3 Ensuring safe injections

About this module…

This module discusses practices that health workers should follow to ensure that they deliver immunization injections in the safest manner.

Injections are considered safe for:

- the *child*, when health workers use sterile needles and syringes and appropriate injection techniques;
- the *health worker*, when he or she avoids needle-stick injuries; and
- *waste handlers* and *the community*, when used injection equipment is disposed of properly and does not cause injuries or pollution.

Contents

1 Using safe injection equipment and techniques

1.1 Types of injection equipment

The types of equipment used to administer injectable vaccines are listed in Table 3.1. Note that auto-disable syringes are the endorsed choice, as explained in the 1999 joint WHO-UNICEF-UNFPA statement given in Box 1.

Table 3.1 Types of equipment used to administer injectable vaccines

Equipment	Remarks
Auto-disable (AD) syringes	equipment of choice
Prefilled AD injection devices	available for some antigens only
Reusable syringes and needles	not recommended
Hypodermic syringes with reuse prevention feature (RUP) and needles	for mixing purposes only

Box 1. WHO-UNICEF-UNFPA joint statement on the use of auto-disable syringes in immunization services

"The auto-disable syringe, which is now widely available at low cost presents the lowest risk of person-to-person transmission of bloodborne pathogens (such as HepB or HIV) because it cannot be reused. The auto-disable syringe is the equipment of choice for administering vaccines, both in routine immunization and mass campaigns."

Auto-disable (AD) syringes for immunization

AD syringes are recommended for all types of immunization sessions not just because they can only be used once and can reduce disease transmission from contaminated equipment, but also because they are disposable and save time previously spent on sterilization.

AD syringes for fixed-dose immunization have the following main features:

- a self-locking mechanism that allows only one use; this is called a reuse prevention feature (RUP)
- a fixed needle (usually 23G x 25 mm, but various sizes are manufactured)
- a specific scale mark showing only the quantity to be administered.

Each AD syringe is sterilized and sealed in plastic or paper blisters by the manufacturer. All AD syringes have plastic caps to keep the needle sterile; some also have caps on the plungers. They are supplied in three volumes: 0.5 ml for most vaccines and 0.05 ml or 0.1 ml for BCG.

AD syringes have different types of locking mechanisms that are triggered at different times. Some syringes lock their plunger at the start of the injection while others do so at the end. AD syringes that lock at the start are preferred since they completely prevent reuse. Some AD syringes are retractable, meaning that the needle can be pulled in the barrel. This mechanism adds stick injury protection (SIP) to reduce the risk of needle-stick injuries.

General steps for using AD syringes

Each type of AD syringe requires a specific technique for its use. But for all types, the plunger can go back and forth only once. Health workers should not move the plunger unnecessarily and should not inject air into a vaccine vial when using an AD syringe, as this might disable it.

The general steps to follow when using AD syringes are given below. Note that the steps should should be adapted depending on manufacturer's instructions for the type of syringe being used.

1. Remove the syringe from its plastic wrapping (peel the package open from the syringe plunger end), or detach the plastic cap.
2. Take off the needle cap without touching the needle.
3. Insert the needle in the vaccine vial – its tip should be in the lowest part or bottom of the vial.
4. Pull the plunger back to fill the syringe just past the 0.5 ml or 0.1 ml or 0.05 ml mark.
5. Remove the needle from the vial. To remove air bubbles, hold the syringe upright and tap the barrel. Then carefully push the plunger to the volume mark. For the last dose of a multi-dose vial, keep the needle tip in the fluid at all times, making sure to empty the full contents of the vial.
6. Proceed with the injection at the appropriate site (see Module 5 (*Managing an immunization session*), Section 4 for details on injection technique).
7. Push the plunger forward and inject the vaccine. At the beginning or just at the end of the injection, the plunger will automatically lock so the syringe cannot be reused.
8. Do not recap the needle after use.

9. Dispose of the needle and syringe in a safety box, which is a leak-proof, puncture-resistant container for sharps waste.

Hypodermic syringes with reuse prevention features (RUP)

RUP syringes are disposable syringes with self-locking mechanisms that allow only one use. They are the recommended choice for reconstituting vaccines, just as AD syringes are recommended for administering vaccines.

General steps for using RUP syringes for reconstituting vaccines

Just as with AD syringes, each type of RUP syringe requires a specific technique for its use. But for all types, the plunger can go back and forth only once and so health workers should take care not to move it unnecessarily.

General steps to follow when using RUP syringes are given below. Note that they should be adapted depending on manufacturer's instructions for the type of syringe being used.

1. Remove the RUP syringe from its wrapping (peel the package open from the syringe plunger end) or detach the plastic caps.
2. If there is a detachable needle, fit it onto the hub of the syringe and take off the cap without touching the needle.
3. Insert the needle in the diluent vial and move the tip of the needle to the lowest part or bottom of the vial.
4. Pull the plunger back to fill the syringe, making sure to empty the full contents of the vial.
5. Remove the needle and syringe from the vial. If needed, remove air in the syringe by holding it upright and pushing the plunger slowly until the air goes out.
6. Insert the needle and syringe into the vaccine vial.
7. Push the plunger in completely to ensure that all the diluent goes into the vaccine vial.
8. Remove the needle and syringe from the vial and ensure that the syringe is locked.
9. Dispose of the needle and syringe directly in a safety box.
10. Shake the vial to mix the diluent with the vaccine (see Module 5 (*Managing an immunization session*), Section 4 for details on reconstitution technique).

Prefilled AD injection devices

Prefilled AD injection devices are single-dose packets of vaccine with a needle attached (see Figure 3.1). This type of injection device can also be used only once. Some prefilled devices are equipped with a vaccine vial monitor. In addition to having the same advantages as AD syringes, they:

- are easy to use since no vaccine reconstitution is required
- prevent vaccine contamination
- make administering an accurate dose easy
- deliver vaccine and syringe in the same set (separate orders are not needed)
- reduce waste that can occur with multi-dose vials.

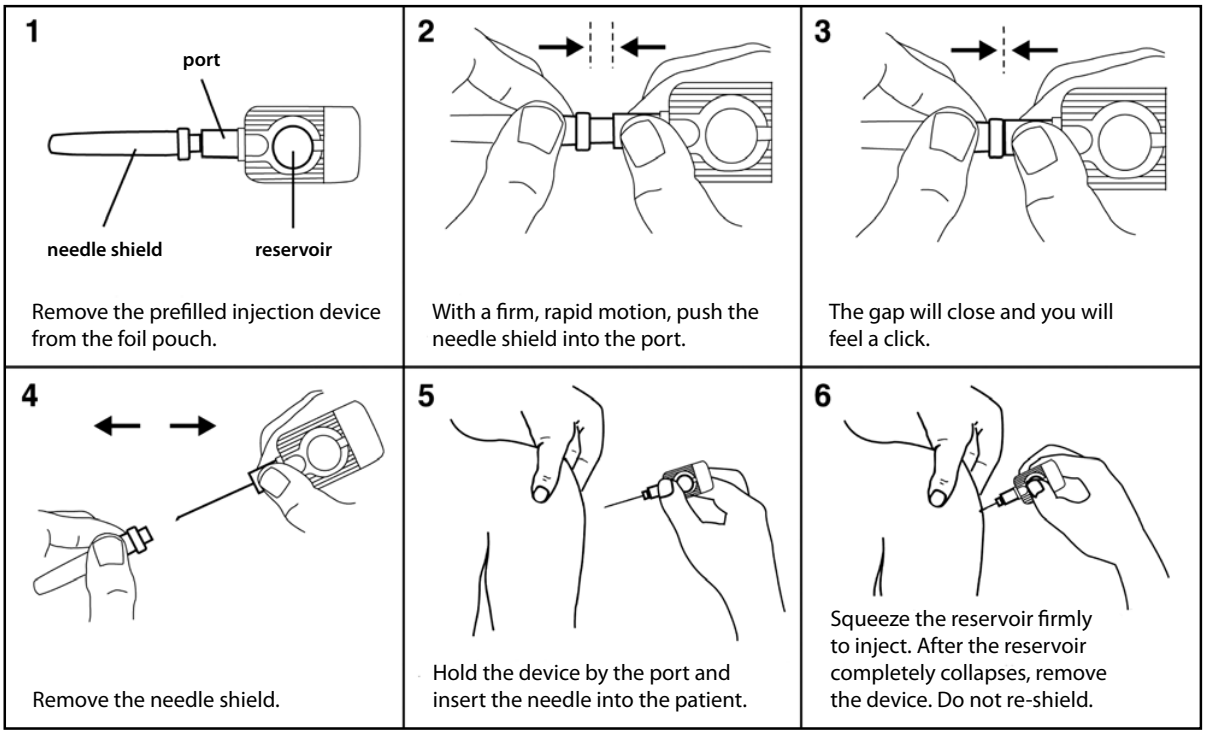
Prefilled hepatitis B, tetanus toxoid and pentavalent (DT(whole cell)P+HepB+Hib) AD vaccine injection devices are now available and prequalified by WHO. They are also called "cPAD", which stands for "compact, prefilled autodisable injection techonology". Prefilled hepatitis B AD devices are used primarily to provide home vaccination to newborns. Prefilled tetanus toxoid AD devices are used for home vaccination of women during mass vaccination campaigns.

General steps for using prefilled AD injection devices

Every prefilled AD injection device is sterilized and sealed in its own foil package by the manufacturer. The vaccine is contained in a sealed syringe or bubble-like reservoir that prevents it from coming in contact with the needle until its administration. Using it requires the steps below:

1. Prepare or activate the prefilled bubble-like injection device by pushing the needle shield (or cap) into the port as shown in Figure 3.1. This opens the fluid path between the needle and the reservoir that contains the vaccine.
2. Remove the needle shield.
3. Insert the needle into the injection site (see Module 5 (*Managing an immunization session*), Section 4 for details on injection technique).
4. Deliver the dose by squeezing the reservoir until it is empty.
5. Dispose of the used AD device directly in a safety box.

Figure 3.1 Activation and use of prefilled bubble-like auto-disable device



Sterilizable syringes and needles

Sterilizable syringes and needles are **not recommended** for use in immunization programmes.

Disposable syringes and needles that could potentially be reused

Disposable single-use syringes and needles that could potentially be reused because they do not have RUP devices are also not recommended for immunization programmes. The reuse of syringes and needles carries a high risk of transmitting infections. This risk prompted the 1999 WHO, UNICEF and UNFPA joint policy statement (see Box 1).

While RUP reconstitution injection devices are the equipment of choice for mixing vaccine with diluent, they may not always be available. If RUP devices are not available and disposable syringes and needles are used to reconstitute vaccine, they must never be reused for reconstitution or injection.

1.2 Estimating AD and RUP syringe needs

See Module 4 (*Microplanning for reaching every community*), Section 5 for details on estimating supply needs.

1.3 Giving the right vaccine safely

Proper vaccine storage and handling as well as clinical assessment and administration at immunization sessions are essential. Module 2 (*The vaccine cold chain*) discusses how to handle vaccines to ensure that they are safe and effective at the time of use. Module 5 (*Managing an immunization session*) contains details on assessing which vaccines are needed for each child and the techniques for their reconstitution and administration. Table 3.2 introduces some examples of incorrect immunization practices, and adverse events following immunization are discussed further in Module 5 and Module 6 (*Monitoring and surveillance*).

Table 3.2 Examples of incorrect immunization practices and possible adverse events following immunization

Incorrect practice	Possible adverse events following immunization
Non-sterile injection due to:	
• reuse of disposable syringe or needle • improperly sterilized syringe or needle • contaminated vaccine or diluent	Infections such as local abscess at injection site, sepsis, toxic shock syndrome, or death Transmission of bloodborne infections such as hepatitis or HIV
Reconstitution error due to:	
• inadequate mixing of vaccine • reconstitution with incorrect diluent • drug substituted for vaccine or diluent • inappropriate reuse of reconstituted vaccine at subsequent session	Local abscess at injection site Vaccine ineffective[a] Negative effect of drug (for example, insulin, oxytocin, muscle relaxants) Death
Injection at incorrect site such as:	
• BCG given subcutaneously • DTP/DT/dT/TT too superficial • injection into buttocks	Local reaction or abscess Local reaction or abscess Sciatic nerve damage
Vaccine transportation/storage incorrect such as:	
• VVM changed colour • clumping of adsorbed vaccine	Local reaction Vaccine ineffective[a]
Contraindications ignored	Avoidable severe reaction

[a] Strictly speaking, ineffective vaccine is considered to be an effect, not an adverse event.

1.4 Simple ways to improve injection safety

The following is a summary of points to improve injection safety that are discussed in more detail in Module 2 (*The vaccine cold chain*) and Module 5 (*Managing an immunization session*) and included here to emphasize their importance.

- Prepare injections in a clean, designated area that is free from blood and body fluid contamination.
- Prepare each dose immediately before its administration – do not prepare several syringes in advance.
- Never leave the needle in the top of the vaccine vial.
- Follow product-specific recommendations for storage, handling and use of vaccines.
  - Follow safe procedures to reconstitute vaccines. The correct diluent must be used for reconstituting freeze-dried vaccines.
  - Use only the diluent supplied by the manufacturer for each vaccine – check the labels.
  - Diluents must be cooled before reconstitution.
- Dispose of used AD and RUP needles and syringes in a safety box.
- Follow national multi-dose vial policy for opened vials.
- Use a new AD needle and syringe for every child:
  - Inspect the packaging very carefully.
  - Discard the needle and syringe if the package has been punctured, torn or damaged in any way.
  - Do not touch any part of the needle.
- Discard a needle that has touched any non-sterile surface.
- Position the child carefully to minimize risk of movement and injury.

Refer to Annex 3.1 for unsafe immunization practices that must be avoided.

2 Preventing needle-stick injuries

Needles can be dangerous. They can injure health workers and, if contaminated with hepatitis B, hepatitis C, HIV or other infections, they can transmit diseases.

Needle-stick injuries can happen at any time, particularly during and immediately after an injection. This risk is increased when:

- health workers recap needles or walk around carrying used needles
- children are not positioned properly during injections
- unsafe disposal practices leave people and/or animals exposed to used needles and syringes.

This section describes steps to prevent needle-stick injuries by addressing potential risks from handling equipment, workspace arrangement, positioning of children and waste disposal.

2.1 Minimizing the need to handle needles and syringes

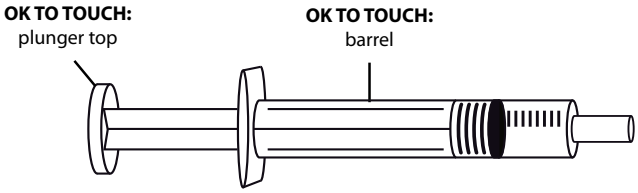
In general, the more injection equipment is handled, the greater the risk of needle-stick injuries. Reduce risk due to handling of equipment through the following steps.

- Place a safety box close to the person giving vaccinations so used needles and syringes can be disposed of immediately, easily and without walking to find a sharps container.
- Avoid recapping the needle. If recapping is absolutely necessary – for example, if the injection is delayed because the child is too agitated – use the one-hand technique of placing the cap on a table or tray and reinserting the needle by sliding it inside without using the other hand.
- Do not remove the used needle from the syringe with your hands.
- Do not carry used syringes and needles around the work site for any reason.
- When ready to administer, draw the vaccine into the syringe, give the injection and dispose of the syringe in the safety box without putting it down between steps.
- Close the safety box securely when it is three quarters full.
- Do not manually sort needles and syringes.

2.2 Handling syringes and needles safely

Any part of the syringe that is touched becomes contaminated. Although the barrel and plunger of a syringe have to be touched to prepare and give an injection (see Figure 3.2), care should be taken to avoid touching parts that come into contact with the vaccine or the child (see Figure 3.3).

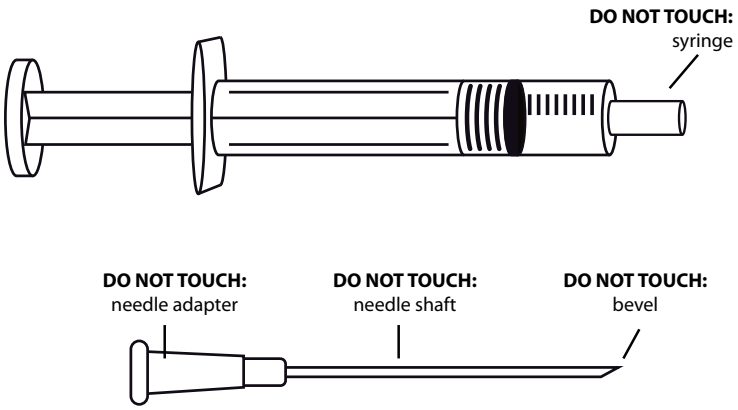
Figure 3.2 Parts of a syringe and needle that may be touched



Do not touch:

- the shaft of the needle
- the bevel of the needle
- the adapter of the needle
- the adapter of the syringe
- the plunger seal of the syringe.

Figure 3.3 Parts of a syringe and needle that must not be touched



IMPORTANT:
If any of these parts are touched, discard the needle and syringe and get new sterile ones.

2.3 Setting up the immunization work area to minimize risk of injury

To minimize risk of needle-stick injury, staff should arrange their workspace following general rules:

- The vaccinator (person giving doses of vaccine) should be between the child and all needles and sharp objects.
- The vaccinator should be able to see the opening of the safety box when discarding needles. The safety box may be on a table or the floor depending on whether the vaccinator is standing or sitting. He or she should be able to reach it easily and without much change in position.
- The vaccinator should be able to dispose of used needles and syringes directly in the safety box without putting them down on other surfaces.
- The vaccinator should have only one child – with caregiver(s) – at a time in their workspace.
- Each vaccinator should have a separate safety box, especially at busy sites.
- The vaccine carrier should be in the shade.
- Tally sheets should be within easy reach.

See Module 5 (*Managing an immunization session*) for more details and illustrations.

2.4 Positioning children correctly for injections

Unexpected motion at the time of injection can lead to needle-stick injuries. This may occur more often with children who are not positioned properly before injections are given. To minimize this risk, see Module 5 (*Managing an immunization session*) for details and illustrations on positioning children for vaccinations.

2.5 Practising safe disposal of all medical sharps waste

Used sharps must be placed in a safety box and then disposed of properly. Follow the procedures for safe disposal outlined in the next section of this module.

3 Disposing of used syringes and needles

3.1 Why is it important to handle sharps waste properly?

Sharps waste can cause serious health and environmental problems. Unsafe disposal can spread some of the very same diseases immunization programmes are working to prevent.

Dangers to health

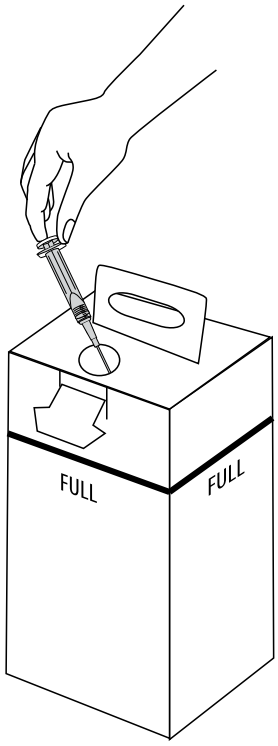
Leaving used syringes and needles in the open or on the ground puts the community at risk. Most frequently, children are the unfortunate victims of needle-stick injuries from haphazard disposal of needles.

Dangers to the environment

Inappropriate treatment of waste leads to environmental pollution. Open burning and low-temperature incinerators release toxins into the air; they should be used only as temporary emergency solutions when no other options are available. Throwing used needles and syringes into bodies of water can contaminate the natural environment and injure wildlife.

Figure 3.4 Safety box

When a safety box is not in use, close the opening on the top.



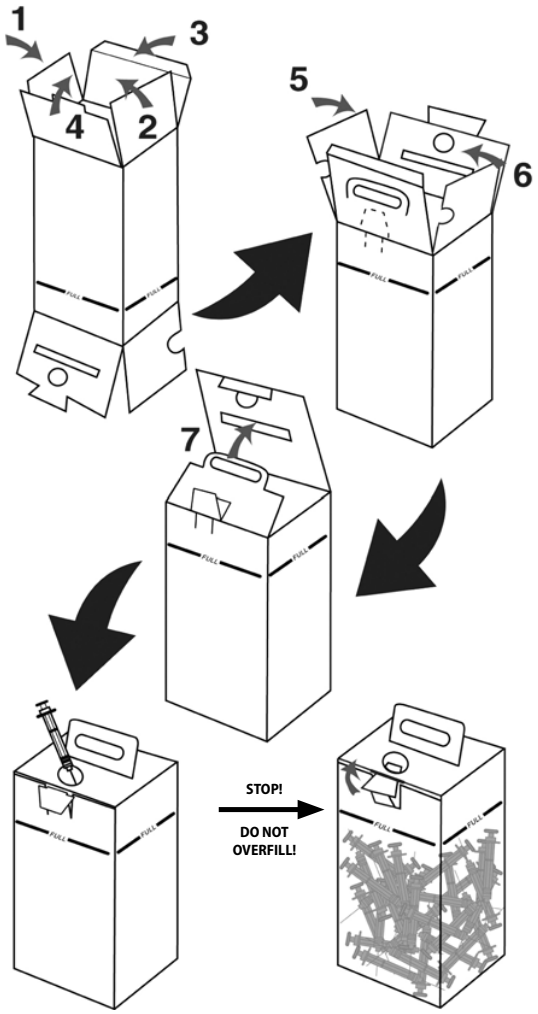
3.2 Safety boxes

All used disposable injection equipment should be disposed of in a safety box immediately (see Figure 3.4). Safety boxes are sharps waste containers that needles cannot pierce and that can be disposed of when full. Reusable, sterilizable sharps containers made of metal or heat-resistant plastic may also be available for use with autoclave shredder systems. If a safety box is not available, locally available materials can be used to create a functional and safe sharps container (see Figure 3.6).

How to assemble a safety box

Safety boxes require proper assembly before use, as shown in Figure 3.5. Many come with picture instructions printed on the side.

Figure 3.5 Safety box assembly and use



What to do if safety boxes are not available

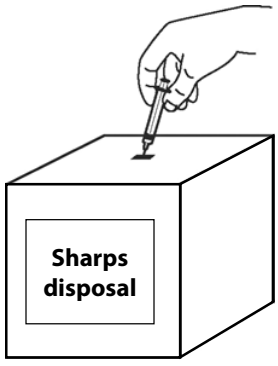
If safety boxes are not available, strong cardboard boxes, metal cans or thick plastic containers may be used to collect needles and syringes and transport them to a site where they can be properly treated (buried, incinerated or autoclaved and shredded). Containers should be sealed when they are three-quarters full. They should not be reused once filled – emptying sharps containers for reuse increases the risk of accidental needle-stick injuries and infections.

How to create a good sharps container if a safety box is not available

- Find a strong cardboard box (a local shop may have some). Ideally, the walls of the box should be strong enough to keep needles from piercing through and causing needle-stick injuries.
- If needed, place one box inside another to create a stronger container that can prevent needles piercing through.
- Close the box securely on the top and bottom – seal it with strong adhesive tape or similar material.
- Cut a small hole in the top – it should be just big enough for a needle and syringe to enter (maximum 38 mm).
- When the box is three quarters full, seal the opening.
- Dispose of the box properly (see next sections of this module).

Figure 3.6 shows a homemade safety box.

Figure 3.6 Homemade safety box



How to help ensure safe handling of safety boxes

- Never squeeze, sit or stand on safety boxes. Do not handle or shake the safety box more than necessary.
- Take extra care when carrying safety boxes to disposal sites. Hold the box by the handle on top (or at the top above the level of the needles and syringes if there is no handle).
- Keep safety boxes in dry places that are out of children's and others people's reach.
- Train staff on safe handling; do not ask untrained staff to handle safety boxes.

3.3 Using safety boxes

All injection equipment should be destroyed by proper waste disposal methods (see Section 3.4). Collecting sharps waste in safety boxes or similar containers both decreases risk of injury during handling and helps ensure proper disposal.

Safety boxes should be placed within reach of the staff administering injections (as described in Section 2.3 of this module and in in Module 5 (*Managing an immunization session*)) so that needles and syringes can be disposed of immediately. If needle removers or needle cutters are available, used needles and syringes should be separated immediately after each injection. After removing the needle with one of these devices, the syringe should go in the safety box. Needles remain in a separate safe container, which, when almost full, should be closed and disposed of properly (see next section for disposal methods).

Safety boxes should be closed when they are three quarters full. Used needles and syringes should never be transferred from safety boxes to other containers. A five-litre safety box can hold about 100 syringes and needles.

For the best use of safety boxes, you should never dispose the following items in them:

- empty or discarded vials
- cotton pads
- dressing materials
- intravenous bags or tubes
- latex gloves
- any plastic materials or waste products.

Once three quarters full, safety boxes should be closed, treated and destroyed appropriately, preferably quickly at a nearby site to minimize handling.

Used needles and syringes must never be dumped in open areas where people might step on them or children might find them (inside safety boxes or loose). They should never be disposed of along with general non-sharps types of waste.

3.4 Disposing of filled safety boxes

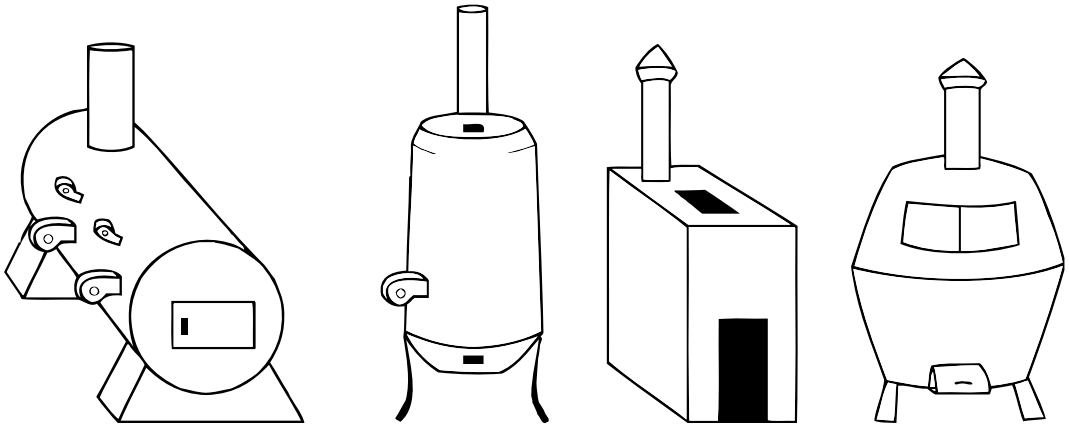
Methods commonly used to destroy or dispose of filled safety boxes are described below. Any selected method of waste disposal must comply with national and sub-national environmental and health regulations.

Incineration

Incineration can completely destroy needles and syringes. Fires burning at temperatures higher than 800 °C will kill microorganisms and reduce the volume of waste to a minimum. Properly functioning incinerators ensure the most complete destruction of needles and syringes. High temperature, dual-combustion incinerators with air filters produce less air pollution than incinerators burning at lower temperatures (see Figure 3.7). Some hospitals have on-site incinerators. Others transport the waste to cement factories to dispose of it in high-temperature kilns.

The compound in which incineration takes place must be secure. Staff members conducting the incineration should wear safety glasses, heavy gloves and any other personal protective equipment required by local and national guidelines.

Figure 3.7 Common types of incinerators *(This is not an exhaustive illustration)*



MANUFACTURERS
(High-temperature double combustion with filtration)

VULCAN
(Air-propulsed incinerator)

DE MONFORT
(Double combustion incinerator)

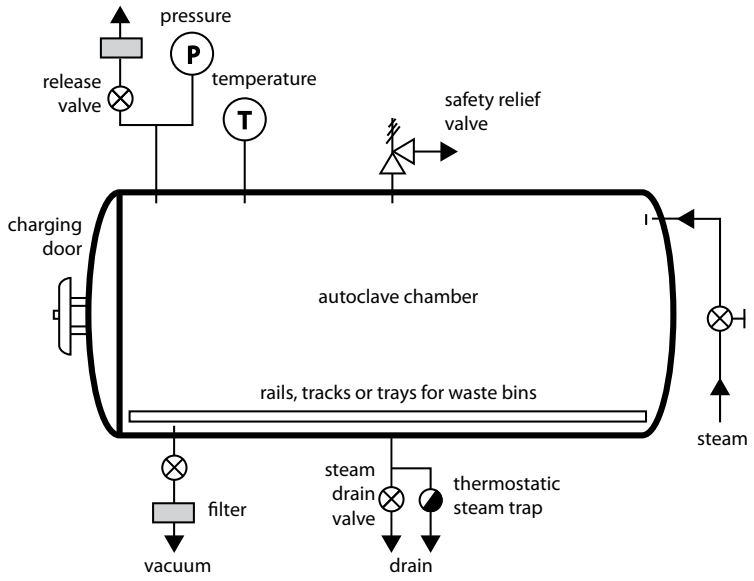
SICIM
(Auto-combustion incinerator)

Steam treatment (autoclaving)

Autoclaving, if available, is an alternative that avoids pollution associated with incineration (see Figure 3.8). Waste treatment autoclaves can range in size from about 20 L to over 20 000 L.

The operation of autoclaves requires the proper combination of temperature/pressure and exposure time to achieve disinfection. A minimum recommended temperature-exposure time criterion of 121 °C for 30 minutes is suggested for sharps waste. Since the autoclave does not eliminate the physical hazard from sharps, a post-treatment shredder that is designed to minimize handling is also recommended.

Figure 3.8 Simplified schematic of a vacuum autoclave

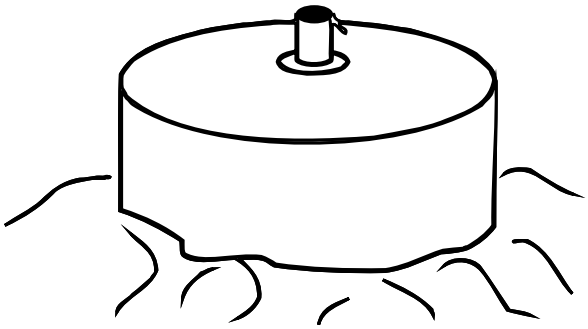


Source: WHO (2014) *Safe management of wastes from health care activities*. Second edition. Geneva: World Health Organization

Encapsulation

A safety pit is an option for the disposal of used needles and syringes that are loose. A safety pit is usually two metres deep and one metre in diameter so that it can be lined with a locally made concrete pipe. The pit should have a concrete lid with a capped metal pipe set in it. Used needles and syringes are dropped through the metal pipe and into the pit (see Figure 3.9). Cement is poured into the pit to seal the opening when it is full.

Figure 3.9 Safety pit



Burial in a disposal pit

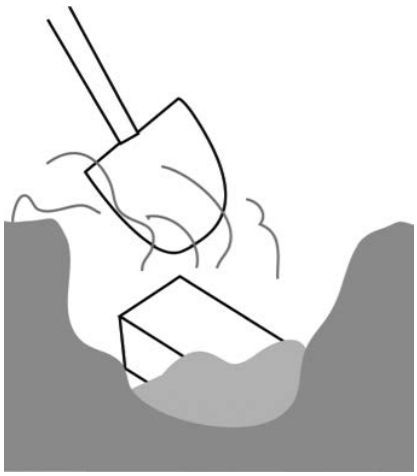
Used injection equipment may be buried in a disposal pit. The site should be chosen carefully – there should be enough space for a pit large and deep enough for bulky boxes to be buried with minimum risk of contaminated sharps being released into the surroundings and doing harm (see Figure 3.10).

If a disposal pit is to be used, several steps must be followed.

- Choose a site where people will not dig or build latrines in the future.
- Choose a qualified staff person to supervise the burn using appropriate equipment.
- Fence off and clear the area.
- Dig a pit at least two metres deep. Make sure that buried materials will not escape from the pit, for example, during the rainy season.
- When ready to bury them, take filled safety boxes to the pit site and place them in it. Do not open or empty the boxes.
- After placing the boxes in the pit, immediately cover them with at least 30 cm of soil. If possible, cover the site with concrete when the pit is full.

Only qualified staff should perform this task.

Figure 3.10 Disposal pit



IMPORTANT:

The two options below are to be considered as last resort options since they are not in keeping with WHO policy for the treatment of waste.

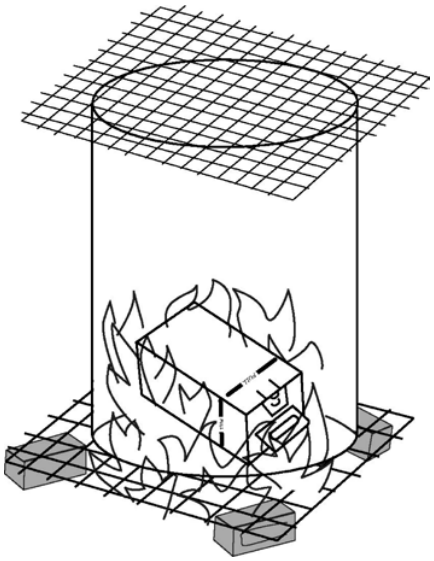
Burning in a metal drum

This option should only be considered as a last resort, short-term emergency response since low-temperature burning produces toxic emissions and is a public health and environmental hazard.

If contaminated sharps must be destroyed by burning in a metal drum or container (see Figure 3.11), several steps must be followed:

- Choose a site in an unused area that is as far from buildings as possible. The area should be fenced and cleared.
- Choose a qualified staff person to supervise the burn using appropriate equipment.

Figure 3.11 Metal drum



- Place four bricks on the ground in a square pattern.
- Put a metal screen or grate on top of the bricks.
- Remove both ends of a 210-litre steel drum. This will allow air to flow through the drum and the contents to burn better. If a metal drum is not available, build a cylinder from sheet metal, bricks or clay. A chimney may be added to the removable top of the drum or container.
- Place the drum on top of a metal screen or grate.
- Put filled safety boxes in the metal drum. Mix paper, leaves or other flammable material in among the safety boxes to help them burn.
- Sprinkle a small amount of kerosene, if available, on the boxes and other material in the drum.
- Place a fine metal screen over the top of the drum to reduce flying ashes.
- Put wood, paper or other flammable material under the drum and ignite the material.
- Warn people to stay away to avoid smoke, fumes and ash from the fire.
- Allow the fire to burn until all of the safety boxes have been destroyed.
- Once the fire is out, allow the residue at the bottom of the drum to cool and carefully collect it. Bury it in an unused location. Cover it with at least 30 cm of soil. If possible, seal the residue pit with cement once it is full.

Only qualified staff should perform this task.

Burning in an open pit

This option should also only be considered as a last resort since it produces toxic emissions and is a public health and environmental hazard. It is always preferable to collect safety boxes for later disposal at a more appropriate treatment site.

If burning waste in the open as shown in Figure 3.12 is the only option, several steps must be followed.

- Choose a site in an unused area that is as far from buildings as possible. The area should be fenced and cleared.
- Choose a qualified staff person to supervise the burn using appropriate equipment.
- Dig a pit at least one metre deep, but not so deep that it will be difficult to start the fire. Staff should not have to enter the pit to start the fire.
- Place filled safety boxes in the pit. Mix paper, leaves or other flammable materials with the boxes to help them burn.
- Sprinkle a small amount of kerosene on the boxes, if available, and ignite the fire.
- Warn people to stay away to avoid smoke, fumes and ash from the fire.
- Let the fire burn until all boxes are destroyed and then follow the instructions for burying residue above.

Only qualified staff should perform this task.

Figure 3.12 Open burning in a pit

IMPORTANT:

The remains of safety boxes, including needles, should be buried after burning, whether a metal drum or an open pit was used. The remains should be buried deep in a pit, controlled landfill or similar location where people cannot access them.

Annex 3.1 Unsafe immunization practices

	Do not recap the needle
	Do not leave the needle inside the vial
	Do not touch the needle
	Do not dispose of used needles in an open cardboard box
	Do not overfill the safety box