SECTION 2

Procurement and management of supplies and equipment

This section provides practical guidelines for all stages of procurement and management of medical supplies and equipment. It is divided into the following sub-sections:

- **Section 2.1** covers ordering and procurement.
- **Section 2.2** covers storage and stock control.
- **Section 2.3** covers care and maintenance.
- **Section 2.4** covers cleaning, disinfection and sterilisation.
- **Section 2.5** covers disposal of waste.

2.1 Ordering and procurement

Estimating and calculating requirements

When you have decided what supplies and equipment you need, you then need to calculate or estimate what quantities of each of these items is required. It is important to order the right quantities.

Ordering too little (understocking) will result in shortages and your health facility will be unable to provide effective treatment and care, undermining staff and patient confidence in the service. Ordering too much (overstocking) will result in a build up of stock and wastage, for example of items that are not used before their expiry date or that become spoiled if unused for too long, as well as tying up valuable funds unnecessarily.

The amount you order will depend on factors that you can anticipate, such as how much stock is normally used, how many patients will need to be treated, seasonal demands, how often you place an order, and the storage capacity of your health facility. You may also need to order a limited quantity of extra stocks of some items so that your facility can deal with unexpected events, such as epidemics and natural disasters.

Quantification methods

Quantification is the process used to calculate or estimate the quantities of medical supplies, drugs and equipment required. It is usually done once a year or during the planning for a new health programme or project. Proper quantification ensures that there is enough stock to meet demand, and avoids both understocking and overstocking. It is also a useful tool for preparing budget estimates, adjusting quantities to match a fixed budget, and monitoring use of supplies and equipment by health facility staff.

The most commonly used quantification methods are:

- **Consumption method** – which uses data about actual use or past consumption to calculate what quantities will be required in future.
- **Morbidity data method** – which uses data about prevalence and incidence of disease and health problems, and the standard treatments for these, to estimate future needs.

The consumption method is the preferred method for estimating requirements. An example of how to use this method to calculate the quantity of crepe bandage needed for 12 months is given in Table 2.1. More detailed information about quantification methods and how these can be used to calculate drug requirements is provided in Appendix 2.

Table 2.1 **Calculating consumption**

Step 1: Select the time period for calculating consumption

To calculate the quantity of crepe bandages required for a 12 month period for 10,000 patients. You have the following data for 12 months:

Opening stock balance	100 crepe bandages
Stock received	1000 crepe bandages
Closing stock balance	200 crepe bandages
Wastage	0
Stockout	2 months

12 months is the most practical time period to use for calculation, because it allows for seasonal variations in requirements. If the data you have available covers a shorter or longer time period, use Step 4 to adjust it to calculate requirements for 12 months.

Step 2: Calculate the consumption for each item during the time period

Recorded consumption = Opening stock balance + Stock received – Closing stock balance

Recorded consumption = 100 + 1000 – 200 = 900 crepe bandages

To calculate consumption you need accurate stock cards with a record of all items received and issued. Or you can calculate consumption for each item by adding together all the stock issues made (to do this you need a record of all items issued).

Step 3: Adjust consumption figures for wastage or stockouts

Wastage
Real consumption (RC) = Recorded consumption – Wastage (avoidable losses)

Real consumption = 900 – 0 = 900

AND/OR

Stockout

$$\text{Adjusted RC} = \text{Real consumption} \times \frac{\text{Period in calculation (months, weeks, days)}}{\text{Period in stock (months, weeks, days)}}$$

$$\text{Adjusted real consumption} = 900 \times \frac{12}{10} = 1080 \text{ crepe bandages}$$

Wastage of 5-10% is considered to be unavoidable, but you will need to adjust the consumption figure if it is more than 10%. You can estimate wastage by checking the number of patients treated and items issued. For example, if your stock records show that you have issued 40 bandages, but have treated 25 patients with 1 bandage each, there are 15 you cannot account for. Check to see how many are in the dressing room. If there are 10, you know 5 have been wasted, i.e. 12.5%. You will also need to adjust the consumption figure for any item that has been out of stock for more than 1 month during the time period, using the stockout formula. NB: If there are no stockouts, no adjustment is made. If there is no wastage, the recorded consumption is the real consumption.

Step 4: Adjust to time period or patient numbers for which quantities are required

Time Period (e.g. 12 months)

$$\text{Annual consumption} = \text{Real consumption} \times \frac{12 \text{ months}}{\text{Months in stock}}$$

$$\text{Annual consumption} = 900 \times \frac{12}{10} = 1080 \text{ crepe bandages}$$

OR

Patient numbers (e.g. 10,000 patients)

$$\text{Consumption per 1000 patients} = \frac{\text{Adjusted real consumption} \times 1000}{\text{Total number of patients}}$$

$$\text{Consumption per 1000 patients} = \frac{1080 \times 1000}{10{,}000} = 108 \text{ crepe bandages}$$

So for 10,000 patients you need:
108 x 10 = 1080 crepe bandages

This step is not needed if you have data for the period in calculation, e.g. if you are calculating for 12 months and you have data for 12 months. However, if the data available is for less or more than 12 months then you need to adjust the figure, in the same way as for 'out of stock' adjustment in step 3.

Use the patient numbers calculation if you need to calculate consumption in terms of quantities per numbers of patients, e.g. the amount of item used per 1000 patients. The number 1000 patients is used for ease of calculating needs and for planning.

The consumption method depends on reliable consumption data and effective stock control, especially accurate record keeping. To use this method you need a monitoring system that both provides information about actual rates of consumption of supplies and equipment and highlights higher than expected consumption of particular items and potential misuse of supplies.

Quantification methods are useful for **estimating annual requirements**. However, actual annual consumption can be different from estimated consumption. Also, many health facilities place orders more than once a year, either on a regular basis or when the need arises. To calculate the **exact quantities** to order to ensure there are enough supplies to last until the next order, you need to use the **stock control system** (see also Section 2.2). You also need to take into account factors including **lead time and frequency of orders, reserve stock, minimum and maximum stock**. Information about these factors should be recorded on stock cards.

Lead time and frequency of orders

The length of time between placing an order and receiving the items is called the **lead time** (or the **delivery time**). The lead time and the frequency of ordering will affect the quantities you order. The less frequently you place an order, the larger the quantities of each item you need to order to maintain stocks until the next delivery. On the other hand, if orders are placed frequently, you need to order less to maintain stock levels between deliveries.

Stock levels

The **stock level** is the quantity of an item that is available for use in a given period of time. The **reserve stock** (sometimes also called **safety stock** or **buffer stock**) is the lowest level of stock for each item, and quantities should not be allowed to fall below this level. Your reserve stocks are essentially extra supplies to ensure that there are no stockouts if there is an unexpected increase in demand or a delay in receiving supplies.

The quantity of reserve stock depends on the **average monthly consumption** and the **lead time**. Use information about average monthly consumption and Table 2.2 to help you estimate the amount of reserve stock.

Average monthly consumption (AMC) is the average quantity of an item that is issued each month over a period of months. It takes account of seasonal variations in demand and is calculated using the following formula:

$$\textit{Average monthly consumption} = \frac{\textit{Total quantities issued in the time period}}{\textit{Number of months in the time period}}$$

Using Table 2.2, if, for example, the lead time is 2 months for a particular item you would need to have an extra 1 month's stock as a reserve stock.

Table 2.2 **Lead time and reserve stock**

Lead time	1 month	2 months	3 months	6 months	12 months
Reserve stock	2 weeks usage	1 month usage	1.5 months usage	2 months usage	3 months usage

If there are factors that could increase lead times, for example, bad roads, unreliable transport or conflict, consider increasing the amount of reserve stock.

The **minimum stock level** (sometimes called the **re-order level**) is the stock level that indicates you need to place an order to avoid running short of supplies. The minimum stock level can change over time, so check it regularly and make any necessary adjustments to the stock card and your orders. To calculate the minimum level, use the formula:

Minimum stock level = Reserve stock + Stock used during lead time

The **order quantity** is the quantity of items that is ordered to be used in one supply period, and it depends on the length of time between orders (i.e. frequency of ordering) and average monthly consumption. If, for example, you place an order every 6 months, the quantity ordered should maintain stocks above the reserve stock level until the next

supplies are received i.e. last for 6 months. To calculate the order quantity, in other words how much you need for the supply period, use the formula:

Order quantity = Time between orders x Average monthly consumption

The **maximum stock level** is the maximum amount of any item you should have in stock at any time. You will usually only have the maximum level in stock just after receiving a delivery. The maximum level helps to prevent you from over-ordering. This level can change over time, so check it regularly and make any necessary adjustments to the stock card and your orders.To calculate the maximum stock level, use the formula:

Maximum level = Reserve stock level + Order quantity for one supply period

Table 2.3 shows how you can use the formulae to calculate how much to order, using 5ml disposable syringes as an example.

Table 2.3 **Calculating order quantity**

Annual requirement:	480 x 5ml disposable syringes
Time between orders:	6 months
Balance:	120 x 5ml disposable syringes
Lead time:	2 months

Formula	**Calculation**
AMC = $\frac{\text{Total quantities issued in the time period}}{\text{No. of months in the time period}}$	Average Monthly Consumption = $\frac{480}{12} = 40$
Reserve stock = 1 month if lead time is 2 months	Reserve stock = 1 x 40 = 40
Minimum stock level = Reserve level + Stock used during lead time	Minimum stock level = 40 + (2 x 40) = 120
Order quantity = Time between orders x AMC	Order quantity = 6 x 40 = 240
Maximum stock level = Reserve level + Order quantity	Maximum stock level = 40 + 240 = 280

Notes:
- the quantity ordered should replenish the stock to the maximum stock level
- adjust the order quantity to the nearest amount which matches the pack sizes available
- this calculation must be done for each item on your list

Although this method of calculating may appear difficult, with practice it becomes easier to use. Try to learn to use this method, because it is an important approach to help you manage stock and purchasing.

If the above method is too difficult, a simpler method is to calculate the quantity to be ordered by adding the annual amount required to the annual reserve stock and then adjusting the total to the supply period. Again using the 5ml disposable syringe example, the annual amount required is 480, and the annual reserve stock (if the order period is every 6 months, 2 x 40) 80 = 560 packs. Divide 560 by 12 months to calculate the amount required for 1 month and then multiply by 6. So the quantity to be ordered every 6 months will be 560 ÷ 12 x 6 = 280.

Calculating for an increase or decrease in order quantity

To calculate changes in the quantity of an item to order, for example, where an item's rate of use is increasing or decreasing you need to know the **order quantity**, **minimum level** and the **stock balance**. The formula to calculate how much extra or less stock should be ordered is:

Quantity to be ordered = Order quantity + Minimum order level − Stock balance

Use this formula, when there is a substantial difference between minimum order level and the stock balance at the time new supplies are being ordered.

Ordering guidelines

Running out of supplies is a serious problem, and having an oversupply is a waste of money and space. The **Maximum** and **Minimum** (Max/Min) system is a common system for keeping the right amount of supplies and to make sure that you never run out of stock. There are several variations of the Max/Min system and there are also different ways of calculating the maximum, minimum, and order quantity. In some systems, you have to make orders according to a regular schedule, for example once a year or periodically. In others, you are able to order supplies as and when you need to. Use the following to help you decide whether or not to place an order:

- If you place orders on a regular basis, order additional supplies if the stock balance is equal to, or less than, or even greater than the minimum stock level. Table 2.3 shows how you can calculate how much to order.
- If you order supplies as and when you need them, check the stock balance of each item and order enough to take quantities up to the maximum stock level. This is sometimes called a topping up system. Remember that some items such as syringes and needles, cotton wool and other supplies that are used every day need frequent re-ordering to keep stock at adequate levels.
- If the stock balance frequently falls below the minimum stock level, because consumption has increased, you need to revise the minimum and maximum stock levels. (If demand has increased unexpectedly or for no obvious reason, report this to your supervisor.) Review minimum and maximum stock levels regularly, because consumption patterns and lead times for items change. If you do not review these stock levels, you may run short of fast-moving items and/or overstock slow-moving items.
- If the stock balance reaches the equivalent of 1 month's consumption, you need to place an order. As a general rule, the stock balance should not fall below 1 month's supply or exceed 2 month's supply at any time.
- If you receive supplies through a kit system, you may not place regular orders. However, you still need to monitor actual consumption, in case kit quantities are not sufficient so that you can order additional supplies.

Estimating costs

Before you place an order, you need to do a cost estimate, to check you are within budget. Start by making a list like the one shown in Table 2.4 (see Section 1), using catalogues published by government stores, medical supply organisations or manufacturers to obtain prices. Remember to include the costs of consumables and accessories. The total price for each item (Column 4) = Unit price x No. of units (Column 2 x Column 3). The total cost is the sum of all the figures in Column 4. Also as part of the cost estimate you should budget at least an additional 5-7% of the purchase price of capital items of equipment to cover the cost of maintenance and running costs.

Table 2.4 **Calculating costs**

1: **Item**	2: **Unit price**	3: **No. of units**	4: **Total price**
		TOTAL COST	

If you are importing supplies or equipment, you also need to consider the costs of import duties, pre-shipment inspection, customs clearance, freight and insurance, transport, handling and storage. If the total cost is more than your budget, the best approach is to decide which of the 'not so essential' items you can do without. Avoid reducing quantities of 'vital' and 'essential' items.

Practical tips for budgeting

- Obtain at least three quotations.
- Remember to include costs of import duties, pre-shipment inspection, customs clearance, freight and insurance, transport, handling and storage.
- Ask for advice about these costs from the supplier.
- As a general rule, add 20-30% to the cost of the item(s) to cover freight and insurance costs and, for items of capital equipment, add 5-7% to cover maintenance and running costs.
- If the total cost is more than your budget, decide which of the 'not so essential' items you can do without.

Freight and insurance charges for imported goods

Freight charges vary enormously, depending on the volume and weight of the items ordered, the type of goods (for example, hazard or heat-sensitive goods), mode of transport (sea, land or air) and distance. The value of freight is based on the weight or volume of the goods rather than on the value of the goods. Hazardous or heat-sensitive goods can cost considerably more to transport and may be restricted to particular modes of transport. For example, laboratory reagents, which are flammable, require special packing and documentation, and vaccines, which must be kept cold during transport, require an effective cold chain.

The insurance charge is related to the value of the goods. A freight contract that includes insurance is more expensive, but insuring goods against loss or damage is very important. If you insure goods, you can make a claim if they are lost or damaged during freighting. This usually takes the form of a refund, a credit or replacement of goods. You cannot make a claim for loss or damage if you did not insure the goods.

When you are putting together a budget add approximately 20-30% of the cost of the order to cover the cost of freight and insurance. For example, if the total cost of the item ordered is US $100, then you need to add US $20-30 to your budget, to cover the cost of freight and insurance. Ask your supplier or freight forwarders for estimates of freight and related insurance costs before placing the order. Responsible suppliers will advise on the best way to freight and insure goods.

Table 2.5 **Freight terms**

Suppliers use a range of freight terms. These are referred to as INCOTERMS (International Chambers of Commerce Terms) and are often given as acronyms or initials. As a purchaser, you need to know what these initials mean. The most commonly used are:

CIF (Cost, Insurance, Freight) – if you are ordering from a local supplier, CIF means that the price includes delivery to your store. If you are ordering from a supplier outside the country, CIF means freighting of goods to the 'port of entry' i.e. sea or airport, but you are responsible for any costs after the goods have been unloaded, for example, clearing customs, transport.

C&F or **CFR** (Cost and Freight) – means the same as CIF, except the purchaser is responsible for insurance of goods during transport and delivery.

FOB (Free on Board) – the supplier arranges for all costs up to the port and time of shipment, and the purchaser is then fully responsible for freight and insurance of the goods.

EXW (Ex-Works or Ex-Warehouse) – the price of the goods includes no freighting or transport costs, and the purchaser collects the goods from the supplier and arranges freight and insurance.

CPT (Freight and Carriage Paid) – the supplier arranges freighting of the goods directly to the agreed destination, but the purchaser must arrange insurance.

CIP (Freight, Carriage & Insurance Paid) – is like CPT but the supplier arranges insurance on the purchaser's behalf against damage or loss of goods in transit.

FCA (Free Carrier) – the supplier arranges to deliver goods to a 'named' freight forwarder. For example, ECHO will deliver to a destination in the European Union and the freight forwarder and purchaser take full responsibility for the goods from there.

Pre-Shipment Inspection

Pre-Shipment Inspection (PSI) involves inspection of goods before they are shipped, to check the quantity and quality of goods to be exported and to ensure that they are fit for their intended purpose and are adequately packed for shipment. PSI is a legal requirement for some countries for customs clearance or import. PSI may be required for shipments of all goods, or it may only be required for shipments over a certain value. You need to check current procedures with your national customs department, as well as with your supplier. Failure to comply with PSI requirements can cause delays in customs clearance and extra expense, or can result in goods being confiscated or returned. Be aware that you, as the buyer, must request PSI.

Identifying suppliers

You need to decide, if you have a choice, whether to order supplies locally or internationally and to select a supplier. Criteria for selecting a supplier (see also Section 1) include:

- Price
- Quality
- Delivery times
- Guarantees and warranties
- Reputation
- Reliability

Potential suppliers include wholesalers and retailers, manufacturers, central medical stores, and non-profit supply organisations, for example, European suppliers such as Action Medeor, ECHO International Health Services, and IDA, JMS in Uganda and MEDS in Kenya.

You need to make a careful comparison of local and international costs. The prices charged by international suppliers may seem to be lower, but imported products often have additional costs, such as import duties, freight, handling and insurance. Whenever possible, obtain quotations (a request for a price) from at least three suppliers so that you can compare prices.

Do not select a supplier on the basis of price alone. The cheapest suppliers may provide poor quality products, delivery and service. Although equipment may be supplied with a guarantee or warranty, check that the manufacturer or supplier is liable for repairs and maintenance. If there is no authorised agent or representative in your country, you may find you have to send the item back to the manufacturer and this could be very costly.

Try to find out about other factors such as reliability and delivery times. After you have selected a supplier, monitor their performance to ensure that they continue to provide good service.

Certain conditions may be attached to funding for equipment and supplies from donor agencies. For example, donors may stipulate that you must obtain a minimum of three quotations and that items must be BP or CE marked or ISO approved.

Placing an order

Place your order using an **order form** (see example in Figure 2.1 below). Some health facilities use **requisition forms** or books for ordering supplies from district or national stores. Each order is numbered sequentially. Pre-printed requisition forms make ordering easier and help to avoid mistakes.

When placing an order or re-ordering:

- Check the stock records to find out the stock balance and decide what items and how much of each item you need to order.
- List the supplies to be ordered alphabetically and in sections, for example, drugs, equipment, consumables. Only include one item and one item size on each line. If you are ordering from a catalogue, write down the catalogue code number for each item.
- Provide a full and clear description of each item.
- Specify the quantity of each item. Place orders for complete packs. For example, if you need 34 rolls of crepe bandage and a pack contains 12 rolls, order 3 packs.
- Check that all copies of the order are easy to read and signed by an authorised person.
- Check that the order includes your full contact details and, if you are not the recipient, include the contact details of the person, agency or institution to which the goods should be delivered.
- Make at least two copies of the order. Keep one copy in the health facility and send one copy to the supplier.
- Specify, if appropriate, whether the item is to be delivered or collected, the method of shipment (for example, sea, land or air), contact details of the organisations responsible for shipment and payment, and instructions for packing (for example, carton size and weight).
- Include any other special instructions (for example, no delivery at weekends or during holidays) and, if applicable, account number.

Figure 2.1 **Sample order form**

Consignee (recipient): Health facility:

Date: Authorised signature:

Code/Cat. no	Description	Unit size	No. of units	Unit price	Total value
ET181P	Bandage crepe 5cm	12 rolls/pack	4	£2.35	£9.40
ET18104P	Bandage crepe 10cm	12 rolls/pack	2	£3.90	£7.80
ET182P	Cotton wool absorbent 500g, paper wrapped	1	5	£1.50	£7.50
ER13001P	Microscope slides, 76 x 26mm, 1mm thick, frosted end	100/pack	2	£3.45	£6.90

Specifications

A specification is a detailed description of an item. It is important to provide suppliers with a clear and complete description, to make sure that you receive the specific item you require. It is usually better to write generic specifications that describe items by type rather than by brand name. However, there may be times when you need to specify an exact model or manufacturer, for example, for particular products such as microscopes.

Figure 2.2 **Sample specification form**

	Example 1	Example 2
Purpose	Forceps dissecting	Syringe disposable
Features	14cm, spring type, 1 x 2 teeth	2ml, fixed 21G needle, plastic wrapped
Material	Stainless steel	Disposable plastic
Pack size	Pack of 1	Pack of 100
Quantity	4	2

- **Purpose** – what the item will be used for, e.g. general purpose forceps, dressing forceps, dissecting forceps, episiotomy scissors.
- **Design and features** – e.g. manual, electric or battery operated and the type of battery needed; length, height and width; toothed or plain; wheels or no wheels; handles; curved angled or straight; sharp or blunt; small or large; sterile or non-sterile.
- **Material** – e.g. stainless steel, sterilisable plastic, disposable, paper packed or plastic packed, epoxy coated, fine or robust.
- **Consumables, accessories and spare parts** – e.g. additional items required to use an item such as bulbs for lamps. Remember that while some equipment uses standard supplies, other equipment requires specific supplies, and you will need to order accordingly.
- **Unit or pack size** – the number of items in each unit or pack, e.g. 12 rolls of crepe bandage or 100 syringes.
- **Quantities** – the exact quantities or number of units or packs required, e.g. 5 packs of 12 rolls of crepe bandages.
- **Safety** – e.g. power requirements for equipment, equipment earthed, pin plugs compatible with 3-pin plug with 3-way socket or adapter, type of battery.

Other specification considerations include:

- When ordering things that need to be used together, e.g. needles and syringes, battery-operated items and types of batteries, pay particular attention to specifications to ensure that you order compatible items.
- When ordering electrical items, include information about voltage frequency, wattage and Hz requirements for your facility.
- When ordering spare parts, provide as much information as possible, e.g. manufacturer, model or type of equipment the spare part is for, spare part serial number, a description of the part, and if possible a diagram including accurate measurements.
- When ordering chemicals, reagents and stains, provide the correct name and, if possible, the chemical formulae, and indicate whether you require powder, liquid concentrate or ready-made preparations.

Sometimes a supplier may offer an alternative, if they are unable to supply the specified item. Check that the alternative is appropriate for your needs and affordable within your budget. For example, 14cm instead of 12cm scissor dressing may be acceptable, but 19G instead of 23G disposable needles may not be appropriate.

Practical tips for ordering

- Develop written procedures and assign responsibility for ordering.
- Only order items your health facility needs and is authorised to keep.
- Carry out a stock take before ordering more supplies.
- Ask for quotations before placing orders. Use the same format as an order form, but state clearly that it is a quotation request. Also ask for a pro-forma invoice, which provides a complete breakdown of costs and which also makes ordering easier.
- Keep records of past orders that show supplier contact details, code and catalogue numbers, and unit quantities, to help you make subsequent orders.
- Fill in order or requisition forms clearly. Provide as much detail about requirements and specifications as possible to avoid supply of incorrect items or quantities or delays in filling your order.
- Each supplier will have its own forms. It is particularly important to fill out the forms from your national supplier. For other suppliers, you may not need to fill out the form as long as you provide the relevant information.
- Make sure that equipment is supplied with the necessary consumables, accessories and spare parts or, if not, order these at the same time.
- For goods with expiry dates, specify in your order the minimum expiry dates required (i.e. the expiry date from the time of arrival of goods in-country).

Handling donations

Procurement also includes donation of drugs, supplies and equipment. Donated goods can be of great value to health facilities with limited resources, but donations are not always useful or totally 'free'. For example, recipients may have to pay for customs clearance, storage, insurance and transport. There are also costs associated with staff time to organise arrangements and sort out what is and is not useful, and with disposing of inappropriate items.

Health facilities with limited resources are often worried about refusing or complaining about donations. Do not feel obliged to accept donations unless the goods being offered are appropriate to your needs. Establish and use donation guidelines and policies, or use the practical tips in the box to help you manage donated supplies.

Practical tips for receiving donations

- Decide what supplies and equipment are needed and in what quantities, and prioritise the list of items you plan to request.
- Check that national regulations allow these goods to be imported.
- Check that the donor has the capacity to fulfil the request.
- Provide potential donors with clear and comprehensive information about the items needed and how they will be used.
- Before agreeing to accept a donation, check that the supplies being offered conform to national policy or the WHO Drug Donation Guidelines or WCC/CISS Guidelines on Medical Equipment Donations and are suitable for your facility and staff. Confirm who will be responsible for covering the costs of transport, freight, insurance, import duties and customs clearance. If the supplies include drugs or sterile supplies, check that these will have an adequate expiry date (at least a year or half the shelf life if the expiry date is less than a year).
- When donations are received, check expiry dates and labelling, make sure that equipment is fully functioning and is supplied with relevant manuals, spare parts and consumables, and, where appropriate, accessories.
- Confirm receipt of donated goods with the donor, including providing information about the condition and appropriateness of the goods.
- Keep a record of all donations received, including those you have not requested, and inform donors of unsolicited donations.
- Refuse inappropriate donations and provide an explanation of the reasons for refusal.

Donor organisations have a responsibility to make sure that they donate appropriate medical supplies, equipment and drugs. For example, equipment should be in full working order and supplied with all technical documents and enough consumables and spare parts for 2 years.

Donors should only provide donations in response to requests, and should know or find out about the recipient, confirm the need for the donation, and check their capacity to handle donations. It is important to ensure that the recipient provides clear specifications of the items required. If offering alternatives, donors should check with the recipient that these alternatives are acceptable.

Before sending donations, it is essential to obtain consent from the recipient and to agree who will cover the costs of international and local transport, freight and insurance, warehousing, clearance, storage and handling. Finally, donors should confirm what items are being sent and when these will arrive so that the recipient can plan to receive them.

2.2 Storage and stock control

Organising the store

Most of your stock of drugs and other supplies will be kept in a store, from which they are issued when needed. Supplies should be stored according to the manufacturer's instructions. Proper storage conditions are important to protect stock from deterioration and damage. The store should be:

- Secure
- Clean
- Free from pests
- Dry
- Not too hot or cold
- Well ventilated
- Not exposed to direct sunlight

To ensure security, keep the store locked. Make one person responsible for looking after the supplies, keeping the keys and locking the store. Appoint someone else to be in charge when the person normally responsible is away. Avoid having more than two sets of keys, and make sure there is always one set available at the health facility.

Keep the store room clean, because dirt attracts insects and rodents. If the store room has windows, put up curtains to keep out direct sunlight. Keep a thermometer in the store room and monitor the temperature daily. If the store room is too hot or poorly ventilated, improve air circulation by installing a fan or perforated airbrick.

Many items, such as laboratory reagents, are made in countries with cool climates so, for example, instructions to protect from excessive heat mean store below 25-30°C. Standard storage temperatures for different instructions are provided in Table 2.6.

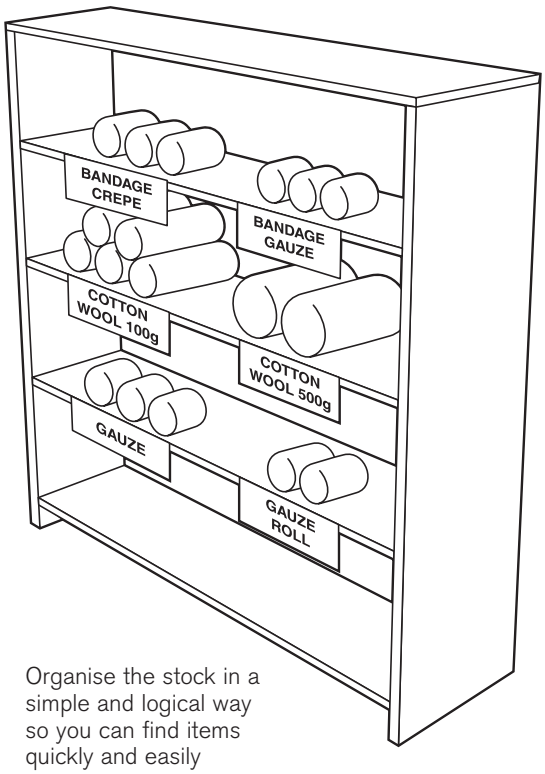
Table 2.6 **Standard storage temperatures**

Description	**Temperature range**
Protect from excess heat	25-30°C
Room temperature	15-25°C to 30°C (depends on local conditions)
Keep cool	8-15°C
Refrigerated	2-8°C
Frozen	Below 0°C

The storeroom should have enough space to put all your medical supplies on shelves or pallets. Organise the store in a simple and logical way so that items can be found quickly and easily, using the following guidelines and the diagrams.

- Make your own shelves using planks of wood supported on bricks or crates, if there is no shelving in the store room.
- Make use of the space in the middle of the room for shelves. Putting shelves all around the walls takes up a lot of space and wastes the space in the middle of the store.
- Store supplies raised off the floor on open shelves or pallets, or in locked cupboards, to protect them from damp and pests.

- Organise the stock into different sections for different categories of supplies, for example, drugs, dressings, instruments, medical stationery, equipment and spare parts, laboratory supplies, disinfectants.
- Clearly label each section of the store, allocate each item to a specific place and label the position of the item on the shelf so that it is easy to read.
- Arrange categories of supplies with a large range of items, such as dressing materials, in alphabetical order.
- Divide supplies into regular use and reserve stock, placing the reserve stock on the same shelves behind the regular use stock. Keep a reserve stock of instruments that are used frequently, such as scissors, suture needles and forceps.
- Remove a whole unit at a time. Partly opened units should not be kept in the store room, but should be kept as limited 'working stocks' for daily use in the relevant service area of the health facility.
- Rotate stock according to the expiry date using the SLFO (Shortest Life First Out) and FIFO (First In First Out) rules. Put items that have the latest expiry date at the back and items with the earliest expiry date at the front. Use the FIFO rule for items without an expiry date and mark these with the date of receipt.

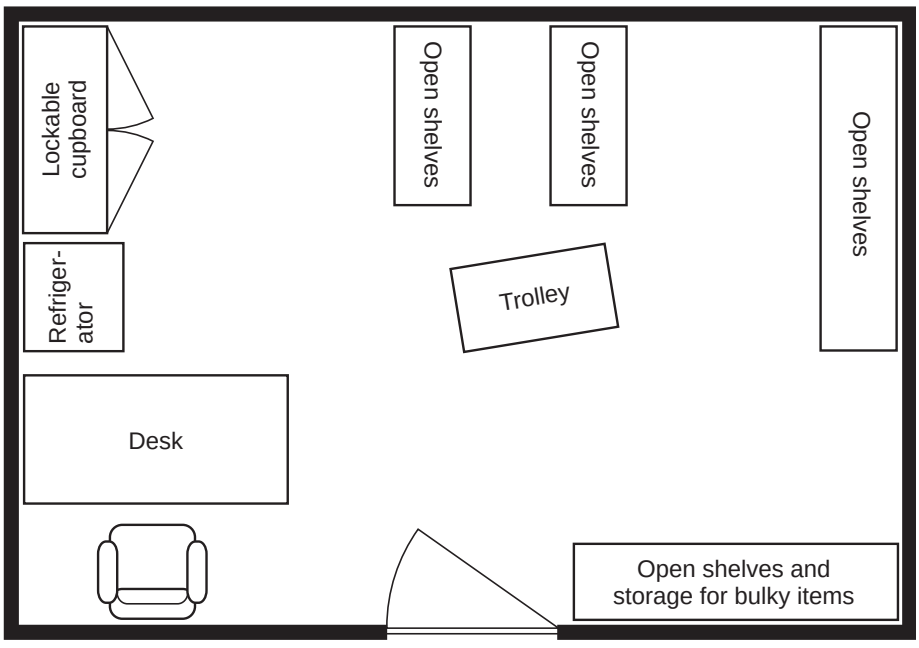


Organise the stock in a simple and logical way so you can find items quickly and easily

- Put a red star or a similar mark on the labels of all items that have an expiry date within the current year.
- Remove expired, damaged or obsolete items from the shelves and dispose of them according to approved procedures (see Section 2.5).

Stock control

Stock control is about the management of supplies in a health facility. Stock control includes keeping accurate and reliable records of stock received and issued, stock taking (checking stocks on a regular basis), and carrying out an inventory of stock at least once a year. A stock control system uses tools such as stock record cards and a stock control ledger. Effective stock control is important to help you order the right quantities of supplies and equipment and, ideally, you should carry out a stock take before placing an order for more supplies.



Floor plan of a small medical storeroom

Store records

Every health facility needs a system for recording stock movement. Reliable record keeping is very important, because errors caused by poor record keeping will affect service delivery. For example, if stock records used to estimate requirements are not accurate, you may order too much or too little. Accurate record keeping depends on easy to use, well-designed methods and forms. Stock cards (stock record cards) and stock control ledgers are the simplest, and examples are provided below.

Stock cards are kept for each type of item in stock. Although time consuming to keep up to date, stock cards have many advantages. They provide information about quantities received, issued and in stock at any time, can be used to calculate orders, and are a useful tool for preventing shortages and over-stocking (see Figure 2.3 below). Stock cards help supervisors to monitor overall consumption and use by different services, and to check stock levels, assess wastage and identify theft.

Figure 2.3 **Sample stock card**

Item:	Unit/pack size:	Card no.
Strength/size:		Code no.
Maximum level:	Reserve stock level:	Lead time:
Minimum level:	Order quantity:	

Date	Received from/ Issued to	No. received	No. issued	New balance	Remarks	Signature

Notes:

1. Make sure each item and each item unit pack, size, strength etc. has its own stock card, e.g. disposable needle 21G, disposable needle 19G.
2. Item: name of the product.
3. Code no.: the national code no. if applicable.
4. Card no.: optional, although numbering cards makes retrieval and filing easier. Cards for the same item should be serialy numbered.
5. Strength/size: of the item, e.g. 21G needles.
6. Unit/pack size: no. of units in each pack, e.g. 100 needles/box.
7. Lead time, Order quantity, Minimum level, Maximum level, Reserve stock level: see Section 2.1.
8. Record quantities issued or received each time there is a transaction.
9. Calculate and record the new stock balance (old balance + quantity received or – quantity issued).
10. Record important information in the remarks column, e.g. expiry date, special conditions for storage, price, supplier, stock take count, unexplained gains and losses, stockouts, average monthly consumption.
11. All transactions should be initialled.

Once a month the information on the stock cards is transferred to the **stock control ledger**. It is simpler to make an order using the summary in the stock control ledger than using all the individual stock cards. The stock control ledger is also a useful tool for analysing stock management and reviewing the accuracy of stock levels (see Figure 2.4 below). You can either obtain a stock control ledger from the district health team or make one yourself, using a separate page to keep records for each type of item.

Figure 2.4 **Sample stock control ledger forms**

Example 1

Item: Code no.

Unit/pack size: Order quantity:

Date	Quantity received	Quantity used	Balance	Quantity to order	Signature

Example 2

Item: Code no.

Unit/pack size: Order quantity:

Order quantity:

Date	Previous count (physical)	Amount received	Amount used	Present count (physical)	Quantity to order	Signature

Practical tips for stock storage and record keeping

- Assign responsibility for stock control and the store room and develop written procedures.
- Keep the store room tidy and well organised. An organised store saves time when ordering or locating items and prevents stock from getting lost.
- Avoid wastage by rotating stock according to expiry dates and FIFO.
- Store drugs, medical supplies and equipment separately, if possible in a different store room, from linen, food and non-medical supplies.
- Make sure store records are completed regularly.
- Keep stock cards in the storeroom. This enables the person responsible for stock control to update the cards after every transaction (ordering, receiving and issuing stock). Write each transaction on a separate line, even if there is more than one transaction on the same day.
- Record any stockouts on stock cards and report these to your supervisor.
- Store stock cards together in a box or keep each card with the stock in the correct place on the shelves.
- Keep and file old cards.
- Carry out random checks to ensure that record cards are being updated regularly and accurately.

Receiving supplies

Make sure at least two people receive and check supplies. It is important to check supplies received before you put them away in the store. Otherwise you may only discover that an item is incorrect, damaged or poor quality when it needs to be used and when it is too late to ask the supplier for a replacement. The following simple checks can avoid these problems and save time in the long term:

- Check the delivery note, packing list and contents against a copy of the order.
- Check the contents and number of boxes against the packing list.
- Check the outer and inner packaging to make sure it is intact and for signs of damage, for example, spots, breakages, leaks, missing labels, tape or lids.
- Check labels are legible and include complete information, for example, the approved name, strengths, storage instructions, manufacturer's details, and expiry date.
- Check that all spare parts, accessories, instruction manuals, and warranty documents are included.
- Check that the voltage shown on your packing list (or packing case) for electrical equipment is compatible with your power supply. Also check that the fuse rating is correct.
- Check the temperature monitor that comes with vaccines to see if there has been any colour change. Record the temperature of the vaccines on the delivery note. If the colour has changed or the temperature is incorrect, there may be a problem with the cold storage used during transport and you should report this to the supplier. Put vaccines and other heat sensitive supplies in the refrigerator at once.
- Check the shelf life and expiry date. Do not accept items if the expiry date has passed. Only accept items nearing the end of their shelf life if you are sure you can use them before the expiry date. The expiry date is the time up to which the manufacturer guarantees the quality of the product and many products, e.g. laboratory reagents, sterile dressings and syringes, are only fit for use for a limited time.
- Check that you file delivery documents with the order forms.
- Check that you keep the manuals together in a dry, safe and easily accessible place.

Report any problems to the supplier and the carrier immediately, explaining the nature of the problem, for example under-supply or damaged goods. Do not use damaged goods.

When you unpack supplies, enter the details on the stock card and enter new items in the **inventory**. It is also important to keep a **goods received record** for equipment items, listing the supplier, date, invoice number and the serial number or other unique identification. Register the guarantee or warranty if necessary. Keep all equipment packaging materials in case you need to transport it again in future.

Make sure at least two staff members receive and check supplies

Issuing supplies

Every health facility also needs a system for recording issue of supplies. The most common method is an **issue book** or **issue voucher** (see Figure 2.5 below). The following information should be recorded every time an item is issued: date of issue, item and quantities issued, name of receiving service or individual, and the signature of the recipient. Give a copy of the issue voucher to the recipient for their records.

After issue, the receiving service or individual should be responsible for care of the item and accountable for loss or breakage. For example, microscope care should be the responsibility of the laboratory or the laboratory technician in charge.

Figure 2.5 **Sample issue voucher form**

Date	Item	Quantity issued (units)	Isued to	Remarks	Signature

Stock taking

Regular stock taking is an important part of stock control. A stock take involves physically counting what is in stock and comparing the counted figures with the balance figures on the stock cards, checking expiry dates and the condition of stock. If there is a difference between the counted figures and the balance figures on the stock cards, you need to find out why. For example, stock may have been received or issued without being recorded or may have been stolen. Ideally you should carry out a stock take before ordering more supplies. If this is not possible because you order stocks very frequently then carry out a stock take at least three times a year.

Inventory of stock

An **inventory** is a list of non-expendable supplies and equipment that are kept at the health facility (see Figure 2.6 below). The person in charge of the health facility should keep a master copy of all items and update this list each time an item is received and issued. Each PHC service or section should keep its own working copy and update their own list. The person in charge of each service should keep an updated list of all the equipment and supplies they receive and include items damaged, broken or sent for repair.

An inventory should be carried out at regular intervals (at least once a year) to check the condition and location of supplies and equipment in use and in stock. Checking the inventory of stock is an important part of stock control and helps to identify purchasing requirements. However, it is often forgotten and so it may be useful to have a set time or times each year for inventory checking.

Figure 2.6 **Sample inventory form**

Date of inventory:	Service/section:	
In-charge name:	Title:	Signature:
Witness name:	Title:	Signature:

Item description	Record		Remarks (e.g. action required, action taken)
	Functional	Non-functional	

Practical tips for receiving and checking stock

- Check all supplies received carefully and immediately before unpacking, putting away and completing paperwork.
- Check packaging of sterile items for damage. If packaging is damaged, products should only be used if they can be re-sterilised before use.
- Check a random sample of stock for damage or deterioration on a regular basis. Remove damaged or expired stock and dispose of safely.
- Carry out a regular stock take and inventory and investigate the reasons for differences in physical counts and stock cards.
- Review whether quantities of stocks used are reasonable or excessive.

2.3 Care and maintenance

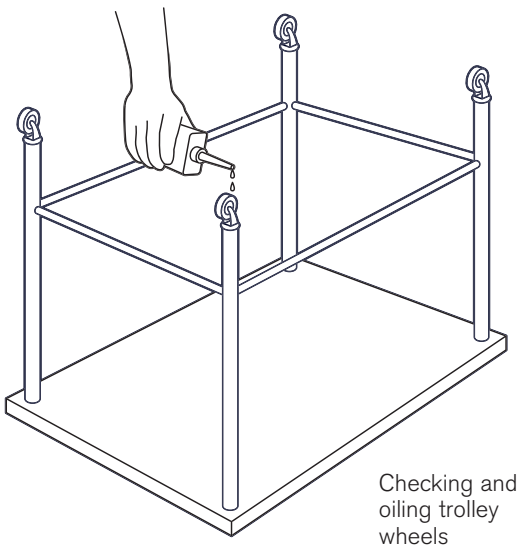
Proper maintenance affects the performance and safety of equipment. Poorly maintained equipment deteriorates more quickly and is more likely to break down. Unreliable or inaccurate equipment is often worse than no equipment at all. A steriliser, for example, with a leaky seal will not sterilise its contents properly.

Both day-to-day maintenance by users and Planned Preventive Maintenance (PPM) are essential to keep equipment in good working condition. This section discusses user maintenance and PPM, illustrated by examples of practical care and maintenance of items of equipment including stainless steel instruments, microscopes, steam sterilisers, and refrigerators.

User maintenance

Health facility staff play an essential role in routine care and maintenance of instruments and equipment, especially cleaning, checking for damage and reporting any defects. Important care and maintenance tasks include:

- Keeping all items clean and dry.
- Protecting items from dust and dirt after use by keeping them covered.
- Switching off and unplugging items when they are not in use.
- Storing items properly when they are not in use, e.g. keeping scissors closed and diagnostic sets in their case.
- Checking and oiling wheels, e.g. wheels on trolleys.
- Checking screws and tightening loose screws.
- Replacing lost, worn, cracked or broken parts, e.g. stethoscope earpieces and diaphragms, and rubber seals in sterilisers.
- Removing batteries when battery-operated items are not in use to prevent corrosion.
- Keeping scissors sharp.
- Unscrewing stethoscope earpieces and removing any aural wax.
- Inspecting bedframes for cracks and splits, e.g. where the legs join the frame.

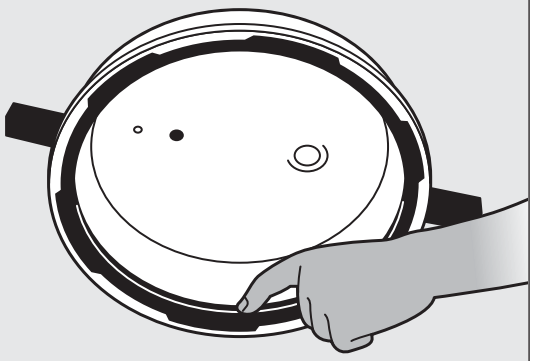


Checking and oiling trolley wheels

You can help to remind staff about these care and maintenance tasks by putting written instructions near the equipment.

Practical tips for steam steriliser care and maintenance

- Clean the inside of the steriliser after use and check regularly for signs of wear and damage. Regularly clean the nozzle that the weights rest on.
- Check for steam leakages around the lids and valve. If there is a problem, turn off the heat, open the pressure valve and wait for the steriliser to cool.
- If steam is leaking out from under the steriliser lid, check the position and quality of the rubber seal and adjust or replace it.
- If steam is leaking out from the safety valve, check the position of the valve and adjust or replace it.
- If you cannot solve the problem, use another steriliser and inform your supervisor.



Checking the rubber seal is in place and is in good condition

Planned Preventive Maintenance

Planned Preventive Maintenance (PPM) is a regular service, recommended by manufacturers and carried out by trained technicians, to check equipment performance and replace parts. PPM should support and supplement user maintenance carried out by staff using the equipment. The frequency of PPM depends on the type of equipment and the manufacturer's recommendation. PPM can double the life time of equipment and reduce breakdowns. For example, a microscope will last around 15 years with proper care and maintenance but only around 8 years if it is not looked after properly. Refrigerators and weighing scales should last for about 8 years, sterilisers for about 6 years, and ward beds about 12 years.

Manufacturers and suppliers usually provide maintenance and repair services, but may not have representatives or authorised service agents in every country. If there is no representative or authorised agent in your country, you will need to identify a specialised organisation that can provide PPM for particular items of equipment, such as the technical unit of your local hospital. All maintenance and repair should be carried out according to the manufacturer's instructions.

Practical tips for microscope care and maintenance

User care and maintenance:

- When the microscope is not in use, keep it covered with a cotton dust cover. Do not keep the microscope in a closed wooden box.
- Before using the microscope, wipe it with a clean cloth to remove any dirt and dust, and clean the lens with lens tissue or a separate piece of clean cotton cloth.
- At the end of each day's work, switch off the microscope and remove the plug from the mains socket.
- Clean the microscope thoroughly according to the manufacturer's instructions – mild soapy solution is suitable for most cleaning purposes.
- Use a rubber bulb to blow air over the microscope to remove dust particles.
- Remove oil residue from the lens with clean lens paper, soft toilet paper or soft cotton cloth.

Keeping the microscope clean and dust free

- Clean the optics with a special solution of 40% petroleum ether, 40% ethanol and 20% ether.
- Ethanol can be used for cleaning mirrors, but do not use ethanol for cleaning lenses, because it dissolves the cement.
- Never dip the objectives in xylene or ethanol because the lenses will become unstuck.
- If the microscope is not going to be used for a few days, put it in a sealed, airtight plastic bag (made from thick polyethylene not PVC) with a packet of silica (silica absorbs moisture from the air). This will protect the microscope from fungal growth and corrosion.
- Do not store the microscope without the eyepieces unless the holes are plugged.
- Report any problems to your supervisor.

Planned Preventive Maintenance:

- Periodically check and clean mechanical parts (adjustment, focus, stage etc).
- Remove any fungal growth.
- Lubricate according to manufacturer's instructions.
- Check optical alignment and spring load.
- Check the integrity of electrical grounding.
- Clean and inspect the microscope for signs of damage.

Practical tips for care and maintenance

- Develop a maintenance strategy that includes both user maintenance and PPM.
- Remember that spending a little money on routine servicing while a piece of equipment is working will improve its efficiency and extend its life.
- Train users in correct use, care and maintenance of equipment.
- Prepare clear instructions and a maintenance checklist for use of each item of equipment. Place the checklist, which should include a cleaning and maintenance schedule and action to be taken if the equipment fails, near the equipment.
- Keep a stock of spare parts e.g. lamps, fuses, and rubber seals. Make sure you order and use spare parts specified by the manufacturer. Incorrect parts can affect performance and safety.
- Identify one person to be responsible for organising maintenance and for arranging in-house repairs and sending equipment away for repair.
- Set up a system for reporting defects and encourage staff to report problems immediately.
- If the district health office is responsible for maintenance and repairs, follow district procedures for reporting and dealing with breakdowns and faults and for replacing equipment.
- Identify local technicians who can perform basic maintenance and repairs, but check their competence and training carefully. Equipment can be damaged if technicians without appropriate skills or experience try to repair it.
- Find out if there is an authorised agent that provides periodic maintenance (PPM) checks or a specialised organisation with the capacity to carry out PPM.
- Make sure you have arrangements in place for accessing specialist technical skills for servicing and repair.
- Keep a detailed record of faults reported, maintenance and repairs. If there are long delays between fault reporting and fault repairing, review your system.
- Keep equipment record cards for all items of equipment. On one side of the card, record details of the model, date of purchase, source, replacement parts, accessories and consumables and the manufacturer's recommended maintenance schedule. On the other side, record maintenance and repairs carried out.

Stainless steel instruments

Surgical instruments are made of stainless steel (SS), anodised aluminium, chrome-plated non-ferrous heavy metals, silver, titanium and plastic. Most instruments are made of stainless steel. SS instruments containing chromium and carbon are subjected to special heat treatment to give them the elasticity or hardness required for their particular purpose.

Tungsten carbide (a hard metal) inserts extend the working life of a SS instrument. Instruments with tungsten carbide are more expensive but have a greater resistance to wear and tear and last longer than those made with ordinary SS. Instruments containing tungsten carbide are easily recognisable because they have gold plated bows.

The appearance, performance and working life of SS instruments depends on the quality of the SS and on proper handling, storage and care. SS instruments will stain, rust or corrode if they are not cleaned and sterilised correctly.

Reasons for damage to SS instruments

- Not cleaning and drying or lubricating the moving parts of new instruments before first use.
- Not cleaning instruments immediately after use or after they have been in contact with corrosive agents, such as iodine tincture, silver nitrate preparations, mercury compounds.
- Not cleaning instruments properly, leaving traces of blood, pus and other secretions.
- Not rinsing instruments properly, leaving traces of detergent or disinfectant.
- Not drying instruments properly, leaving water trapped in joints.
- Using very hot water, which causes protein substances, such as organic matter, to coagulate and stick.
- Using corrosive detergent or disinfectant solutions.
- Storing instruments in saline or disinfectant solutions for long periods of time, or allowing saline solution to dry on the instruments.
- Re-using the same disinfecting solution rather than fresh, clean solution.
- Using tap water with high mineral content (chloride, sodium, calcium, manganese, iron and copper) rather than clean rainwater for cleaning, preparing disinfecting solutions and sterilising.
- Using metal brushes, steel wool or abrasive pads for cleaning, leaving scratches and grooves.
- Mixing instruments made of different metals, for example SS and brass or new and damaged instruments during cleaning, disinfection or sterilisation.
- Using instruments for purposes other than those they were designed for.

Choosing new instruments

Stainless steel instruments have no standard names and are often known by the name of the person who designed them or by specific features. As a result there is a wide range of instruments with the same function but different names, e.g. mayo, kilner and laurence needle holders. There are also groups of instruments that share similar names but perform different functions, e.g. artery forceps, dissecting forceps and sponge holding forceps. Remember that the most important factor to consider when choosing an instrument is its function and purpose.

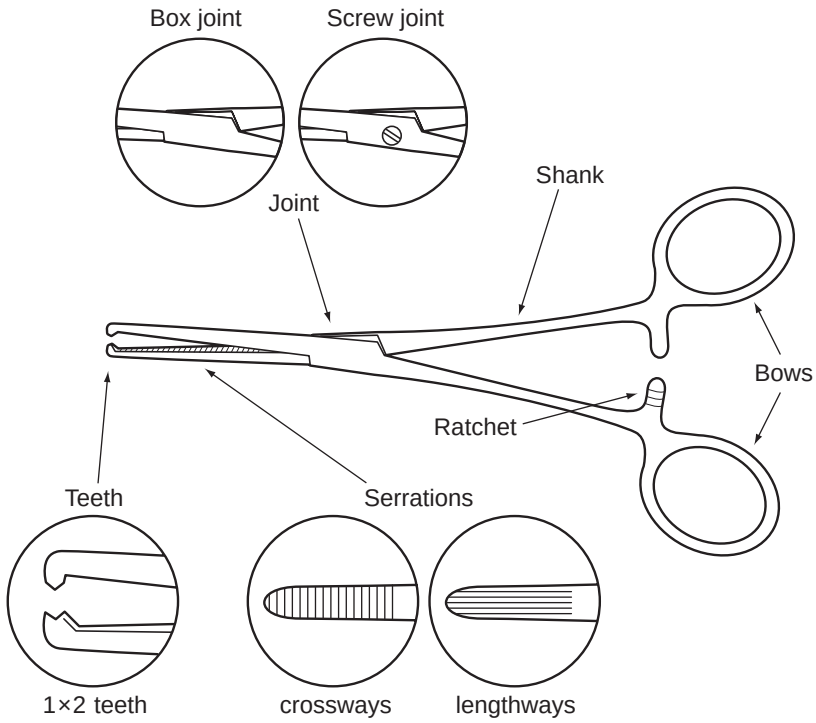
Make sure that you buy SS instruments that conform to international, regional or national standards. Quality is important, especially for instruments that you expect to use frequently and to last a long time. Buying the cheapest, low grade instruments can be a false economy, because they may need to be repaired or replaced more often. However, it may not be cost-effective to buy top grade instruments, because it will be expensive to replace them if they get lost. In most cases it is better to buy middle range, good quality instruments. To help you judge the quality of instruments before you buy them, check that:

- Edges of jaws and handles are even and smooth.
- Ends are of equal length.
- Jaws of forceps are of equal thickness, close evenly and are fully closed when on the last ratchet.
- Jaws and tips of hinged instruments are aligned and do not overlap.
- Serrations mesh properly and evenly.
- Blades of sharp and semi-sharp instruments are sharp.
- Ratchets are deep cut as this ensures that the instrument will be held securely when closed, and will glide smoothly, hold firmly and open easily.
- Handle grips are firm.
- Teeth permit a firm grip.
- Bows (finger rings) are comfortable to use.
- Joints are not loose or stiff.

- Surface is smooth, polished or stain finished.
- There are no dull spots, scratches, chips or dents.

It is also useful to remember that:

- Box joints are stronger and more stable than screw joints.
- Passivated surfaces increase resistance to corrosion (passivation is a process that helps to ensure a corrosion-resistant coating of chromium oxide on the instrument).
- Olive-shaped cut outs help to relieve pressure on instruments, which increases their flexibility and working life.
- Serrated edges prevent tissue and suture materials from slipping. Serrations may be coarse or fine, run lengthways or crossways, run the whole way or only part way of the blade (see Appendix 3).



Parts of an instrument

- Ratchets ensure that the instrument will hold firm when closed, and allow the user to grasp or vary the tension. Ratchets vary in strength and some have a self-retaining clasp.

General rules

Follow the simple rules below for handling, care and storage, to keep your SS instruments in good condition. Guidelines for cleaning, disinfecting and sterilising SS instruments are included in Table 2.7 and in Section 2.4.

- New instruments are supplied without lubricants. Before first use, remove from their packaging, wash carefully, dry, lubricate moving parts, and store in a dry place. Hinged instruments, for example scissors, needle holders, and artery forceps, need regular lubrication.
- Dip instruments in the lubricant one by one, do not soak them in the lubricant. Only use water-based (or water-soluble) lubricants because these allow steam penetration during sterilisation, are anti-bacterial, inhibit corrosion, and prevent joints becoming stiff. Do not use general purpose or oil-based lubricants.
- Every instrument is designed for a specific purpose and should only be used for that purpose. Incorrect use can cause damage. For example, forceps should never be used as pliers or openers, surgical scissors should never be used for cutting gauze.
- Never etch or scratch the instrument surface, for example with the name of the clinic. This removes the protective layer and causes dirt and water to collect in the grooves, which results in corrosion, staining or rusting. Rust weakens instruments and will eventually cause them to break.
- For chemical disinfection, use freshly-made and diluted solution every day. Using the same solution several times reduces its effectiveness and increases the risk of corrosion, because of high concentrations of dirt and debris such as rust particles. The solution may become more concentrated because of evaporation, and this can also cause corrosion.
- Use only detergents or disinfectants recommended by the manufacturer.
- After cleaning, disinfecting and rinsing, store instruments in a dry, clean area that is protected from dust and sterilise when you need to use them. Check that instruments are thoroughly dried before storage.

- Store instruments correctly. For example, scissors should be closed to protect the cutting edge, and forceps closed on the first ratchet to prevent tension and stress.
- Check instruments regularly for damage and to make sure they are working properly. For example, check that scissors are sharp and that forceps align correctly. Handle instruments gently, and avoid dropping, misusing or over-straining them.
- Remember these five steps: **1. Clean**; **2. Inspect**; **3. Lubricate**; **4. Sterilise**; **5. Store**.

Table 2.7 **Looking after SS instruments**

Cleaning	**Disinfection and sterilisation**
• Wear gloves for cleaning instruments. • Soak used instruments immediately after use because they are a contamination risk. • Clean instruments in a solution of cool or warm water and a general purpose detergent. • Use soft bristled brushes (e.g. a toothbrush) to remove debris, paying particular attention to box joints, ratchets, teeth, hinges and serrations. • Rinse thoroughly immediately after cleaning with cool or warm water. • Dry instruments thoroughly. Do not use cotton wool for drying.	• Check the instruments are clean and dry and inspect for damage. • Lubricate moving parts with a water-soluble lubricant. • Make sure all jointed or hinged instruments are open and keep them open by hanging them on a 'mayo' safety pin or in a specially designed rack. • Place instruments with curved jaws so that all the jaws are pointing in the same direction to protect the tips. • Close instruments with ratchets to the first ratchet notch only. • Make sure instruments are not piled on top of each other or overpacked in the boiler or steriliser. • If you have the choice, instruments should be sterilised rather than boiled.

Refrigerators

Your refrigerator provides a safe and reliable cold storage facility. The refrigerator should have two compartments:

- Main compartment – kept at 0-8°C (or 2-8°C) – for vaccines and some drugs.
- Freezer compartment – kept below 0°C – for making ice packs.

Choosing a refrigerator

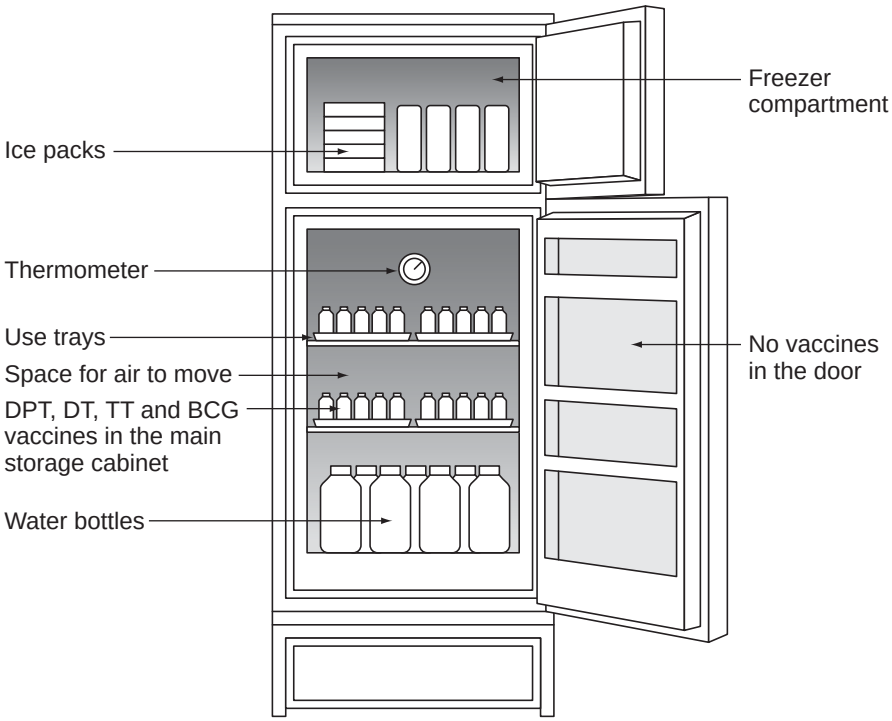
- If your health facility has a stable and reliable supply of mains electricity choose a compression (electrical) refrigerator.
- If the electricity supply is unreliable, or operates for less than 8 hours in 24 hours, or there is no mains electricity, choose an absorption refrigerator (either kerosene and electricity or gas).

The temperature in gas and electrical refrigerators is controlled by a thermostat. The temperature in a kerosene refrigerator is controlled manually by adjusting the kerosene burner wick up and down (a large flame makes the refrigerator colder and a small flame makes it warmer). Make sure you buy a refrigerator suitable for your needs.

General rules

Following these simple rules will keep your refrigerator in good condition and ensure that it works efficiently.

- Keep the refrigerator in the coldest room in the health facility. The room should be well-ventilated and the refrigerator kept away from sunlight, heat and draughts. Draughts can blow out the flame in kerosene and gas refrigerators. Leave at least 20cm between the refrigerator, the wall and other equipment to allow hot air to escape from the back of the refrigerator.
- Keep the refrigerator locked or in a room that can be locked. Always leave the key at the clinic and in a safe place.
- Open and close the door of the refrigerator gently. Make sure that the refrigerator door seals perfectly, to prevent warm outside air from entering. Badly fitting doors and damaged seals cause the temperature inside the refrigerator to rise and reduce its efficiency. Check regularly all around the door seals for damage and to make sure they seal properly. A simple way to do this is to place a sheet of paper between the door seal and cabinet and close the door. If the seal is working properly the paper stays in place and is not easy to pull out.



Stocking the refrigerator

- Open the refrigerator only when necessary and as infrequently as possible. Each time the door is opened, cold air escapes and warm air gets in, causing the temperature in the refrigerator to rise. Only use the refrigerator for storing EPI supplies. Do not store food or drinks in the same refrigerator to avoid unnecessary opening of the door. Avoid re-opening the door immediately after closing. If there is space, put containers of water in the bottom or the door of the refrigerator to keep contents cool when the door is opened.
- Make sure the refrigerator is on a firm, level base. If it has adjustable feet, adjust these by hand. If not, level the refrigerator by placing pieces of cardboard under each corner. To check it is level, place a ball on top and adjust the refrigerator until the ball stops rolling. If possible place the refrigerator on a small timber pallet that keeps it off the ground by about 15cm. This stops water and moisture collecting under the refrigerator and so helps to prevent rusting. It also improves cooling, and allows easy access for cleaning.
- Do not overfill the compartments. If air cannot circulate freely inside the refrigerator, the temperature will rise.
- At least once a month, clean the door gasket and burner, and remove any dust from the condenser.
- When ordering spares such as burners, lamps and wicks, check the size needed (for wicks the size is usually written on side of the burner). Keep wicks wrapped in a plastic bag to protect them and keep them dry.
- Give one person responsibility for the refrigerator, including storing vaccines, diluents and ice-packs, checking and recording the temperature, and maintaining the cold chain.
- Make sure the health facility has a plan of what to do if the refrigerator breaks down and that staff are trained to carry it out.

Practical tips for vaccine storage

- Make sure there is enough space to allow air to circulate freely around vaccines and diluents. Store vaccines in rows in trays, putting the same type of vaccines together in the same tray. Use trays with perforated bottoms and allow 5cm between each tray.
- Put measles and polio vaccines on the top shelf of the main compartment, and BCG, DPT, DT, TT, hepatitis B and Hib vaccines on the middle shelf.
- Do not store vaccines in the refrigerator door, because the temperature is higher than the main compartment.
- Never allow DPT, DT, TT, hepatitis B and Hib vaccines to freeze. These vaccines are damaged if they are exposed to temperatures below 0°C.
- Put diluents next to the vaccines for which they were supplied. Keep enough measles and BCG diluent in the refrigerator to meet the needs of the next immunisation session. The diluent must be cool when it is used, otherwise it may damage the vaccine.
- Store and use vaccines on a First In First Out (FIFO) basis. Write the date of receipt on the box, so you know which ones to use first. Do not keep expired vaccines in the refrigerator.

Table 2.8 **Looking after refrigerators**

Daily checks

- Check the temperature every morning and evening. The temperature pattern will show if there are any faults or the refrigerator is not working efficiently.
- Check the gas bottle or kerosene tank, the flame and the wick. Top up the fuel and adjust the flame and wick as necessary. If you have a kerosene refrigerator, refill the kerosene tank each day (record the amount of fuel added to the tank) and check the flame every morning and evening. Order fuel and spare parts if required.
- Check the freezer for ice build up.
- Report faults to the maintenance officer immediately.

Defrosting

- Defrost the refrigerator regularly (at least once a month).
- Before defrosting the refrigerator, transfer stock to another refrigerator or cold box.
- Speed up defrosting by placing a container of warm water in the freezer and in the main compartment. Do not use knives or sharp instruments to remove ice as these can permanently damage the refrigerator.
- Swab the inside of the cabinet with 70% ethanol while defrosting and keep the door open. Use water and detergent to clean the inside and outside of the refrigerator. Do not use abrasives or bleach, because these will leave grooves that allow micro-organisms to multiply. Dry all surfaces with a clean, soft, dry cloth.
- Return vaccines, diluents and ice packs to their appropriate places. But, only put stock back in the refrigerator when the required temperature (0-8°C) has been reached. People often make the mistake when a refrigerator has been defrosted of setting the thermostat at the coldest setting and restocking immediately with vaccines. This can cause vaccines to freeze making them useless.

PPM

- Follow the maintenance schedule and checks as advised by the manufacturer.
- Thoroughly clean the condenser
- Oil the door fittings, locks and other moving parts. Check that the door is sealing correctly and, if necessary, change the door gasket. Check for visible damage, clean off patches of rust and repaint.

2.4 Cleaning, disinfection and sterilisation

Decontamination is the process of making items safe for handling and before they are re-used. Cleaning, disinfection and sterilisation are procedures used to prevent contamination and spread of infection by medical instruments and equipment.

Table 2.9 **Decontamination procedures**

Recommended process	Suitable for supplies and items	Examples
Cleaning	• In contact with intact skin • Not in contact with the patient • Low infection risk • To be disinfected or sterilised	Bedframes, mattresses with impermeable covers, trolley tops before use, work surfaces
Disinfection	• In contact with intact skin and mucous membrane • Contaminated with readily transmittable organisms • Medium infection risk	Metal tongue depressors, work surfaces, washing bowls, soiled items, contaminated items, thermometers, infectious spills, e.g. blood, urine on mattresses
Sterilisation	• In contact with broken skin or mucous membrane • That penetrate the skin or enter sterile body areas • Contaminated with readily transmittable organisms • Medium to high infection risk	Surgical instruments, dressings, reusable items such as sterilisable syringes and needles

Every member of the health team is responsible for carrying out cleaning, disinfection and sterilisation procedures.

For reasons of safety, staff responsible for cleaning, disinfection and sterilisation should:

- Wash their hands with soap and water.
- Be aware of the risks of contamination.
- Wear thick, protective gloves.
- Be particularly careful when handling sharps and sharp instruments.
- Follow manufacturer's instructions.

Practical tips for using water for cleaning, disinfection and sterilisation

- Use clean water (preferably filtered or boiled) for cleaning, disinfecting and sterilising.
- In areas where tap water and surface water have a high mineral or salts content use clean (filtered or boiled) rainwater for cleaning, preparing disinfection solutions and sterilising. Water with a high mineral or salts content can damage equipment and instruments causing scaling, furring and corrosion of boilers and sterilisers. Boiling or filtering does not reduce the mineral or salts content of water but will ensure that the water is clean.
- Use cool or warm water for cleaning not hot water. Hot water causes protein substances (such as organic matter) to stick to instruments and equipment.

Cleaning

Cleaning is the process of removing visible material such as dirt, grease, blood and body fluids, and reducing the number of infectious micro-organisms (bacteria, viruses, fungi, and spores). Disinfection and sterilisation methods only work properly if items have been thoroughly cleaned and dirt, grease, and organic matter such as mucus, tissue, blood and other body fluids removed. The presence of organic matter can protect germs against, or reduce the action of, disinfectants or sterilising agents. Corrosion and rusting are also caused by inadequate cleaning, rinsing and drying.

- After use and before cleaning, all items should be soaked in water to prevent deposits drying up, as this makes them more difficult to remove.
- Cleaning methods are summarised in Table 2.10.
- After cleaning and before sterilising or disinfecting, all items should be rinsed thoroughly with clean water and dried.

Table 2.10 **Cleaning methods**

Cleaning method	Suitable for	Comments
Clean water	Sterilisable syringes and needles Lancets Latex gloves Reusable plastic, glass, metal items	Soak in clean water after use to loosen or prevent organic matter drying and to make cleaning easier. Most items only need to be soaked for about 30 minutes to remove debris before disinfection or sterilising. Do not leave items, especially metal items, soaking for long periods of time, e.g. overnight, as this can damage them. Soaking poor quality SS instruments for a long time can lead to corrosion and rusting. After cleaning, rinse and dry thoroughly.
Clean water and general purpose detergent, e.g. Omo	Reusable glass and plastic, metal items and SS instruments Spilt blood and body fluids Work surfaces, e.g. examination tables, bench surfaces Ward surfaces, e.g. floors, walls, ceilings	Soak in clean water after use (as above). Do not leave metal items soaking for too long (as above). After cleaning, rinse off the detergent with clean water and dry thoroughly. Never use detergents to clean syringes, needles and lancets.
Clean water and soap	Hands	Wash hands before, after and between contact with each patient and procedure. Never use soap to clean syringes, needles and lancets, or latex materials. Soap can make latex materials sticky and easy to break.

Disinfection

Disinfection is the process of removing micro-organisms or reducing the number to levels that are no longer harmful. Disinfection kills viruses, fungi, bacteria but not spores such as tetanus. Disinfection is, therefore, safe for items that are used for some purposes but not for those where all organisms must be destroyed.

The two main disinfection methods are boiling and chemical disinfection. Guidelines for these two methods are provided in Table 2.11. It is important to remember that chemical disinfectants are not suitable for use with needles and syringes, because traces of chemicals can be toxic, cause irritation and inactivate vaccines.

Disinfection by boiling

It is important to remember that boiling provides high level disinfection but not sterilisation. Boiling is still widely used either because steam sterilisers are not available or because health staff believe that boiling is the same as sterilisation and guarantees that items are sterile. Use the following guidelines for disinfection by boiling:

Preparation of the boiler and the load

- Use a special boiling pan (boiler) or, if not available, a saucepan with a close fitting lid.
- Prepare the items so that they are ready for disinfecting. Make sure they have been thoroughly cleaned, rinsed and dried.
- Check items for signs of damage and to make sure that, for example, joints are not loose.

Loading the boiler

- Load the boiler so that the water will be able to circulate around each item and each part. Arrange the items so that they are not touching each other or the sides of the boiler. Do not overload the boiler.
- Place heavier items at the bottom and smaller, lighter items on top.
- Make sure that hinged instruments are open.
- Do not boil sterilisable needles and syringes unless sterilisation is not possible. Separate the plunger and barrel of the sterilisable syringes and place the needles in a needle container or stick into a gauze swab.
- Fill with enough clean water to make sure that all the items are covered. Boiling without enough water will damage the boiler and the items.

Boiling

- Heat until the water boils, then reduce the heat slightly to save fuel but make sure that the water remains boiling.
- Start timing. Boiling time starts from when the water boils not from the time the water starts to be heated. Boil for the required time (see Table 2.11).
- Do not leave the boiler unattended when in use.
- Do not add any items during the boiling cycle. If items are added, you need to start timing from the beginning again. Similarly, if boiling is stopped at any point, you need to restart again.

Removing the load

- After the required boiling time, shut off the heat source and remove the boiled items. Either take out the tray with its contents and allow it to drain dry or take out the boiled items using sterile or disinfected long handled forceps and place them in a sterile or boiled metal container to dry before using or storing them.
- Allow the boiler to cool down before draining the hot water.
- Do not leave items in the water because it can easily become re-contaminated.
- Do not disinfect by boiling more than 24 hours before you use items. The items may become contaminated even if they are stored in a closed container.
- Clean the boiler after each day's use.

Chemical disinfection

A wide range of chemical disinfectants is available (see Table 2.11). Each is best suited for a specific purpose and must be used in a particular way to be effective. Because not all disinfectants will kill all organisms, a single disinfectant will not fulfil all your requirements, but two different disinfectants will usually be sufficient. Choose disinfectants with the following characteristics:

- Wide range of activity
- Not readily inactivated
- Non-corrosive when diluted
- Non-irritant to skin
- Low cost

Proper disinfection depends on using an appropriate disinfectant at the right concentration and for adequate contact time. It is also important to follow the manufacturer's instructions for disinfectant handling, preparation, use and storage. Incorrect dilution, poor storage and repeated use of the same working solution reduce the effectiveness of chemical disinfection.

Practical tips for chemical disinfection

- Develop a policy for chemical disinfection. Only use chemical disinfection if it is not possible to sterilise or boil.
- Disinfectants may be supplied ready to use or may need to be diluted. Label bottles or containers with the name and concentration of disinfectant and, for diluted disinfectants, the date of dilution/preparation.
- Prepare dilutions with clean water.
- Most disinfectants, once diluted, can only be stored for 1 week. Prepare small amounts at a time to avoid wastage. Do not mix freshly made diluted solution with old solution. Wash and dry the container before filling with new solution.
- Use fresh soaking solution every day. Renew soaking solution during the day if it looks dirty. Never mix fresh solution with old solution. Wash and dry the container before filling with new solution.
- Clean, rinse and dry items thoroughly before disinfecting. All disinfectants are inactivated to some extent by organic matter, rubber, hard water and detergents.
- Wear gloves to avoid irritation of the skin. If there is irritation, wash the affected part with clean water until all the chemical is removed.
- Avoid soaking metal items for too long or in too high concentrations as this causes corrosion and rusting.
- After disinfection, rinse thoroughly with clean water to remove all chemical residues. Alcohol solutions can be allowed to dry without rinsing.

Sterilisation

Sterilisation is the process of destroying or removing all forms of living organisms, including bacteria, viruses, fungi and spores. Carrying out sterilisation is not easy. It requires proper equipment and staff who are trained to use the equipment correctly and to follow procedures. If sterilisation is not possible, disinfection by boiling is a useful alternative. But remember that boiling does not guarantee sterility.

The main method of sterilisation (sometimes also called autoclaving) is steam under pressure, described below and in Table 2.12. This section also includes more detailed information about sterilising reusable needles and syringes.

Sterilisation by steam under pressure

'Pressure cooker' type sterilisers are designed to sterilise unwrapped, non-porous, non-fabric items such as instruments and syringes. They are not suitable for sterilising wrapped or porous items such as swabs. Use the following guidelines for sterilisation by steam of basic supplies and equipment with a portable pressure cooker steam steriliser:

Preparation of the steriliser and the load

- Put the required quantity of water in the steriliser. The level is usually marked or the quantity indicated by the manufacturer. Dry heating without water could damage the items and the steriliser and cause injury to the operator.
- In areas where tap water has high mineral and salts content, use clean rainwater to reduce corrosion, rusting, scaling or furring of metal items and the steriliser. Hard water pads will also help to reduce the build up of scale in the steriliser.
- Prepare the items ready for sterilising. Clean, rinse and dry thoroughly. Check for cleanliness, signs of damage and loose joints or hinges.
- Lubricate hinged instruments before sterilising. Use a water-soluble lubricant as this allows steam to penetrate during sterilisation.

Loading the steriliser

- Load the steriliser. Arrange items so that steam vapour is able to circulate freely around each item and part.
- Make sure that items for sterilisation are not in contact with water. It is the steam that sterilises not the water. Use stands to support trays and baskets.
- Arrange items in the baskets and trays so that they are not touching or stacked on top of each other.
- Make sure that hinged instruments are open, if possible putting ring-handled instruments on a mayo pin to keep them in the open position.
- Place cupped instruments, such as gallipots, upside down to prevent water collecting in them during sterilisation.
- Make sure that sliding windows on drums and containers are open, and that containers with lids are uncovered.
- Only sterilise reusable (sterilisable) syringes and needles (see later in this section).
- Place test strips – TST (TimeSteamTemperature is preferable) – or autoclave tape in the middle of the load, which is where the heat penetration is the slowest.

Sterilisation

- Turn the heat on full, making sure the pressure control (air removal, purge) valve is open (the lever is pushed up). If the air is not expelled, the mixture of hot air and steam and the temperature will not be sufficient to sterilise the items. Check that the small pin in the safety valve is down.
- When you can hear the steam escaping and it forms a strong, steady and continuous jet, close the valve. If necessary repeatedly steam purge according to the manufacturer's instructions.
- Start timing. The sterilisation cycle starts when the steam comes out in a strong, steady and continuous jet, not from when the heat is turned on.
- Sterilise for the recommended time (see Table 2.12). Do not interrupt the sterilisation cycle. If there is an interruption you must start again from the beginning.
- Make sure steam can be heard escaping from the pressure control valve all the time.
- Do not leave the steriliser unattended when it is in use.

Removing the load

- At the end of the sterilisation time, turn off the heat and open the pressure control valve to allow the steam to escape and the pressure to reduce.
- After all the steam has escaped, close the pressure control valve so that sterility is maintained.
- Allow the steriliser to cool down for at least 1 hour before opening or draining the hot water.
- Take care when opening the lid because the load may be hot even after the cooling down time.
- After sterilisation, items must remain sterile until they are used. So, do not open the steriliser lid until you need to use the sterilised items. Items will become contaminated again as soon as they are in the air. Or take items out with sterilised forceps and place them in a sterilised or highly disinfected container and close the lid.
- If you are using the steriliser drum, remove the drum and seal by closing the vents. Also remove any containers with covers or lids and close.
- Before using sterilised items, examine the TST strips to make sure sterilisation has been satisfactory.
- Clean the steriliser after use. Also check regularly for signs of wear and damage (see Section 2.3)

Practical tips for sterilisation

- A wide range of sterilisers is available. Always follow the manufacturer's instructions for the type of steriliser that you are using.
- Air in the steriliser and load results in inadequate steam penetration and incomplete drying of the load. This is because air acts as an insulator for heat and prevents steam reaching the surface of items to be sterilised. Steam purging by opening and closing the valve, removes air and improves the steriliser's performance.
- Always sterilise items for the correct time using a clock or timer. Standard combinations of time and temperature for sterilisation are: 121°C for 15 minutes and 134°C for 3 minutes. You need to know the operating pressure of the autoclave and altitude of your health facility to determine correct sterilising time. If you cannot change the operating pressure then you need to extend the sterilising time.
- Never sterilise single use items such as disposable needles and syringes in order to re-use them, because the high temperatures during steam sterilisation will damage them.
- Indicator strips on autoclave tape are not a reliable guide that sterilisation has taken place. Use TST indicators instead of autoclave tape.
- Because it is difficult to keep items sterile (items are contaminated by contact in the air), carry out sterilisation on the day of use (but not immediately before use as you need to allow time for items to cool down).
- Replace safety valve and gaskets (rubber seals that seal the junction of metal surfaces) immediately if they are damaged or worn.

Table 2.11 **Disinfection by boiling and chemical disinfection**

Method	Kills	Suitable for	Advantages	Disdvantages	Comments
Boiling *Disinfection time:* Boil clean items Altitude — Min Sea level — 10 1000m — 10 2000m — 10 3000m — 20 4000m — 20 5000m — 30 6000m — 45 7000m — 60	Bacteria Spores (some) Viruses Fungi	Metal instruments Sterilisable plastic and glass materials Sutures Sterilisable syringes and needles	• High level disinfection • Low running costs • Quick, simple and efficient • Minimal maintenance • Readily available • Can be done using a range of locally available fuels • Kills wide range of organisms including HIV, hepatitis B	• Does not kill all spores, e.g. tetanus, gangrene • Can cause rusting or blunting of instruments, e.g. scissors • Water must be at the correct boiling temperature (100°C) and maintained at this temperature for the whole disinfection time • Does not ensure sterility	• Boiling in water is high level disinfection not sterilisation. • Boiling is only an acceptable alternative to sterilisation when steam sterilisation is not possible. • Boiling will not kill organisms effectively if items have not been cleaned properly. • Boiled items must be allowed to dry before use or storage. • Boiled items should not be left in the water, which can easily become re-contaminated. • Disinfection time starts from when the water is actually boiling not when it is heating up. Boiling time of 10 min is sufficient to kill non-sporing bacteria, some bacterial spores, viruses, fungi but not fungal spores. • In hard water areas use rainwater to prevent corrosion, scaling or furring of metal equipment and the boiling pan.
Alcohols (Isoprophyl alcohol 70-90%, Ethanol 70%) *Disinfection time:* Soak clean items for up to 15 min	Bacteria Fungi Viruses (some)	Metal instruments Thermometers	• Fast acting • Effective against HIV • Not corrosive to metal • Leaves surfaces dry, no rinsing needed	• Low level disinfectant • Toxic, flammable and volatile • May cause skin irritation • High evaporation rate, poor surface disinfectant • Relatively expensive • Poor activity against organic matter and ineffective against bacterial spores • Sensitive to light	• 70% alcohol is much more effective than higher concentrations. • Must be diluted before use. Requires care when diluting. • Can be easily replaced by PVI (povidone). • Store in a cool place (below 30°C) in airtight containers to avoid evaporation, and protect from light. • Although alcohols are effective against HIV on clean surfaces, they are not suitable for dealing with contaminated surfaces because of their poor penetration of organic matter and high evaporation.

Method	Kills	Suitable for	Advantages	Disdvantages	Comments
Chlorhexidine + Cetrimide (Savlon, HAC) *Disinfection time:* Soak clean items for 10 min	Bacteria Fungi Viruses (limited)	Low level disinfecting Handwashing Surfaces Metal instruments, plastic and rubber ware	• Readily available • Low cost • No staining	• Low level disinfectant • Blunts instruments • Possibility of allergic reactions • Inactivated by hard water, some detergents, soap, organic matter, and iodine disinfectants • No activity against TB and bacterial spores • Poor activity against HIV	• Solutions must be freshly prepared at the recommended concentration for different uses. • Concentrated solution of 1.5% Chlorhexidine + 15% Cetrimide must be diluted before use with clean water. • Soaking for too long or with too high a concentration can corrode metal instruments. • Not suitable for sterilising instruments or for sterile instrument storage. • No particular storage precautions required for concentrated solution. Store unused diluted solution for a maximum 1 week.
Phenolics (Lysol, Jeyes, Stericol, Hycolin) *Disinfection time:* Soak clean items from 30 min–6 hours	Bacteria Fungi Viruses (some)	Glass, e.g. slides, urine containers Surfaces, e.g. floors Instruments Linen Equipment	• Not readily inactivated by organic matter • Cheap • Effective against many organisms, wide range of bactericidal activity, including TB	• Low level disinfectant • Poor activity against bacterial spores and hepatitis B • Variable activity against viruses • Slow activity • Highly irritating to skin and mucous membrane • Strong smelling	• Wide range of phenolic disinfectants with varying composition, concentrations and similar actions. • Pure phenols are not recommended since they are less soluble in water and more irritating. Phenols (containing soap) are preferred. • Should not be used on food preparation surfaces or equipment that may come into contact with skin or mucous membrane. Often used for wiping bench surfaces and floors and when chlorine-releasing disinfectants cannot be used because of their corrosiveness. • Show variable activity and are not recommended for routine disinfection against HIV. • Concentrate solution to be diluted before use. Check manufacturer's instructions for dilution. • Diluted solutions must be stored in airtight containers and not kept for more than 24 hours.

Method	Kills	Suitable for	Advantages	Disdvantages	Comments
Povidone (PVI) (Iodine, Polyvidone-iodine, Betadine, Videne) *Disinfection time:* Soak clean items for 15 min	Bacteria Fungi Spores (some) Viruses (some)	Handwashing Surfaces SS instruments Sutures Blades	• Readily available as aqueous solution or powder form • Low cost • Versatile • Efficient and fast acting • Wide range of activity, including against HIV	• Low level disinfectant • Solution must be made up daily at the time of use • Stains fabrics and surfaces • Discolours, oxidises and may corrode metal • Solution is dark so difficult to see items in soak • May be a skin irritant • Cannot be used with mercury derivative	• Concentrated solution must be diluted before use. • Solution must be freshly prepared at the recommended concentrations for different uses, e.g. for instruments 2.5% PVI. • Solution must be changed daily. • Soaking for too long or with too high a concentration can cause corrosion of metal items. • Concentrated solution 10% PVI must be stored in airtight and opaque containers. • Unused diluted solution 2.5% PVI can be stored for a maximum 1 week.
Virkon *Disinfection time:* Soak items from 3-10 min	Bacteria Fungi Spores Viruses	Blood and body fluid spills Hard surfaces Glass and plastic SS equipment and instruments	• High level disinfectant • Suitable for multiple uses • Fast action • Effective against HIV and hepatitis B • One step disinfectant, cleans and disinfects in one operation (pre-cleaning not necessary) • Built-in colour (pink) indicator of activity • Working solution is non-irritant to skin, eyes • Not readily inactivated by organic matter	• Warm water needed to dissolve powder • Disinfecting solution must be changed weekly (or sooner if pink colour is lost) • Corrosive to some metal items	• One of the newer disinfectants. • Powder disinfectant safer and easier to transport and store. • Suitable for all routine disinfection tasks. • Diluted working solution stable for 7 days and should be discarded after this time or sooner if the pink colour starts to fade.

Method	Kills	Suitable for	Advantages	Disdvantages	Comments
Sodium Hypochlorite 5% (solution) (Bleach, Chloras, Jik, Domestos) **Calcium Hypochlorite** (solid/powder/ granules) **NADCC** (Sodium dichloroisocy-anurate) [Presept, Sanichlor, Haz-Tab] (tablet/powder/ granules) *Disinfection time:* Soak clean items from 10-60 min	Bacteria Fungi Spores Viruses	*0.1% solution* Hands Gloves SS items Cotton and linen *0.2-0.25% solution* Surfaces, e.g. floors and tables Plastic items *0.5-1% solution* Spills of infectious materials, e.g. blood	• High level disinfectant • Readily available • Reasonable cost • Rapid action, potent and wide range of activity including against HIV and hepatitis • Sporicidal, particularly if buffered at around PH 7.6 • Disinfectant of choice against viruses • Active against TB at high concentrations • Suitable for cotton and linen (but risk of discolouration) • Useful as a laboratory disinfectant • Wide range of use	• Highly volatile • Strong oxidising agent, and corrosive to some metals • Concentrated and strong solutions damage textiles • Toxic properties • Potentially irritant, e.g. skin, eyes, lungs • Diluted (working) solutions are unstable and must be freshly prepared daily or as required • Limited storage life • Inactivated by organic matter, particularly if used in low concentrations • Need to avoid mixing strong acids with hypochlorites, as chlorine gas will be released	• Chlorine releasing disinfectants. The power of the disinfectant is expressed as 'available chlorine', usually as % of available chlorine or as mg/l (1mg/l = 0.0001%) or parts/million (1ppm = 0.0001%). Check disinfectant labels for the amount of available chlorine. • Always dilute according to manufacturer's instructions (and chlorine content), in non-metal containers (chlorine oxidises metal). Prepare just before use. • High concentrations are caustic and corrosive. • Low concentrations are non-toxic. • To avoid corrosion, use only for SS instruments. • Solutions exceeding 0.1% should not be used on SS, or left in contact with items for more than 30 min. Do not exceed recommended concentration or contact time.

• Handle carefully, because of rapid deterioration in light and heat, corrosion of metals and damage to fabrics. NADCC is more stable, less corrosive and more resistant to inactivation by organic matter than hypochlorites. Concentrates and working dilutions must be protected from sun, heat and strong light (and humidity for solids). Store in dark or opaque airtight non-metal containers. Undissolved NADCC is very stable when stored dry but unstable when in solution. Store unused diluted solutions for a maximum of 1 week.

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• NADCC is more stable, less corrosive and more resistant to inactivation by organic matter than hypochlorites.
• Concentrates and working dilutions must be protected from sun, heat and strong light (and humidity for solids). Store in dark or opaque airtight non-metal containers.
• Undissolved NADCC is very stable when stored dry but unstable when in solution. Store unused diluted solutions for maximum 1 week.

Table 2.12 **Sterilisation**

Method	Kills	Suitable for	Advantages	Disdvantages
Steam sterilisation **Sterilisers** (Autoclaves, Pressure Cooker [Domestic]) *Sterilisation time:* Steriliser designed to operate at 121°C (250°F) Altitude — Min Sea level — 20 1000m — 30 2000m — 35 3000m — 45 4000m — 50 5000m — 60 6000m — 70 7000m — 80	Bacteria Fungi Spores Viruses	Heat stable items such as reusable glass and plastic All metal items Fabrics Dressings	• Quick and efficient • Low running costs • Reliable • Safe • Environmentally friendly • Appropriate for all health facilities and services • Effective against HIV and hepatitis B	• Can be difficult to find spare parts • Recurrent costs, e.g. fuel, test tapes

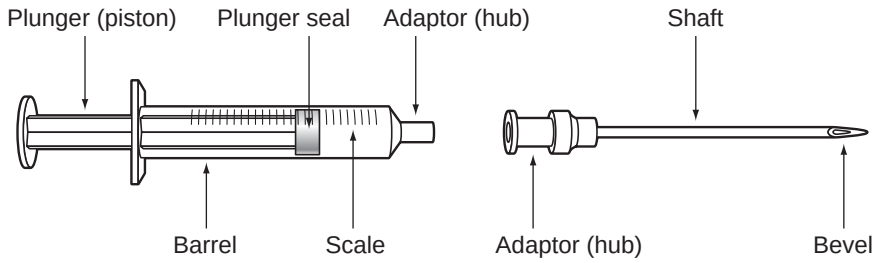
Comments

• If carried out correctly, following the manufacturer's instructions, steam sterilisation can guarantee complete sterility.
• There are many types of sterilisers, ranging from simple hand-operated type to advanced fully automatic models.
• Sterilisers can be grouped according to the type of load they are designed to handle: non-porous items (e.g. instruments, syringes, unwrapped items, non-fabric) and porous items (e.g. swabs, wrapped items). The type of steriliser required will depend on the range of items to be sterilised, workload, staff skills and power supply.
• All types work using the principle of steam under pressure for a specified time. Pressure (created by expelling air) is used to produce high temperature steam. Use steam pulsing (technique where steam is released and admitted again in short continuous pulses by opening and closing the valve) to improve air removal and, hence, the steriliser's performance.
• Steam is much hotter than boiling water.
• The most common combinations for temperature and time (at sea level) are 121°C for 20 min, 126°C for 10 min and 134°C for 3 min. To determine accurately the time needed for sterilisation you need to know the operating pressure of the steriliser and the altitude. Sterilisation time starts when the required temperature (pressure) is achieved, not from the start of heating. Indicator strips, such as TST, should be used – ideally during every sterilisation cycle or at least once a week – to make sure sterilisation has been satisfactorily carried out.
• Sterilisation will not remove blood and other organic matter, and may also result in contaminated material being 'baked' onto items, so cleaning, rinsing and drying before sterilising is essential. If items are not clean all organisms will not be killed. Use clean rainwater if tap water has high mineral and salts content, to prevent corrosion and rusting of metal equipment and steriliser.

Sterilising reusable syringes and needles

A single sterile syringe and needle should be used for each injection. Re-using syringes or needles without proper sterilisation puts the health worker and the patient at risk of cross-infection with bloodborne diseases, e.g. hepatitis and HIV, of contracting infections, e.g. septicaemia and tetanus, and of injection abscesses. WHO estimates that 10-20 million serious infections, of which approximately 1 million are fatal, are caused each year through re-use of, and accidental needlestick injury with, contaminated syringes and needles.

Always follow national policies regarding the use of sterilisable syringes and needles and sterilisation. If national policies are not available, use the following guidelines for sterilising reusable syringes and needles.



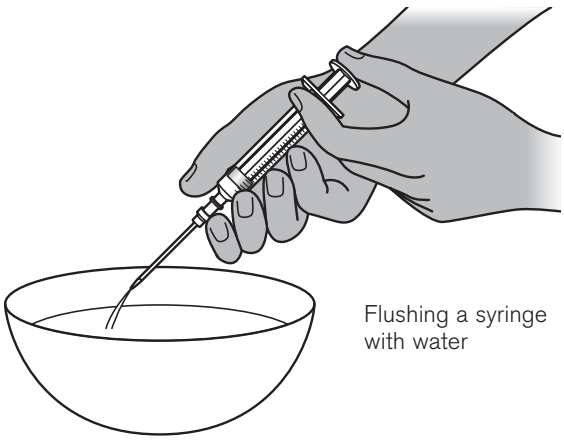
Parts of syringe and needle

Before sterilisation

Preparing reusable syringes and needles for sterilisation involves two steps, soaking and cleaning.

Soaking

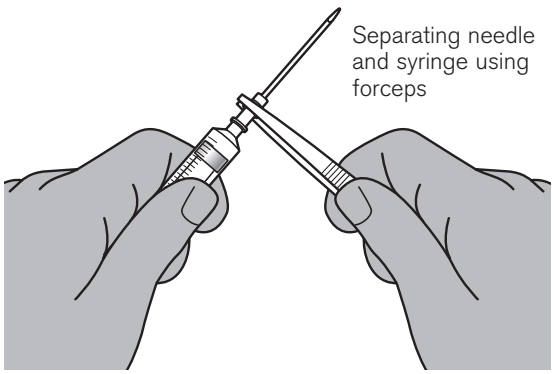
- Immediately after the injection, flush the needle and syringe with clean water 4-5 times. This prevents the needle from becoming blocked.
- Soak used needles and syringes in a bowl of cold, clean water. This makes them easier to clean. To prevent needle-stick injuries, lay the syringes side by side in the container, so that all the needles are pointing in the same direction.



Flushing a syringe with water

Cleaning

- Just before sterilising, pour away the water used for soaking and refill the container with clean water.
- Remove needles from syringes using forceps (to avoid accidental needlestick injury).
- Leave the needles in the water until you are ready to clean them.
- Flush the syringe 3-4 times, separate the barrel and plunger and rinse both in the basin.
- Check that the plunger seal fits inside the syringe barrel properly and you can read the scales on each syringe before loading them into the steriliser. If not, dispose of the syringe.

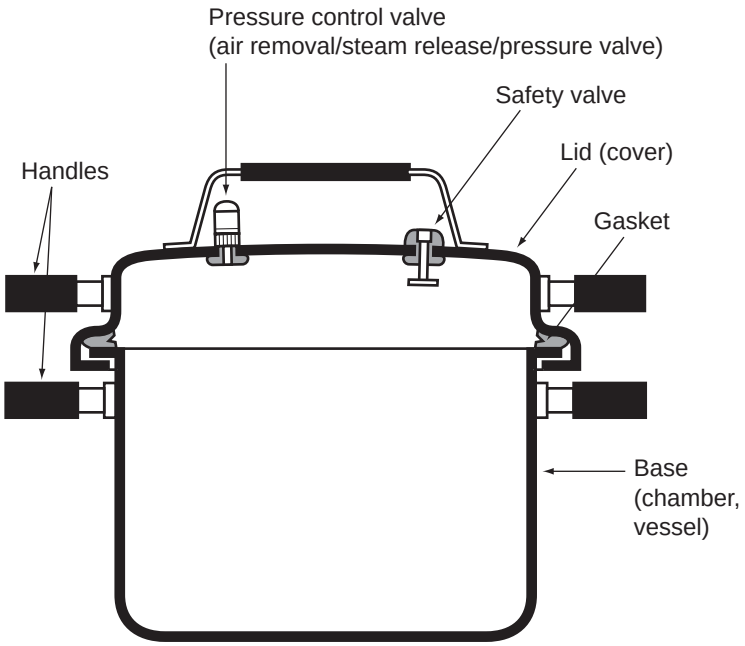


Separating needle and syringe using forceps

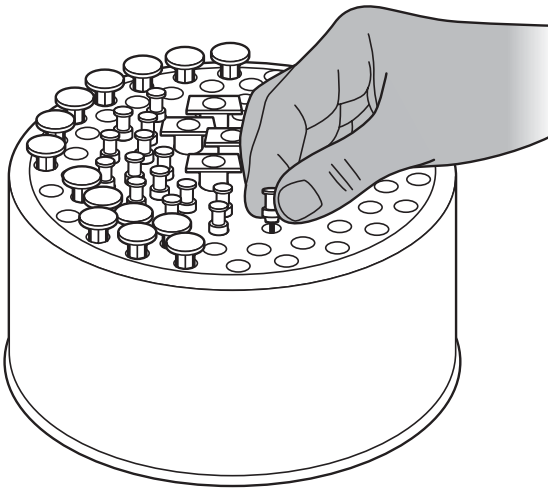
- Use forceps to attach the needle to a clean 5ml syringe. Flush the syringe and needle with water several times. Dispose of blocked needles.
- Test each needle for barbs (hooks) by drawing it across some cotton wool or gauze. If it is barbed it will catch and a wisp of cotton or gauze will stick to it. Throw away barbed needles, because an injection with barbed needle is painful, damages tissues and causes infections.

Sterilisation

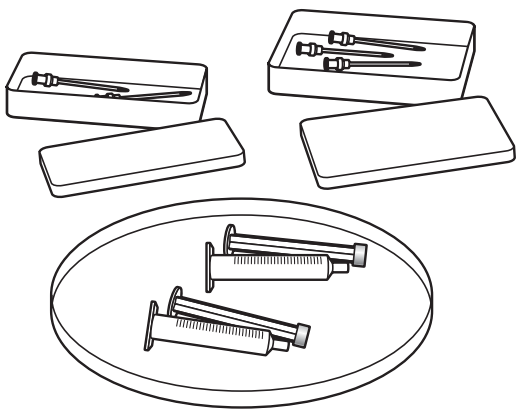
Sterilise syringes and needles using a pressure cooker type steriliser. Table 2.13 describes the steps in loading the steriliser for EPI and general injections and the sterilisation process (see also Table 2.12 and Section 3.1).



Parts of a pressure cooker type steam steriliser



Loading the syringe and needle rack



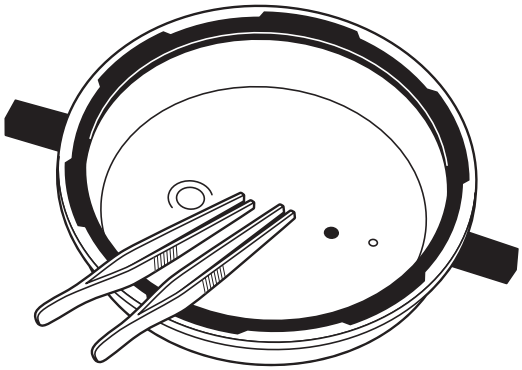
Loading a tray and needle cases

Table 2.13 **Sterilising syringes and needles**

EPI programmes	General injections
When loading the steriliser, whether using a rack or drum, follow these steps: • Place syringe barrels in the largest holes of the steriliser rack, plungers into medium-sized holes, and needles, pointing downwards, into the smallest holes. To make assembly after sterilisation easier, place syringes near the appropriate needles, e.g. BCG needles near BCG syringes. • Fill the steriliser with water up to the water level mark on the inside of the steriliser base. If you are using a hard water pad, place this in the water. • Place the loaded rack(s) in the steriliser, put a TST indicator on top of the syringes and needles. Put the lid on the rack and place two forceps on the lid (with double or triple rack sterilisers on the top rack lid only). If using a steriliser drum, make sure the vents (holes) are open and position the forceps in place. • Before sterilising, check the small pin in the safety valve is down and the pressure control (pc) valve is opened by pushing up the lever. After a few minutes of heating, the water will boil and steam will start to escape from the pc valve. Set the timer for 5 minutes. During this period, air is flushed from the steriliser with steam. The steam can be heard escaping and forms a strong and steady jet. When the timer rings, close the pc valve by pushing down the lever. Start timing for 15 minutes, turn the heat down making sure steam can still be clearly heard escaping from the pc valve at all times. In total there should be 20 minutes of uninterrupted steam. • At the end of sterilisation time, turn off the heat and open the pc valve to release the steam and allow the pressure to reduce (if the steam is not released you will not be able to open the steriliser). After all the steam has escaped, close the pc valve so that sterility is maintained. Leave the steriliser and its contents to cool for at least 1 hour. • Before using the sterilised supplies, check the TST strip to make sure sterilisation has been satisfactory	When loading the steriliser, follow the instructions for loading the EPI steriliser, if using a steriliser syringe rack or drum designed for 2ml and 5ml syringes OR place the syringe parts (barrel and plungers) and needles held in uncovered needle case in the instrument trays or the instrument container. Do not pack the trays or container or the needle case too tightly. The steam must be able to move freely during the sterilisation process. • Fill the steriliser with water up to the mark on the inside of the base. If using a hard water pad put it in the water. Position the V support, trivet or shelf in the water and place the loaded trays or instrument container on top of it. Place the TST indicator in the middle of the load. Put the lid or tray on and position the forceps on the lid. • Before sterilising, check the small pin in the safety valve is down and the pressure control (pc) valve is opened. The lever of the pc valve is pushed up. After a few minutes of heating, water will start boiling and steam will start escaping strongly from the pc valve. Set the timer for 5 minutes. During this period, air will be flushed from the steriliser with steam. The steam can be heard escaping and forms a strong and steady jet. When the timer rings, close the pc valve by pushing down the lever. Start timing for 15 minutes, turn the heat down making sure steam can still be clearly heard escaping from the pc valve at all times. In total there should be 20 minutes of uninterrupted steam. • At the end of sterilisation time, turn off the heat and open the pressure valve to release the steam and allow pressure to reduce. If the steam is not released you will not be able to open the steriliser. After all the steam has escaped close the pc valve so that sterility is maintained. Leave the steriliser and its contents to cool for at least 1 hour. • Before using the sterilised supplies, check the TST strip to make sure sterilisation has been satisfactory.

After sterilisation

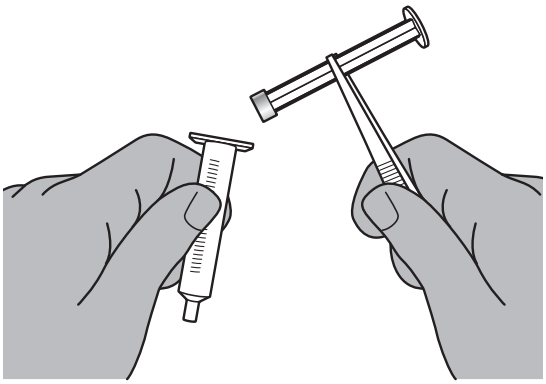
After sterilisation either reassemble syringes and needles for use or store them so that they remain sterile. Before using the sterilised syringes and needles, check the TST tape to make sure sterilisation has been satisfactory.



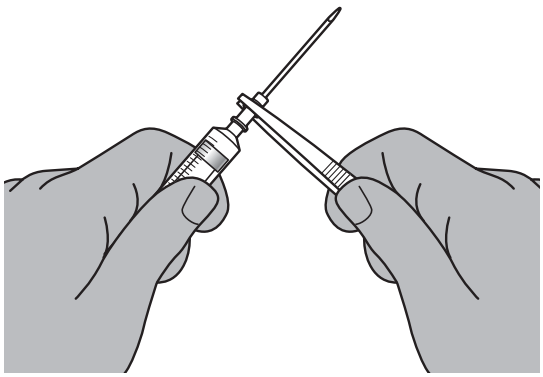
Sterile forceps resting on the steriliser lid

Assembling directly from the steriliser and steriliser drum

- Do not open the sterilised unit until you are ready to use the sterilised syringe and needle.
- Take the lid off the base and put it upside down on the table.
- Move sterile forceps to the lid but do not touch the tips of the forceps with your hands. Place the forceps so that the tips lay inside and the handle rests on the edge of the lid. This way you can pick up the forceps without contaminating the inside of the lid.
- Use the forceps to pick up the barrel. Hold the barrel in your hand being careful to touch only the outside not the hub.
- Pick up the plunger with the forceps and fit it into the barrel. Do not touch the plunger shaft or seal.

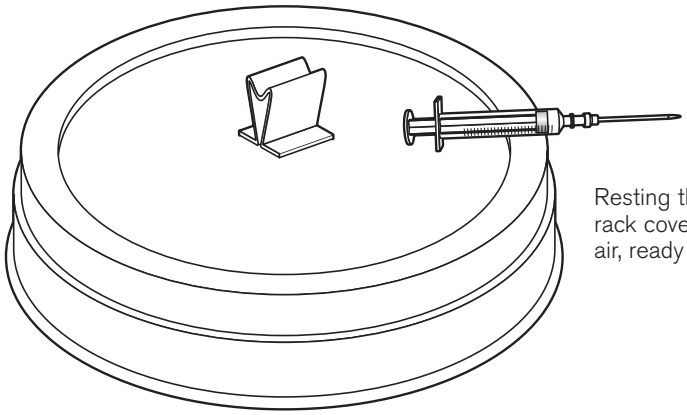


Fitting the plunger into the barrel using sterile forceps



Fixing the needle into the syringe using sterile forceps

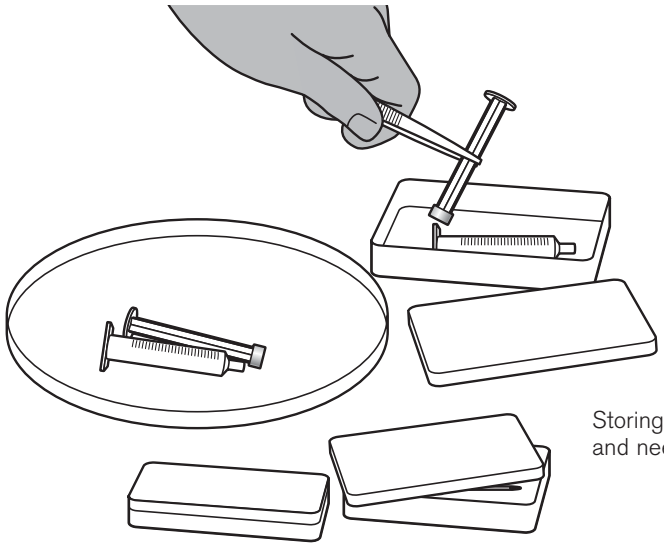
- Use the forceps to pick up the needle by its hub and to fit the needle on the syringe. Turn the needle to fix it securely
- Be careful not to touch the needle shaft or bevel.
- Place the syringe and needle down on the lid so that the barrel is on the lid, and the needle sticks up in the air and does not touch the lid or anything else.



Resting the syringe on the rack cover with needle in the air, ready for use

Storing

- Once sterilised, syringes and needles must remain sterile until they are used.
- If you have sterilised syringes and needles using racks, keep the steriliser closed until you are ready to use them. (The steriliser can be carried as a sterile unit to the immunisation and injection sessions).
- If you have sterilised them using a drum, remove the drum and seal it by closing the vents. This will keep the contents sterile. (The sealed drums can then be carried to the immunisation and injection sessions without the steriliser).
- If you have sterilised them using trays or baskets, keep the steriliser closed until you are ready to use the needles and syringes. Or remove using sterile forceps to lift out the barrels and plungers and to place them in a sterilised container. Put the lid on the container and store until required.
- Take out any uncovered needle cases and their covers and close. If you are not using needle cases, take out the needles using sterile forceps and place in a sterile container. Put on the lid and store until required.



Storing sterilised syringes and needles

Assembling from stored sterile containers

- Do not open the sterilised unit until you are ready to use the sterilised syringe and needle.
- Take the lid off the container and put it upside down on the table.
- Use sterile forceps to pick up the barrel. Hold the barrel in your hand being careful to touch only the outside, not the hub.
- Pick up the plunger with the sterile forceps and fit it into the barrel. Do not touch the plunger shaft or seal.
- Use the sterile forceps to pick up the needle by its hub and to fit the needle on the syringe. Turn the needle to fix it securely.
- Be careful not to touch the needle shaft or bevel.
- Place the syringe and needle on the lid so that the barrel is on the tray or lid, and the needle sticks up in the air and does not touch the tray or lid or anything else.

Practical tips for sterilising syringes and needles

- Never use soap, detergents or chemical disinfectants for soaking or cleaning sterilisable syringes and needles. Traces of these chemicals left on syringes and needles can cause irritation and inactivate vaccines.
- Sterilisable plastic syringes are recommended because they are inexpensive, can be sterilised and are not fragile like glass syringes.
- Reusable syringes should last for 200 sterilisation cycles and reusable needles for 50 sterilisation cycles. However, hard water salt deposits reduce the life of reusable syringes, and in hard water areas they will only last for about 140 sterilisation cycles. Using hard water pads during sterilisation can help to extend the life of reusable syringes.
- After sterilisation you can touch the outside of the barrel, the outside of the hub of the needle or the button of the plunger, but never touch needles with your fingers or with anything else that is not sterile.
- Always wash your hands with soap and water before sterilising or touching sterilised items.
- Ideally, clean and sterilise needles and syringes immediately after an immunisation or injection session. If this is not possible, clean immediately after and sterilise the next morning.
- If you have to sterilise syringes and needles during an immunisation session, allow them to cool before use because hot syringes and needles can destroy or inactivate vaccines.
- Never try to sterilise and re-use disposable syringes and needles. The high temperatures required for effective sterilisation damage disposable syringes and needles.

Practical tips on using and re-using gloves

Health workers should:

- Wear gloves to protect against infection during certain patient procedures, e.g. assisting during delivery, or handling soiled and contaminated material, e.g. blood and other body fluids.
- Use sterile gloves for sterile procedures, e.g. during suturing or surgery.
- Use clean gloves for other procedures not requiring sterile gloves.
- Change gloves between patients and only use a pair of gloves once.

If there are not enough disposable gloves for a 'one use' only approach, wash and disinfect gloves carefully between use:

- Examine gloves carefully and dispose safely of damaged gloves, e.g. gloves that are peeling, cracked, have tears or punctures. To check for tears or punctures:
  - Gently blow into the gloves until they are full of air, twist the cuff and hold them under clear water. If the gloves have holes you will see air bubbles under the water

  OR

  - Fill the gloves with clean water, twist the cuff and squeeze them to see if they leak.
- Wash intact gloves with clean water but not with soap, before disinfection. Soap makes latex sticky and easy to break.
- Disinfect the gloves by boiling for 20 minutes OR soaking them overnight in bleach (sodium hypochlorite) solution. Good quality latex gloves can be disinfected using either of these methods five or more times.
- Gloves can be sterilised, but only if you have the equipment to sterilise and package them to keep sterile.
- Dry gloves out of direct sunlight. Sprinkle gloves inside with talcum or starch powder when dry and before re-use, to re-lubricate them.

2.5 Disposal of waste

Waste disposal is essential in all settings, including those with limited resources where staff may be reluctant to throw away supplies, such as disposables, which are seen as 'still functional' and valuable.

Proper management of waste products helps to keep the health facility clean and tidy, prevents the spread of disease, reduces the risk of injury, and prevents re-sale and re-use. Incorrect management of waste places waste handlers, health workers and the community at risk of infection and injury.

Waste handling and management

Waste handling, treatment and disposal methods must be practical, safe, affordable, appropriate and sustainable. To ensure proper management of waste:

- Adopt a safe disposal policy that conforms to national guidelines. If these are not available you can adapt WHO guidelines.
- Ensure you have sufficient funds in your budget for proper waste management.
- Involve staff in developing policy and protocols for collecting and handling waste.
- Train all facility staff, including cleaners and handymen, in proper waste collection, handling and disposal and explain the health risks of unsafe practices.
- Assign responsibilities for waste collection, handling and disposal. This includes appointing an official waste handler to collect and manage waste, and making sure health staff sort the waste they produce into categories for different disposal methods.
- Provide staff with the equipment and clothing they need to manage waste correctly and to protect their safety. Provide waste handlers with protective clothing (overalls), heavy duty gloves and boots; provide clinic staff with disposable gloves, and provide goggles to those responsible for incineration to protect their eyes.
- Monitor waste management activities.

Waste collection, treatment and disposal

Waste material should be sorted, ideally at the site where it is generated, for collection. In some urban areas, the MoH may collect waste for centralised treatment and disposal. Waste should be placed in sealed bags for transport. If there is no collection service, seperate waste into material for incineration, burning or burying and, where appropriate, recycling or re-use.

Collect waste daily and take it to a secure, safe central collection or storage point for treatment and/or disposal. Never deposit waste in the open or on the surface of open dumps. Follow these practical guidelines:

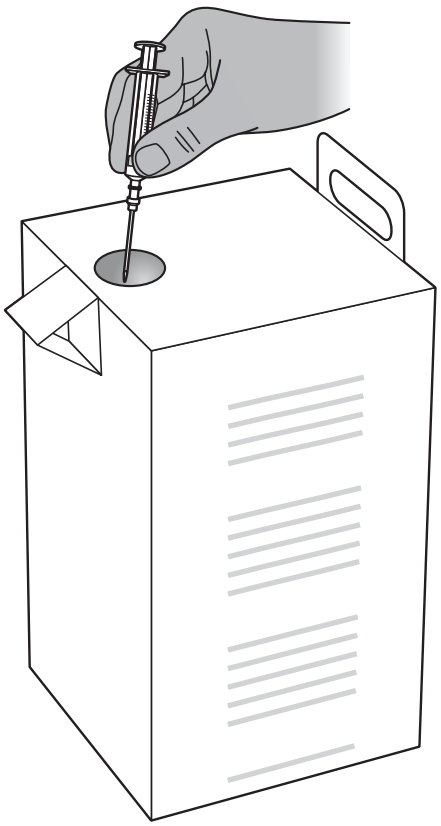
- Collect waste in good quality metal or plastic buckets which have a close-fitting lid or in strong, leakproof plastic bags.
- Make sure you have enough containers to be able to replace full buckets with clean, empty ones.
- Keep containers covered to avoid attracting flies and rodents.
- Replace containers before they become too full.
- Clean and disinfect buckets between use. If you use chlorine for disinfection, use plastic buckets because chlorine causes metal buckets to rust.
- Dispose of waste regularly. Waste should not be stored for more than 24-48 hours before disposal. In very hot climates, organic waste such as organs and placenta should be disposed of immediately if possible.
- Reusable or recyclable materials, e.g. plastic, metal and glass items, should be kept separate from other categories of waste for decontamination before re-use.
- Set aside and designate a specific place as the disposal site. The site should be at least 30m away from the health facility and from drinking water sources, to avoid contamination.

- Put up a fence around pits or incineration sites. This should secure and protect against theft and scavenging and prevent accidents and entry of animals and unauthorised persons.

Treatment and disposal methods depend on the type of waste. Different methods of waste treatment and disposal are summarised in Table 2.14 and different types of waste are summarised in Table 2.15.

Collection and disposal of sharps waste

Sharps are items that can pierce the skin, for example needles, lancets and scalpels. As noted in Section 2.4, health workers and patients are exposed to the risk of infection through sharps injuries from used needles and re-use of contaminated needles and syringes. Proper disposal of sharps, in particular needles and syringes, is therefore extremely important and methods for collecting sharps waste are described below. These methods, designed to be used where sharps waste is generated, e.g. dressing room, ward or immunisation site, could minimise the risk of accidental needlestick injuries by reducing the need for health workers to recap needles. These methods also reduce the risk of infection from re-use of disposable needles and syringes by encouraging disposal at point of use.



Puncture proof safety box

Safety box

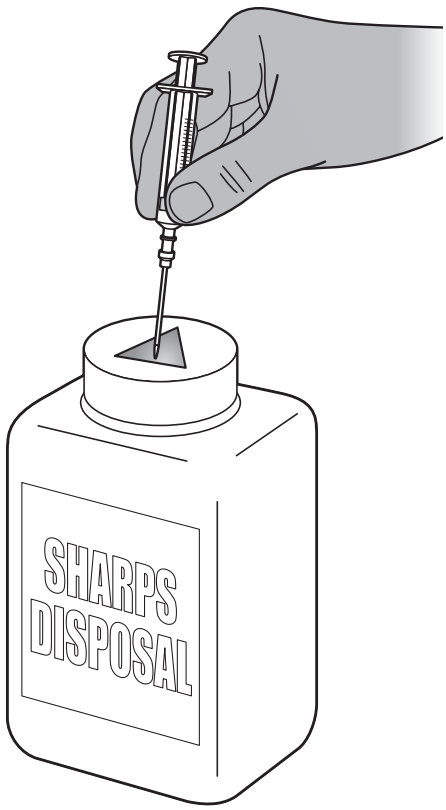
Safety boxes are special boxes for collection of used needles and syringes. They come as flat packs for ease of storage and transport, but are also available as rigid plastic containers in a range of styles and sizes. When the box is nearly full, it is sealed and disposed of by incineration, burning, or burying in a deep pit.

Whereas safety boxes are used for collecting needles and syringes, the three methods described below minimise the volume of sharps waste by separating syringes (non-sharps) from needles (sharps).

Puncture resistant container

Puncture resistant containers can be locally and cheaply made from sealable, thick plastic or metal containers, for example, old tablet bottles. A small hole is cut in the lid, and the needle part of the 'syringe and needle' is put into the hole and allowed to slide towards one of the corners of the container so that the hub is under the lid. When the syringe is pulled up, the needle falls into the container.

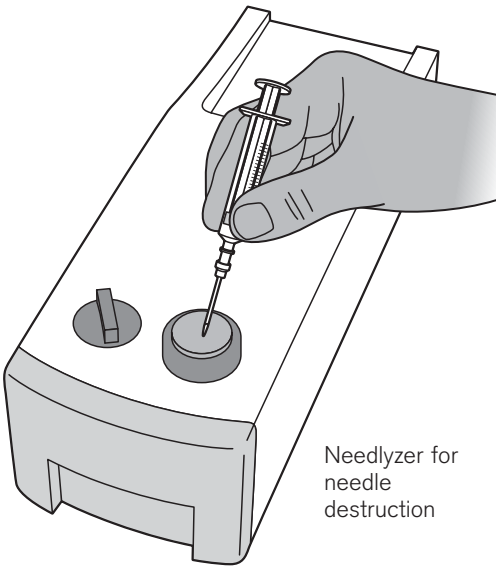
The small hole in the lid prevents sharps spilling out if the container is knocked over, reduces the risk of accidental needlestick injuries or re-use, and decreases the amount of sharp waste by separating syringes from needles. When nearly full, the hole is taped over and the container is incinerated, burned, or buried in a deep pit. Used syringes should be treated as infectious waste and incinerated or burned.



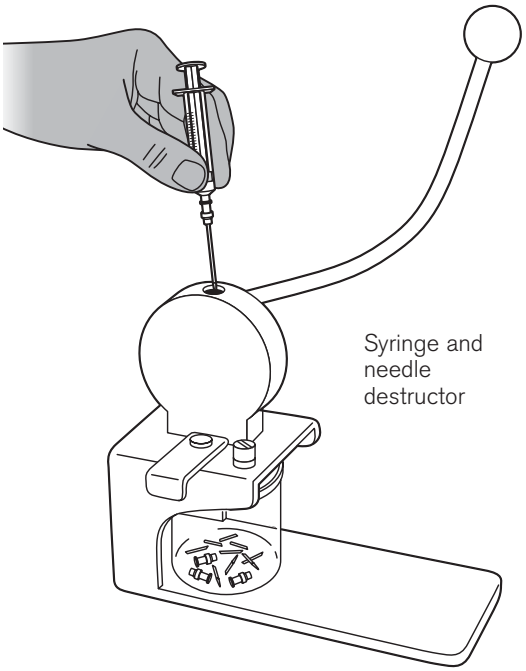
Puncture resistant container

Needlyzer

A Needlyzer is a device that destroys the needle all the way up to the hub and totally eliminates the sharp. The needle is destroyed by being oxidised while it is still attached to the syringe, butterfly, vacutainers, tubing etc. The Needlyzer is powered by a rechargeable battery and can destroy up to 30 needles per second. Granular powder generated by the oxidisation process is collected in a small replaceable cartridge, which has the capacity to hold debris from 3,000-5,000 destroyed needles. The syringe is left intact and, again, should be treated as infectious waste.



Needlyzer for needle destruction



Syringe and needle destructor

Balcan destructor

The Balcan destructor is a manually-operated device made of specially hardened stainless steel that renders both needle and syringe unusable. It has a hole at the top into which the full length of the needle is inserted. Pushing the destructor handle in one motion cuts the hub of the syringe and chops the needle into several pieces. The debris is collected in a pot fitted and secured underneath the destructor.

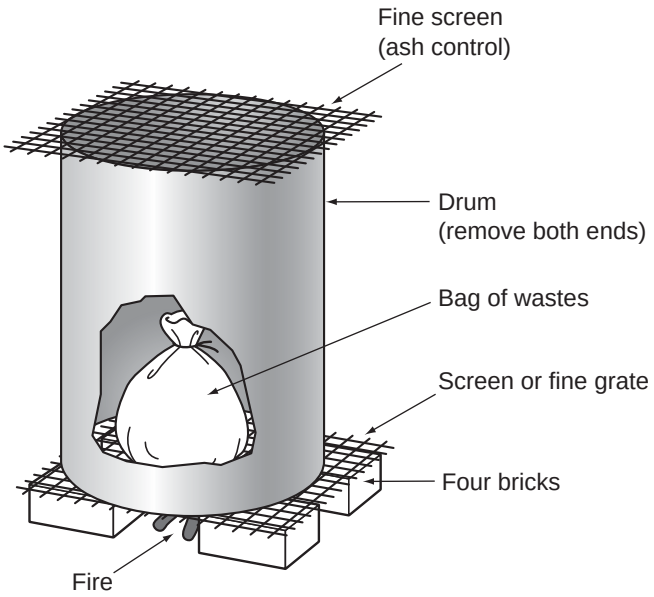
When the pot is full it is sealed with a lid and incinerated, burned or buried. The destructor pot can hold approximately 250 chopped needles. Remember that cut needles are still sharps and should be treated as such. Syringes that have been rendered useless can be disposed of as common waste and do not need to be incinerated or burned.

The Balcan destructor is also suitable for use with reusable syringes that can be sterilised. It has a simple mechanism that allows needles to be safely removed and destroyed, leaving the reusable syringe intact.

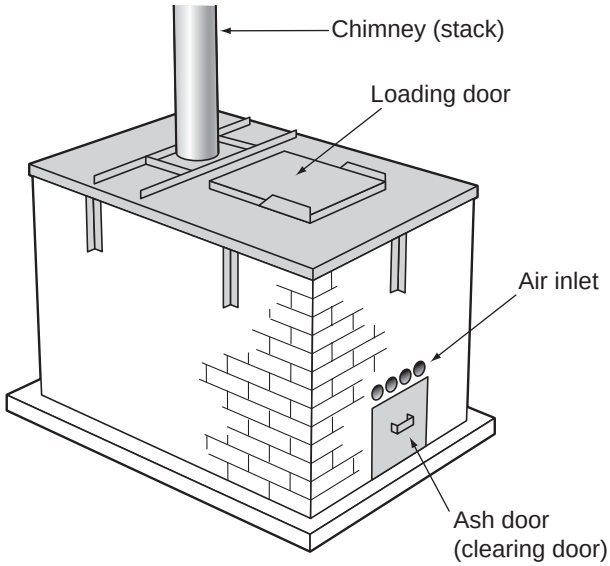
Table 2.14 **Different methods of waste disposal**

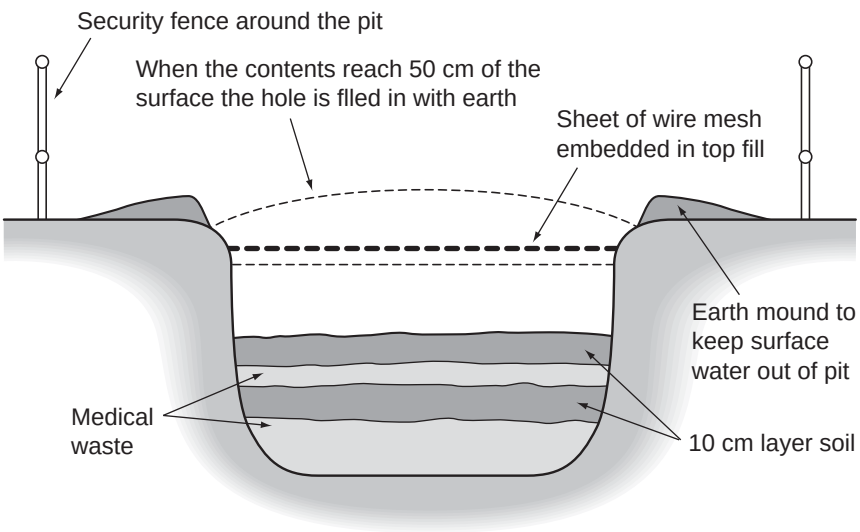
Method	Comments	Advantages	Disadvantages
Incineration	Incineration is often the simplest and most appropriate waste disposal method, although not necessarily in urban settings or small facilities. Incineration should be carried out at least twice a week. Suitable on-site options include a simple, low-cost, low-maintenance, 2-chamber incinerator that uses locally available fuel, can reach a temperature greater than 800°C, is easy to operate and maintain, and can incinerate approximately 10kg of waste per hour, e.g. the DMU incinerator or the Medcin 400: – DMU incinerator, designed to be built on site using bricks, firebricks and steel, uses local fuel (wood or charcoal or kerosene or diesel). – Medcin 400, pre-assembled, gas incinerator. See Appendix 1 for more information.	• Reduces volume and weight of waste. • Makes waste unusable. • Prevents scavenging • Decontaminates and produces less hazardous waste and non-infectious debris. • Does not require highly trained operators, but staff must be trained in safe and correct use of incinerator.	• Running costs, e.g. fuel, may be too high for some health facilities. • Not environmentally friendly.
Burning	Burning is one of the most common methods of waste disposal and is an acceptable alternative if incineration is not possible. Burning waste in a shallow pit or drum, e.g. the Dunsmore drum burner, is safer for operators and less of a hazard than uncontrolled open burning. After waste burning is completed, ash and other debris should be removed from the drum or pit and buried safely. – Dunsmore drum burner, 210 litre steel drum, with both ends removed, placed over a fire. (Other fire-resistant material, e.g. a large section of clay pipe, can be used instead of a steel drum). Burns one bag of waste at a time. A strong metal grate holds the burning waste above the fire, and a fine screen on top of the drum prevents ash blowing out.	• Reduces volume and weight of waste. • Makes waste unusable. • Prevents scavenging. • Produces less hazardous waste and non-infectious debris. • Low cost.	• Can be difficult to burn waste completely without generating smoke and to maintain a high temperature. • Partially destroyed or decontaminated waste material can be hazardous. • Requires mixing with material that burns easily, e.g. wood shavings. • Not environmentally friendly.
Burying in a deep pit	The pit should be 4-5m deep and 1-2m wide and its boundary lined with material, e.g. clay that prevents pollution of drinking water sources. Only use in areas where there is no risk of flooding, the water table is low and will remain at least 1.5-2m below the base of the pit even during the rainy season. Cover each load of waste with a layer of soil, leaves or ash to prevent bad smells, avoid attracting insects and rodents, and to speed up decomposition. Protect the pit and prevent accidents with a tight-fitting cover over the opening. You may need more than one pit if your facility produces a lot of waste.	• Low cost. • Relatively safe, if waste is buried properly.	• Can pollute water if the soil is permeable or the pit is too close to the water table. • Only practical for a short time. Once available space is filled a new pit is needed. • Must be protected with a fence or guarded to prevent scavenging.
Encapsulation	Encapsulation involves filling a plastic or metal container with waste, adding 'immobilising' material, e.g. cement mortar, clay or bitumous sand, when the container is about ¾ full, waiting for the material to dry, then sealing and burying the container.	• Simple and safe. • Suitable for drugs, chemicals, sharps. • Prevents scavenging. • Reduces water source pollution risk.	• Can be costly. • Not recommended for infectious or non-sharps waste, because of the large volumes involved.

Dunsmore drum burner
for health care waste



DMU incinerator for mixed
health care waste





Burial pit for health care waste

Table 2.15 **Different types of waste**

Waste type	Disposal method	Comments
Infectious waste Waste contaminated by blood, body fluids, laboratory cultures, dressings and other materials that have been in contact with infected patients	Incineration Burning	Collect in good quality plastic or metal buckets with close-fitting lids or leakproof plastic bags. If possible, use double packaging, e.g. plastic bag inside bucket. Keep buckets covered, empty them when they are almost full, clean and disinfect between use. Collect infectious waste and general medical waste together rather than seperately (see below). Certain infectious waste, e.g. sputum from TB patients should be disinfected before disposal in accordance with national guidelines.
General medical waste Syringes (without needles), bandages, swabs, paper, gloves	Incineration Burning	Collect in a good quality plastic or metal bucket with a close-fitting lid, along with infectious waste. Incinerate or burn used syringes that have been separated from needles. Do not bury waste that will not decompose, e.g. plastic or metal items. Incineration or burning reduces the volume of waste.
Drugs and vaccines Expired, damaged or spoilt, unused, unidentifiable	Return to supplier Incineration Burning Encapsulation Discharge to sewer Pit latrine	Follow national procedures for dealing with expired, damaged and unidentifiable drugs and vaccines. Keep a register of action taken or disposal method. Inform your supervisor. It is important to dispose of drugs and vaccines carefully to prevent pilfering, re-sale and re-use of expired or ineffective drugs and vaccines. For this reason, do not throw them away in their original packaging. Collect in lockable containers and keep separate from other supplies in a secure, locked place. Dilute mild cough mixtures, IV solution, eye drops with large amounts of water and pour down the sink or into a pit latrine. Pour in more water after disposal. Incorrect disposal can potentially contaminate water supplies. In practice, expired or damaged items that were supplied by the government health system, should be returned to the district store for disposal. Mark items as 'expired' or 'damaged' when returning to sender. Incineration and burning is only suitable for disposing of small quantities of drugs, but could be used for expired or damaged drugs provided from sources other than MOH, when it would be too expensive to return to sender. If drugs are still usable, try to find another health centre that can make use of them.
Chemical waste Unused, expired reagents, disinfectants	Incineration Burial in deep pit	Collect in a good quality plastic or metal bucket with a close-fitting lid. Follow the same disposal methods as for infectious waste if you have the authority to dispose of chemical waste or, preferably, return reagents and undiluted and expired disinfectants to the district store.
Waste containing heavy metals Batteries, BP gauges, broken thermometers	Recycling Encapsulation Burial in deep pit	Collect in a good quality plastic or metal bucket with a close-fitting lid. Do not burn or incinerate because waste containing heavy metals is toxic and pressurised containers may explode. Encapsulation is the safest method for dealing with this type of waste.
Delivery waste Placenta, aborted foetus	Pit latrine Placenta pits	Collect in plastic bags or, if not available, plastic buckets with close-fitting lids. Health workers should only deal with placenta or aborted material if this is culturally acceptable. In some cultures, the family will want to take the material home.

Waste type	Disposal method	Comments
Sharps Needles, needles and syringes, blades, scalpels, broken glass, ampoules, infusion sets	Incineration Burning Encapsulation Burial in deep pit	Sharps are hazardous and need careful handling, as there is a risk of needlestick injury, cuts and puncture wounds, and of infection of these wounds if sharps are contaminated or through subsequent handling of waste. Dispose of single use needles and syringes after one use and of reusable needles and syringes when these are damaged or worn out. Never recap or remove used needles from the syringe by hand. Collect used sharps in safety boxes or puncture resistant sealable containers, not flimsy cardboard boxes. Keep containers close to where sharps waste is generated. Tape over the hole and dispose of the container when it is nearly full. Throw it into a deep pit, incinerate or burn. Destruction by incineration at a temperature above 800°C (lower temperatures will just make the sharps soft and pliable) is the best method, although care is needed to avoid potential needlestick injuries when emptying the incinerator. Sharps, including needles in containers, should be mixed with other waste before incinerating or burning.
Organic waste Food and vegetable matter	Compost pit Organic waste pit	Collect in a bucket with close-fitting lid. Biodegradable waste, including animal dung, can be composted and used as fertiliser after 4-6 months.
Cholera waste Cholera stools and vomit	Chemical disinfection Pit latrines Burial in deep pit Incineration Burning	This is highly infectious waste. Put liquid waste (stools and vomit) in a pit latrine or bury it. Disinfect it first by mixing it with disinfectant, such as cresol, lysol or bleach. Incinerate semi-solid waste. If this is not possible, burn then bury it. Collect cholera waste separately and keep it separate from other waste, if possible in single use plastic bags. Disinfect buckets and containers used for collecting all types of cholera waste, preferably with 150ml of 2% chlorine, each time after emptying.