UNHCR Guidelines on selecting and using disinfectants

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The original French version of this handbook was prepared by Brigitte RENCHON, a consultant pharmacist with UNHCR, in collaboration with *Médecins sans Frontières* (Paris).

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The UNHCR Programme and Technical Support Section (PTSS, Geneva) would appreciate receiving copies of any adaptation or translation of this handbook.

UNHCR, P.O.Box 2500, CH-1211 Geneva 2 Dépôt (Switzerland)

Contents

I - Introduction

This Handbook is for medical and sanitation officers and anyone else involved directly in medical care, environmental hygiene or any other measure to combat infection. There are paragraphs particularly relevant to each of these.

Experience has shown that, in matters of disinfection, questions or practical problems very frequently crop up. This is mainly due to the particular circumstances found in refugee situations, the excessive variety of disinfectants available and a lack of precision or contradictions found in publications.

In practice, disinfectants are frequently used in an improper fashion which often makes them ineffective or at times even dangerous. More effective, selective and rational use would help avoid both infections and also the waste of money and energy.

The MAIN PART of this Handbook comprises:

- A *lexicon of important terms* relating to disinfection (Chapter II);
- An *analysis of needs in refugee situations,* that is to say a discussion of the advisability of using disinfectants in different applications (Chapter III);
- A *list of the best-suited disinfectants to* meet the needs.(Chapter IV);
- *Specifications for utilisation* of the products selected (Chapter V);
- *Instructions* for use of each product selected (Chapter VI). This chapter also includes a number of instructions for use of disinfectants which are not on the list but are frequently

met in practice;

- Finally, *technical specifications* concerning the implementation of disinfection (Chapter VII). special disinfecting measures relating to AIDS, the disinfection and sterilisation of medical equipment, the precautions essential when preparing and storing antiseptic solutions, the disinfection of a well or water reservoir, chlorinating of water and disinfecting measures to be taken in cases of cholera epidemics.

The APPENDICES are less directly useful in the field but they discuss the selection made and provide additional information.

- *Appendix A* reviews the main disinfectants by analysing the advantages and disadvantages for use in refugees situations.

- *Appendix B* gives a comparative table of the prices of the main disinfectants - purchase prices, cost prices of the ready-to-use product in the field taking into account transport costs.

Finally, the INDEX at the end of the Handbook will help the reader in seeking answers to any problems which may arise with regard to disinfection.

II - Definitions

As certain terms relating to disinfectants have variable or imprecise meanings, the following definitions will be adopted in this Handbook:

Disinfection: The elimination or destruction of a large part of the undesirable micro-organisms(1)(1) borne by a material or other object.
Thorough disinfection: The elimination or destruction of all micro-organisms except the most resistant i.e. bacterial spores.

Decontamination: Disinfecting of items soiled by infectious matter (pus, blood, excrement, etc.).

Disinfectant: A product for disinfection.

Antiseptics: A disinfectant that can be applied to living tissue (skin, wounds, mucosa) without causing harm.

Sterilisation: The elimination or destruction of all micro-organisms carried by any material or object.

Asepsis: Prevention of contamination by micro-organisms.

III - Identification of needs

The particular conditions of refugee situations call for a precise analysis of disinfection needs. This analysis will help avoid any excessive reaction such as exaggerated concern or, conversely, dangerous negligence.

Dispensaries and other medical facilities

Dispensaries are certainly the places where the use of disinfectants is most obvious and most necessary, for these premises receive infected persons who have come for treatment and other particularly sensitive persons (the sick and injured). Moreover, it is here that acts conducive to the introduction of germs into the human body are performed and the recent appearance of the AIDS virus (HIV) has considerably increased the risks of any form of medical treatment conducted without the necessary aseptic precautions.

Above all, the following must be disinfected :

- *wounds* (open or infected)
- *infections of the mucosa or skin, etc.*
- *the skin, before certain medical acts* (injection, incision, introduction of an intravenous drip, etc.)
- *the hands of the nursing staff*
- instruments and other medical equipment
- working tables
- *the clothes and covers of certain patients* (typhus, cholera, etc.)
- *any material in contact with medical waste* (refuse bins)
- *the floors*, if possible (cement, wooden or tiled floors).

Disinfection does not suffice for:

- *medical waste* (bandages, needles, syringes or other single-use materials, laboratory materials, operating-theatre waste). These must absolutely be incinerated separately from other waste and if possible daily (attention : pricking or cutting objects are particularly dangerous to handle).
- *Needles, syringes, surgical instruments*

Indeed, all equipment which comes into contact with sterile parts of the body must be sterile (page 35).

In the field, true sterilisation can generally be achieved only by using an autoclave (a small pressure-cooker type autoclave is most suitable, relatively cheap and very quickly amortized). In certain cases a good electrically-operated hot-air steriliser could be used.

If true sterilisation cannot be achieved, the equipment must undergo thorough disinfecting - boiling for 20 minutes, or disinfecting with a very powerful disinfectant (page 36).

So the needs for disinfection of medical facilities are therefore multiple and extremely varied. There is no single product which can meet all these needs.

Chapter IV gives a list of the best-suited products for use in the field.

Excreta

There is a very great temptation to try to disinfect excreta, which are known to be dangerous and highly contaminated, especially in periods of epidemics.

It is quite illusory and pointless to want to disinfect excreta. Illusory because the disinfectant applied will act only on the surface and pointless because the disinfection will occur quite naturally by biological processes if the excreta are kept in a pit or a tank or simply buried for a sufficient amount of time. BUT EVERYTHING MUST BE DONE TO STOP THE SPREAD OF EXCRETA. IF DEFECATION IS ALLOWED TO OCCUR WITHOUT CONTROL, NO DISINFECTION MEASURE CAN PREVENT THE DANGERS (defecation must take place in supervised places such as pits, latrines trenches or defecation fields).

In the case of occasional soiling of the ground by excreta, that excreta must be collected and buried or evacuated to latrines or trenches rather than simply covered with disinfectants.

In defecation trenches, lime may be used, not for disinfection (ineffective), but to limit odours and flies. The same effect is obtained by covering excreta with cinders or earth but the use of lime nevertheless helps in using the same trench for longer because it requires a lesser volume.

In defecation fields, it is preferable to cover the excreta with a spadeful of earth (except if it is very hot

and very dry because the sun and the dryness will then act as disinfectants themselves).

In pit latrines, the addition of disinfectants is not only ineffective from a disinfection point of view but also counter-indicated because it inhibits the natural biological decomposition process (the reduction in volume is therefore far slower and the pits fill up far more quickly).

The addition of large quantities of phenolic disinfectants (creosol, Lysol, etc.) is more strictly counter-indicated because of the risk of pollution that they constitute for the underlying water tables.

The installation of a ventilation pipe fitted with a fly (and mosquito) trap grill is a less costly solution which will last longer than the addition of lime in dealing with the problem of flies and odours. This is the principle of the Ventilated Improved Pit Latrine as described by Winblad and Kilama in *Sanitation Without Water* (see bibliography page 53).

In no case should insecticides be used in latrines to solve a problem of flies or mosquitoes as this will simply favour the emergence of resistance.

For the maintenance of public latrines the external parts of the latrines (wooden floors, cement slabs, door handles, etc.) should be cleaned and disinfected daily (even several times a day) to prevent the spread of faecal germs on the hands and feet of the users. However, it would be as well not to pour disinfectants into the latrines because they can hinder their operation (only chlorine in small quantities can be used without danger).

Material coming into contact with excreta, and hence soiled, must be disinfected to avoid the spread of faecal germs. Particular disinfection measures to be taken in case of cholera epidemics are given on page 47.

Water

It is impossible to give an absolute definition as to when and how water should be treated in a refugee situation. That will depend on too many factors and such a problem can obviously not be covered in this Handbook.

There are, however, emergency cases where a total guarantee of the quality of the water has to be given (e.g. cholera or typhoid epidemics or the threat thereof) and, in these circumstances disinfection (chlorinating) of the water is generally the fastest and most reliable solution.

The indications given in the practical specification sheet (page 42) will help non-specialists to master this technique better.

Chlorinating is, however, not presented as a universal solution for it is a relatively complicated process which calls for constant attention and special equipment (reservoirs, a chlorine generating product and residual chlorine testing kits).

Once the emergency has passed, the choice of a method for supplying water which does not call for treatment and the implementation of effective water-protection measures are preferable to any treatment. If treatment is, nevertheless, essential, a filtering process would no doubt prove much better over the long term.

A technical specification sheet (page 39) explains how to disinfect a well after accidental pollution (for example an animal falling into it), after floods or when it is brought back into service after a period of disuse.

A technical specification sheet (page 41) explains how to disinfect a reservoir.

Human corpses

In general corpses are not particularly dangerous unless death was due to the plague, typhus or cholera.

In the case of the plague or typhus, the danger comes from lice or fleas. This being so, any corpses

bearing such creatures have to be powdered with an effective insecticide before being handled.

In the case of death by cholera, corpses have to be disinfected before being handled in preparation for funerals for they carry many cholera germs (cholera vibrios) on the entire surface of the body (technical specification sheet, see page 47).

If the body is to be buried, then burying it at some depth (1.5 metres) in a place not constituting any danger of water pollution will suffice regardless of the cause of death. If it is not possible to bury the corpse at a sufficient depth because of the nature of the soil (rocks), then corpses must be covered with lime (quick lime or slaked lime) to avoid the emission of putrefaction odours and the attraction of carrions.

Animal corpses

Animal corpses have to be buried with the same precautions as human corpses (see above) except when there is suspicion of a dangerous disease transmissible to humans or animals (e.g. rabies or anthrax).

In this case, the local veterinary authorities must be contacted immediately.

If instructions cannot be rapidly obtained from the veterinary authorities, the suspected corpses have to be burned. If that is not possible because of a lack of oil or wood or because of the excessive number of corpses, they must be buried at sufficient depth in a dry place which presents no danger of water contamination and with a good layer of lime above and below.

In the case of anthrax, burn (or bury) the animal on the spot if possible.

Any surfaces and equipment that came into contact with suspicious corpses have to be disinfected with a solution of 2% formaldehyde or a solution of 2% active chlorine. (1)(2)

In cases of rabies or anthrax, use a 4% solution of formaldehyde or 5% solution of active chlorine (1)(3) and repeat the application three times at one hourly intervals.

Abattoirs and butchers

These places must be regularly cleaned and disinfected. Objects and surfaces which come into contact with the meat must be disinfected with a chlorinated solution (1)(4) and not with a phenolic disinfectant which gives the meat a very unpleasant flavour.

Abattoir waste and carcasses have to be burned or placed in a pit (dug in some place which presents no danger of polluting water) and, to avoid odours and swarming flies, they should be covered with a good layer of earth or lime.

IV - A limited list of suggested disinfectants

As a limited selection of disinfectants permits users to become better acquainted with them and allows stocks to be more easily managed, we can suggest a shortlist of disinfectants suitable for all the needs mentioned in the preceding Chapter.

- ***ordinary soap***,
- ***T chloramine*** *(sodium tosylchloramide),*
- ***iodine*** *(in the form of iodised polyvidone),*
- ***gentian violet,***
- ***calcium hypochlorite*** *or* ***sodium dichloro-isocyanurate*** *(NaDCC),*
- ***cresol in soapy solution form*** *(Lysol) or same other similar phenol compound.*

These six products plus ***lime*** in certain specific situations can meet all of the disinfection needs

encountered in refugee situations.

The reasons for choosing these products are set out in Appendix A. All the main disinfectants are reviewed there along with arguments justifying their selection or rejection for use in the field.

The characteristics taken into account are effectiveness, polyvalence, stability (in the presence of heat or humidity), ease of preparation, safety (in transport, storage and use) ease of supply and the cost/efficiency ratio.

None of the products selected have all the desired qualities but each has certain advantages in the field which largely outstrip the disadvantages. If there were a single product effective against all germs, which was cheap, stable, non-toxic and non-corrosive, the problem of disinfection in refugee situations would obviously be much simpler.

Comments

Among the products proposed, gentian violet and iodine are on the WHO list of essential medicaments. T-chloramine (sodium tosylchloramide) is not on that list but it has been preferred to chlorhexidine for the reasons set out in Appendix A (page 54).

Ordinary soap, calcium hypochlorite, sodium dichloro-isocyanurate and cresol in soapy solution are not on the WHO list of essential drugs but that is because they are not medicaments.

V - Specifications for utilisation of selected products

See the corresponding monograph for each product mentioned (Chapter VI).

General disinfection

Indications	*Product of choice*	*Possible alternative product*
Sundry items	0.2% active chlorine (1) or 5% Lysol (2)	
(Bed or personal) Linen (white cotton)	0.1% active chlorine (1)	5% Lysol (2)
Clothing and covers	5% Lysol (2)	
Wooden or cement floors	0.2% active chlorine (1)	5% Lysol (2)
Reservoirs, tanks	200 ppm active chlorine (1)	
Latrine maintenance (slabs, floors)	0.2% active chlorine (1) (3)	5% Lysol (2) (3)

The 0.2% active chlorine solution is far less costly than the 5% lysol, it acts far more quickly and is a better virucide. It should be given preference except where corrosion is to be feared.

(1) The active chlorine solutions are prepared from calcium hyperchlorite or from sodium dichloro-isocyanurate (NaDCC), (page 24).

(2) Lysol is the soapy solution of cresol but it can be replaced by some other phenolic disinfectant: Cresyl(r), Creoline(r), Lyorthol(r), etc.(page 28).

(3) Chlorine in small quantities is not dangerous for the operation of latrines. Lysol, on the other hand, can hinder the biological processes; there is also a risk of its polluting the underlying water tables.

Disinfection of medical facilities

Indications	*Product of choice*	*Possible alternative product*
Open wounds or infected burns	T-Chloramine at 5g/litre (1)	IPV at2.5% (2) Chlorhexidrine-cetrimide at 0.03% - 0.3%
Operational wounds	IPV at 2.5%	IPV at 0.5%
Infected mucosa	T-Chloramine at 2g/litre	
Mycoses	Gentian violet at 5g/litre	
Dermatoses (impetigo, eczema, etc.)	Gentian violet at 5g/litre	
Injection or IV drip site	IPV at 2.5% (3)	Chlorhexidrine-cetrimide at 0.03% - 0.3% (8)
Skin prior to surgery	IPV at 10%	
Umbilical cord	IPV at 10%	
Hands - hygienic washing	Soap (4)	
Hands - surgical washing	Soap followed by IPV at 10% (5)	
Instruments - pre-cleansing steeping	T-Chloramine at 20g/litre	0.1% active chlorine (7) 5% Lysol Chlorhexidrine-cetrimide at 0.03% - 0.3% (8)
Instruments - thorough disinfection (6)	T-Chloramine at 20g/litre IPV at 2.5% 0.1% active chlorine (7)	
Working surfaces, furniture, etc.	0.2% active chlorine (7) 5% Lysol	
Splattered blood	T-Chloramine at 5g/litre 0.5% active chlorine (7)	T-Chloramine at 20g/litre

IPV = Iodised Poly-Vidone

T-Chloramine = Sodium tosylchloramide

For (1), (2), (3), (4), (5), (6), (7) and (8), see next page:

(1) If the wound is seriously soiled by foreign bodies, it may first be washed with soap.

(2) Use Iodised Polyvidone (IPV) only in exceptional cases for these indications because of it price

(Chloramine and chlorhexidine-cetrimide are far less costly).

(3) If the skin is dirty, clean first with soap and water.

(4) Attention: soap should not be left in the water between uses. Place it on a stand so that it can drain.

(5) See instructions for use of iodised polyvidone (page 31).

(6) Only where an autoclave or hot-air steriliser and boiling cannot be used (page 36).

(7) The active chlorine solution is prepared from calcium hyperchlorite or from sodium dichloro-isocyanurate (NaDCC).

(8) Chlorhexidine can also be used alone at 0.05%, but it is better to use an association of chlorhexidine+cetrimide (see page 54).

VI - Instructions for use of the main disinfectants

This chapter contains instructions for use of the selected products. Other instructions have been added because they concern products frequently used in the field.

Information on other disinfectants, for which no instructions are given, will be found in Appendix A.

Prices are indicated in Appendix B.

CETRIMIDE

(Cetavlon (r), etc.)

The use of this medicament is counter-indicated:

- it is hardly any more efficient than ordinary soap:
- water-based solutions are very often contaminated:
- it is not on the WHO list of essential drugs.

Indications

- For cleaning wounds
- For cleaning soiled equipment

Presentation

- Soluble powder
- 20% concentrated solution for dilution
- 40% concentrated solution for dilution

Dilution

- Used in a 1% cetrimide solution:

  10 g of powder to one litre of water,
  or 50 ml of 20% solution in 950 ml of water,
  or 25 ml of 40% solution in 975 ml of water,

- Prepare the solution with drinking water from a distribution network or from boiled water which has previously been filtered if necessary.

- Carefully wash the bottle with hot water and leave it to dry before each refilling.

Precautions

- The water-based solutions, when diluted for use, are very easily contaminated by pathogenic germs (if possible prepare the solutions only when needed).

- This is incompatible (neutralisation) with soap and iodine and their derivatives (e.g. iodised polyvidone).

- Is not suitable for sterilising instruments (nor for keeping them sterile).

Comments

- This product is counter-indicated (limited effectiveness and high risk of contamination of water-based solutions).

- The combination of chlorhexidine and cetrimide is far more effective.

- *Preservation*: No special precautions.

  Never keep diluted solution for more than one week.

LIME (Quick lime and slaked lime)

Indications

- To cover decomposing organic matter to prevent the release of putrefaction odours which draw flies and encourage their reproduction.

Presentation

- Slaked lime is a white powder

- Quick lime or unslaked lime comes as grey blocks (or granules) or white powder.

Indications

- *Corpses*

- If it is not possible to bury corpses at a suitable depth, spread lime on the bottom of the pit and on top of the corpses (one kg of lime for 10 kg of corpse).

- If it is possible to bury the corpse at a suitable depth, the use of lime is not justified (regardless of the cause of death).

- *Refuse dumps*

If it is not possible to cover refuse with earth or to incinerate it, or should this not solve the problem of odours or flies, regularly spread lime on the refuse (beware of wind, cover the lime with a little earth).

- *Excreta*

Make daily use of defecation trenches where it is not possible to use earth or cinders as covering material.

Precautions

- Lime is an irritant for the skin and dangerous for the eyes (if lime enters the eye, immediately wash in abundant quantities of water: risk of irreversible lesions and blindness).

- Lime dust is dangerous for the eyes and the respiratory system.

- Lime should be used only by persons who have been forewarned and are well equipped (gloves, boots, goggles and over-garments).

- Lime can be spread only in places inaccessible to children.

Comments

- It does not matter whether slaked or unslaked lime is used.

Quicklime or unslaked lime is cheaper, less voluminous for the same weight and it takes 25% less for the same effect but it does call for greater precautions when handling (it can cause burns on damp skin).

- Hydraulic lime (lime which hardens on contact with water and which is used as mortar) is not suitable.

- Do not confuse lime with chloride of lime (bleaching powder) which is a product which generates chlorine and is not a sort of lime.

- *Preservation : close bags well after use.*

CHLORAMINE = CHLORAMINET = SODIUM TOSYLCHLORAMIDE

(Clonazone(r), Hydroclonazone(r), etc.)

Indications

- *Antiseptic*

- cleaning of soiled wounds
- disinfection of infected wounds or mucosa (abscesses, ulcers, etc.).

- *Disinfectant*

- disinfection of medical instruments
- disinfection of floors, surfaces and sundry items

Presentation

- As powder or 250 mg, 500 mg or 1 g tablets. It has a slight odour of chlorine. The tablets have to be easily and completely soluble otherwise powder is preferable.

Dilution

- *As an antiseptic*

- for general use, 5 g per litre
- in case of repeated use on mucosa, 2 g per litre

- *As disinfectant*

- for disinfection of instruments, 20 g per litre
- for disinfection of floors, surfaces and sundry items, 5 g per litre

- Prepare the solutions with drinking water from a distribution network or from boiled water that has previously been filtered if necessary.

Indications

- For wounds and mucosa: for bathing, irrigation or compresses (chloramine solutions can advantageously replace DAKIN solutions). If used over a long period protect the healthy skin around the wounds with Vaseline

- *For the thorough disinfection of instruments and laboratory equipment*, soak the previously cleaned instruments in a 20 g per litre solution for 15 minutes.

Precautions

- Take precautions to avoid any risk of the tablets being swallowed. DO NOT KEEP THEM WITH ORAL TABLETS.

Comments

- There are 12 or 20 mg tablets for disinfection of drinking water for individual or family use (1 tablet per litre of clean water).

- 1 g of chloramine produces 250 mg of active chlorine.

- *Preservation :*

- *Keep ready-to-use solutions for no more than one week.*

- *Solutions used for soaking instruments must be replaced daily.*

- *Solutions must be kept sheltered from light - use an opaque or brown bottle (do not use metal containers).*

Products for generation of CHLORINE

(Calcium hypochlorite, chlorinated lime, bleaching powder and liquid bleach, sodium dichloro-isocyanurate or NaDCC)

Indications

- disinfection of objects, instruments, bed linen, etc.

- disinfection of floors and surfaces (tables, draining-boards, etc.)

Presentation

- Calcium hypochlorite (HTH), granules containing.....± 70% active chlorine

- Chlorinated lime, bleaching powder, powder containing.....± 25% active chlorine

- Sodium hypochlorite solutions (liquid bleach, Milton(r)..... ± 4% active chlorine

- Bleach 12° chlorometric.....± 5% active chlorine

- Bleach 15° chlorometric.....± 5% active chlorine

- Bleach extract 48 degrees chlorometric.....± 15% active chlorine

(to be diluted in 3/4 litre of water to produce liquid bleach with 4% active chlorine)

- Sodium dichloro-isocyanurate or NaDCC:

- in powder.....± 60-65% active chlorine

* in tablets (Actisan(r), Bayrochlor(r), Javel solid(r), etc.) at 1.5 g of active chlorine per tablet.

The power of chlorine generating disinfectants is expressed in terms of active chlorine (generally percentages of active chlorine).

The concentration of calcium hyperchlorite solutions is sometimes expressed in chlorometric degrees:
1° chlorometric = approximately 0.3% active chlorine

The concentration of diluted solution is expressed in % or in ppm (parts per million) of active chlorine (1 ppm = 1 mg per litre = 0.0001%)

Dilution

UTILISATION MADE FROM	**Clean conditions** (e.g. clean instruments, clean linen, etc.) 0.1% = 1000 ppm active chlorine	**Average conditions** (e.g. floors, draining-boards, straw mats, tables. etc.) 0.2% = 2000 ppm active chlorine	**Very dirty conditions** (e.g. heavily soiled equipment, laboratory equipment, splattered blood, spittle, etc.) 0.5% = 5000 ppm active chlorine
12^{o} liquid bleach (4% active chlorine)	25 ml/litre	50 ml/litre	125 ml/litre
Calcium hypochlorite (70% active chlorine)	1.5 g/litre = ± 1 heaped tablespoon to a 10-litre bucket of water	3 g/litre = ± 2 heaped tablespoons to a 10-litre bucket of water	7 g/litre = ± 5 heaped tablespoon to a 10-litre bucket of water
Sodium dichloro-isocyanurate - NaDCC (1.5 g active chlorine per tablet)	1 tab. to 1.5 litres or to make it simple, 1 tab. per litre	1 tab. to 3/4 litres or to make it simple, 2 tabs. per litre	3 tabs. per litre

- The active chlorine content must always be verified on the packaging of the product available in order to rectify the doses if necessary.

- Solutions with a higher active chlorine content for certain special conditions can be obtained by adjusting the doses.

- The dilutions should always be made up just before the products are to be used, in non-metallic recipients.

- It is normal that there be a calcium hypochlorite and calcium chloride deposit in the solutions (use from the top).

- Prepare the solutions with clean water.

Precautions

- Handle concentrated products with care (avoid shocks, avoid exposure to high temperatures or naked flames).

- Avoid breathing in the vapours when opening the recipients and the dust when handling the products.

- Do not mix with detergents (Teepol$^{(r)}$, OMO$^{(r)}$, etc.).

- Do not put dry products, especially calcium hyperchlorite, in contact with organic matter (e.g.: corpses), for there may be a risk of explosion.

- *Disinfection of linen* **:** use only for cottons and linens (which are likely to be bleached). Do not exceed 15 minutes' soaking. Do not exceed 0.1% (1000 ppm) active chlorine. Rinse thoroughly (at least three

times) in clean water after soaking.

- *Disinfection of instruments* : to avoid corrosion use only for stainless steel instruments, do not use repeatedly solutions exceeding 0.1% (1000 ppm) active chlorine, do not exceed 30 minutes' contact, use cold, rinse thoroughly and dry after disinfection.

- NaDCC is less corrosive than calcium hyperchlorite solutions and liquid bleach.

Comments

- T chloramine (sodium tosylchloramide) is also a product which generates chlorine (25% active chlorine), but it acts more slowly than the products mentioned here. As it is less irritating, it is particularly interesting as an antiseptic for infected wounds and mucosa.

- Calcium hypochlorite, liquid bleach and bleach powder can also be used to prepare anti-septic solutions (DAKIN solution), provided that one teaspoonful of bicarbonate of soda is added to each litre of the final solution (to neutralise the alkalinity).

- For wounds : a 0.1% solution (1000 ppm) of active chlorine.

- For mucosa : a 0.05% solution (500 ppm) of active chlorine.

- Trichloro-isocyanuric acid (ATCC) with 90% active chlorine is a very similar product to NaDCC, but as it is poorly soluble its use is limited. It is used principally for maintaining the chlorinating of swimming-pool water in the form of tablets placed in floaters.

- *Preservation :*

- *Keep the products in hermetically sealed recipients protected from heat, light (and humidity for solid products).*

- *Chlorinated lime, liquid bleach and bleach powder keep very badly (a maximum of a few months in the case of the bleach and extract of bleach).*

- *Calcium hypochlorite keeps relatively better.*

- *NaDCC is by far the most stable.*

CHLORHEXIDINE

(Hibitane(r), etc.)

Indications

For cleaning and disinfection of :

- skin and mucosa

- wounds

- burns

- ulcers

- abscesses

Presentation

- 5% concentrated solution of chlorhexidine digluconate to be DILUTED before use. Ensure that the concentrated solution supplied can be diluted with ordinary water, and not distilled water (for this to be possible, the formulation has to contain a co-solvent).

- There are 20% chlorhexidine solutions but they do not generally contain a co-solvent and therefore have to be DILUTED WITH DISTILLED WATER to avoid any chlorhexidine precipitation.

Dilution

- Used in a water-based solution at 0.05% chlorhexidine, that is to say 10 ml of 5% solution to one litre of water.

- Use drinking water from a distribution network or boiled water previously filtered if necessary.

- Carefully wash the bottle with hot water and leave it to dry before each refill.

Precautions

- Do not allow contact with cerebral tissues, the meninges or a damaged tympanum.

- Do not use at the same time as soap (neutralisation).

- Do not use for ear washes.

- Not suitable for sterilising instruments (nor for keeping them sterile).

Comments

- The association of chlorhexidine and cetrimide is more interesting as it has a better detergent (cleaning) power and can always be diluted with undistilled water (as the cetrimide acts as the co-solvent).

- *Preservation :*

- *concentrated solution* : no special precautions
- *solution diluted for use : 1 week maximum*

CHLORHEXIDINE + CETRIMIDE

(HAC(r), Savlon(r), etc.)

Indications

For cleaning and disinfection of :

- skin and mucosa

- wounds

- burns

- ulcers

- abscesses

- sundry items

Presentation

- A concentrated 1.5% chlorhexidine and 15% cetrimide solution to be DILUTED before use.

Dilution

- Make up a 2% dilution of the concentrated solution : 20 ml of concentrated solution to one litre of water. This solution contains 0.03% chlorexidine and 0.3% cetrimide.

- Use drinking water from a distribution network or boiled water previously filtered if necessary.

- Carefully wash the bottle in warm water and leave it to dry before each refill**.**

Precautions

- Do not allow contact with cerebral tissues, the meninges or a damaged tympanum.

- Do not use at the same time as soap (neutralisation) or an iodised disinfectant (e.g. iodised polyvidone).

- Do not use for ear washes.

- Not suitable for sterilising instruments (nor for keeping them sterile).

Comments

- *Preservation :*

- *concentrated solution* : no special precautions
- *solution diluted for use : 1 week maximum*

Soapy solution of CRESOL - Lysol

Indications

- For cleaning and disinfection of equipment (floors, items, instruments, surfaces, linen, etc.)

Presentation

- Concentrated solution (containing 50% cresol and 50% liquid soap) to be diluted before use.

Dilution

- To be diluted in water when needed : 2 to 5% according to the degree of soiling (1 part concentrated solution to 50 to 20 parts water, that is to say 200 to 500 ml per 10 litres of water).

Indications

- *Items and instruments*: soak in diluted solution for 30 minutes, brush carefully, rinse and sterilise if necessary.

- *Premises* : evacuate patients, wash with diluted solution, rinse and air to eliminate the disagreeable and irritating odour.

- *Linen*: soak in the diluted solution for six hours, rinse thoroughly.

Precautions

- Not to be confused with pure cresol that has not been mixed with soap (see comments).

- Do not use for disinfection of food or material that come into contact with drinking water or foodstuffs.

- A very irritating product for skin and mucosa:

- never use on wounds , skin etc.
- avoid contact with hands when using.

Comments

- Lyorthol(r) sodium cresylol, Cresyl(r), Creoline(r), 5% chloroxylenol and Dettol(r) are similar products which can be used and diluted in the same way. Dettol(r) can also be used on the skin, on wounds and on mucosa.

- Cresol (not used with soap) can possibly be used but it is not advisable for it is less soluble in water and more of an irritant than the soapy solution. Moreover it has no detergent power and stains linen.

- *Preservation : Keep recipients well closed.*

Alcohol-based IODINE solutions (iodised alcohol, tincture of iodine)

The use of this medicament is counter-indicated : see comments.

Indications

- For disinfection of healthy skin (operative field, puncture or injection sites)
- treatment of cutaneous mycoses.

Presentation

- Iodised alcohol (1 to 2% in 70^{o} to 80^{o} ethanol)
- Tincture of iodine (5% in 80^{o} to 90^{o} ethanol + 3% potassium iodide) is an old and very concentrated iodine preparation which should no longer be marketed or prepared.

Precautions

- Very irritating solutions
- Can cause allergic reactions
- Their use on wounds is counter-indicated (painful and slows healing)
- Incompatible with mercurial derivatives.

Comments

- Alcohol-based iodine solutions are of very limited use. They are extremely irritating, costly and are very difficult to preserve as the alcohol evaporates (they become even more irritating as they age).
- These can well be replaced by iodised polyvidone which is far less irritating and far easier to preserve (see the "Iodised polyvidone" technical specifications on page 31).
- *Preservation : A few weeks maximum.*

POTASSIUM PERMANGANATE

The use of this drug is counter-indicated:

- the risk of its being ill-used is too high
- it is not on the WHO list of essential drugs.

Indications

- Superficial wounds
- Seeping eczema
- Mycoses, especially of the toes (athlete's foot).

Presentation

- Dark violet crystals to be dissolved
- Tablets to be dissolved: they come in various dosages 0.25 g, 0.5 g and 1 g.

Dilution

- Dilute 0.01% (100 mg to 1 litre of water).
- The concentration must be precise :

• if it is too concentrated, it is caustic

- if it is too diluted, it is ineffective.

A balance is necessary to obtain the right concentration from the crystals.

Precautions

- Handle dry product or concentrated solutions with care (skin burns and risk of explosion if brought into contact with an easily oxidisable product).

- Take precautions to ensure that the tablets are not swallowed. Do not keep them with oral tablets. INGESTION IS VERY SERIOUS: risk of perforation of the digestive tract.

- Repeated application dries the skin.

Comments

- This product offers no particular advantages other than that it is not very costly.

- Its use is counter-indicated because of the constant errors made in diluting from crystals and the risks of the tablets being swallowed.

- *Preservation :*

- Dry product : protected from the air (well-closed recipient)

- Solution diluted for use : maximum one week.

IODISED POLYVIDONE = IODISED POVIDONE = IPV

(Betadine(r), Iso-Betadine(r), etc.)

Indications

- Disinfection of the skin, wounds and burns.

- Treating mycoses, cutaneous infections and cutaneous manifestations of certain viroses (herpes, shingles, etc.)

- Disinfection of medical instruments

- Disinfection of hands before undertaking surgery.

Presentation

- 10% concentrated IPV solutions to be used pure or diluted.

Dilution

- **Pure (= 10% IPV solution)** for disinfecting the skin

- **Diluted 2.5% IPV** for disinfecting wounds, burns and instruments (one part concentrated 10% solution + three parts of water).

- **Diluted 0.5% IPV** for mucosa (one part concentrated 10% solution + 19 parts of water).

- Dilute with drinking water from a distribution network or with boiled water previously filtered if necessary.

Indications

- *Disinfection of the skin*

- Before an injection or placing an intravenous drip : apply a **2.5% IPV** diluted solution (if the skin is dirty, wash first with soap and water).

- Before surgery : 2 applications of concentrated solution (**10% IPV**) after washing the skin with soap

and water, rinsing and drying.

- *Disinfection of umbilical cords*

Use a concentrated solution (**10% IPV**)

- *Treating cutaneous mycoses and viral infections* (herpes, shingles, etc.)

Use a concentrated solution (**10% IPV**) twice a day.

- *Disinfection of wounds and burns*

One application of **2.5% IPV** diluted solution with each change of dressing.

- *Treatment of infections and mycoses on the mucosa*.

Apply a **0.5% IPV** diluted solution twice a day.

- *Thorough disinfection of stainless steel instruments*

Soak the **clean** instruments for 15 minutes in a **2.5% IPV** diluted solution.

- *Disinfection of the hands*

After carefully soaping the hands for some time, then rinsing in boiled water, rub the damp hands with a little **10% IPV** solution until they are dry.

Precautions

- Do not use repeatedly on very large surfaces or where there are new-born babies.

- Never use with a mercury derivative (e.g. mercuresceine, Mercurochrome**(r)**, thiomersal, Merfen(r), certain disinfecting soaps, etc.) because of the risk of necrosis.

- Stop use in case of allergic reaction.

Comments

- Relatively costly product but very effective and polyvalent.

- <u>*Preservation*</u>:

- *10% IPV concentrated solution: no special precautions.*
- *2.5% IPV solution: one week maximum.*
- *0.5% IPV solution: to be prepared when needed*
- *Solution used for disinfecting instruments: replace daily.*

METHYLROSANILINIUM CHLORIDE

= gentian violet = GV = Crystal violet

Therapeutic action

- Antifungal

- Antiseptic

- Drying agent.

Indications

- Treatment of mycoses

- of the skin

- of the scalp (tinea)
- of the buccal and vaginal mucosa.

- Treatment of weeping dermal infections (eczema, impetigo, etc.)

- Treatment of burns and superficial wounds

Presentation

- Powder to be dissolved

- 0.5% solution.

Dilution

- Used as a 0.5% = 5g per litre saturated solution. Dissolve one teaspoonful of powder in one litre of water. Shake several times, allow to decant, filter through cotton wool or carefully decant into another bottle to eliminate any deposits.

- Use drinking water from a distribution network or boiled water, previously filtered if necessary.

- Carefully wash the bottle with hot water and leave it to dry each time before refilling.

Indications

- Apply once daily.

- The solution may be used in the mouth without danger.

Precautions

- May give rise to permanent pigmentation (do not use on the face in people with light skin).

Comments

- *Preservation* :
- *the powder : unlimited*
- *the solution diluted for use : never keep diluted solutions for more than one week.*

VII - Technical specifications for implementing disinfection

DISINFECTING AND STERILISING MEDICAL EQUIPMENT

Special disinfection measures relating to AIDS

The appearance of AIDS has thrown a new light on the problem of hygiene in medical practice. The risk of transmission by contaminated equipment is relatively low but it does exist.

However, no particular precautions need be taken because of the AIDS virus (HIV). AIDS is not the first disease that can be transmitted by contaminated equipment. Hepatitis B, in particular, can easily be transmitted in this way.

If the elementary rules of asepsis involving the destruction or the decontamination of soiled materials and the proper disinfection or sterilisation of reusable medical equipment were respected they would be more than sufficient to avoid the transmission of AIDS by medical or surgical acts. But they are all too often neglected which involves a risk of contamination for patients and health staff alike.

Evacuation and decontamination of soiled materials

All materials soiled by particularly infectious matter (blood, excreta, pus, etc.) must be handled with gloves, tongs or any other intermediary instruments, but not directly with bare hands.

Soiled material will therefore be treated differently according to whether it is to be reused or not:

- *Disposable equipment* as well as *dressings, operating-theatre waste* and *laboratory waste* must be incinerated daily.

  Needles must not be recapped after use nor bent, broken or manipulated in any way with the hands in order to avoid accidental pricking. They must be collected in a non-pierceable recipient and placed as close as possible to the place of utilisation.

  Single-use syringes and needles must be incinerated daily. If this is not possible, they must be collected in a recipient filled with disinfectant (Chloramine T solution at 20 g per litre or active chlorine solution at 0.5% = 5000 ppm) and then buried with the recipient.

- *Reusable injection equipment* will be treated as instruments except that vaccination equipment will be rinsed in pure water without disinfectant because residual disinfectant can inactivate vaccines.

- *Reusable stainless steel instruments and utensils* must, to avoid the drying out of soiling, be immediately steeped after use in a freshly prepared disinfectant solution for at least 15 minutes (chloramine T or 0.1% = 1000 ppm active chlorine solution). Use this solution in the cold state and try not to exceed 30 minutes in order to prevent corrosion (to avoid too long a period of contact, it is often preferable to steep the instruments in clear water adding disinfectant only half an hour before cleaning).

ATTENTION : steeping soiled instruments in a disinfectant solution reduces the risks of accidental contamination but it does not provide absolute security especially in cases where there are large amounts of blood or other organic matter. Steeping in a disinfectant solution can in no case replace the wearing of gloves by the personnel responsible for cleaning the instruments.

After this decontamination operation, the instruments have to be rinsed then washed with soap or detergent, again rinsed and finally dried. They are then ready for the final disinfection or sterilisation.

Comments

Staff responsible for cleaning the instruments:

- must wear rubber or thick plastic gloves (household gloves)
- must handle cutting or pricking material with particular attention (needles, scalpels, etc.)
- must be warned of potential risks (AIDS, hepatitis B) in case of injury, accidental pricking or skin lesions.

In the case of accidental injury, immediately wash then soak for 5 minutes in solution of 2.5% iodised polyvidone or a 2% chloramine T solution (sodium tosylchloramide) or a 0.1% (= 1000 ppm) active chlorine solution.

Blood splattered on surfaces, tables etc., must be covered with a 0.5% (= 5000 ppm) active chlorine solution or a 2% chloramine T solution. Leave in contact for 10 minutes at least and then wipe with a piece of absorbent paper or cotton wool which will then be disposed of. Then clean and disinfect the surfaces as normal.

Final disinfecting and sterilising of instruments and reusable materials

After decontaminating and cleaning, instruments and reusable material must be finally disinfected or sterilised according to the use to which they are to be put.

ANY ITEM OR MATERIAL WHICH COMES directly or indirectly INTO CONTACT WITH A STERILE PART OF THE BODY MUST BE STERILISED AND KEPT STERILE until used. That means, items which penetrate the skin and mucosa (such as needles and surgical instruments), objects that come into contact with sterile cavities (such as urinary probes, certain dressings, instruments and gloves used

in surgery), objects through which flow liquids injected into the vascular system or other sterile parts of the body (such as syringes or perfusion tubes).

ANY OBJECT OR DEVICE THAT COMES INTO CONTACT WITH THE MUCOSA MUST BE STERILISED OR THOROUGHLY DISINFECTED (e.g. thermometers, otoscope ends, specula or examination gloves).

STERILISATION must be carried out either by:

- Steam sterilisation (autoclave).

This is the best method of sterilisation for all reusable materials such as syringes, needles, instruments, rubber materials, fabrics and dressings. Sterilisation is carried out either in an actual autoclave or in a presser cooker which has been adapted to take an over-pressure of one atmosphere. It must be carried out at at least 121^{o}C (250^{o}F) which is equivalent to one atmosphere over-pressure (or 1 bar or 15 psi) for 20 minutes.

Certain autoclaves can be used on an oil or gas stove. Domestic pressure cookers may possibly be used as an alternative but then the duration has to be increased as the temperature obtained is only about 110^{o}C.

- Hot-air sterilisation (in a 'Poupinel' oven).

This method is suitable for metal and heat-resistant glass instruments but it is reliable only with a good electrically heated apparatus with a thermometer in good condition (too low a temperature is ineffective and too high a temperature will ruin the instruments). Sterilisation is conducted at 160^{o}C for 2 hours or 170^{o}C for 1 hour (the duration has to be counted from the time at which the required temperature is attained).

EXTRA THOROUGH DISINFECTION can be achieved either by:

- Boiling (for 20 minutes from the time that the water reaches boiling point).

This can be done in any recipient (preferably with a lid and a perforated basket for draining the equipment after boiling).

- Steeping in one of the following solutions :

	Recommended concentration	*Preparation*	*Minimum contact*	*Comment*
Hypochlorites Dichloro-isocya-nu (NaDCC)	0.1% active chlorine (1000 ppm)	see note (1)	15 minutes	(2)
Chloramine T Tosylchloramine	2%	20 g per litre	15 minutes	(3)
Iodised polyvidone (Iodised povidone, PVI)	2.5%	1 part 10% concentrated solution + 3 parts water	15 minutes	(3)
Ethanol	70%	8 parts 90% ethanol + 2 parts water	15 minutes	(4)

Isopropanol	70%	7 parts isopropanol + 3 parts water	15 minutes	(4)
Formaldehyde	4%	1 part formol + 3 parts water	30 minutes	(5)
Glutaraldehyde	2%	Add the activator supplied with the solution	30 minutes	(5)

(1) The 0.1% or 1000 ppm (1 ppm = 1 part per million = 1 mg/ml = 0.001%) active chloride solution is prepared from either recently manufactured bleach (less than 3 months old) or from calcium hypochlorite, or else from sodium dichloro-isocyanurate (see the "Products for generating chlorine" instructions on page 24), account being taken of their respective chlorine content.

(2) As these products oxidise metals, the solutions are suitable only for stainless steel. Steeping should take place in a cold solution and should not exceed one half hour and must be followed by thorough rinsing in fresh water.

(3) If the instruments are to be immediately used, they need not necessarily be rinsed of chloramine T (sodium tosylchloramide) and iodised polyvidone solutions.

(4) Ethanol and isopropanol must be used at 70% (70^{O}) for maximum efficiency (the most concentrated solutions are the least effective). The price of these alcohols, the additional transport cost (special packaging and the fact that they are heavy) and the complex import formalities for ethanol mean that they are of limited interest.

(5) Steeping for several hours in solutions of aldehydes, formaldehyde (formol) and glutaraldehyde (Cidex(r)) will allow for thorough sterilisation (destruction of all germs) but these solutions have many disadvantages which limit their interest, i.e. thorough rinsing is essential (toxic residue), toxic vapour (formol) and very high cost (glutaraldehyde).

ATTENTION: it is to thoroughly clean equipment before sterilisation or final disinfection in such a way as to remove any residue (blood, tissue, mucus, etc.) which might otherwise hinder the process of destroying the micro-organisms.

Procedures that can be used in the field

Without electricity, the only reliable procedure for obtaining proper sterilisation is the use of an autoclave. Many medical centres, however, do not yet have autoclaves or modified pressure cookers. In this case, boiling is an acceptable alternative to sterilisation. It destroys most of the pathogenic organisms including the AIDS and hepatitis B viruses. It is simple and can be used anywhere.

Chemical disinfection can only be used as an alternative to sterilisation as a last resort and, even then, only when the proper preservation and dilution of the disinfectant can be guaranteed. Indeed, the effectiveness of chemical disinfection can be hindered by incorrect dilution, by storage in poor conditions or by the extended use of the same solution (solutions must be changed at least once a day).

Chemical disinfection should *never* be recommended for syringes and needles. They must be disinfected in autoclaves or boiled.

PREPARATION AND STORAGE OF ANTISEPTIC SOLUTIONS: ESSENTIAL PRECAUTIONS

Antiseptics are disinfectants used for bodily care (disinfecting the skin, wounds and mucosa).

As paradoxical as it may seem, water-based antiseptic solutions may be contaminated by germs when being handled and may become germ cultures, especially in the case of the *Pseudomonas aeruginosa*

(pyocyanic).

TO AVOID THE CONTAMINATION OF SOLUTIONS, ESSENTIAL PRECAUTIONS MUST BE TAKEN:

- Make all water-based dilutions either with:

- drinking water from a distribution network
- boiled water, previously filtered if necessary or
- water filtered through a well-maintained candle-shaped filter in good condition (brushed and disinfected or boiled once a week).

- ***Change all water-based solutions once a week at least***.

To facilitate this, set one day of the week when all solutions are systematically changed.

- Prepare only small volumes at a time to avoid wastage or temptation to keep expired solutions.

- Never add fresh solution to a residue of out-dated solution (wash the bottles and allow them to dry before refilling them)

- Do not use a cork stopper

Indicate the name and concentration of products on all bottles.

DISINFECTING A WELL after pollution

Wells must be disinfected :

- after construction (before they come into service)

- after repair or maintenance

- after a period of non-use (before being put back into service)

- after accidental pollution (after a landslide, if an animal falls in, or after floods, etc.).

Comment

Open wells must be maintained once a year (drained, the entire lining must be examined, repaired if necessary, any sediments accumulated on the bottom must be removed). The best time to carry out this maintenance is at the end of the dry season.

Technique

- Brush the walls above the water line with a solution of 200 ppm (1)(5) active chlorine obtained by diluting 10 times a solution at 2000 ppm (see the "Products for generating chlorine" instructions on page 24)

- Determine the volume of water contained in the well:

Volume of a cylinder : $V = p \times r^2 \times h$

where V= Volume in cubic metres
p = 3.14
r = radius of the well = 1/2 the diameter in metres
h = height of the water in the well in metres

Example

A well of 140 cms in diameter and with a water height of 3.5 metres:

Volume = 3.14 x (0.7 x 0.7) x 3.5 = approx. 5 cubic metres.

- Determine the quantity of chlorinated product to be used to chlorinate all the water at a dilution of 100

mg of active chlorine per litre (100 ppm).

For one cubic metre, 140 g of calcium hypochlorite will be needed at 70% or 66 dichloro-isocyanurate (NaDCC) tablets with 1.5 g active chlorine; with another chlorine-generating product, calculate the dose according to the percentage of chlorine.

Comment:

In countries were water is rare, chlorinate at only 50 mg per litre (50 ppm) to avoid having to throw away too much water at the end of the operation.

- Dilute the chlorinated product in buckets of water (without exceeding 250 g of product per 10 litre bucket).

Attention : do not use metal buckets because the metal reduces the chlorine (plastic, rubber or earthenware would be suitable).

- Empty the buckets into the well and mix the water with a large (clean) stone, at the end of a (clean) rope.

- Leave for 12 hours to take effect. Do not allow any access to the wells (this water is not suitable for consumption).

- Draw off the water and discard it until it no longer smells of chlorine, then continue using the well as normal.

Comment

If the well is equipped with a pump, proceed in the same manner but, after having poured the chlorinated product into the well and stirred the water, pump until the water which comes out smells of chlorine. Leave it for 12 hours to take effect, then pump and discard the water until it has no further smell of chlorine.

DISINFECTING A WATER RESERVOIR after pollution

Reservoirs must be disinfected whenever external pollution may have occurred. That is to say :

- after construction

- after repair or maintenance

- after a period of non-use (before being put back into service)

- after accidental pollution (after a landslide, if an animal falls in or if drainage water has entered, etc.).

Comment

Reservoirs must be regularly maintained (emptied, the sediments which have accumulated on the bottom removed, the wall brushed if possible and then disinfected).

Technique

Begin by draining the water, removing any sediments accumulated on the bottom and, if possible, brushing the wall

Then :

either

- brush walls with a solution of 200 ppm (1)(6) of active chlorine obtained by diluting 10 times a 2000 ppm solution (see the "Products for generating chlorine" instructions on page 24?) and ensuring proper ventilation in the reservoir to avoid the inhalation of toxic chlorine vapours,

- allow to take effect for 30 minutes and rinse,

- fill and then continue using as normal.

Or

- fill the reservoir with chlorinated water at 50 ppm active chlorine

- for one cubic metre, you need 70 g of 70% calcium hypochlorite or 33 dichloro-isocyanurate (NaDCC) 1.5 g active chlorine tablets,

- add the chlorinated product dissolved in buckets of water at the start

- wait 12 hours,

- remove the water and continue using as normal.

DISINFECTING CONDUITS BRINGING WATER TO RESERVOIRS OR DISTRIBUTION POINTS.

Wash the conduits with water then fill them with chlorinated water at 50 ppm (see above).

Leave in contact for several hours. Remove this water. During the period of contact, work the valves and taps so that all surfaces come into contact with the chlorinated solution.

CHLORINATING DRINKING WATER

These instructions have been prepared to allow non-specialists to master as best they can the technique of chlorinating water when necessary. Chlorinating is, however, not presented as a universal treatment but quite the contrary (see reservations expressed in Chapter III on page 9).

Technique

The only reliable procedure, which does not call for too much supervision and which is within the capabilities of a non-specialist, is the intermittent chlorination of the water in reservoirs, by adding chlorine when the reservoirs are being filled then allowing it to act, after which the water is distributed.

Distribution is made intermittently or by alternating between two reservoirs (using the first reservoir when filling and chlorinating the second).

1. *Necessary equipment* :

- One or more pumps,

- Reservoirs

- A DPD chlorine tester with a stock of DPD1 tablets.

- Calcium hypochlorite with which a 1% chlorine solution is prepared in a normal way (see the "Products for generating chlorine" instructions on page 24).

Use 1 to 2 kg of calcium hypochlorite per day for 10,000 persons at the rate of 15 litres of water per person per day.

If no calcium hypochlorite is available, chloride of lime (bleaching powder) or liquid or powdered bleach which has been very recently prepared or sodium dichloro-isocyanurate can be used (1)(7).

2. *Preparing the 1% active chlorine solution*

Prepare the 1% active chlorine solution as indicated in the following table and keep it in a hermetically sealed, opaque, non-metallic recipient sheltered from the light and heat (make up a new batch every one to two weeks depending upon the temperature).

See handling precautions relating to the "Products for generating chlorine" instructions on page 25).

Preparation of the 1% active chlorine solution		
From	*Dilution*	*Comments*
Calcium hypochlorite with 70% active chlorine	15 g/litre = 1 heaped tablespoonful per litre	Allow the deposit to decant and use surface liquid.
Chloride of lime with 30% active chlorine	33 g per litre = 2 heaped tablespoonsful per litre	
Liquid bleach with 5% active chlorine	200 ml per litre	Suitable only if very recently made up (<3 months) and if kept sheltered from high temperatures
Bleach powder with 15% active chlorine	75 ml per litre	
Sodium dichloro-isocyanurate NaDCC with 1.5 g of active chlorine per tablet	7 tablets per litre	Ensure that excipients in the tablets are innocuous.

Comment

Chloramine T (sodium tosylchloramide) can be used for chlorinating water for individuals or families. There are 12 or 20 mg chloramine tablets available (1 tablet per litre of clear water).

Factors to be checked to ensure efficient chlorination.

1. ***Turbidity*** (muddy water)

Chlorination is effective only with clear water; otherwise the water has to first be decanted and/or filtered which can remove most of the protozoan cysts and intestinal worm eggs against which chlorination is ineffective.

2. ***pH***

The doses given in this instruction sheet are suitable only if the pH is less than 8 (if pH is between 8 and 9, the rate of free residual chlorine to be maintained must be twice as high).

pH is very easily measured with the comparator generally coupled to the residual-chlorine doser (see "Measuring pH" below).

3. ***Contact time***

At the above-mentioned doses, a minimum contact time of 30 minutes must be allowed between the addition of the chlorine and distribution of the water.

4. ***Temperature***

If the temperature is very low (a few degrees centigrade), the doses or contact time will have to be increased.

5. ***Concentration of free residual chlorine***

When water is chlorinated, it is necessary to ensure that some free residual chlorine remains in the water distributed. Indeed, there are substances in the water which consume the chlorine. The presence of free residual chlorine in the water, 30 minutes after chlorinating, proves that sufficient chlorine has been added for disinfection purposes.

The dose of chlorine necessary to obtain free residual chlorine varies from water to water and, with water

from the same origin, it can vary from one day to the next.

Measuring free residual chlorine is very easy with a small DPD-tablet testing device (see "Measuring free residual chlorine" below).

Attention :

The odour and taste of chlorine are no proof that any free residual chlorine is left and may frequently result from chlorinated compounds which have been formed by the action of chlorine on substances present in the water.

Implementing chlorination

1. *What quantity of chlorine should be used?*

Using 10 litres of water (in a plastic or earthenware recipient, but not metal), the quantity of 1% chlorine solution needed to obtain a free residual chlorine rate of 0.5 mg/ml (0.5 ppm) is determined by adding (e.g. with a syringe) 1 ml every 10 minutes and checking the rate of free residual chlorine (when 0.5 mg / ml has been reached, check that this level is maintained for at least half an hour).

Then calculate the quantity of 1% chlorine solution necessary to chlorinate the reservoir.

2. *Adding chlorine to a reservoir*

Add the 1% active chlorine solution when starting to fill the reservoir (to ensure mixing).

When the reservoir is full, wait half an hour and measure the free residual chlorine level which should be 0.5 mg / ml at least. If it is insufficient, add more chlorine (in this case, mix, wait half an hour longer and recheck).

The water can then be distributed.

3. *Checking free residual chlorine in distributed water*

The rate of free residual chlorine :

- must never fall below 0.2 mg per litre (= 0.2 ppm); the ideal level being 0.2 to 0.5 mg per litre (= 0.2 to 0.5 ppm);

- if it is above 0.7 to 1 mg per litre, the taste and odour are likely to be (very) unpleasant.

Measuring free residual chlorine and measuring pH

Small chlorine testers for swimming pools (using the DPD tablet method) and which consist of a plastic recipient with a little float pan for dosing residual chlorine and another for measuring pH, are very cheap and perfectly suitable (e.g. "Pooltester" at about US$ 7 in 1990).

Orthotolidine testers are not suitable. They are not very precise and are potentially toxic for the user.

1. *Measuring free residual chlorine*

Method

- Rinse the pans with the water to be analysed and leave a few drops in them.

- Place one DPD tablet in the chlorine dosing pan and wait one to two minutes for the tablet to disintegrate.

Attention : do not touch the tablets with fingers.

- Fill this pan and the central pan (the "control") with the water to be analysed.

- Place the cover on it and shake.

- Then, without waiting, compare the colour obtained against the coloured scale (reading it facing the

light but not direct sunlight).

This will give the rate of free residual chlorine in ppm or in mg per litre (1 ppm = 1mg per litre).

Attention :

- Free residual chlorine must be measured immediately after the water has been drawn.

- Use only DPD 1 tablets (carefully check the number on the wrapping because there are also DPD 3 tablets which are useless in this situation).

- If the measurement shows 0 mg per litre, make sure that it is not a false negative reading due to a high concentration of free residual chlorine.

2. *Measuring pH*

Method

- Fill the pan provided for that effect with the water to be analysed, adding a tablet or small drop of pH indicator and compare the colouring obtained against the coloured scale.

If the pH is higher than 8, chlorination is less effective. In this case the free residual chlorine rate to be maintained must be twice as high (at least 0.4 ml per litre in distributed water).

Special case - Chlorinating water directly in wells

Where it is impossible to chlorinate water in the reservoirs, it is possible to try chlorinating it directly in the wells although this calls for constant attention and gives rather unsatisfactory results. If the water is muddy, chlorination is not 100% effective. Furthermore, after each addition of chlorine, the taste is unpleasant and people may not want to drink that water.

Use this method only if it is certain that the people will not go to other, more dangerous water points.

Technique

- Add 500 ml to one litre of 1% active chlorine solution for each cubic metre of water contained in the well (calculate the volume, see "Disinfecting a well" on page 39).

- Mix with the recipient that is used to draw the water.

- Wait half an hour.

- Check the free residual chlorine level.

- Rechlorinate as soon as the level drops below 0.5 mg per litre.

Comment

The chlorinating pots described in many manuals do not give satisfactory results in practice as the diffusion of chlorine is very irregular.

The use of these pots may even be dangerous as they give a false sense of security.

The use of floaters with trichloro-isocyanuric acid (1)(8) tablets (a product for generating chlorine used in swimming pools) certainly gives better results.

DISINFECTING MEASURES IN CASES OF CHOLERA EPIDEMICS

In the case of epidemics, the distribution of soap accompanied by a "house-call" campaign to promote ***hand-washing*** (after defecation and before preparing or taking a meal) and the ***washing of cooking utensils*** (after meals) is far more important than any disinfecting measure in the strict sense of the term!

Certain particular disinfecting measures must however be taken in addition to the following basic measures:

- tracking down sick persons and treating them,

- supervising and possibly treating water,

- strict monitoring of defecation areas.

Measures to be taken at the processing centre

- Check that the proceeding centre is isolated from any other medical facilities and enforce strict checks on all movements into and out of the building.

- Set-up a place where disinfecting solutions will be prepared daily:

• solutions of 0.5% (5000 ppm) and 0.2% (2000 ppm) active chlorine are prepare from calcium hyperchlorite, from sodium dichloro-isocyanurate or from some similar product (see table on page 24)

• The 0.05% (500 ppm) active chloride solution for disinfecting skin and hands is to be prepared preferably from chloramine (2 g / litre) or from calcium hyperchlorite (1/2 tablespoonful of 70% chlorine hyperchlorite per 10-litre bucket to which can be added a tablespoonful of bicarbonate of soda to make the solution less irritating) or from sodium dichloro-isocyanurate (one 1.5 g active chlorine tablet to 3 litres)

• Lysol (or any other similar phenol disinfectant) is diluted at 5%.

Preferably use opaque recipients with a lid and tap.

See preparation and precautions for the use of these solutions in chapter VI (pages ?23, ?24 and ?28).

- As patients arrive, disinfect:

• their skin (0.05% solution of active chlorine);

• their blankets and clothing (5% Lysol or possibly a 0.2% solution of active chlorine for cotton);

• equipment (vehicle, stretcher, etc.) used to transport the patients (0.2% solution of active chlorine or 5% Lysol).

- Disinfect patients' clothing and covers as they leave the centre.

(Comment: after disinfecting clothes and covers, rinse and leave to dry in the sun).

- Staff and persons accompanying patients must wash their hands with soap and rinse with 0.05% active chlorine solution when leaving latrines, the wards and the processing centre.

Also disinfect feet or shoes of all persons leaving the centre (0.02% active chlorine solution or 5% Lysol) by making them walk through a footbath.

- Every day clean the floors of hospital wards and the beds with a 0.2% active chlorine solution or possibly 5% Lysol (if the floor is made of hard earth, try to cover it with a large plastic sheet).

- Disinfect crockery and other items used by patients with a 0.2% solution of active chlorine then rinse and allow to dry.

- Patients' stools and vomit must be poured into a pit (latrine) reserved for that purpose. It is not necessary to disinfect the stools and vomit themselves but the recipients which are used to collect them must be washed with a 0.2% chlorine solution each time they are emptied.

If the stools and vomit are collected in holes in the ground next to the patients' mats, pour a little glass of 0.5% active chlorine solution into the hole several times a day and then fill the holes when the patient leaves.

- When a patient dies, wash him with a solution of 0.5% active chlorine or 5% Lysol and stop up the body orifices with cotton wool soaked in disinfectant. Pack the body in a plastic bag (failing which a blanket soaked in 5% Lysol). The body must then be rapidly buried by the staff whose job it is to do so

and not by the family (unless cultural habits so require).

Comment: When a solution of active chlorine and Lysol can be used for the same purpose, give preference to the active chlorine solution because it is far less costly and acts much faster. Lysol is however preferable if the corrosive or discolouring action of chlorine would be a problem (for example, for oxydisable materials, covers and clothing).

Measures to be taken in the camp

- At the patients' place of domicile, equipment soiled by excreta or vomit must be disinfected with a 0.2% active chlorine solution or 5% Lysol.

- Stools and vomit on the ground of the camp must be collected with a shovel to be removed to the latrines. On hard floors, then disinfect with a 0.2% solution of active chlorine. On earth, disinfectants are not very effective. In this case, remove as much of the soiled earth as possible.

- Adding disinfectants in the latrines to disinfect the contents is useless and ineffective.

Lime or ashes may be added to the latrines in order to repel the flies (the role of flies is nevertheless of relatively secondary importance in the propagation of an epidemic).

The external part of the latrines (the slab or floor) must be cleaned at least twice a day with a 0.2% active chlorine solution.

- In communal kitchens, avoid distributing or using vegetables or fruits to be eaten raw. Instead they should be washed in water to remove the earth, soaked for 5 minutes in a solution of 50 ppm chlorine (5 ml of solution at 1% per litre) and rinsed in drinking water.

Measures to be taken with water.

Set up a system of chlorination if necessary and double check on free residual chlorine (see the technical instructions on page 42).

If the chlorinated water is brought in by tanker, check the free residual chlorine level on arrival.

VIII - Appendices

Main disinfectants - Arguments in favour of their selection or rejection in conditions specific to refugee situations

Comparative table of prices of different disinfectants

MAIN DISINFECTANTS

Arguments in favour of their selection or rejection in conditions specific to refugee situations:

ALCOHOLS

Ethanol (Ethyl alcohol) and *isopropanol* (isopropylic alcohol) may be of interest in dispensaries or hospitals for disinfecting healthy skin (hands, injection sites, etc.) or as a solvent for other antiseptics whose effectiveness they can then enhance.

They do, however, have too many disadvantages and too few advantages to justify their use in refugee situations. They are costly, their utilisation is very limited and they are subject to very strict rules with regard to air transport, thus making their price in the field quite prohibitive (see table of comparative prices Appendix B, page 57). Furthermore, the import and transport of Ethanol are generally subject to very strict formalities.

ALDEHYDES

Formaline (Formol)

Formaline or formol (a water-based solution of formaldehyde) is a very powerful disinfectant but with very few uses because of its toxic and irritant nature.

Paraformaldehyde (trioxymethyline) and *Aldhylene*(r).

Paraformaldehyde is a solid polymer of formaldehyde which is frequently used in the form of "formol" tablets for the makeshift sterilisation of instruments.

Aldhylene(r) is a methanol solution of formaldehyde which is used in the same way as the formol tablets (in a hermetically sealed enclosure for several hours with the instruments to be sterilised). Formol and Aldhylene(r) tablets act through the formaldehyde gas that they release.

These "sterilisation" processes must however be abandoned as they are not entirely reliable.

Glutaraldehyde

Glutaraldehyde is marketed in the form of solutions which allow for the proper sterilisation of medical equipment by steeping, but this product has too limited a range of indications, is too costly and calls for too many precautions when being handled for it to be interesting in the field.

QUATERNARY AMMONIUMS

Quaternary ammoniums are compounds with disinfecting and detergent properties. They form frothy, watery solutions.

Of these, the most important are:

- Benzalkonium chloride,
- Cetrimide - cetyltrimethylammonium bromide (Cetavlon(r))
- Cetylpyridinium chloride.

As disinfectants, quaternary ammoniums are not very interesting as they are not active enough or are entirely inactive against many germs. Moreover, their watery solutions diluted for use are very easily or very frequently contaminated and colonised by pathogenic germs including the dangerous *Pseudomonas aeruginosa* (pyocyanic).

Given this major disadvantage, plus their low level of effectiveness, quaternary ammoniums must be excluded.

Comment

They are more interesting when used in association with other antiseptics to which they can contribute fairly useful detergent properties for cleaning objects or very soiled wounds (see Chlorhexidine + cetrimide, page 25).

An instruction sheet on the use of cetrimide is included in this manual (page 21) because this product is frequently found in the field.

LIME

The term "Lime" covers two different varieties which are:

- quick lime or calcium oxide (CaO) and
- slaked lime or calcium hydroxide ($Ca(OH)_2$).

Quick lime becomes slaked lime by absorbing water (the transformation is slow when in contact with moist air or fast with the release of considerable heat if the quick lime is brought into contact with water).

Lime is sometimes used in the form of milk of lime (a suspension of calcium hydroxide in water obtained

from quick lime or slaked lime). The alkaline pH (11-12) of this suspension accounts for its disinfecting properties but milk of lime acts very slowly. It is barely active, if at all, with regard to certain germs and it leaves a thick white powdery deposit. Its only real interest is for whitewashing walls.

In its dry form, lime is often used for its "disinfecting" properties but this power is very often over-estimated (especially when it is used on excreta). It is particularly interesting for its other properties, i.e. when spread in sufficient quantities on decomposing organic matter, it prevents the release of sickening odours (by reducing the putrefaction process and absorbing the gases formed) and it avoids the swarming of insects and other animals (rodents, birds of prey etc.). Animals are no longer attracted by the odours and are repelled by the lime (especially flies).

For these properties, lime may be a very useful product in emergencies where circumstances do not allow for the burying or incineration of corpses. In a refugee situation, such circumstances are exceptional. It should be pointed out that lime does not replace burial but does make it possible to postpone it or to use a thinner layer of earth.

If available in the country, it can be used on refuse dumps or excreta (to reduce odours and flies) but less "chemical" solutions are preferable (covering with earth, the use of ventilated latrines equipped with fly traps, etc.). It cannot be imported for such uses.

From the point of view of efficiency, either quick lime or slaked lime can be used (*in situ* quick lime becomes slaked lime and it is the alkaline pH which is responsible for the action and not the heat released during the transformation). Quick lime is cheaper, more voluminous for the same weight and it takes 25% less to achieve the same action but it does need greater precautions when being handled.

An instruction sheet on the use of lime is given in chapter VI, page 22.

ATTENTION

- "hydraulic" lime is not suitable. This is a lime which contains calcium silicate and aluminates and which hardens on contact with water. It is used only in mortar for construction purposes.

- Lime chloride is a product for generating chlorine (see below). Its indications are those for chlorinated disinfectants and not those for lime.

CHLORINE (PRODUCTS FOR GENERATION OF)

The main disinfectants which generate active chlorine are :

- calcium hypochlorite,

- lime chloride,

- sodium hypochlorite solutions (liquid bleach, Milton(r), etc.),

- Chloramine T = sodium tosylchloramide,

- chlorinated cyanurates (sodium dichloro-isocyanurate and trichloro-isocyanuric acid).

All of these products are recognisable by the odour of chlorine which they give off.

These are extremely interesting disinfectants because:

- They are extremely powerful (destroying bacteria, spores, viruses and microscopic fungi).

- There are generally very cheap (both to buy and to use in the field).

- They have a deodorising as well as a disinfectant action.

- They have a very wide range of uses:

- for disinfecting surfaces, equipment, floors and linen (except certain metals and certain fabrics),

- for disinfecting water and everything that comes into contact with water (reservoirs and conduits etc.),
- for disinfecting food and all equipment that comes into contact with food,
- for disinfecting wounds and infected mucosa.

Certain products are particularly suited for one or other of the indications given but in case of need, by taking certain precautions, any of the products can be used for these applications.

Chlorine-generating products require special precautions during transport, storage and use (page 24) and generally have a limited shelf life. However, the advantages of some of these products largely outweigh their disadvantages. *Calcium hypochlorite and especially sodium dichloro-isocyanurate (NaDCC) are the disinfectants of choice for general disinfection. Chloramine is the disinfectant of choice for medical care*.

Calcium hypochlorite and lime chloride are often available locally (enquire with the water and sanitary authorities) but lime chloride is not very interesting because it decomposes very fast and solutions leave a heavy deposit.

Sodium dichloro-isocyanurate (or NaDCC) or sodium dichloro-s-triazine-trione must generally be imported but, despite the high price, the advantages are considerable over calcium hypochlorite for it is far more stable, totally soluble and has a lower corrosive effect. Furthermore, it does not come under IATA regulations for the air transport of corrosive substances, unlike calcium hypochlorite.

Trichloro-isocyanuric acid (ATCC or trichloro-s-triazine-trione) is not very soluble and for that reason it is interesting only for certain specific uses. It is generally found in the form of large tablets to be placed in floaters for maintaining the chlorine level in swimming pools.

Chloramine T (sodium tosylchloramide) may be provided through medication channels.

Sodium hypochlorite solutions (bleaches) are often available locally but it would be as well not to trust these products because of their poor stability. Furthermore, they cannot be imported because of their weight.

Chlorine-generating products do not form part of the WHO list of essential drugs but they do not fall within the purview of that list as they are not strictly speaking drugs at all.

CHLORHEXEDRINE

Chlorhexedrine is an interesting disinfectant because it is effective against many germs, it is non-toxic and not very irritating. However, in the field, chlorhexedrine has the major disadvantage of having to be diluted in distilled water unless some other solvent which allows the use of ordinary water can be included in the formulation of the concentrated product. The risks of receiving solutions in the field not containing a co-solvent, means that much care must be taken in the choice of chlorhexedrine. The association of chlorehexedrine and cetrimide may be diluted with ordinary water.

Chlorhexedrine does appear on the WHO list of essential drugs. However, for the same indications as chlorhexedrine, chloramine T (or sodium tosylchloramide) has more advantages and is therefore preferred. However, if chlorhexidine with a co-solvent (Hibitane(r)) or the association of chlorexidine and cetrimide (HAC(r) or Savlon(r)) is easily available, it may be used as a supplement. Instructions for use of chlorexidine and the association of chlorexidine and cetrimide are given in chapter VI, pages ?26 and ?27).

MERCURY DERIVATIVES

Apart from having a low disinfectant power, mercury derivatives have disadvantages which means that their use must be forbidden. They are poisonous, they pollute the environment and frequently cause allergies.

They should absolutely be excluded from any list on which an iodine derivative such as iodised polyvidone is included (used on the same wound they will cause a formation of mercury iodide which is

a necrotising compound).

The main mercury derivatives are ***phenylmercury*** borate (Merfen(r)), ***thiomersal*** (Merthiolate(r), Timerosal(r)), nitromersal and mercuresceine (merbromine and mercurochrome). The last-mentioned is still very often used even though it is not particularly effective.

No mercury derivatives is included on the WHO list of essential drugs.

IODINE

Iodine is a very powerful disinfectant which destroys bacteria, viruses and fungi. It is used as a medical disinfectant in the form of alcohol-based solutions (iodised alcohols and tincture of iodine) or in the form of water-based solutions of iodophoric derivatives (which means : containing iodine), the best known of which is iodised polyvidone.

Alcoholic iodine solutions (tincture of iodine, iodised alcohol) are of very limited use for they are extremely irritating and cause allergies. Furthermore, they keep badly. Over the long term they form iodhyraulic acid which is extremely irritating. Moreover, in poorly closed recipients the evaporation of the alcohol, which can be very rapid in warm countries, increases the iodine content and hence the irritating and sensitisation power of the compound. Alcoholic solutions of iodine are of no interest in the field.

Iodised polyvidone solutions are far more interesting for they keep far better and are less irritating than alcoholic solutions. They also have a far broader field of utilisation. This product is worth considering because of its efficiency and its many applications. It can be used on equipment as well as on skin and wounds. When used on the skin, it has the advantage of leaving an antiseptic film which has a prolonged action. The relatively high price of iodise polyvidone nevertheless means its use must be limited to certain precise indications where it cannot be replaced by any less costly product such as a sodium polyvidone solution.

An instruction sheet for the utilisation iodised polyvidone is given in chapter VI (page 31).

Iodine is on the WHO list of essential drugs (1990) by way of an example of a therapeutic group.

POTASSIUM PERMANGANATE

Potassium permanganate has the advantage of being very cheap and stable (in dry form) but its disadvantages largely outstrip these advantages (limited effectiveness, dangerous to handle and to use).

There is no justification for its being used in a refugee situation but, as this product is still often found in the field, an instruction sheet is nevertheless given in chapter VI (page 30) to avoid any dangerous errors in its use.

Potassium permanganate is not on the WHO list of essential drugs.

PHENOLS

Phenols are interesting disinfectants because they are effective against many germs and are relatively cheap. However, they do not act very quickly and are not suitable for :

- disinfecting the skin and wounds because they are, with very few exceptions, too irritating.

- disinfecting anything that comes into contact with food (because the slightest trace leaves a very bad taste)

- disinfecting anything coming into contact with water (because the tiniest traces leave a very bad taste especially after chlorinating).

So, their use is reserved for disinfecting surfaces and objects

There are many phenol disinfectants of various compositions but which have comparable action. They are differentiated especially by their solubility in water and their irritant power (by inhalation or skin contact).

Of these, the most important are :

- ***Phenol*** which is hardly used any more because it is very expensive and very irritating.

- ***Creosol*** (or ***cresylol*** or ***cresylic acid***) which is extremely irritating and relatively insoluble in water. It is advantageously replaced by its more soluble derivative, sodium cresylol and Lysol (which is a soapy solution of cresol).

- ***Cresyl***(r)***, sodium cresylol, Creoline***(r)***, Lyorthol***(r)***, Sudol***(r) and ***white fluids*** are all phenol derivatives which, in water, give clear solutions or milky emulsions and which are used in the same way as Lysol.

- ***Chloroxylenol*** (***Dettol***(r)) is a far less irritating phenol derivative than the others and it can be used for disinfecting wounds but its very high price makes it uninteresting (except if occasionally it is available on the spot).

The most interesting phenol derivative because of its price and its availability is the ***soapy solution of cresol*** or ***Lysol*** (see the instruction sheet on page 28). This is selected for general disinfection of objects and surfaces which cannot be disinfected by chlorinated solutions because of the risk of corrosion.

Phenols are not on the WHO list of essential drugs but they do not fall within the purview of that list as they are not strictly speaking drugs at all.

GENTIAN VIOLET (METHLYROSANILINIUM CHLORIDE)

Gentian violet is an antiseptic with relatively limited antibacterial properties (active especially on Gram +) and is unpleasant to handle because it stains.

It is worth including it, however, because of its very good results on mycoses and dermatites (especially seeping dermatitis)

Its indications are fairly limited but it is relatively cheap and keeps almost indefinitely in dry form.

It is on the WHO list of essential drugs (1990).

An instruction sheet is given in Chapter VI (page 32).

SUNDRIES

Well-known antiseptics such as :

- ***eosin***

- ***hexachlorophene***

- ***silver nitrate***

- ***hydrogen peroxide*** (concentrated oxygenated water)

cannot be used for refugee situations because:

- either they are of little effect (eosin)

- or their scope of use is very limited (silver nitrate, hexachlorophene)

- or because of their toxicity (hexachlorophene)

- or because they keep badly (hydrogen peroxide)

COMPARATIVE TABLE OF PRICES OF DIFFERENT DISINFECTANTS

ATTENTION : *The prices given here are by way of indication. They help only in that they give some idea*

of the price and allow comparison.

Purchase price : is the average purchase price in Europe for a generic product.

Price in the field : price of the solution, diluted ready for use including cost of air transport, special packing for inflammable and corrosive substances.

(average price*(9) of air transport from Europe to Africa US$3 per kg).

Product	*Purchase price* (10)(in US$)*	*Price*(11)* *in the field per litre of ready-to-use solution (in US$)*
Disinfecting alcohol	2.80 per litre	11.00
Chloramine T - 500 mg tablets (sodium tosylchloramide)	5.40 per 1000 tabs.	0.08 (5 g per litre solution)
Concentrated chlorhexidine-cetrimide solution (Savlon (r)) 1.5% - 15%	2.40 per litre	0.10 (0.03% chlor. + 0.3% cetrim. solution)
Sodium dichloro-isocyanurate tablets with 1.5 g of active chlorine	0.07 per tab.	0.17 (solution of 2 tabs per litre = approx 0.2% active chlorine
Calcium hypochlorite granules with 70% active chlorine	5.40 per kg.	0.04 (3 g per litre solution = 0.2% active chlorine)
Soapy solution of cresol (Lysol)	4.00 per litre	0.30 (5% solution)
Concentrated iodised polyvidone (10%)	5.00 per litre	8.00 (10% solution) 2.10 (2.5% solution)
Gentian violet	80.00 per kg.	0.40 (0.5% solution)

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X - Index

I

J

L

M

Endnotes

1

(1) Micro-organisms = bacteria (in vegetative and sporulous form), microscopic fungi (in vegetative and sporulous form) and virus and protozoa.

2

(1) See "Chlorine-generating products" instructions for use (page 24)

3

(1) See "Chlorine-generating products" instructions for use (page 24)

4

(1) See "Chlorine-generating products" instructions for use (page 24)

5

(1) 1 ppm = 1 part per million = 1 mg per litre.

6

(1) 1 ppm = 1 part per million = 1 mg per litre.

7

(1) The UK Department of the Environment has authorised the use of chloro-isocyanurates (= trichloro-isocyanuric acid and sodium dichloro-isocyanurate) for disinfection of drinking water in emergency or temporary situations in doses that should not exceed 10 mg of product per litre for a maximum of 90 days a year.

8

(1) The UK Department of the Environment has authorised the use of chloro-isocyanurates (= trichloro-isocyanuric acid and sodium dichloro-isocyanurate) for disinfection of drinking water in emergency or temporary situations in doses that should not exceed 10 mg of product per litre for a maximum of 90 days a year.

9

* 1990 prices

10

* 1990 prices

11

* 1990 prices