PREFACE

Phlebotomy, bloodletting and parenteral therapy are all important because they provide essential services to those in need of medical treatment, care and support. Phlebotomy and bloodletting – the drawing of blood – has been practised for centuries and is still one of the most common invasive procedures in health care. Without phlebotomy the process of diagnosing diseases and infections would be nearly impossible. Parenteral therapy is equally important for getting sustenance into the body through the veins.

Each step in the process of phlebotomy affects the quality of the specimen and is thus important for preventing laboratory error, patient injury and even death. For example, the touch of a finger to verify the location of a vein before insertion of the needle increases the chance that a specimen will be contaminated. This can cause false blood culture results, prolong hospitalization, delayed diagnosis and cause unnecessary use of antibiotics.

Over shaking of test tubes in transit can lyse or break open red blood cells, causing false laboratory results. Clerical errors in completing forms and identifying patients are common, costly and preventable. Other adverse effects for patients are common; these include bruising at the site of puncture, fainting, nerve damage and haematomas.

Phlebotomy also poses risks for health workers. It is still common to see a phlebotomist carry out dangerous practices known to increase the risk of needle-stick injury and transmission of disease. Recapping of needles is a case in point.

These guidelines outline the simple but important steps that can make phlebotomy, bloodletting and parenteral therapy safer for health workers and patients, to improve the quality of blood specimens and to promote best practices in phlebotomy as well as for correctly setting up and maintaining parenteral therapy.

The practice of quality health care service provision should be based on the principle of duty of care and first to do no harm to patients and clients. All healthcare workers are mandated to utilize this very important resource to ensure proper phlebotomy, bloodletting and parenteral therapy practices at all times.
ACKNOWLEDGEMENTS

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<td>CVP</td>
<td>Central venous pressure</td>
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<td>HAI</td>
<td>Health Service Acquired Infection</td>
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<td>NIP</td>
<td>Namibia Institute of Pathology</td>
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<td>OPD</td>
<td>Out Patient Department</td>
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<td>PEP</td>
<td>Post Exposure Prophylaxis</td>
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<td>Personal Protection Equipment</td>
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Acquired immunodeficiency syndrome (AIDS)
Morbidity resulting from infection with the human immunodeficiency virus.

Administrative controls to reduce exposure
A method of minimizing patient or employee exposures through enforcement of policies and procedures, modification of work assignment, training in specific work practices, and other administrative measures designed to reduce the exposure.

Alcohol-based hand rub
An alcohol-containing preparation (liquid, gel or foam) designed for application to the hands to reduce the growth of microorganisms.

Antiseptic hand washing
Washing hands with water and soap or other detergents containing an antiseptic agent. Recommended when carrying out an aseptic technique.

Antiseptics
Antimicrobial substances applied to living tissue or skin to prevent infection. They differ from antibiotics, which destroy bacteria within the body, and from disinfectants, which are used on non-living objects.

Aseptic technique
The manner of conducting procedures to prevent microbial contamination.

Auto-disable (AD) syringe
A syringe designed to prevent reuse by locking or disabling after giving a single injection. Several types of AD syringes are commercially available.

Biohazard (biological hazard)
A risk to the health of humans caused by exposure to harmful bacteria, viruses or other dangerous biological agents, or by a material produced by such an organism.

Bloodborne pathogens
Pathogenic microorganisms in human blood which are transmitted through exposure to blood or blood products, which can cause disease in humans.

Capillary blood collection
Blood collected from capillaries, the smallest of a body’s blood vessels, measuring 5–10 μm in diameter, which connect arterioles and venules. Blood collected by this method is usually by heel or finger-prick.
Cross-contamination
The act of spreading microbes (bacteria and viruses) from one surface to another.

Disinfection
Killing of infectious agents outside the body by direct exposure to chemical or physical agents.

Disposal
In the context of this document, disposal refers to the storage and subsequent destruction of injection or blood sampling equipment to avoid reuse or injury.

Engineering controls
Methods of isolating or removing hazards from the workplace. Examples include sharps disposal containers and safer medical devices, etc.

Finger-prick
A method of capillary sampling. In medicine, some blood tests are conducted on venous blood obtained by finger-prick.

Hand hygiene
Any type of hand cleansing.

Hand washing
Washing hands with soap and water, and drying thoroughly afterwards with single-use towels.

Hepatitis B infection
Hepatitis caused by hepatitis B virus (HBV) and transmitted by exposure to blood or blood products, or during sexual intercourse. It causes acute and chronic hepatitis.

Hepatitis C infection
Hepatitis caused by a hepatitis C virus (HCV) and transmitted by exposure to blood or blood products. Chronic Hepatitis C can cause cirrhosis and primary liver cancer.

Hierarchy of controls
A concept developed in occupational health industrial hygiene to emphasize prevention.

Human immunodeficiency virus (HIV)
A virus mainly transmitted during sexual intercourse or through exposure to blood or blood products. HIV causes acquired immunodeficiency syndrome (AIDS).

Infection control
A health-care organization’s program, including policies and procedures, for the surveillance, prevention and control of health-care associated infections.
**Injection**
Percutaneous introduction of a medicinal substance, fluid or nutrient into the body. This may be accomplished most commonly by a needle and syringe.

**Intradermal injection**
A shallow injection given between the layers of the skin, creating a “weal” on the skin.

**Intramuscular injection**
An injection given into the body of a muscle.

**Intravenous injection**
An injection given into a vein.

**Intravascular**
Within a blood vessel.

**Jet injector**
A needle-free device that allows the injection of a substance through the skin under high pressure.

**Lancet**
A blood-sampling device to obtain a capillary sample of blood for testing.

**Needle-stick**
Penetrating stab wound caused by a needle.

**Occupational exposure**
Exposure to materials that results from the performance of an employee’s duties.

**Parenteral**
Piercing mucous membranes or the skin barrier through subcutaneous, intramuscular, intravenous or arterial routes; for example, through injections, needle-stick, cuts or abrasions.

**Pathogen**
A microorganism capable of causing disease.

**Personal protective equipment**
Specialized equipment worn by an employee to protect against a defined hazard.

**Phlebotomy**
The act of drawing or removing blood from the circulatory system through an incision or puncture to obtain a sample for analysis and diagnosis.
Post-exposure care and prophylaxis for HIV
Preventive interventions offered to manage the specific aspects of exposure to HIV, and prevent HIV infection in exposed individuals.

Post-exposure prophylaxis (PEP)
A medical response given to prevent the transmission of bloodborne pathogens after potential exposure. It is available for HIV and hepatitis B.

Recapping
The act of replacing a protective sheath on a needle. Recapping needles using two-handed methods increases the risk of needle-stick injuries and is not recommended.

Safe injection
An injection that does no harm to the recipient, does not expose the health worker to any risk and does not result in waste that puts the community at risk.

Sharp
Any object that can penetrate the skin; sharps include needles, scalpels, broken glass, broken capillary tubes and exposed ends of dental wires.

Sharps container
A puncture-resistant, rigid, leak-resistant container designed to hold used sharps safely during collection, disposal and destruction.

Sharps injury
An exposure event occurring when any sharp penetrates the skin.

Sharps protection device
A sharp or needle device with a built in safety feature used for withdrawing body fluids, accessing a vein or artery, or administering medications or other fluids.

Single-use syringe
A sterile syringe intended for the aspiration of fluids or for the injection of fluids immediately after filling (ISO 7886-1).

Solid sharp
A sharp that does not have a lumen through which material can flow, e.g. a suture needle, scalpel or lancet.

Standard precautions
A set of practices designed to prevent the spread of infection between health workers and patients from contact with infectious agents in recognized and unrecognized sources of infection.

Sterile
Free from living microorganisms.
**Subcutaneous injection**  
An injection delivered under the skin.

**Syringe with reuse prevention feature**  
A sterile single-use hypodermic syringe of a design such that it can be rendered unusable after use (ISO 7886-4).

**Work practice controls**  
Techniques that reduce the likelihood of exposure by changing the way a task is performed.
1. INTRODUCTION

Phlebotomy – the drawing of blood – has been practiced for centuries and is still one of the most common invasive procedures in health care.

Phlebotomy is the act of drawing blood, usually from a vein but it can also be from an artery or from capillaries. The blood samples are taken mainly for laboratory tests for clinical investigation, but can also be for blood donation. It is essential that healthcare workers (HCWs) who undertake phlebotomy must be well trained in these procedures.

Each step of drawing blood can affect the quality of the sample with incorrect results which can adversely affect patient management, injure the patient if the HCW is untrained in blood drawing or severe reactions to the equipment used. Transportation of samples to the laboratory should be well organised with safe, robust containers to carry the sample containers from point of origin to the laboratory, to ensure good quality results.

Mislabelling of forms can result in incorrect diagnosis and treatment for the wrong patient. These errors are common, costly and preventable.

These best practice guidelines have been adapted from and follows the layout of the current World Health Organization (WHO) Guidelines for Drawing Blood: Best practices in phlebotomy (2010). The Guidelines will be used as a practice and teaching guide towards delivering a safe and high standard of care, for the protection of health care workers, patients and visitors towards improving clinical practice in Namibia.

1.1 Issues in Phlebotomy

By its nature, phlebotomy has the potential to expose health workers and patients to blood from other people, putting them at risk from bloodborne pathogens. These pathogens include human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), and those causing viral haemorrhagic fevers. For example, outbreaks of hepatitis B have been reported with the use of glucometers (devices used to determine blood glucose concentration. Diseases such as syphilis and malaria may also be transmitted via contaminated blood, and poor infection control practices may lead to bacterial infection where the needle is inserted and contamination of specimens.

If a blood sample is poorly collected, the results may be inaccurate and misleading to the clinician, and the patient may have to undergo the inconvenience of repeat testing.
The three major issues resulting from errors in collection are haemolysis, contamination and inaccurate labelling.

1.2 Objectives

The objectives of these guidelines are to:

- Improve knowledge and awareness of the risks associated with phlebotomy among all healthcare workers involved in the practice
- Increase safe practices and reduce blood borne virus exposure and transmission
- Improve patient confidence and comfort
- Improve the quality of laboratory tests

1.3 Target Audience

This document is aimed at:

- Those who perform or supervise phlebotomy in the private and public sectors, in hospitals, community clinics and other health-care facilities, including those involved in home-based care
- Health trainers and educators
- Procurement officials (who need to be aware of which equipment and supplies are safe and cost effective).

1.4 Indications for Blood Sampling and Blood Collection

The most common use of blood sampling is for laboratory tests for clinical management and health assessment. Categories that require specialist training include:

- arterial blood gases for patients on mechanical ventilation, to monitor blood oxygenation
- neonatal and paediatric blood sampling
  - heel-prick (i.e. capillary sampling)
  - scalp veins in paediatrics
- capillary sampling (i.e. finger or heel-pricks or, rarely, an ear lobe puncture) for analysis of capillary blood specimens for all ages; examples include testing of iron levels before blood donation, blood glucose monitoring, and rapid tests for HIV, malaria and syphilis
Blood collection is used to obtain blood from donors for various therapeutic purposes.

1.5 Definitions

For the purposes of this document, the term “phlebotomy” covers the terms:

- *blood sampling* for purposes of laboratory tests
- *blood collection* for donation
2. ASPECTS OF PHLEBOTOMY

2.1 Indications for Phlebotomy

Blood is drawn for laboratory tests for clinical management and health assessment and to obtain blood from donors for various therapeutic purposes.

Sampling sites in adults are:
- Veins usually from the forearm, but occasionally femoral vein stabs can be carried out by medical staff if other sites are not easily available
- Arterial blood gases for patients on mechanical ventilation and those with respiratory distress, to monitor blood oxygenation
- Capillary sampling (i.e. finger or heel-pricks or, rarely, an ear lobe puncture) for analysis of capillary blood specimens for all ages; examples include testing of iron levels before blood donation, blood glucose monitoring, and rapid tests for HIV, malaria and syphilis

For neonates and paediatrics, blood samples are taken via:
- Heel-prick (i.e. capillary sampling)
- Scalp veins in paediatrics
- Blood samples may be taken via veins usually from the forearm, neck jugular superficial vein
- Femoral vein (for doctors) if there is no other site available
- Umbilical vessel catheters (SOPs)

2.2 Risks Associated with Phlebotomy

There are some concerns relating to the practice of drawing blood because by its nature, phlebotomy practices expose healthcare workers and patients to blood and its pathogens.

2.3 Transmission of Disease

Blood borne viruses such as hepatitis B and C and HIV, and viral haemorrhagic fevers (VHF) can be transmitted via contaminated blood. This can happen when the following occurs:
- Sharing the same medical devices between patients either accidentally or knowingly, an outbreak of hepatitis B associated with a common glucometer is a case in point
- Exposure to contaminated blood
- Poor infection control practices (such as not wearing gloves and recapping of needles which can result in needle stick injuries) during the procedure of taking blood from patients
2.4 Poor Sampling Technique

If the blood sample is taken with a large gauge needle which is bigger than the intended vein, there is a chance of getting a haematoma and causing damage to the vein. If the needle’s gauge is too small, the blood will haemolyse. Both of these situations can give erroneous results which will affect clinical management or require a repeat sample which will greatly inconvenience the patient.

The risk of haemolysis increases by:

- Using the incorrect gauge of needle, either too wide or too narrow
- Pressing the plunger to force the blood into the tube and thereby causing the blood cells to lyse
- Taking blood from an intravenous line - these lines usually have infusion chemicals in them which increase haemolysis
- Under filling the sample tube so that the ratio of blood to anticoagulant is greater than 1:9
- Reuse of improperly filled tubes with varying amounts of anticoagulant
- Mixing or shaking the tube vigorously
- Venepuncture site not dry after the application of skin preparation (alcohol)
- Too high vacuum on the blood extraction

2.5 Serious Side Effects for Patients

Serious side effects from drawing blood are rare, but the phlebotomist must take a clear history prior to proceeding with bleeding. Usually there is bruising (most common) but rarely, syncope (fainting) or seizures.

2.6 Exposure of Healthcare Workers to Blood

The most common risk for healthcare workers is accidental exposure to sharps, particularly after these have been used on a patient. The techniques to reduce such injuries are:

- To be careful and alert. Concentrate on the patient and do not get distracted
- To keep a strong puncture proof sharps container within arm’s reach of where blood is being drawn
- To be trained in not only the procedure but also on how to use the devices available for bloodletting
- To never recap needles with both hands, if one must recap then use only one hand
- To dispose the needle and syringe as one unit immediately after use
3. BEST PRACTICES IN PHLEBOTOMY

Best practices in phlebotomy involve the following factors:

• Planning ahead
• Using an appropriate location
• Quality control

3.1 Planning Ahead

The first and important step when drawing blood is planning; it reduces risk to both patient and healthcare worker. Assemble the equipment necessary to take blood, make sure the laboratory forms and other paperwork are in place and nearby, and there is a quiet atmosphere where the patient can be attended to. There must be adequate supply of all the required items to carry out the blood draw.

- The age of the patient and the medical condition need to be taken in account when planning
- Verify and complete consent as required: e.g. situational (informed) consent, written consent or verbal consent

3.2 Appropriate Location

For ambulatory patients, there should be a separate phlebotomy room or area which is well lit, airy and out of the main stream of hospital traffic where the phlebotomist can concentrate on the patient and his or her needs, keeping them calm and comfortable.

If the patient is confined to bed, ensure privacy by using bed curtains; make sure there is sufficient light and space to work in. Very often blood is drawn in the OPD consultation room. This is acceptable as long as above rules are met. Overcrowding and a busy area can lead to unnecessary accidents.

3.3 Procedure for Drawing Blood

The steps for taking blood are shown in Figure 1. To summarise, first assemble all the necessary equipment, decontaminate your hands either with alcohol rub or by washing hands with soap and water and drying. Introduce yourself, identify the patient, select a correct size vein for drawing blood and apply the tourniquet before proceeding with taking blood. Once the blood has been drawn, the specimen tubes will be filled as shown in Figure 2.
If a vacuum extraction system is used then the blood goes directly into the tube. If a needle and syringe is used, pierce the rubber stopper with the needle and press the plunger slowly to make sure there is no haemolysis. If there is no stopper let the blood flow into the tube with gentle pressure. Place the stopper and rotate gently to mix. Do not shake vigorously.

Figure 1: Assembly of equipment and taking a blood sample (source WHO Guidelines for drawing blood: Best Practices in Phlebotomy, WHO, 2010)
6. Ask the patient to form a fist so that the veins are more prominent.

7. Put on well-fitting, non-sterile gloves.

8. Disinfect the site using 70% isopropyl alcohol for 30 seconds and allow to dry completely (30 seconds).

9. Anchor the vein by holding the patient's arm and placing a thumb BELOW the venepuncture site.

10. Enter the vein swiftly at a 30 degree angle.

11. Once sufficient blood has been collected, release the tourniquet BEFORE withdrawing the needle.

12. Withdraw the needle gently and then give the patient a clean gauze or dry cotton-wool ball to apply to the site with gentle pressure.

13. Discard the used needle and syringe or blood-sampling device into a puncture-resistant container.

14. Check the label and forms for accuracy.

15. Discard sharps and broken glass into the sharps container. Place items that can drip blood or body fluids into the infectious waste.

16. Remove gloves and place them in the general waste. Perform hand hygiene. If using soap and water, dry hands with single-use towels.
3.3.1 The Procedure

Intravenous blood drawing (phlebotomy)

Assemble all the necessary equipment

You will need:

- A request form
- A kidney dish
- Cotton wool and plaster
- Specimen tubes
- A pair of gloves
• Correct blood collection bottles
• Vacuum blood drawing needle and barrel (butterflies are good to take blood with), or
• Needle and syringe – safety engineered devices are recommended
• Alcohol wipe
• Tourniquet
• Sharps disposal container

3.3.2 Method of Drawing Blood for Phlebotomy

• Introduce yourself to the patient
• Identify the patient and ensure it is the same person as the request form
• Make the patient comfortable and explain what you are about to do
• Apply the tourniquet
• Decontaminate your hands (alcohol rub is acceptable)
• Wear a pair of gloves (well-fitting non sterile)
• Clean the skin at point of insertion with 70% isopropyl alcohol swab. Apply liberally and allow drying thoroughly
• Assemble the needle and barrel (Vacutainer® holder).  
• Ask the patient to make a fist to improve visibility of the vein
• Enter the vein at an angle of 45 degrees
• Slide the vacuum collecting specimen tube inside the barrel Vacutainer® holder) making sure it is perfectly straight. Push into place to extract blood
• The specimen tube may be changed several times until all blood required for laboratory tests are taken
• Place specimen tube in a firm rack to prevent accidents
• Remove the tourniquet
• Apply pressure with a cotton wool or gauze (ask patient to help). DO NOT BEND THE ELBOW - IT WILL CAUSE A HAEMATOMA
• Discard the needle (ideally the barrel (Vacutainer® holder) and needle are discarded together) in a sharps container
• Often the needle and barrel (Vacutainer® holder) are separated and the holder is retained. If this is to happen, make sure of the following:
  o Cap the needle with one-hand scoop capping before untwisting
  o Use a forceps to separate needle and barrel (Vacutainer® holder)
  o Use a device specifically for the purpose of removing the holder
• Label and check specimen tubes again
• If the holder is to be retained, clean it with an alcohol swab removing all visible blood
• Remove gloves and discard
• Wash hands
• Store specimen tubes safely for transportation to the laboratory
Figure 4: Labelling blood tube after having taken a sample: ensure the information on the form corresponds to the patient’s information
4. BLOOD SAMPLING SYSTEMS

There are several systems available for phlebotomy. Depending on the knowledge and training of the phlebotomist, the most appropriate method should be chosen.

4.1 Needle and Syringe

A hypodermic needle and syringe is the most common means of blood sampling and is considered an open system. As long as the phlebotomist is experienced in taking blood it can be safe but there are concerns regarding safety for the healthcare worker with accidental injuries.

4.1.1 How to use a Needle and Syringe to Draw Blood

- Open the needle packaging at the hub end and keep it capped
- Open the sterile packaging for the syringe from the back (plunger end) keeping the nozzle protected
- Carefully place the nozzle of the syringe into the hub of the needle and once in, secure well
- Keep the needle and syringe as one unit until ready for use

4.1.2 The Correct Needle Gauge

It is important to select the correct needle gauge so that it fits comfortably in the vein and does not cause damage during blood drawing.

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<th>Needle Gauge</th>
<th>Adult</th>
<th>Paediatric / elderly</th>
<th>Neonate</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-18</td>
<td>Yes</td>
<td></td>
<td></td>
<td>Blood donation</td>
</tr>
<tr>
<td>19-20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Yes</td>
<td>Yes (winged)</td>
<td>Yes (winged butterfly)</td>
<td></td>
</tr>
</tbody>
</table>
4.2 Vacuum Extraction

These systems are widely used and are safe because they function as a closed system with little exposure to blood for the phlebotomist, but training and skill in its use is required. The system comes as a double ended needle which can be screwed into a barrel (See Fig 5a). One end of which goes into the patient’s vein (the longer one) and the other end has a rubber cuff on it, which is for the laboratory sampling bottle to connect to, so that blood can be drawn by a vacuum inside the bottle.

When the needle is in the vein, the laboratory sampling bottle is pushed onto the other end of the double ended needle to ensure that it is secure and that the blood flows into the tube at a constant rate. The system has different types of sample bottles for both adults and children and can also be used with butterfly needles and come with luer lock connectors (Figure 5b).

The advantage of this vacuum system is that there is low risk of exposure to blood for the healthcare worker and there is also less chances of haemolysis, the volume of blood required is measured by the amount of vacuum present. Disabling and reuse prevention systems are commercially available.

The disadvantages are that the system is costly compared with a needle and syringe, and training is required to use it efficiently. While the needle and barrel are single use units to be discarded after each use, it is possible to unscrew the needle and reuse the barrel between patients. If the needle has to be removed it can be done by either holding the end with pliers or similar device and discarding the needle after removing it; or the cap can be put back on using one hand capping only, but this practice is dangerous and not advisable.
Figure 5: Two methods of taking blood: a) Using a vacuum extraction tube. b) Using a butterfly needle

The illustration below shows the correct way to introduce the laboratory vacuum sample tube into the holder.
Blood banks are specifically aimed at dealing with blood donation under skilled conditions in a clean environment. The infection rates, albeit very low, are dependent on the type of blood donor, the conditions under which blood is donated and whether it is a voluntary non-remunerated or remunerated (paid) donor.

Measures for preventing infection in blood donation:

- The most important measure is to select blood donors correctly
- Take a brief history with screening questions that will identify high risk donors.
- During the procedure, although bloodletting is similar to drawing blood, skin disinfection is of the essence to avoid skin contaminants from entering the blood or blood products
- Finally, all donor blood must be tested for blood borne viruses and other infections before allowing the blood to be used for therapeutic reasons

### 5.1 Requirements for Venepuncture for Blood Donation

#### 5.1.1 Equipment

All the equipment used for blood donation, such as blood pressure monitors, scales, donor couches and chairs, blood monitors and mixers, bag tube sealers and transportation systems with refrigeration must be calibrated regularly, maintained and serviced at set times.

#### 5.1.2 Room and Layout

The room should be furnished with chairs or tables with cleanable surfaces such as vinyl. Containers for transporting blood must be able to withstand cleaning with hypochlorite.

The room should be airy and light, with floors and surfaces that can be easily cleaned with soap and water and can withstand a wipe over with hypochlorite (bleach). The area should be quiet and safe for the healthcare workers and the donors.

Processing once the blood has been taken should be done in a clean and hygienic environment.

#### 5.1.3 System of Blood Letting

The system must be a closed system with a blood collection bag containing anticoagulant and an integral tube and needle for bloodletting. Blood taken for
haemoglobin analysis is done via a capillary stick and a single use disposable lancet which is immediately discarded.

The most important aspect to bear in mind is the disinfection of the skin around the needle entry area. The skin should be cleaned with a skin prep containing 2% chlorhexidine in 70% isopropyl alcohol or similar. The skin should be wiped in a circular motion for a minimum of 30 seconds with 30 seconds drying time. The site must not be touched again during insertion of the needle.

5.2 Before a Blood Donation

The WHO has developed a set of guidelines prior to blood donations which should be carefully followed:

- Advice and counselling for the potential donor about the process of blood donation
- Relevant history using a questionnaire covering health risks, risky behaviour and any surgery the patient might have undergone, particularly a mastectomy (take blood from the other arm)
- Current medications and chronic infections
- History of abnormal bleeding
- History of previous donations of blood
- Conduct a thorough physical examination including weight, blood pressure, signs of infection or scarring on potential sites
- Offer the donor fluids to help reduce the risk of fainting
- Obtain written consent based on national requirements

5.3 Practical Guidance for Blood Donation

Blood donation venepuncture should follow all the basic IPC rules as any venepuncture for blood sampling such as hand hygiene and wearing gloves, but the following are a few aspects that require particular attention.

Step 1: Identify the donor and label the collection bag and test tubes

- Ask the donor’s full name
- Ensure the blood collection bag is the correct type
- The labels on all the samples belonging to this particular patient are correctly labelled with the name and number
- Check that all the labels match each other and the donor’s information.

Step 2: Select the vein

- Select a large firm vein preferably in the antecubital fossa which is free of lesions or scars
- Apply the tourniquet
• Ask the donor to open and close the fist a few times
• Once the vein is selected, release the pressure to prepare the vein.

Step 3: Disinfect the skin

• One step procedure
  o Take an antiseptic which contains 2% chlorhexidine gluconate in 70% isopropyl alcohol
  o Wipe the skin and cover the entire area by applying for at least 30 seconds
  o Let it dry for a further 30 seconds
• Two step procedure (if chlorhexidine in 70% isopropyl alcohol is not available)
  o Use 70% isopropyl alcohol and cover the area for 30 seconds
  o Allow to dry for 30 seconds
  o Then apply tincture of iodine or 2% chlorhexidine gluconate for 30 seconds
  o Allow to dry

Never touch the site after the skin has been disinfected.

Step 4: Perform the venepuncture

• Apply the pressure
• Ensure a smooth entry using a 16 gauge needle which is integrated with the blood collecting bag
• Remove the tourniquet when the blood flow is established
• Ask the donor to open and close the fist a couple of times during blood collection
• Collect blood samples from the diversion pouch

Step 5: Monitor the donor and the donor unit

• Keep an eye on the donor to make sure there are no signs of:
  o Pallor, sweating or fainting
  o Developing a haematoma on the site
  o Changes in blood flow indicating the needle has shifted and needs to be repositioned
• Mix the collecting bag with the anticoagulant every 30 seconds or so.

Step 6: Remove the needle and collecting samples

At the end of the procedure, cut off the needle with scissors once it has been withdrawn or if a retractable needle is used, activate it and discard it into the sharp container.
 o Collect blood samples for the laboratory tests.
o Put dry cotton on the puncture site and apply pressure and a firm bandage.

5.4 After a Blood Donation

5.4.1 Donor care
o Ask the donor to remain in the chair for a few minutes to relax.
o Inspect the venepuncture site to ensure the bleeding has stopped, if not apply pressure.
o Ask the donor to sit up slowly, and make sure he or she is not feeling dizzy - offer the donor some refreshments.

5.4.2 Blood unit and samples
Transport the blood in a refrigerated leak proof container to its destination, complete with its documentation.

5.5 Adverse Events
Adverse effects following blood donation are usually very rare if the donor has been properly checked prior to blood donation. However, when it does occur, adverse events can range from mild to severe and all of them should be considered serious and treated accordingly. An abridged version of the WHO guidelines is shown below.

Table 2: Adverse events associated with donating blood (Source: WHO 2010)

<table>
<thead>
<tr>
<th>Adverse event</th>
<th>Incidence</th>
<th>Cause</th>
<th>Management</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haematoma</td>
<td>2-3%</td>
<td>Failed venepuncture</td>
<td>• Apply pressure and firm bandage</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inadequate pressure after donation</td>
<td>• Allow movement but no heavy lifting</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Apologise</td>
<td></td>
</tr>
<tr>
<td>Vasovagal reaction-</td>
<td>1%</td>
<td>Anxiety, low blood volume, hot or humid</td>
<td>Mild: Discontinue donation, loosen clothes, monitor blood pressure and give fluids.</td>
<td>Person should not donate again</td>
</tr>
<tr>
<td>sweating, bradycardia, vomiting</td>
<td></td>
<td>room</td>
<td>Severe: Call physician, if becomes unconscious, put in recovery position, might have a fit.</td>
<td></td>
</tr>
<tr>
<td>Delayed faint syncope</td>
<td>1 in 10,000 donors</td>
<td>Physical stress, dehydrated, 1-4 hours after donation.</td>
<td>Give fluids- hot drinks or water - sit in supine position</td>
<td>May donate blood later but not if it repeatedly occurs</td>
</tr>
<tr>
<td>Arterial puncture</td>
<td>1 in 30,000 or 50,000 donors</td>
<td>Abnormal brachial artery, blood is bright red, may result in an arterio venous fistula later</td>
<td>Stop if early in procedure, call physician, apply firm pressure for 15 min and explain clearly to donor that it is not serious but bruising might occur.</td>
<td>Give relevant contact information</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Nerve damage</td>
<td>Unknown</td>
<td>Nerve endings bruised during venepuncture, haematoma, pain and paraesthesia, motor or sensory loss</td>
<td>Spontaneous recovery in 24 hours, refer to physician if necessary.</td>
<td></td>
</tr>
</tbody>
</table>
6. ARTERIAL BLOOD SAMPLING

6.1 Reasons for Taking Arterial Blood Sample

Arterial blood samples are taken to determine blood gases particularly patients who are ventilated. The samples must be taken by healthcare workers who are formally trained in this practice. Bloods can be taken by an arterial catheter or more commonly, using a needle and syringe from an artery. These syringes may be pre-heparinised to prevent clotting, and must be handled appropriately to minimise exposure to air.

6.2 Site

The most common site is the radial artery but occasionally the brachial or femoral artery might be used. Larger arteries are not always suitable for the purpose of taking routine arterial blood because these are not as easily accessible as the radial artery. Alternative sites for access are brachial or femoral arteries, but these have several disadvantages in that they may be harder to locate, because they are less superficial than the radial artery, have poor collateral circulation and are surrounded by structures that could be damaged if the technique is poor.

6.3 Complications

The complications are several which is why skill and technique is required to take an arterial sample. These are, arteriospasm, haematoma, nerve damage, fainting or vasovagal attack, and drop in blood pressure, faint or loss of consciousness. Sampling errors can occur when the sample is inappropriately collected and incorrectly handled due to:

- Presence of air in the samples
- Venous rather than arterial blood collected
- Incorrect quantity of heparin in the syringe or poor mixing after blood is drawn
- Delayed specimen transportation

6.4 Practical Guide to Arterial Blood Sampling

6.4.1 Equipment and supplies

The equipment needed to carry out arterial blood sampling:

- Pre heparinized syringe
- Needles (20, 23, 25 gauge) of appropriate size
- Safety syringe with needle cover that allows the syringe to be capped before transportation
• Bandage for site
• Container with crushed ice for transportation of sample to the laboratory (if not point of care analysis)
• Local anaesthetic if needed

6.4.2 Procedure

The steps for taking arterial blood sample are as follows:

• Identify the patient, and introduce yourself
• If the patient is unconscious confirm identity checked by another person
• Place the patient on his or her back and make sure the patient is relaxed
• Locate the radial artery and conduct the Allen Test pressure for collateral circulation. If the Allen Test fails, move to the opposite radial artery
• Find the arterial site and make a note of it
• Carry out hand hygiene
• Layout work area and equipment
• Wear sterile gloves, gown and face cover to protect from splashes
• Disinfect site with 70% isopropyl alcohol and allow to dry.
• Assemble needle and syringe and draw up heparin to the recommended amount
• Holding the needle and syringe like a dart, use the index finger to locate the pulse again, and then enter the artery at a 45 degree angle approximately 1 cm distal to the index finger (Figure 6)
• Advance the needle to the artery until a blood flashback appears and then allow the syringe to fill by itself – DO NOT pull back the syringe plunger
• Withdraw needle and syringe, place a clean dry piece of gauze or bandage over the site and apply firm pressure. Check for bleeding for up to 3 minutes
• Cover the tip of the needle either as part of a safety device mechanism, or use one hand scoop technique for capping
• Expel air bubbles, cap the syringe and roll the syringe gently between hands and avoid spillage
• Label the syringe. Dispose off all the used material appropriately
• Remove gloves and wash hands. Check patient for signs of bleeding
• Transport the sample immediately to the laboratory

Figure 6: A radial artery puncture using the thumb as a guide
7. **PAEDIATRICS AND NEONATES**

The person taking blood from children or neonates must be well trained in the practice and ideally should have specialised in paediatric phlebotomy. There should be a written standardised procedure to ensure a uniform sampling technique which will reduce pain and psychological trauma.

### 7.1 Procedure and Site

Blood should be taken from either a vein or a finger (or heel) prick depending on the quantity of blood required and the test. Venepuncture is more common in the older child and should be carried out by an experienced phlebotomist. A finger or heel prick will depend on the age and weight of the child and the skill of the person taking the blood.

#### 7.1.1 The Procedure for Venepuncture

- Identify the patient either by the wrist band or by asking the parents or guardians. Check the particulars against the clinical notes.
- A winged steel needle (23 or 24 gauge) with an extension is preferred, and makes taking the sample easier by attaching the end to a syringe no bigger than 5 ml.
- If using a vacuum tube, use one with a small collection volume to avoid the vein from collapsing.
- Use a safety engineered device if possible. Layout all the equipment in advance.
- Immobilise the child as shown in Figure 7. This is very important to avoid trauma.
  - One phlebotomist is designated to draw blood and the other HCW or care giver immobilises the child.
  - Ask the two adults to stand on either side of the examination table.
  - The person who will be holding the child will:
    - Stretch his or her arm out across the table and place the child on its back with its head on top of the outstretched arm.
    - Pull the child close, as if cradling it. Grasp the child’s elbow with the outstretched arm.
    - Use the other arm to reach across the child and grab the wrist in a palm up position - this anchors the child’s shoulder and immobilises it. The other hand acts as a tourniquet (Figure 7).
- Ask the person holding the child to tighten and release the child’s wrist to improve blood flow. Keeping the child warm increases the blood flow so either wrap the child or use something warm to dilate the blood vessels.
- Look for the vein using a transluminator or similar.
7.1.1.1 **Drawing Blood**

The procedure is as follows after the patient has been immobilised:

- Carry out hand hygiene. Identify the child again to confirm
- Wipe with 70% isopropyl alcohol (chlorhexidine is to be avoided if possible in the very young)
- Puncture the skin 3-5 mm distal to the vein for easy access
- Draw blood steadily

7.1.2 **Procedure for Heel Or Finger Prick (See Section on Capillary Sampling)**

**Figure 7:** The procedure for immobilising a child during blood sampling (Source: WHO 2010)
15. Place dry gauze over the venepuncture site and slowly withdraw the needle.

16. Ask the parent to continue applying mild pressure.

17. Remove the butterfly from the vacuum tube holder.

18. Dispose of the butterfly in a sharps container.

19. Properly dispose of all contaminated supplies.

20. Label the tube with the patient identification number and date.


22. Remove gloves, dispose of them appropriately and perform hand hygiene (if using soap and water, dry hands with single-use towels).
8. CAPILLARY SAMPLING

Blood from a finger, or heel can be taken from patients of any age and is designed to take small quantities of blood for specific tests. It is commonly used in paediatrics because the samples of blood are small, the procedure is relatively painless and quick and easy to do in experienced hands (Figure 8).

8.1 The Procedure

8.1.1 Site for Sampling

Adults usually have blood taken via a finger prick; children might have either a finger prick or more often a lateral heel prick. If the child is up to 6 months old and weighs approximately up to 10 kg, then a heel prick is recommended. For the older child a finger prick is appropriate.

- Do not use a surgical blade to carry out a skin puncture
- Do not use the lancet more than once - it can lead to a site abscess in the child

8.1.2 Length of Lancet

To avoid pain the length of the lancet in a neonate is around 0.85mm up to a maximum length of 2.2 mm. For adults the length can be up to 2.4 mm.

8.1.3 Order of Draw

With skin (finger or heel) punctures the haematology specimen is collected first, then the chemistry and the blood bank specimens. This sequence is used to minimise the effect of clumping. With venepuncture the order is reversed and is also better if two or more samples are needed.

8.1.4 Procedure for Capillary Sampling

8.1.4.1 Adult

- Prepare the skin using 70% isopropyl alcohol at the site and allow it to dry completely
- Puncture the skin with a quick sharp deliberate stroke an get a good flow of blood
- Wipe away the first drop of blood
- Avoid squeezing too hard because it allows plasma to ooze
- Collect blood in the appropriate tube
- Apply pressure to the site when completed
8.1.4.2 Child - Paediatric or Neonate

- Immobilize the child as previously described
- Prepare the skin using 70% alcohol only
- Puncture with a swift sharp jab
- If taken from the finger, ask the person holding the child to squeeze and loosen gently
- Keep the child warm

If the first two attempts on a child fail, get someone else to take the blood - DO NOT continue to hurt the child.

Figure 8: Capillary sampling from a finger prick
8.2 After the Procedure of Capillary Sampling

- Make sure the bottles are labelled correctly
- Clean up blood spills or any other fluids
- Remove all equipment from the bed or site of phlebotomy
- Discard all sharps in the sharps container
- Remove gloves and carry out hand hygiene

8.3 Complications

Possible complications are:

- Collapse of the veins
- Osteomyelitis of the puncture is too deep and hits the periosteum
- Nerve damage especially with finger punctures in neonates
- Haematoma and loss of venous access (short term)
- Scarring
- Local or generalised necrosis
- Skin excoriation from adhesive tapes

8.4 Data entry

Enter the relevant information into the register and keep a record of the following:

- Date of collection
- Patient name
- Patient ID number / date of birth
- Unit location
- Test or tests required
- Amount of blood collected
- Method of collection
- Phlebotomist’s initials (full name and signature)

8.5 Before Leaving

Make sure the child is comfortable with no pains and is not anxious. Reward the child with praise, and if possible with a sticker or a smile and a pat.
9. PARENTERAL THERAPY

Parenteral route – injections and infusions

There are several ways in which medication and vaccine are administered to patients and this depends on the dosage, pharmacological properties of the medication or reasons for giving the compound.

Reported infection rates (average) are as follows:

- Intra muscular injections (IM) - 5-15%
- IV bolus injections (IV) - 4% blood stream infection
- Peripheral line infusion - 10-15%
- Central line infusion - 30-40%

These rates can be drastically reduced by good IPC practices and aseptic techniques.

9.1 Parenteral Routes of Administration

The most common routes for injectable medicines are:

1. Intra-dermal
2. Subcutaneous
3. Intra-muscular
4. Intra-venous
   a. Bolus injection
   b. Infusion
      i. Peripheral line
      ii. Central venous line

Figure 9: Diagram of various types of injections and their placements
9.1.1 Intra-Muscular (IM) and Subcutaneous Injection

Intra muscular injections are used to deliver a fixed dose of medication or vaccine. It is a simple procedure but can sometimes go wrong, resulting in up to 15% of infections at the injection site.

9.1.1.1 The Procedure for Intra Muscular Injection

The adverse effects of an intra-muscular injection cannot be underestimated. The procedure should be clearly followed, no matter how many times you have given an intra-muscular injection.

9.1.1.2 Procedure for Intramuscular Injection

- Select an appropriate site which has adequate amount of muscle for the intended dose
- Carry out hand hygiene
- Remove sterile syringe from package without touching the nozzle. Open package from the back of the syringe
- Open the needle package from the hub end (back)
- Insert nozzle of syringe into needle and remove from its packaging
- Insert into medicine vial and draw the required amount of medication
- Change the needle if indicated. When a mass vaccination campaign is underway, the number of available hypodermic needles do not allow for a change each time. Thus perform hand hygiene
  - Wipe the site with an alcohol swab and allow to dry completely
  - Choose appropriate site
  - Hold the limb steady and enter vertically (at 90 degrees) into the muscle
  - Draw back the plunger of the syringe to ensure there is no blood
  - Inject drug into site with a slow, steady amount of pressure - do not hurry because the drug needs to diffuse
  - Withdraw needle and syringe and discard into a sharps container immediately
  - Rub the site gently for 30 seconds
  - Give cotton wool or gauze to patient and ask him or her to put it on the site and rub gently
  - Mobilise the limb to avoid accumulation of the drug

9.1.1.3 Adverse Events

- Injection abscess due to infection introduced during procedure
- The wrong route of administration - entering a blood vessel
- The incorrect volume for the muscle selected for injection
- Abscess especially during Bacille Calmitte-Guerin (BCG) vaccination
- Nerve damage especially in the gluteal region resulting in damage to limb
**9.1.1.4 Subcutaneous Injection**

For a subcutaneous injection follow the same guidelines as for IM injection. However, to insert the needle, hold the limb steady and enter at 45 degree angle.

**9.1.1.5 An Intra-Dermal Injection**

Make sure the arm is steady. Enter the subcutaneous tissue at an angle of 15 degrees and watch while a bubble forms under the skin as you inject the medication. Do not rub. Allow the site to absorb the fluid.

**9.2 Intravenous Therapy**

**9.2.1.1 Introduction**

Intravenous therapy is described as the introduction of any medication, substance or chemical directly into the venous system. It is estimated that at any one time up to 20% of patients admitted to hospital will have an intravenous device *in situ*. The introduction of an intravenous device allows direct access into the bloodstream bypassing most natural defence mechanisms. While inserting an intravenous device is common and usually targets the veins, arterial lines are commonly inserted in intensive care units (ICU) or operating theatres, and should be undertaken with care.

The aim of these guidelines is to make healthcare workers aware of the risks and encourage them to carry out carefully planned procedures.

*Figure 10: Cross section of placing an intravenous cannula*

**9.2.1.2 Risk Assessment for Intravenous Access**

Before introducing an intravenous device, injection or cannula in to a vein of a patient, several steps should be carefully considered.
1. Does the person need an intra-venous device or will oral medication be equally effective?
2. Is the site selected on the patient appropriate for intravenous cannulation?
3. Is the cannula the appropriate size for the selected vein?
4. How long is the intravenous device going to be in place (approximately)?
5. What type of substance is it going to be infused?
6. How can it be best managed to avoid infection? The risk factors such as age, co-morbidity and skin rashes or conditions should be assessed prior to carrying out the procedure.

9.2.1.3 Contamination of the Intra-Venous Site

9.2.1.3.1 Intrinsic Contamination

Figure 11: Routes of intrinsic contamination for intravenous therapy

The intrinsic contamination can occur during preparation, storage and reconstituting fluids for intravenous use. Devices such as cannulae, administration sets, three way taps (open), connectors and other additions can become contaminated during storage or transportation.

*If the wrapping of any intravenous item used in an intra-venous system is not intact, consider it non-sterile and discard immediately.*

Inspection of the intra-venous device, administration set and injection ports should be carried out before these are used. The fluid bags should be inspected to ensure clarity, lack of precipitation, appropriate expiry date and most importantly, that an air let with a filter is in place to make sure the solution remains uncontaminated during the infusion.

*The insertion of a hypodermic needle into a sterile fluid container to allow gravitational air removal should never be permitted - it allows access to pathogens from the environment and hands of staff.*
9.2.1.3.2 Extrinsic Contamination

The hands of HCWs play an important role in transmitting pathogens but other factors should also be considered:

- Skin preparation using 70% isopropyl alcohol (swab) which is allowed to dry before inserting an intra-venous device
- Repeated entry into an injection port without cleaning with alcohol and allowing it to dry first
- Site dressing which is not clean (cut prior to use and left stuck to a surface) and contaminated with blood or fluids
- Addition of medication or fluids without cleaning the injection bungs thoroughly before puncture
- Breaking the circuit for whatever reason especially when changing bags
- Several additive ports on the administration set
- Open port cannula or three way taps
- Hypodermic needles used for increasing air entry
- Leaving a loaded syringe in an injection port (usually for frequent bolus injections)
- Using the same loaded syringe on several patients

9.2.1.4 Procedure for Inserting an Intravenous Cannula

- Intravenous cannulation is an aseptic procedure
- Talk to the patient and inform him or her of what you are about to do. Try to explain some of the steps if possible. It helps to relieve stress and spasm of the blood vessels, facilitating the phlebotomist job
- Ask about any allergies he or she may know about
- Make the patient comfortable and cooperative
Collect the equipment needed for carrying out intra venous cannulation PRIOR TO STARTING PROCEDURE.

- Hand alcohol rub (or wash hands if visibly contaminated)
- Tourniquet
- 70% isopropyl alcohol swab (alco wipe or similar)
- Gloves (well fitting)
- Cannula size which will fit the vein
- Administration set (preferably with a loose sleeve luer lock) - primed and fitted with an inbuilt air vent and filter
- Transparent adhesive strapping

9.2.1.4.1 Select the Site of Insertion

- Inspect both arms
- The forearm on the non-dominant side is preferred but other sites might be chosen if there are fewer options. Inserting an IV cannula into a vein over a joint (ulnar area) increase risk of bruising, dislodging and leaking
- Ensure the site is clean and the skin is intact. In case of burns patients this may not always be possible
- Occlude the blood vessel and inspect and make sure the size of the vein and the cannula match without causing obstruction or pain. Once satisfied, release the occlusion
- If a previous IV site has either bruised or fluid has leaked (extravasation), use the other arm if possible. If not, then go above the previous site to ensure a patent (open) blood vessel

9.2.1.4.2 Prepare the Site for Insertion of an IV Cannula

- Once the site has been selected, apply the tourniquet and examine the vein
- Clean the entry site with an alcohol swab (70% isopropyl) working from the site of insertion outward in circles
- Avoid going over the same area repeatedly
- It is recommended that the alcohol swab be applied for at least 30 seconds
- If this is not possible, allow the site to dry completely. DO NOT TOUCH THE SITE AGAIN

9.2.1.5 The Insertion Procedure

- Open the cannula packaging but do not remove from the package
- Decontaminate hands thoroughly. If using alcohol rub, allow to dry
- Wear gloves (may be non-sterile but clean)
- Take out the cannula from its packaging, remove the protective cap
Draw the skin towards you to fix the vein and insert the cannula at an angle which will slide into the vein
Look for flashback (blood in the hub)
Release the tourniquet
Apply pressure with your non-dominant thumb above the cannula to prevent excessive bleeding
Remove the stilet and discard into a sharps container immediately
Attach the administration set after wiping away any sign of blood with an alcohol swab
Anchor the cannula using a U-technique (See Figure 13). A cross over tape increases the piston effect
A transparent semi-permeable dressing is best to allow easy visual inspection of the IV site and is also protective
Run the fluid through the vein and keep watching to ensure free flow
Once satisfied, anchor the administration set and set the rate of flow
Remove and discard all used items appropriately
Remove gloves and decontaminate your hands

Figure 13: Well sited and anchored cannula. Note the stabilizing tape across the hub of the cannula

9.2.1.6 Addition of Medication

It is common that bolus or additional fluids are administered to severely ill patients. These have to be carried out with great care to ensure sterility.

9.2.1.6.1 Injection Ports

Injection ports should be closed with a levelled silicone bung that can be easily wiped clean with an alcohol swab prior to each bolus injection.

9.2.1.6.2 Three Way Taps (Stop Cocks)

Taps are sometimes necessary to give bolus injections but are not recommended for routine use. If these are used, the ports must be closed after each injectable
with a needle or preferably with a syringe (needle less systems). All ports must be cleaned prior to use.

9.2.1.6.3 Multi-Dose Vials (MDV)

MDV are commonly used for reconstituting medication or when several doses are made up in larger quantities due to cost considerations. Paediatric medication is often reconstituted in MDV and then the prescribed doses are removed and given to patients. Several outbreaks of hepatitis B and C have been reported when the same needle and or syringe is used to withdraw medication.

The surface of the rubber diaphragm should be wiped with alcohol and allowed to dry. Closed needleless systems with non-return valves are available on the market and have shown to greatly reduce bacterial contamination and are recommended.

If a needle and syringe is used to withdraw medication, a fresh needle must be used for each entry and then changed before administration to the patient. The same syringe should never be used repeatedly to withdraw medication.

Figure 14: a) a multi dose vial b) vial in use and c) a needleless system

9.2.1.6.4 Additional Fluids

If extra fluid bags have to be attached to the same IV system, it is best to use an administration set with two lines rather than piggy-backing on to the line via an injection port.
This increases contamination unless a needleless system is used.

9.2.1.7 Complications

9.2.1.7.1 Mild Complications

Localised to the site of cannulation and will require relocation of IV cannula if it persists or is clinically indicated:
- Extravasation - fluid leaking
- Redness and swelling at site of cannula entry (could be allergic or microbial)
- Allergic reaction to the tape or skin antiseptic or to latex gloves used by the HCW.

9.2.1.7.2 Moderate

The swelling and redness has extended beyond the IV site and may be extending slowly or rapidly. This may or may not be accompanied by systemic symptoms such as fever.
- Localised infection introduced at time of insertion
- The IV cannula has been disturbed and become infected during manipulation of either the IV site or when changing administration sets
- The IV site is covered with thick elastoplasts and there has been:
  - Accumulation of blood and fluid below
  - The plaster strip has introduced microbial contamination to the IV site (classically happens when strips are cut and left stuck on a surface as pre-preparation)
- Reaction to medication infused - incompatibility or contamination
- Inappropriate therapy

Incidence reports are to be written and presented to management.

9.2.1.7.3 Severe

Onset of severe systemic disease including signs of bacteraemia with temperature spikes, localised or generalised signs of infection and excessive pain in arm. Sometimes signs of vascular occlusion are noticeable and the patient may lose life, limb or both.

- Contaminated intravenous fluids especially with fungi and environmental organisms- endotoxin released.
- Contaminated intravenous devices and administration sets - could be intrinsic or extrinsic.
- Leaking administration set which has gone unnoticed
- Introduction of infection during incorrect management of IV site
- Introduction of bolus IV injections via contaminated additive ports (especially open three way taps)
• May have a systemic infection which spread and seeded on the IV cannula.
• Allergic reaction to IV fluids
• Incorrect dosage or medication

Incidence reports are to be written and presented to management

9.2.1.7.4 Reporting Adverse Reactions

All adverse reactions must be reported in the patient’s notes. Severe reactions warrant an enquiry and the adverse reaction reports must be filled and investigated.

9.3 Central venous pressure (CVP) line insertion

The insertion of a CVP line is an aseptic procedure and should be carried out preferably in a clean or sterile environment. This is not always possible because many lines are inserted in the Intensive Care Units.

Sterile drapes, gown and gloves are recommended. Masks are optional but preferred. Setting up a CVP line usually requires two persons - one to insert the CVP line and the other one to assist.

9.3.1 Method for Insertion of CVP Line

• Collect all the necessary equipment and place it on an intra-venous trolley
• Carry out hand hygiene
• Set up a sterile field by draping the patient from knees to head with sterile drapes
• Place the patient in a flat, comfortable position (angle of 45 degrees)
• Inspect the site of insertion. Make sure there are no small abrasions, skin lesions or broken skin in the immediate vicinity
• Surround the site with sterile drapes but with adequate space for a good visual field
Clean the site with a sustained action antiseptic (usually alcohol based chlorhexidine 0.5% to 2% in 70% isopropyl alcohol) for at least 2 minutes, making sure the area is well covered. Allow to dry

Carry out aseptic hand hygiene

Wear sterile gown and gloves

Insert the CVP line with minimum trauma and bleeding (depending on whether there is guide wire or direct insertion)

Clean the site thoroughly again with the recommended skin disinfectant and dry

Apply a clear transparent dressing to the CVP insertion site dressing for easy inspection, semi-permeable to reduce collection of fluid around the insertion site, although some fluid collection is inevitable from the skin

Clean the hub thoroughly with an alcohol wipe before connecting the administration set

All venous entry points such as three-way taps or ‘traffic lights’ should have closed ports and left connected even when not in use to avoid contamination

Each of the ports should be labelled with the type of infusion to prevent cross contamination or adverse drug reactions

Discard all sharps and waste appropriately

Remove protective clothing, carry out hand hygiene

Record in the patient’s notes

For jugular and subclavian CVP, do a chest X-ray before commencement where applicable

After the CVP procedure, a chest X-ray must be done

**9.3.2 Maintenance of CVP Lines**

The CVP lines should be visually inspected frequently for leakage, redness or fracture

It is preferable that the administration sets are changed each day at the same time under strict aseptic conditions

Multi-lumen catheters can be shut off individually and changed aseptically when required

If heparin locks have to be introduced, these should be done aseptically

The CVP line can remain in-situ as long as it fulfils its function and is not a source of infection

The dressing should be changed when it looks moist and should be handled with great care in an aseptic manner

All administration sets and ports should be clearly labelled and checked to ensure there is no incompatibility between infusions (particulate matter)

If there is leakage, accidental disconnection or any break in the system, it should be corrected immediately and noted in the patient’s records

Blood samples taken from CVP lines can be misleading and are best avoided unless specifically indicated

Blood cultures should not be taken routinely from CVP lines as they usually reflect colonisation
• In case of central line associated blood stream infection, a sample of blood for culture should be taken from a peripheral site and one from the CVP line for comparison
• Once removed the CVP tip may be sent for culture but these results could be misleading
10. QUALITY ASSURANCE

Quality Assurance is an essential element of clinical practice and must be integrated into the clinical programmes to ensure safe practice.

The WHO Best Practice guidelines recommend the following quality assurance parameters.

All practices require astringent quality control measures to ensure safety of the patient as well as that of the HCW. These reflect the high standards of quality care for both the patients and the staff. These include:

- Availability of appropriate supplies and protective equipment
- Availability of post-exposure prophylaxis (PEP)
- Avoidance of contaminated phlebotomy equipment
- Appropriate training in phlebotomy
- Cooperation on the part of patients

10.1 Adequate Supplies - Procurement

Management (administration) is responsible for ensuring that there is adequate number of supplies of the right devices and materials to ensure patient and staff safety. Some of these supplies might be general and others more specific.

There must be IPC input into the specifications and procurement of the supplies.

10.1.1 For Hand Hygiene

- Hand washing with running water and non-bacterial liquid soap
- Hand drying such as paper towels or the provision for alcohol based hand rub (ABHR)
- Provision of well-fitting non-sterile gloves

10.1.2 Supplies for All Procedures

- Chlorhexidine 2% in alcohol for cleaning the skin
- Single-use disposable needles, and syringes or lancing devices in sufficient quantities - one per patient must be made available. The needle and syringe is disposed as a single unit into a robust sharps container. Here, experience and skill plays an important part in safety
- In some countries there are re-use prevention devices or safety engineered devices which are effective in reducing exposure to blood for the healthcare workers However, these are expensive and require specialised skills for their use. Not all of them are appropriate for drawing blood
- Butterfly needles with luer locks for children or those with difficult veins
- Covers or bandages for after the blood has been drawn
- Sufficient laboratory sample tubes must be available to prevent dangerous practices (e.g. emptying blood to recycle laboratory tubes)

### 10.2 The Elements of Quality Assurance

There are several aspects to quality assurance (QA), however only the most important ones are outlined here.

**10.2.1 Education**

All staff carrying out phlebotomy must be trained in the anatomy of the limbs, be aware of risk to blood exposure, and most importantly the consequences of poor infection control and prevention practices. Those dealing with neonates and paediatrics must be trained in specialised phlebotomy. It is the responsibility of the institution to ensure all staff is trained.

**10.2.2 Standard Operating Procedures**

Each step or procedure must have a clear SOP which is in writing and readily visible to all healthcare workers. The SOPs must be based on local practice with evidence based principles in order to achieve best practice. These written policies are for the protection of the patient as well as the staff.

**10.2.3 Correct Identification of the Patient**

The information on the laboratory form should match the patient identification and ideally should be carried out by two separate individuals. In the case of blood donation, the donor identity should match the results of the screening test accurately. With blood sampling there must be an accurate tracking system to match the laboratory results to the patient or donor.

**10.2.4 The Condition of the Sample**

The sample should arrive in the laboratory in a condition fit to process and to yield accurate results. If the transportation of samples is inappropriate the blood might lyse, or the tubes might get broken, thus affecting the quality of the results.

The patient might have to be called in for another sample. Good transportation will improve the quality of laboratory results.

**10.2.5 Incidence Reporting**

There must be a log or register which will contain a record of all adverse events establishing accurate details of the incident, possible cause and management of adverse events.
10.3 Quality Care for Patients and Health Workers

The quality assurance programme should improve the safety standards and quality of care for patients and healthcare workers as well as the laboratory results.

10.3.1 Healthcare Workers

The quality assurance programme should include the following:

10.3.1.1 Availability of Post-Exposure Prophylaxis

- The healthcare facility should display clear instruction on what to do in case of accidental exposure to blood and body fluids
- Accidental exposure and specific information about an incident should be recorded in a register
- Support services should be promoted for those who undergo accidental exposure PEP can help to avert HIV and hepatitis B infections. Hepatitis B immunization should be provided to all health workers (including cleaners and waste handlers) as outlined in the National Guidelines on Post Exposure Prophylaxis for HIV, HBV and Tetanus (2010) for protection of healthcare workers, either upon entry into health-care services or as part of PEP

10.3.2 Avoidance of Contaminated Phlebotomy Equipment

Equipment used in the drawing of blood or blood donation must be free of pathogens and not contribute to healthcare associated infection (HAI). This is particularly true of common use articles such as tourniquets; reusable finger prick devices such as glucometers which might become contaminated with blood (have been implicated in outbreaks of hepatitis B). Ensure all items are thoroughly cleaned before use on the next patient.

10.3.3 Safe Equipment

If staff is trained and able to use safety engineered devices then these can be provided - they are known to reduce needle stick injuries (NSI) by 65%. However, if staff is more experienced and competent in using needles and syringes, these should be provided in adequate amounts.

There must be a sharps container for each phlebotomy station to prevent any movement with a used needle and syringe and the used needles and syringe should be disposed off in a sharps safety box immediately after use.

There must be adequate provision of gloves, single use disposable needles and syringes, and other similar equipment including laboratory sample tubes.
10.3.4 Training in Phlebotomy

As mentioned earlier, all staff should be trained in phlebotomy to ensure safety of the patient and also themselves. If the phlebotomists have not been trained formally it is the responsibility of the institution to ensure that they are trained adequately (in-service) so as not to pose a danger to themselves or their patients.

The curriculum and length of training will be governed by local requirements but the essentials in training must be covered.

Supervision by experienced staff and structured training is necessary for all healthcare workers, including doctors, who undertake blood sampling.

10.3.5 Patient Cooperation

One of the essential markers of quality care in phlebotomy is to involve the patient and get his or her cooperation. This is of mutual benefit. There must be clear instructions either verbal or in writing for each patient so that there is confidence in the procedure.

10.4 Quality of Laboratory Sampling

Factors that influence the outcome of laboratory results during collection and transportation include:

- Knowledge and skills of staff involved in blood collection
- Use of the correct gauge of hypodermic needle to prevent haemolysis or abnormal results
- The anatomical insertion site for venipuncture
- The use of recommended laboratory collection tubes
- Patient–sample matching (i.e. labelling)
- Transportation conditions
- Interpretation of results for clinical management

10.4.1 The Blood Sample

The blood samples should be taken in such a manner that there is no haemolysis or deterioration of the sample. The type of laboratory sample tube required for the various tests is shown in the table shown below (Table 3).

- The blood bottles must be single use only. This will ensure that there is no crossover of blood between patients
- The samples should be taken by an experienced phlebotomist or practitioner
• The sample should be taken with the right type of equipment to ensure no harm to the patient and no damage to the sample
• The blood samples must be stored in a manner that deterioration of the sample quality does not occur

10.4.2 Dangerous Procedures

The main risk is that of needle stick injury due to dangerous practices which is well known but re-emphasised here:

• Recapping used needles using two hands
• Recapping and disassembling vacuum-containing tubes and holders
• Reusing tourniquets and vacuum-tube holders that may be contaminated with bacteria and sometimes blood
• Working alone with confused or disoriented patients or small children who may move unexpectedly, contributing to needle-stick injuries

10.5 Protecting Patients

10.5.1 Training of Healthcare Workers

As previously mentioned staff who work in phlebotomy must be trained. If they work with special patient groups such as neonates or paediatrics, they will require further training. Phlebotomists working in settings with more technology may be trained in techniques for plasma and red cell exchange, photophoresis, stem cell collection and cord blood collection.

10.5.2 Wearing of PPE

All healthcare workers should wear the appropriate personal protective equipment (PPE), well fitting, non-sterile gloves and must decontaminate their hands before and after dealing with the patient and the procedure.

10.5.3 Location of Phlebotomy Service

It is in the interest of the patient that the area where blood drawing is carried out is dedicated, quiet, clean and safe. All surfaces should be cleaned using a good detergent, and in some cases disinfectants might be advised. Cleaning should take place at the start of each working day and in-between procedures as indicated.

All necessary equipment must be available and visible during the working day to reduce confusion and unnecessary movement of the staff.

The patient’s consent and cooperation must be taken before starting. A leaflet or poster might be helpful.
Table 3: Recommendation for types of vacuum tubes for different laboratory tests

<table>
<thead>
<tr>
<th>Order of use</th>
<th>Type of tube/usual Colours$^b$</th>
<th>Additive$^c$</th>
<th>Mode of Action</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Blood culture bottle (Yellow-black striped tubes)</td>
<td>Broth mixture</td>
<td>Preserves viability of microorganisms</td>
<td>Microbiology-aerobes, anaerobes, fungi</td>
</tr>
<tr>
<td>2</td>
<td>Non-additive tube</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Coagulation tube$^d$ (light blue top)</td>
<td>Sodium citrate</td>
<td>Forms calcium salts to remove calcium</td>
<td>Coagulation tests (prothrombin time), requires full draw</td>
</tr>
<tr>
<td>4</td>
<td>Clot activator (red top)</td>
<td>Clot activator</td>
<td>Blood clot, and the serum is separated by centrifugation</td>
<td>Chemistries, immunology and serology, blood bank (cross-match)</td>
</tr>
<tr>
<td>5</td>
<td>Serum separator tube (red-grey tiger top or gold)</td>
<td>None</td>
<td>Contains a gel at the bottom to separate blood from serum on centrifugation.</td>
<td>Chemistries, immunology and serology</td>
</tr>
<tr>
<td>6</td>
<td>Sodium heparin (dark green top)</td>
<td>Sodium heparin or lithium heparin</td>
<td>Inactivates thrombin and thromboplastin</td>
<td>For lithium level use sodium heparin, for ammonia level use either</td>
</tr>
<tr>
<td>7</td>
<td>PST (light green top)</td>
<td>Lithium heparin anticoagulant and a gel separator</td>
<td>Anticoagulants with lithium, separates plasma with PST gel at bottom of tube</td>
<td>Chemistries</td>
</tr>
<tr>
<td>8</td>
<td>EDTA (purple top)</td>
<td>EDTA</td>
<td>Forms calcium salts to remove calcium</td>
<td>Haematology, Blood Bank (cross match) requires full draw</td>
</tr>
<tr>
<td>9</td>
<td>Blood tube (pale yellow top)</td>
<td>Acid-citrate-dextrose (ACD,ACDA or ACDB)</td>
<td>Complement inactivation</td>
<td>HLA tissue typing, paternity testing, DNA studies</td>
</tr>
<tr>
<td>10</td>
<td>Oxalate / Fluoride (light grey top)</td>
<td>Sodium fluoride and potassium oxalate</td>
<td>Antiglycolytic agent preserves glucose up to five days</td>
<td>Glucoses, requires full draw (may cause haemolysis if short draw)</td>
</tr>
</tbody>
</table>
11. MONITORING & EVALUATION

A monitoring and evaluation system should be in place to offer surveillance of management of phlebotomy services and adverse events, and to document improvements. The indicators to use include:

- Number and rate per 100 full-time workers of sharps exposures and other occupational injuries occurring among health workers in the past 12 months

- Number and rate of patients with adverse events in response to phlebotomy such as haematoma, syncope, infection or nerve damage

- Number of reported cases of blood borne pathogens transmitted during phlebotomy (disease that is capable of receiving and responding to reports of cases and clusters of infections)

- Number (and percentage) of phlebotomy sessions where essential equipment was not available and phlebotomy sessions were cancelled

- Number (and percentage) of laboratory test results lost due to errors or poor quality, for example:
  - blood culture contamination rate
  - blood transfusion adverse events
  - haemolysis
  - number of specimens with illegible or missing paperwork or labels
  - number of specimens that could not be processed due to inadequate sample volumes

- Number (and percentage) of trained staff in the health care facility performing phlebotomy, bloodletting and parenteral therapy activities

- Number (and percentage) of juniors who are supervised by trained staff
Annex A: Devices Available for Drawing Blood

The information given in this appendix is based on advice from the Centers for Disease Control and Prevention (5).

Table A.1 Devices for drawing blood

<table>
<thead>
<tr>
<th>Type of device</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conventional devices</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypodermic single-use needle and syringe</td>
<td>Widely available, Least expensive, Comes in wide range of needle lengths and gauges, Does not require special training, Can be used for blood drawing in paediatric population, For patient with small or difficult veins, blood drawing can be easier than an evacuated tube system, If heparinized, can be used for arterial blood drawing</td>
<td>Requires blood transfer, creating additional risk for needle-stick injuries or blood splashing, Difficult to draw large or multiple blood samples, A smaller syringe and paediatric laboratory tube should be used for paediatric patients</td>
</tr>
<tr>
<td>Vacuum-tube systems</td>
<td>Safer than using hypodermic needle and syringe, Eliminates blood transfer, Allows numerous blood samples to be collected through single venepuncture</td>
<td>Requires user to be skilled in its use, Reuse of needle holder (tube holder) creates risk for needle-stick injuries during disassembly, Mixing components from different manufactures can create a problem during use, A smaller tube with a reduced vacuum should be used for paediatric patients, Higher cost</td>
</tr>
<tr>
<td>Winged steel needles (butterfly)</td>
<td>Good for blood drawing from paediatric population or patient with small or difficult veins, Allows better precision than hypodermic needle or evacuated tube needle</td>
<td>Because of the air in the tubing, first tube must be collected without additive or discarded, Difference in winged steel needles for evacuated system tubes and winged infusion set can create confusion, Higher cost</td>
</tr>
<tr>
<td>Type of device</td>
<td>Advantages</td>
<td>Disadvantages</td>
</tr>
<tr>
<td>---------------</td>
<td>------------</td>
<td>---------------</td>
</tr>
<tr>
<td><strong>Safety-engineered devices</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auto-disable (AD) syringes</td>
<td>Not recommended for phlebotomy, designed to prevent reuse, does not reduce the risk of needle sticks</td>
<td>During probing, safety mechanism can be activated, requiring new venepuncture, requires blood transfer, creating risk of needle-stick injuries, difficult to draw large or multiple blood samples, does not offer needle-stick prevention, air in the syringe can affect test results.</td>
</tr>
<tr>
<td>Safety engineered devices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self re-sheathing needles and syringes</td>
<td>Needle forward over the needle provides guard around the used needle, reducing the risk of needle-stick injury; also prevents reuse</td>
<td>Needle cannot be covered when syringe is full of blood or during blood transfer, requires user's compliance, additional training, high cost.</td>
</tr>
<tr>
<td>Winged steel needles with passive or active safety mechanism</td>
<td>Needle-locking mechanism helps to reduce the risk of needle-stick injury and prevents reuse. If syringe is used for blood drawing, allows for safer transfer of blood.</td>
<td>If used in connection with vacuum tubes, because of the air in tubing, the first tube is either without additive or discarded. Requires additional training, high cost.</td>
</tr>
<tr>
<td>Manually retractable evacuated tube systems</td>
<td>Safer than using hypodermic needle and syringe because does not require blood transfer. Allows numerous blood samples to be collected through single venepuncture. Safety mechanism prevents reuse and helps to reduce the risk of needle-stick injuries.</td>
<td>Requires skill in its use. Reuse of needle (or tube) holders creates risk of needle-stick injuries during disassembly. Components from different manufacturers may be incompatible. Smaller volume (1–5 ml) tube with lower vacuum should be used for paediatric patients to reduce haemolysis. Requires additional training, high cost.</td>
</tr>
<tr>
<td><strong>Lancets</strong></td>
<td>Retractable; prevent needle-stick injuries</td>
<td></td>
</tr>
<tr>
<td><strong>Active</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manually retractable syringes</td>
<td>Safety mechanism retracts the needle into the syringe, reducing the hazard of needle-stick exposure and the possibility of reuse.</td>
<td>Safety mechanism cannot be activated when syringe is full of blood and during blood transfer, requires health worker to use it as recommended, requires blood transfer, creating risk of needle-stick injuries, difficult to draw large or multiple blood samples.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self re-sheathing needles and syringes</td>
<td>Sleeve forward over the needle provides guard around the used needle, reducing the risk of needle-stick injury; also prevents reuse.</td>
<td>Needle cannot be covered when syringe is full of blood or during blood transfer, requires user's compliance, additional training, high cost.</td>
</tr>
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</tbody>
</table>
Annex B: Training course content for Phlebotomists

Before undertaking phlebotomy, health workers should be trained in, and demonstrate proficiency for, the blood collection procedures on the patient population that will be within their scope of practice.

Training should cover paediatric, neonatal and intensive care, and blood transfusion, as appropriate. Competence in phlebotomy practices should be an essential part of the final evaluation of those training as health workers.

The outcome of the course should be safety of patients, adequacy of the laboratory specimens, and safety of health workers and the community.

Course contents

- Anatomy of the phlebotomy sites from which the worker is authorized to access blood.
- Infection prevention and control:
  - Elements of standard precautions relevant to venepuncture (hand hygiene, wearing non-sterile gloves).
  - Use of antiseptics – skin disinfection
  - Cleaning and disinfection of materials used on more than one patient, including tourniquets, scissors and specimen carriers
  - Disposal of used equipment especially sharps
- Protection of the patient:
  - Patient identification, including children and confused patients
  - Awareness of the institution’s rule to halt and seek help after a defined number of unsuccessful draws
  - Informed consent and patient rights
  - Managing supplies for patients in isolation
  - Awareness of contraindications to blood draws including drawing on the same side as a mastectomy, through infected or scarred tissues, and through in-dwelling vascular devices (per institutional policy)
- Protection of the health worker:
  - Immunization with Hepatitis B
  - Awareness of high risk devices and practices
  - Ability to state who and when to contact for support in the event of exposure to blood and body fluids
  - Awareness of the benefits of PEP and the need to have source patients tested and HIV
• PEP started, preferably within hours
  o Avoidance of two-handed needle recapping, disassembly of devices, removal of needles prior to injecting blood into tube
  o Placement and use of sharps container within arm’s reach

Appropriate use of personal protective equipment, including gloves
Types of equipment available for blood sampling, and procurement and use of equipment
• Practice taking blood samples, including blood sampling and simulated blood sampling (capillary blood, arterial blood, venous blood from adults and children according to responsibilities)
• Practice on artificial arms and clinical skills development
• Special techniques:
  o capillary puncture
    ▪ heel and finger-pricks
    ▪ lancets
    ▪ capillary tubes (filter paper, capillary blood tubes, rapid test strips, etc.)
      o venous blood
    ▪ large volume (bloodletting – aware that this must be done under direct physician order and management)
    ▪ winged needles
    ▪ evacuated tubes
    ▪ blood cultures
• Adverse events and management
• Occupational exposure and management:
  o the country’s relevant occupational health regulations, including PEP for prevention of HIV and hepatitis B
  o the procedure for, and benefits of, reporting occupational exposure to blood
  o first aid after exposure (see management)
  o PEP (importance of timely response)
  o surveillance and use of data for prevention of occupational exposure
• Waste management, including disposal of waste and sharps, and procedures for spillage and breakage
• Laboratory practices, including type of samples, forms, labelling and transportation
• Standards of practice. Sustainability of training programme
• Career path. Skill-based incentives