the field surveys, a testing distance of 1 metre, with appropriate optotypes, is suggested. To compensate for refractive errors a pinhole device or optical correction should be incorporated in the testing procedure.

For visual acuity testing, evaluation of each eye is done initially with an optotype equivalent of 0.3 (6/18 or 20/60). Those with this level of visual acuity are not tested further. Persons with acuity less than 0.3 are then tested with the largest optotype, and if this is correctly identified, progressively smaller optotypes are presented to determine the best achievable visual acuity up to 0.3. These optotypes usually correspond to
the limits of the categories of visual impairment shown in Table 1, i.e., 0.02, 0.05, 0.1 and 0.3.

For persons who do not respond to the largest optotype, it must be determined whether they did not see it or simply could not understand the test. In these cases the ability to count clearly the separated fingers (of an adult), against a contrasting background, at a distance of 3 metres may be regarded as equivalent to a visual acuity of 0.05 (3/60) and, at 1 metre, to a visual acuity of 0.02 (1/60). Visual testing should be done with adequate illumination of the test object. If the individual cannot even count fingers, the ability to perceive light is tested and recorded.

In the case of adults and children who are unable to cooperate, the presence of vision is confirmed by the ability to fix on and follow a target. This test does not determine a category level as described in Table 1. To test for the ability to fix on and follow an object, the individual’s attention is drawn to a light source or some other object, which is held about 30 to 50 cm from the face. Each eye is tested separately. Those with normal vision look directly at the target with each eye and follow it as it moves. It may be necessary to distinguish between wandering eye movements (due to lack of attention) and eye movements that are sometimes exhibited by partially sighted children.

Techniques for examination of the eye

A dependable source of artificial light should be used to examine the eyelids, the conjunctiva, the cornea and the lens. The examiner should utilize magnification of some kind, preferably a binocular loupé (giving 2 × to 3 × magnification) or an instrument with higher magnification (e.g., 6 × loupé with built-in illumination). A biomicroscope (slit lamp) may be a useful additional means of examination of the anterior part of the eye, if the examiner is familiar with its use and if an appropriate electrical supply is available.

Adults to be examined should sit facing the examiner, who is also seated (Figure II). Children can stand facing the examiner. Infants and very young children may be positioned so that the head lies face up between the examiner’s knees with the child’s body held firmly on the knees of another adult who sits facing the examiner (Figure III). It is helpful to restrain infants by wrapping them in a cloth to limit arm and leg movements but the feet should not be allowed to push against any firm surface.

The examiner’s hands should be cleaned with an appropriate disinfectant, after examining each patient, and should be dried before examining the next person.

Other procedures

Photography of selected cases may be useful for teaching or research purposes connected with trichiasis, trachoma intensity, corneal opacities,
Fig. II. Examination of an adult. The examiner and patient sit facing each other. It is recommended that the examiner should use a telescopic loupe providing 2 to 3 times magnification. A hand-held light (torch) is used here, but a fixed source of illumination may also be employed. An assistant is useful to help verify the identity of each patient and position them.

cataracts, or even retinal lesions, if the appropriate photographic apparatus is available. Photography should not interfere with the primary purpose of the survey, and only under special conditions with appropriate equipment can it be a substitute for direct examination.

Laboratory tests can be useful in surveys among trachomatous populations. Giemsa-stained conjunctival smears can provide direct evidence of infection with *Chlamydia* and with bacterial pathogens. In untreated populations, the prevalence of inclusions is a good indicator of the accuracy of the clinical diagnosis of trachoma intensity. Only the smears from individuals with trachoma of severe or moderate intensity need be examined however. If such smears are used to assess the effect of treatment, care should be taken to compare smears taken from the same age group and at the same time of year.

The procedures for obtaining specimens for laboratory testing should be planned carefully in advance so that the specimen receives appropriate handling. This advance planning should be done with the laboratory personnel responsible for processing the material in the laboratory.
Fig. III. Examination of a young child. The child's head is held between the examiner's knees. The child's hands are held down and the feet are held together on one side of the assistant or parent. In this way the child is immobilized firmly but gently and cannot push against any object or turn its head.
The survey team should be prepared to treat simple eye diseases that are encountered (conjunctivitis, xerophthalmia, etc.) and to refer cases with more serious lesions (e.g., cataract, corneal ulcer) for definite therapy. If the survey team is unable to provide basic health care, the general medical conditions requiring urgent action should be referred for treatment. It may be necessary to furnish transport for this referral.

**Clinical signs to be recorded**

What is required from the examination will be determined by the purpose of the survey and may be limited to a few physical signs. In some cases it may be desirable to include further details or to carry out a more complete examination.

In practice, the examination is organized in a graded manner so that the records of all persons examined have a minimum common set of clinical findings (e.g., visual acuity, trachoma signs, and causes of visual impairment, if any).

### 4.3 Recording of Data

Depending on the purpose of the examination and on the type of information required, trachoma records should be kept either on individual forms or cards, or on survey sheets. The records should include data on locality, household, age, sex, and date of examination. The key to the coding of the physical signs should be available to each examiner at the time of examination, either as a separate reference sheet or on the records themselves. The clinical findings must be recorded at the time of examination of each person.

The signs are recorded by listing them preferably according to the sequence of the examination. This order differs from the sequence followed previously in WHO’s and other trachoma record forms. The minimum clinical data to be recorded are:

1. Visual acuity (see section 4.2)
2. Clinical signs of trachoma (see Chapter 2)
   - trichiasis/entropion
   - tarsal conjunctival follicles
   - tarsal papillary hypertrophy
   - conjunctival scarring
   - corneal scarring
   - intensity of trachomatous inflammation (this should be recorded at the time of examination)
3. Causes of visual impairment, if any, as follows:
   (1) Refractive error
   (2) Strabismic or refractive amblyopia
   (3) Corneal opacity
(4) Cataract
(5) Chorioretinal lesions
(6) Disorders of the optic nerve and visual pathways
(7) Glaucoma
(8) Atrophy or absence of globe
(9) Other
(10) Undetermined/unspecified.

The data for each cluster can be summarized for each 5-year age group below 15 years of age (0–4 years, 5–9, 10–14) and for each 10-year age group above 15 years. Although the scoring of signs suggested here is suitable for machine or computer processing, it will often be of value to tabulate the data “by hand” before leaving the examination site. This daily tabulation will be useful to monitor the activities of the examination team. For reporting to the next level, the results of all the sampled clusters in a single region may be pooled or summarized as the number of clusters with severe and/or moderate intensity trachoma of “less than 5 %”, “5–< 10 %”, “10–< 20 %”, “20–< 50 %”, and “50 % and more”. Similarly, clusters with a prevalence of trichiasis/entropion and severe corneal scarring by age group may be summarized as “less than 1 %”, “1–4 %”, “5–9 %”, “10–19 %” and “over 20 %” for reporting to national health authorities. Other reporting schemes may be used following the principle that relevant information should be available at each administrative level.
5. THERAPEUTIC STRATEGIES

Control programmes should be focused on communities with a substantial prevalence of blinding trachoma as indicated by the presence of:

(a) corneal blindness;
(b) potentially blinding trachomatous trichiasis and entropion;
(c) moderate and severe trachomatous inflammation.

Communities with severe active hyperendemic blinding trachoma are among the most neglected and may not have any effective primary health care in operation. Specific programmes for prevention of blindness may thus be required in addition to the development of primary health care.

In all communities in which intervention is required, especially in those with the most severe blinding disease, it is desirable to plan the strategy of intervention in three overlapping phases:

*Phase I (attack)*: initial intensive control interventions accompanied by public information and activities to promote eye health.

*Phase II (consolidation)*: continuation of specific treatment in selected population groups or individuals, as required, with further development of information and activities to promote eye health.

*Phase III (maintenance and surveillance)*: integration of specific trachoma control activities with primary health care, with provision for the treatment of individual cases. There should also be surveillance for any signs of a recrudescence of blinding hyperendemic trachoma—as indicated first by a rising prevalence of the more severe grades of trachomatous inflammation—and for new or recurrent cases of trichiasis/entropion.

The decisions on the choice and duration of the measures to be applied will depend on the results of initial and subsequent assessments.

Communities in which trachoma is endemic can be differentiated into four types requiring different strategies, as described below. It is not possible to give precise and quantified criteria because the dividing lines may vary according to local factors such as the availability of resources and facilities, density of population, and presence of other priorities.
1. **Communities with active hyperendemic blinding trachoma**

All the indicators—(a) corneal blindness, (b) trichiasis and entropion, and (c) active trachomatous inflammation—are present at a significant level. In such communities, trachoma control activities should start with intensive control interventions which include:

- Intensive chemotherapy, either topical or possibly systemic; depending on local conditions, this chemotherapy can be either community-wide or limited to certain age groups or other segments of the population. A high prevalence of severe or moderate trachomatous inflammation, especially in older children and adults, can be taken as an indicator of the need for community-wide treatment. On an individual basis, treatment is essential only for cases with moderate and severe inflammation.
- Case-finding for trichiasis and entropion and provision of lid surgery.
- Stimulation of community awareness, training of local personnel, and eye health promotion.
- If necessary and practicable, provision for cataract surgery.

This should be followed by consolidation activities consisting of:

- chemotherapy for selected cases;
- screening for further cases needing lid or cataract surgery;
- provision of such surgery, locally or by referral;
- family-based action for eye health promotion, including improved personal hygiene and family sanitation, and the treatment of individual cases with topical antibiotic.

2. **Communities with inactive or partially active endemic blinding trachoma**

These are communities in which specific interventions or other changes have substantially reduced the prevalence of severe and moderate inflammation but in which a substantial prevalence of corneal blindness is still present. If trachoma in the community is still partially active, potentially blinding lid distortion may also be present. The persistence of active trachomatous inflammation indicates the need for intensive intervention followed by consolidation; the presence of trichiasis and entropion indicates the need for lid surgery followed by surveillance.

3. **Communities with low levels of blinding trachoma**

In communities with a low prevalence of all three indicators, it is usually possible to limit the initial intensive interventions to selected segments of the population, followed by family-based promotion of eye health. Alternatively, consolidation activities may be sufficient.

4. **Communities with non-blinding trachoma**

Such communities have little or no trachomatous corneal blindness or trichiasis. There may be some cases of severe or moderate intensity but this is usually confined to a narrow age band of the population. These
communities will have a much lower priority for trachoma control programmes—even if mild trachoma is highly prevalent in them—than communities with trachoma of blinding severity. If resources permit, it may be desirable to implement the consolidation activities outlined above.

5.1 Medical Treatment

General considerations

Operational considerations limit the choice of drugs and routes of administration that can be used in control programmes. In many programmes, an antimicrobial drug is administered to everyone in a community or to a segment of the population on the basis of sample survey findings. This form of mass treatment or blanket treatment is usually given in circumstances where untoward complications cannot be monitored easily. In some programmes, individual case-finding for active trachoma is carried out so that selective treatment may be given only to persons with active trachoma. The risks of drug administration, especially by the oral or systemic route, must be weighed carefully against the beneficial effects in each control programme.

In laboratory tests, *C. trachomatis* is inhibited by sulfonamides, tetracyclines, erythromycin and related macrolides and by rifampicin. These drugs are effective in the treatment of active trachoma.

Although penicillin, other beta-lactam antimicrobials, and chloramphenicol have some action in the laboratory, they are generally considered to be ineffective in clinical usage. The aminoglycoside antibiotics (streptomycin, neomycin, gentamicin, etc.), polymyxin B and bacitracin have no effect on *C. trachomatis*, and the effect of trimethoprim is weak. Cycloserine is active in the laboratory but has not been tested clinically.

The sulfonamides were the first drugs to provide specific effective treatment for trachoma. Topical therapy with sulfonamides appears to be only partially effective. Adequate treatment with oral sulfonamides requires full therapeutic doses (as recommended for the treatment of severe systemic infections) for approximately 2–3 weeks. When oral sulfonamides are given for such periods, untoward reactions occur in a substantial proportion (about 5%) of the persons treated. The incidence of certain adverse effects can be minimized by maintaining strict control of correct dosage to each individual and by avoiding dehydration, but in many circumstances this may not be possible. Some of the reactions may be very serious, e.g., Stevens-Johnson syndrome (erythema multiforme).

Since their introduction, the tetracyclines have been widely used for the treatment of trachoma by topical application and, on a more limited scale, by oral administration. Tetracyclines (tetracycline, chlortetracycline and oxytetracycline) are widely available as 1% ophthalmic ointments and are relatively inexpensive. Higher concentrations (up to 3%) have been
prepared but are less well tolerated. Other derivatives have also been used. Although more expensive than ophthalmic ointments, oily suspensions of 1%, tetracyclines have several advantages: they are easier to apply, involve less wastage than ointments, cause less inconvenience to the recipients and are thus more easily accepted. Attempts have been made to improve the efficacy of topical antibiotics by utilizing different additives or vehicles.

Other methods of application of drugs to the eye that are being investigated include ocular inserts of different types, which are capable of maintaining a continuous concentration of antibiotics in the conjunctival sac, and of thus increasing the efficacy of treatment. To be practical, such preparations should be easy to apply, well tolerated and retained, and of competitive cost in comparison with other systems of treatment.

Topical chemotherapy for trachoma must be intensive and prolonged. Six weeks is the minimum recommended duration for continuous intensive treatment with tetracycline. With less frequent applications, the duration of treatment must be prolonged and may need to be extended to months or even years.

The recommended intermittent treatment schedule consists of twice daily applications of tetracycline for 5 consecutive days, or once daily for 10 days, each month and for 6 months each year, to be repeated as necessary; this has been widely used and has definite operational advantages.

Short courses with the same topical tetracycline preparations can be used for the control of bacterial infections during seasonal epidemics of conjunctivitis and may have to be repeated annually.

Oral therapy with tetracyclines has been effective for selective treatment in well monitored programmes. Tetracyclines, given 4 times daily, or doxycycline once daily for 3-4 weeks have been equally effective. Nevertheless, oral tetracycline therapy cannot be recommended for community-wide use to replace topical chemotherapy; for this purpose, its use should be regarded as experimental.

Oral tetracyclines should not be administered to pregnant women because of the possibility of adverse effects on the fetus. Other potential hazards include photosensitization (worse with dimethylchlorotetracycline), staining of teeth in children under about 7 years of age (least marked with oxytetracycline and doxycycline), slowing of bone growth during the period of administration, and gastrointestinal disturbances. Furthermore, the wide use of oral tetracyclines may result in the emergence of resistant bacterial pathogens.

Both topical and oral erythromycin and related macrolides have been shown to have a beneficial effect on trachoma in therapeutic trials, but they have not been used on a wide scale. Recent laboratory evidence indicates that a few strains of C. trachomatis are resistant to erythromycin.

Rifampicin has a higher intrinsic activity against C. trachomatis than all other antibiotics, but laboratory studies have shown the occurrence and rapid induction of strain resistance. However, small-scale trials have
demonstrated that 1% rifampicin ointment is effective in the treatment of trachoma.

Tetracycline ophthalmic preparations continue to be recommended for use in trachoma control programmes. Nevertheless there is need for basic and operational research to develop more effective methods of drug application to the external eye and to evaluate other approaches to the chemotherapy of trachoma.

**Method of topical application of antibiotic ointments and drops**

The antibiotic preparations should be applied in the lower conjunctival sac, while the lower lid is gently pulled down and away from the eye with the tip of a finger. The patient should be asked to look up. The amount of ointment to be applied is about 1 cm in length; if an oily suspension is used, one correctly placed drop is enough. After the application, patients should be asked to close their eyes gently and keep them closed for approximately half a minute. The eyelids should not be wiped or rubbed immediately after application of the antibiotic. Under normal conditions a 5-g tube and a 5-ml bottle should each be sufficient for 30–40 applications.

**Objectives of chemotherapy in the control of hyperendemic trachoma**

In communities with severe blinding hyperendemic trachoma the objectives of chemotherapy are:

1. **Reduction in the intensity of trachoma, and hence of the incidence of blindness**

   This can be achieved by sufficiently intensive chemotherapy of individuals with severe trachomatous inflammation.

2. **Reduction in transmission of infection**

   This can be achieved by:

   (a) initial intensive chemotherapy, either oral or topical, which can substantially reduce the amount of *C. trachomatis* in the community;

   (b) protracted but less intense topical chemotherapy, given either continuously or intermittently, which can reduce the shedding of transmissible *C. trachomatis* and of ocular bacteria;

   (c) intermittent topical antibacterial chemotherapy, which can rapidly reduce the prevalence and severity of bacterial opthalmia, thereby reducing the quantity of eye discharge which facilitates the transmission of *C. trachomatis*.

3. **Treatment of individual cases**

   Individual cases will benefit, and many will eventually be cured, in the course of systematic large-scale treatment as outlined above. Alternatively, in communities with lower endemicity, treatment
should be applied to individuals selected by case-finding rather than by community-wide coverage.

Some adults in communities with blinding trachoma will have clear-cut signs of active trachoma and should receive appropriate chemotherapy. For other adults, with severe progressive disorganizing cicatricial trachoma, intensive chemotherapy may also be of value.

5.2 Surgical Treatment

The provision of simple eyelid surgery in the community itself is essential to block the chronic pathway to blindness from trachoma. This pathway leads to blindness through progressive corneal damage, which is caused by trichiasis and entropion and greatly aggravated by defects in lid closure and tear function. This kind of surgery does not have to deal with acute episodes of disease and so can be provided at any convenient time, preferably by mobile teams. Experience has shown that selected and appropriately trained medical auxiliaries can perform most of the lid surgery needed, if there is a shortage of ophthalmologists or of general practitioners trained in this work. The active participation of primary health care workers is essential for the effectiveness of surgical programmes. Their activities should include identification of individuals with inturned eyelids who may need corrective surgery, removal of inturned eyelashes (epilation) as a temporary measure until surgery can be provided, and basic follow-up care after surgery.

Once the backlog of trichiasis and entropion has been dealt with, there will be a continuing need for surgery on a lesser scale. Further cases of potentially blinding lid distortions will continue to appear as a result of progressive contraction of severely inflamed and cicatrizied tissues, long after the infective stages of trachoma have been controlled in the community. In severely affected communities, periodic surveillance with provision of lid surgery will therefore be required for many years.

Emergency treatment is required to halt the acute pathway to blindness through corneal ulceration or perforation from bacterial infection, which may be associated with trachoma. This treatment rests on the early recognition of corneal ulceration by peripheral health workers, immediate antibiotic therapy, and rapid referral to specialized eye services. Immediate and intensive antibacterial chemotherapy is the mainstay of preventive action.

For corneal ulceration, systemic penicillin should be added to hourly topical therapy with tetracycline or erythromycin. In many cases this therapy should be supplemented topically by one of the following: gentamicin or other aminoglycoside, polymyxin B, colistin or, if these are not available, chloramphenicol.

Once perforation has supervened, reconstructive corneal transplantation may be the only measure that can restore vision. However, the long-
term visual results of corneal grafting depend largely on high quality
follow-up with prolonged, carefully monitored topical immunosuppressive
treatment that is not practicable in the conditions prevailing in the
communities suffering from blinding trachoma. In some cases with corneal
scarring, optical iridectomy may restore useful vision.
These considerations emphasize the necessity for strengthening sec-
dary eye care services. One of the results of an effective programme for
control of trachoma is that the previously underserved rural people will
themselves recognize and express the need for surgical and other curative
eye services.

Choice of operative procedures

Trichiasis

Minor degrees of trichiasis, especially if localized, can be dealt with
temporarily by epilation or more permanently by electrolysis or
cryotherapy. However, unsuitable forceps may break off the lashes instead
of pulling them out and, even with successful epilation, the lashes may
regrow in stunted form or be misdirected so that they abrade the cornea
more severely. Nevertheless, careful epilation, repeated as needed, is a
useful procedure that can be provided by lay persons to relieve symptoms
and preserve vision until a definitive procedure can be done.
Electrolysis is a relatively safe and definitive procedure but may need
considerable skill and optical magnification with illumination for visual
control to guide the fine electrode deep into the individual lash follicle.
Moreover, suitable instruments are not widely available.
Cryotherapy is especially effective but needs careful regulation to avoid
sloughing; it also causes depigmentation of the skin. An isolated group of
misplaced or metaplastic lashes can be effectively dealt with by splitting the
lid along the grey line and freezing only the tarsal layer bearing the
unwanted lashes, thereby preserving the greater bulk of lashes in normal
position in the skin and muscle layer.
The more generalized forms of trichiasis due to trachoma are, however,
generally associated with entropion, as evidenced by "conjunctivalization
of the lid margin", the shiny conjunctiva-like epithelial surface extending
outwards over the lid margin beyond the line of Meibomian gland orifices
in the area that has been rubbing on the globe (Fig. 10). Trichiasis with this
sign indicates the need for entropion surgery rather than the usual trichiasis
procedures alone.

Entropion with trichiasis

There are many good operations for cicatricial entropion, and in-
numerable modifications of these. The specific indications for some of these
are discussed below. However, the prime requirement in trachoma control programmes is to train and equip a sufficient number of operators to do one or possibly a small range of procedures with great skill, confidence and speed.

Depending on the need, the resources, and the circumstances, it may be more beneficial to perform one simple entropion operation on all who need it, rather than to attempt to provide perfect correction for each individual case, at the cost of treating only a fraction of those in need.

Identifying those in the community with entropion is the single most valuable screening procedure in trachoma work. Each person so identified is on the trachomatous pathway to blindness and deserves the most effective correction that is practicable.

The worse the entropion and the more it is complicated by deficient lid closure from notching or fibrosis of the levator, or by deficient tear secretion, the more likely is the entropion to result in blindness if it is not corrected. These severe cases have the highest risk of becoming blind and need extra time and care in the surgery, because they are the most difficult to cure. However, if the cornea is already totally opaque, operation is needed only to relieve symptoms, and a simple entropion procedure may suffice. If the cornea is still clear (or capable of clearing) and useful visual function remains, full correction of the entropion with restoration of normal lid closure should be the objective.

Of the many operations available, only four will be described and discussed because they represent the main types of procedures and cover the needs of almost all cases.

1. Anterior lamella reposition operations
   e.g., Grey line split operation
   Grey line split operation with mucosal graft
   Grey line split operation with levator recession

2. Wedge tarsal grooving operation
   e.g., Streetfeild-Snellen

3. Lid margin rotation operation
   e.g., Trabut operation with levator recession

4. Tarsectomy
   e.g., Tarsectomy with levator recession

Anterior tarsal grooving operations (of the type described by Streetefield) work well in the usual cases of trachomatous entropion (with thickening of the tarsal plate), but are unsatisfactory in the much less common cases in which the tarsal plate is soft, floppy and not thickened. For these cases, an operation that repositions the anterior lamella of the lid (skin, muscle and lash-bearing area) is much more appropriate, unless keratinization or metaplastic lashes in the paramarginal conjunctiva require eversion of this zone by a lid margin rotation procedure or localized cryotherapy. Anterior lamella reposition can be achieved by procedures such as the grey line split operation which may sometimes need to be combined with a mucosal graft.
Lamella reposition procedures and the tarsal grooving operations do not cause any further shortening of the lid, whereas lid margin rotation, tarsoectomy and other procedures that evert the paramarginal strip of tarsal conjunctiva thereby produce shortening of the lid. This is of no importance unless there is a functional deficiency in lid closure, caused by trachomatos fibrosis of Müller’s muscle. However, the anterior lamella lid margin rotation or tarsoectomy procedures can each give access to dissect out the levator and so recess Müller’s muscle, thus allowing the lids to close. These approaches are also well suited to procedures to correct defects in closure from notching of the lid. Furthermore, they are applicable to the lower lid where the same principles apply.

The *choice of operation* for trichiasis and entropion may be summarized as follows:

1. With normal gentle lid closure, as in sleep, one of the following is appropriate:
   - Anterior lamella reposition
   - Tarsal grooving, if the tarsal plate is thickened
   - Lid margin rotation
   - Tarsoectomy

2. With gross disorganization of the intermarginal strip with notching, keratinization or metaplastic lashes in the paramarginal conjunctiva:
   - Lid margin rotation
   - Tarsoectomy

3. Recurrent entropion may require only the original operation to be repeated with more skill; or it may require a different operation, depending on the pathology present:
   - Anterior lamella reposition with mucosal graft
   - Lid margin rotation
   - Tarsoectomy

4. With defective gentle lid closure:
   - from lid notching:
     - Anterior lamella reposition
     - Lid margin rotation
     - Tarsoectomy
     - with dissection and excision of the notching and of the tarsal or pretarsal scar, and with recession of the levator
   - from fibrosis in Müller’s muscle:
     - Anterior lamella reposition
     - Lid margin rotation
     - Tarsoectomy
     - with dissection and recession of Müller’s muscle
- with markedly defective tear production associated with corneal signs of dryness:

\[
\text{Anterior lamella reposition} \quad \text{with dissection and recession of Müller's muscle to produce a mild degree of bilateral ptosis}
\]

\[
\text{Lid margin rotation} \\
\text{Tarsectomy}
\]

One or more of the following may be required in addition:

\( (a) \) a similar procedure on the lower lid to correct any functional shortening so that the lid margin lies higher than the lower limbus when looking ahead;

\( (b) \) a lateral tarsorrhaphy to reduce further the area of globe exposed for evaporation of tears;

\( (c) \) cautery occlusion of both upper and lower puncta and canaliculi to block the tear outflow from the eye when there is continuing deterioration despite the above measures.

**Operative procedures**

Surgical correction of trichiasis/entropion requires proper training and familiarity with basic surgical techniques. The procedures described for the different types of operations which are recommended may vary considerably in their details. Standard surgical textbooks and articles giving detailed descriptions of the procedures to be utilized should be consulted.
6. TRAINING

Effective control of blinding trachoma does not depend on the presence and availability of curative hospital eye services. Substantial benefits, however, can be obtained by the introduction of relatively simple measures which can be applied by appropriately trained health personnel, including auxiliaries. Training is therefore an essential part of trachoma control measures.

Because conditions vary in different countries, or within different regions of the same country, it is not possible to provide detailed recommendations for training that would be valid everywhere. It is possible, however, to define tasks in four progressively comprehensive levels and to list broad categories of personnel who might be involved in their implementation. Job descriptions and training programmes can then be tailored to existing conditions according to needs and resources.

The four levels may be considered to correspond, in general, to four types of personnel involved in blindness prevention programmes:

1. Auxiliary personnel
2. Health assistant (ophthalmic assistant or nurse, or non-specialized health assistant)
3. General practitioner or health officer (physician)
4. Specialist (ophthalmologist or health administrator).

Level 1 often includes "non-health" personnel such as social workers, teachers, and others. Each higher level includes responsibility for, and supervision of, the tasks mentioned in the lower levels. The level for progressively complex tasks should not be rigidly fixed, but will depend on local conditions and the types of available and suitable personnel. Indeed, it is possible that type-1 personnel may be trained to perform level-2 activities, and type-2 personnel to perform level-3 activities. For example, surgical repair of trichiasis is usually performed by trained ophthalmic surgeons, but general practitioners can easily be trained to do it, and in some countries, ophthalmic nurses have been successfully trained to perform this task satisfactorily.
The *tasks* to be performed in trachoma control programmes can be grouped under four major headings:

I. *Organization and administration*

   Level 1. Maintain records of supply utilization.
   Level 2. Implement programme activities according to established procedures.
     - Maintain inventories and record distribution of supplies.
     - Maintain records of patients and of activities performed.
     - Operational supervision.
     - Maintain lists of patients requiring services from a higher level and cooperate in organizing the delivery of these services.
   Level 3. Ensure appropriate distribution and utilization of resources.
     - Monitor record-keeping (operational and administrative).
     - Operational and administrative supervision (including personnel and budget).
   Level 4. Identify needs and resources (human, physical and financial).
     - Select methods and criteria.
     - Overall planning, evaluation, coordination, and eventual integration of activities into other health services.

II. *Special health activities*

   A. Identification of disease and recording of findings
     - Level 1. Recognition of "normal" and of "inflamed" eyes. Recognition of "blindness" (inability to count fingers at 3 m).
     - Level 2. Identification of trachoma (trichiasis/entropion, corneal opacity, follicular conjunctivitis).
     - Visual acuity testing.
     - Level 3. Scoring of relevant clinical findings (T/E, F, P, C, CC), determination of degree of intensity and severity, and diagnosis of the stage of trachoma.
     - Diagnosis of other common eye diseases.
     - Level 4. Full identification of a whole range of clinical findings in trachoma, differential diagnosis, and diagnosis of other eye diseases.

   B. Treatment
     - Levels 1 and 2. Topical application of ophthalmic antibiotic preparations in mass treatment programmes. Epilation of inturned eyelashes.
     - Level 3. Intensive, systemic treatment of selected cases under direct supervision.

III. *Environmental interactions*

   Level 1. Participate in community-based pertinent interventions (disposal of human and animal waste, water supply, garbage disposal, fly control).
Level 2. Identify factors contributing to persistence of blinding trachoma.
Level 3. Design and advise on required interventions.
Level 4. Advise on and coordinate with related development activities (environmental, social, economic and agricultural).

IV. Promotion of eye health

Level 1. Establish contact and maintain interest at community level.
Train family members to apply topical antibiotic and to pull out inturned eye lashes.
Advise on personal hygiene.

Level 2. Identify behavioural factors contributing to the persistence of blinding trachoma.

Level 3. Promote active participation of community leaders and teachers.

Level 4. Initiate, advise on, and coordinate information and educational activities relevant to eye health.

In addition to training in the performance of these tasks, primary health workers must be given clear guidelines on making decisions and on the specific actions to be taken. First of all, the health worker must decide whether action is required or not; secondly, he must decide whether the matter should be referred to another level, higher or lower. Thirdly, if the action falls within his competence, he must decide which of the alternative procedures is appropriate. The referral of cases obviously presupposes the existence or establishment of adequate transport and referral facilities. These referral services should also provide the required infrastructure for the training programme.

Training in the control of trachoma is one aspect of the overall training of health personnel in eye care. This training should be aimed primarily at the first three types of personnel described above. However, eye specialists who have been trained in industrialized countries and at university centres in developing countries seldom receive adequate training in trachoma and blindness prevention or in related disciplines that are essential for the organization and supervision of trachoma control activities; these include epidemiology, microbiology, sanitary engineering, statistics and management. To undertake this work, health administrators and ophthalmologists will need an orientation course or briefing on these subjects in order to reorient their clinical approach towards more comprehensive, community-oriented activities.

For other categories of personnel, training should be carried out locally, as much as possible on the job itself; this should be complemented by short training courses. Continuous adherence to uniform criteria and the maintenance of appropriate levels of competence, accuracy and responsibility must be ensured by periodic visits by the supervisor and, if necessary, by refresher training. Participation in training must be considered as an essential part of the duties of all personnel.
7. HEALTH EDUCATION

Trachoma control is essentially based on:

(1) the availability of services, including properly trained manpower, supplies, equipment, and effective administrative management and organization for prevention and treatment of the disease; and

(2) an adequately motivated and well-informed public to demand, accept, and utilize the services needed for the control of this disease and for the maintenance of health.

It must be borne in mind, however, that trachoma is at the same time:

– a specific communicable keratoconjunctivitis; and
– a disease associated with general health conditions, especially personal hygiene and environmental health.

Efforts should not, therefore, be limited to direct therapeutic services, and special attention should be given to the community’s feelings, desires, and aspirations. Health education on trachoma should begin before starting the treatment programme, and then should be continued during the programme and thereafter as an integral part of general health education activities in the country.

An overall programme in a field such as trachoma control, where the individual is asked to accept a new pattern of behaviour (especially in personal hygiene) and where the community must consider major problems (such as providing safe water supplies which require effort, time, and money), can seldom accomplish its aims merely through showing a film or using other mass media. The inculcation of a new habit is an educational process that requires time and special effort. Experience in trachoma control and other similar programmes has shown the effectiveness as well as the economic benefits of well-conceived and systematic health education.

In order to minimize the effort it may be advisable to focus activities primarily on special population groups. Primary-school children are a very susceptible and accessible group, and health education in trachoma must
be strengthened within their educational programme. However, it may be
difficult for any health department to involve itself with the education of all
children. Hence, the most effective approach is to give due attention to
health education in trachoma in teacher-training courses for teachers in
areas where trachoma is a major health problem.

Use may be made in these programmes of various communication media
that facilitate learning, and learning should eventually lead to appropriate
attitudes and behaviour. This process of knowledge leading to particular
attitudes, and hence to behaviour consistent with it, should not be taken for
granted. Many other factors are involved, including socioeconomic
conditions, cultural trends, conditioned responses and social values, that
might hinder or enhance the process. Thus, any trachoma control
programme should include surveys to determine some of the factors that
influence the knowledge-attitude-practice process.

Opportunities for trachoma control also exist in maternal and child
health clinics, where group discussions with mothers may be of great
importance.

One essential aspect of health education is the need for simplicity and
honesty in the message conveyed. In no case should simplicity overshadow
honesty, for people are entitled to know the truth and, if once disillusioned,
they will not cooperate in further programmes.

In summary, health education is an essential aspect of trachoma control
because trachoma is a disease closely related to behaviour. For control
campaigns to succeed, health behaviour must be patterned on the available
health knowledge.
8. EVALUATION

Evaluation of results

Results of control activities can be evaluated by the objective measurement of changes occurring in the clinical and epidemiological pattern of the disease. Evaluation is essential to assess the needs and to establish priorities for further action. It also provides information for administrative decisions.

Criteria for evaluation are provided by changes occurring in the age-specific prevalence rates of the various degrees of intensity of active inflammatory disease and of disabling and potentially disabling lesions. Data on the age-specific prevalence of different stages of trachoma have less direct value. In the interpretation of these data, it should be noted that these rates may only be estimates because precise census data are often not available. Moreover, variations in the application of criteria of diagnosis and selection may further affect the result of the evaluation of a programme.

The changes in rates of intensity of inflammatory trachoma give a rapid measure of the effect of antibiotic treatment and of environmental and other interventions. The age-specific rates of the degrees of conjunctival scarring measure the longer-term effects. The changes in rates of trichiasis and entropion yield information on the reliability of screening for these lesions and on the amount and efficacy of corrective surgery performed.

In the evaluation of trachoma programmes, effective control measures result first in a decrease of severe and moderate intensity cases, and then a decrease in the incidence and overall prevalence of active trachoma. From a public health point of view, the most important criterion to evaluate is the prevalence of blinding lesions which are the long-term outcome of moderate or severe intensity of inflammation. The occurrence of new cases of blinding and potentially blinding lesions may be dramatically reduced by an effective and efficient programme. However, unless surveillance and control are maintained as part of continuing activities, severe active disease may recur and new cases of trichiasis and entropion will be overlooked.
Evaluation of administrative and operational efficiency

In general the efficiency of a programme is measured by the actual activities performed (e.g., the number of individuals examined or of cases treated) over a given period in relation to specified targets. Evaluation must include cost-benefit or cost-effectiveness estimates. Such estimates are usually difficult to obtain because the benefits resulting from the prevention to blindness are not easily measured. Cost estimates may be made more easily in "vertical" programmes, but such estimates will be less certain as trachoma control activities become integrated into general health activities. Furthermore, the specific benefits caused by indirect interventions, such as promotion of eye health and environmental sanitation, are difficult to measure.
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