

Technology for Health

Joseph Taylor

Eye drops for rural populations

An outline is given of materials and methods suitable for the production of essential eye drops at low cost in rural locations in developing countries.

One in every ten patients attending general outpatient clinics in rural areas in most parts of the developing world complains of symptoms affecting the eyes. Almost half of these patients have conjunctivitis. Eye medications are rarely available in rural clinics because of either financial constraints or inaccessibility. In this context the local production of topical anti-infective eye drops is highly necessary.

Half the cost of commercially prepared eye drops is in their containers. Consequently, empty glass vials that have been discarded in health units should be the starting point for the production of eye drops in rural situations.

In small rural outpatient clinics it is not necessary to have many types of eye drops, but there should be at least an antimicrobial and a topical anaesthetic for use when removing foreign bodies, performing simple tonometry, and examining painful eyes. Chloramphenicol eye drops or enriched tetracycline eye ointment is of value in the

treatment of the majority of superficial eye infections, such as conjunctivitis; atropine can be sight-saving in some of the more dangerous eye conditions, among them leprosy and uveitis, as well as in the emergency treatment of eye injuries. Fluorescein paper strips allow the early recognition of corneal ulcers, small foreign bodies, and corneal exposure in leprosy and other conditions. Thus a few cheap, simple preparations make it possible to cope with the majority of eye conditions, even in rural situations. The information given below is based on experience gained over the past 20 years in East and West Africa. A revised edition of a manual originally produced by the Christoffel Blindenmission International is now available from WHO's Prevention of Blindness Programme (1).

Materials required

Used glass vials are needed, preferably having a capacity of 5 ml or 10 ml.

Several varieties of disposable plastic dropper are available; if these cannot be afforded, reusable ones can be employed, although they are not recommended as it is difficult and time-consuming to clean them.

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A drug is, of course, required, as is a preservative, usually either phenylmercuric nitrate or benzalkonium chloride. In order to prevent decomposition during the sterilizing process an antioxidant such as sodium metabisulphite can be used.

It is desirable to use freshly distilled water, preferably on the day it has been prepared. An electrically powered still is the easiest to use but, if electricity is not available,

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still may be heated by gas or kerosene. If necessary a solar-powered still can be used: one panel of six solar heat collectors will yield between five and eight litres of distilled water in eight hours of sunshine. This type of still has the additional advantage of being air-cooled and thus does not require running water, whereas conventional stills need either running water or a cooling tank.

If it is not possible to prepare distilled water, eye drops can be made by using rain-water that has just been boiled for 20 minutes and filtered. This is not ideal but it is safe to use except postoperatively or after penetrating injuries of the eye have been sustained.

A pharmaceutical balance is required: a simple beam balance with sliding weights is the easiest to use and maintain in good condition.

For filtration a glass funnel with ordinary filter-paper can be used but this is a slow system. A conical flask with a sintered glass filter attached to a hand vacuum pump is

efficient and cheap; a similar system with glass fibre pads overcomes the need to clean a sintered glass filter. A syringe with a disposable micropore filter is easy to use but is more expensive.

A hand press is used for sealing disposable plastic pipettes on to vials. However, some simple plastic droppers can be pushed on to vials by hand.

Beakers, measuring jars, conical flasks, fluted glass funnels and other items of glassware are necessary.

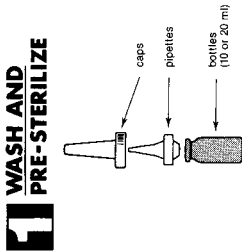
In order to sterilize eye drops a simple water-bath is appropriate at all but the largest units where autoclaving may be available. A water-bath with a perforated tray can easily be made, allowing bottles to be held in steam above boiling water. A specially designed eye-drop steamer, costing approximately US\$ 200, can be obtained with or without an electric element.

Method of preparation

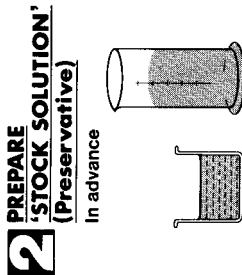
It is good practice to prepare only one type of eye drops on any given day, for example chloramphenicol, amethocaine, or atropine eye drops.

Stock solution containing preservatives is prepared and sterilized. The raw materials are weighed out and stock solution and distilled water are added to give the required volume. The drops are filtered and dispensed into vials that have been carefully cleaned and washed in distilled water. Droppers (pipettes) are then attached. The drops should be sterilized immediately: sterilization should not be postponed from one day to the next. A label should indicate the date of manufacture. Eye drops are preferably stored in a refrigerator at about 4°C so as to maximize their shelf-life.

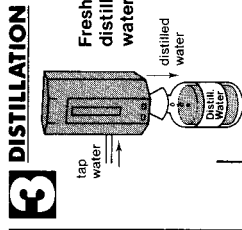
THE PREPARATION OF EYE DROPS



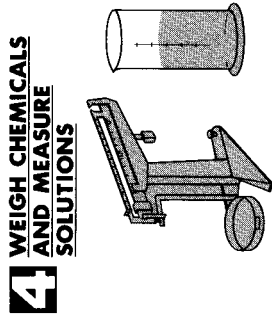
1 WASH AND PRE-STERILIZE



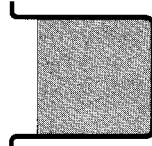
2 'STOCK SOLUTION' (Preservative)
In advance



3 DISTILLATION



4 WEIGH CHEMICALS AND MEASURE SOLUTIONS



5 PREPARE EYE-DROP SOLUTION:

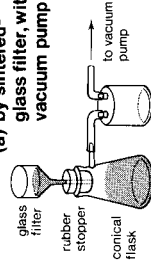
Dissolve chemicals, add stock solution and make up final quantity with fresh distilled water

Prepare in beaker or measure (500ml or 1 litre)

6 FILTRATION:

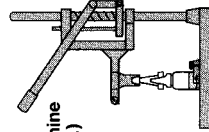
By one of the following methods:

- (a) by sintered-glass filter, with vacuum pump
- (b) similar arrangement with two-part filtration funnel and filter-paper
- (c) alternatively: filter-paper and glass funnel
- (d) Antlia - pump with bacteria - proof filters may be used for smaller quantities



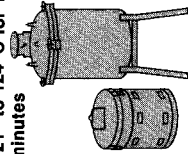
7 CAPPING

of bottles by means of sealing machine (Stella press)

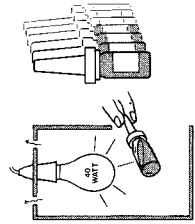


8 STERILIZATION

in autoclave (pressure cooker) at 121° to 124°C for 15 minutes



9 VIEWING AND LABELLING



PROGRAMME FOR THE PREVENTION OF BLINDNESS
WORLD HEALTH ORGANIZATION
1211 Geneva 27, Switzerland



For example, chloramphenicol 0.5% eye drops can safely be used for a year after sterilization if stored in a refrigerator, but only for four months if held at ambient temperature. The figure on p. 65 outlines the method used.

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Some thought has been given to finding a type of eye drops for the treatment of common superficial eye infections among rural people, and it may well prove that 1% polyvidone iodine eye drops are suitable for this purpose. They are easily made, keep well, and are active *in vitro* against the common bacterial and fungal pathogens and the human (alpha) herpes virus 1 and 2, and

trials are in progress on their clinical effectiveness.

Polyvidone iodine drops are made by dissolving 1 g polyvidone iodine powder in 100 ml distilled water or freshly boiled and filtered rainwater. Sterilization is performed by steaming over a water-bath. The drops are kept at ambient temperature and retain their potency for a long time. They can be safely used for the prophylaxis of ophthalmia neonatorum. No obvious corneal toxicity has been demonstrated. For many years, 10% polyvidone iodine has been used as a preoperative skin preparation without any problem, even before intraocular surgery.

A 10% aqueous solution of polyvidone iodine, widely available as Betadine, can be conveniently used as the starting point for the preparation of 1% polyvidone iodine drops: 1 ml Betadine is diluted with 9 ml normal saline. □

Reference

1. *The local small-scale preparation of eye drops.* Geneva, World Health Organization, 1990 (unpublished document WHO/PBL/90.20).