

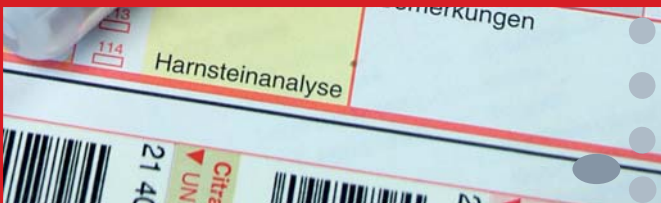


Marc Deschka

# Blood Collection in Practice

A Guideline for phlebotomists

Easy and safe sampling of capillary and venous blood  
from in- and outpatients



## The author



Marc Deschka is a freelance medical journalist and has written numerous technical articles and various medical reference books.

Recently published books:

- Laborwerte von A-Z
- Medizinische Abkürzungen
- Wörterbuch Medizin pocket
- Medical Pocket Dictionary
- Notfallmedikamente XXS pocket
- Arzneimittel Rettungsdienst pocket
- EKG-Monitoring

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## Preface and important information

Clinical experience and research make medical science a continually changing process. In producing this leaflet, utmost diligence was applied to ensure that any and all information provided conforms to the most recent know how. The author does not assume any warranty to this effect. Liability for physical injury, damage to property or economical loss, if any, is excluded.

Consequently, users are requested to compare the information provided with state-of-the-art findings and, in case of doubt, seek expert advice.

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# 1. Blood collection techniques

## 1.1. Capillary blood collection

Capillary blood is a mixture of blood originating from arterioles, venules and capillaries, as well as interstitial and intracellular fluids. Capillary blood is frequently collected in paediatric and geriatric medicine but is also a method generally applied to adult patients, e.g. for blood gas analyses, glucose and lactate determination.

As capillary blood collection yields very small blood volumes only, this method is not suited for analyses requiring volumes in excess of one millilitre. In such cases (e.g. blood cultures) blood should be collected by venipuncture. Likewise, capillary blood is not suited for coagulation analysis. Other criteria that exclude capillary blood collection are inflammations and circulatory disturbance local to the puncture site as may occur with centralized patients suffering from shock.

### 1.1.1. Preparation

#### 1.) Assemble materials required on the Safety-Tray:



- Disposable gloves
- Swabs
- Disinfectant
- Semiautomatic disposable lancets (Safety-Lancets)
- Sample tubes (e.g. blood gas capillaries, Microvettes, blood sugar test strips and blood sugar measuring instrument)
- Multi-Safe disposal box
- Adhesive bandages, if required (Caution: Not recommended for small children due to the risk of swallowing) and material to stimulate the blood flow (humid cloth or hyperaemizing ointment)

2.) Identify the patient.

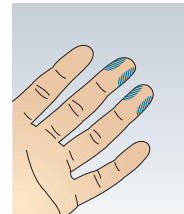
3.) Inform the patient about the purpose and the blood collection procedure.

### 1.1.2. Selection and preparation of puncture site

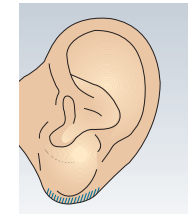
#### 1.) Selection of puncture site

For routine practice, the standard puncture sites for capillary blood collection are the lateral sides of the finger tip of the middle, ring and little finger, the lower section of the earlobe and, particularly with infants, the lateral areas of the heel. Puncturing the finger tip can be a very upsetting experience, therefore patients may prefer blood collection from the earlobe because it is less painful. Puncturing the index finger and thumb is rather awkward as these are the two digits most frequently needed to touch and hold objects so that a puncture site would be very inconvenient for patients in everyday life. For the same reason, puncturing should be restricted to fingers of the patient's "non-dominant" hand. Prior to puncturing, it should also be checked if capillary blood has already been collected recently from the patient. A good blood circulation provided, slightly pressing the former puncture site again will frequently suffice to stimulate the blood flow from this site and will avoid the need for repeated puncturing.

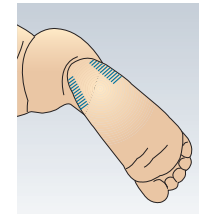
#### 1 Finger tip



#### 2 Earlobe



#### 3 Heel



## 2.) Preparing the puncture site

Warming the puncture site will increase blood flow after puncturing by up to seven times the normal volume. This will ensure optimal preconditions for capillary blood collection. Moreover, enhanced blood circulation leads to an "arterialisation" of the capillary blood to an acceptable comparability with the analyses obtained from arterial blood, and is therefore a basic precondition to yield representative results particularly in capillary blood gas analyses.

In practice, the patient's hand or foot is wrapped with a cloth soaked in approximately 40°C water and left in place for three to five minutes. A rubber glove can be used for optimal results. Alternatively and for capillary blood collection from adults, the earlobe can be rubbed with a hyperaemising ointment.

- Disinfect hands.
- Ask patient to sit or lie down (to avoid risk of collapse).
- Wear disposable gloves.
- Ensure optimum accessibility of the puncture site: e.g. ask the patient to push back hair behind his/her ear before puncturing the earlobe.
- Clean the puncture site using a skin disinfectant. (Leave disinfectant to dry)
- Twist the cap until it separates from the Safety-Lancet. (Fig. 1)
- Hold the Safety-Lancet against the puncture site, warn the patient and press the firing button. (Fig. 2)
- Discard the Safety-Lancet into the Multi-Safe disposal box. (Fig. 3)



1. Twist the protective cap until it separates from the Safety-Lancet.



2. Press the Safety-Lancet firmly against the chosen and cleaned puncture site and press the firing button.



3. Dispose of the Safety-Lancet into a sharps container.

### Product features:



- Primed system ready for use – one application step less.
- The sterile, disposable product cannot be reused.
- Easy handling - secure firing button avoids the risk of unintentional activation and deactivation of the system.
- Ridged lancet body ensures safe grip.
- Small contact face for precise puncturing
- 5 different options
- Version for heel puncturing



Description	Mini	Normal	Extra	Super	Neonatal
Penetration depth	1,6 mm	1,8 mm	1,8 mm	1,6 mm	1,2 mm
Needle size	28 G	21 G	18 G	blade 1.5 mm	blade 1.5 mm
Blood volume	low	medium	medium to high	high	medium to high

### 1.1.3. Puncturing and sampling



After puncturing: Avoid pressure or "milking" of the puncture site to prevent the risk of haemolysis and contamination of the sample with tissue fluid.



- Discard the first drop of blood.
- Hold the punctured limb downwards.
- Collect the blood drop on a test strip (e.g. for blood sugar measurement) or with an end-to-end capillary (e.g. for blood gas analysis).

Observe the order of draw when collecting blood with the Microvette® to avoid contamination:

- 1.) EDTA
- 2.) Lithium Heparin / Lithium Heparin-Gel
- 3.) Fluoride
- 4.) Serum / Serum-Gel

Recommended by CLSI/NCCLS Document:  
"Procedures and Devices for the Collection of Diagnostic Capillary Blood Specimens"

### Blood collection with the Microvette®

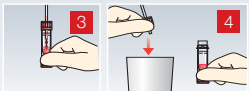
#### 1.) Capillary technique



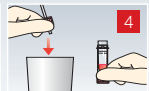
1. Hold the Microvette® in a horizontal or slightly inclined position and collect blood with the end-to-end capillary



2. Collection is complete when the capillary is entirely filled with blood.

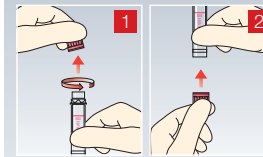


3. Hold the Microvette® upright to allow blood to flow into the collection tube.



4. Twist to remove the cap including the capillary and discard as a complete unit.

#### 2.) Sampling with the collection rim

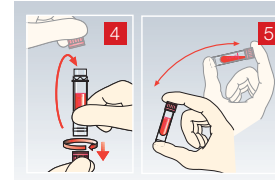


1. Slightly twist the cap to detach.
2. Attach the cap to the tube base.

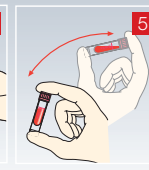


3. Use the special rim to collect the blood drops.

#### To complete collection:



4. Remove the cap from the tube base and close the Microvette® ('click' position).



5. Mix samples thoroughly and gently!

#### 1.1.4. After blood collection

- Press a swab on the puncture site or let the patient hold the swab. Residues of hyperaemising ointment applied prior to puncturing, if any, can now be removed using a Vaseline swab.
- If requested by the patient, cover the puncture site with adhesive dressing.
- Discard contaminated materials in accordance with applicable regulations.
- Disinfect your hands.
- Proceed with the analysis of the blood samples.
- Record blood collection and results.

## Microvette®

### Product features:



- For the collection of even the smallest blood volumes from 100 µl to 500 µl.
- Different inner tube options – conical tube for a high supernatant after centrifugation or cylindrical tube for enhanced mixing results.
- Range of collection techniques.
- The special cap design minimizes aerosol effect when the tube is opened.

## Microvette® – Order of draw\*



EDTA



Lithium Heparin /  
Lithium Heparin-Gel



Fluoride



Serum /  
Serum-Gel

\*Recommendation in accordance with the CLSI/NCCLS directive:

"Procedures and Devices for the Collection of Diagnostic Capillary Blood Specimens"

## 1.2. Venous blood collection



Routinely, venous blood collection is the method of choice whenever major blood volumes are required for laboratory diagnostics (e.g. for blood cultures) or other reasons exclude capillary blood collection, such as, for example, patients in shock, inflammations, or coagulation analyses. Venous blood can either be drawn from a venous catheter already in situ or by venipuncture.

Available in a wide range of preparations to suit a multitude of diagnostic applications, the user-friendly S-Monovettes from SARSTEDT have been well established for venous blood collection.

### Preparation



Serum



Serum-Gel



Lithium-Heparin



EDTA K



Citrate 1 in 10



Citrate 1 in 5



Fluoride

### Fields of application

Clinical Chemistry, Serology, special analyses

Clinical Chemistry, Serology

Plasma recovery for Clinical Chemistry, Serology

Haematology (e.g. Hb, HK, erythrocytes, leucocytes)





Coagulation analyses (e.g. Quick, PTT, TZ, Fibrinogen)

ESR determination to the Westergren method or using the S-Sedivette®

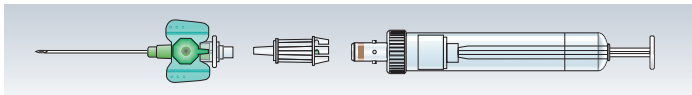
Glucose determination (24 h stability) and enzymatic lactate



In order to prevent contamination of the blood samples with undesirable chemicals inevitably causing wrong analysis results, particular care should be taken to observe the following order of draw when collecting blood with the S-Monovette®:

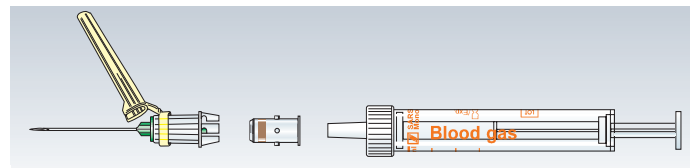
- (Blood cultures)
-  Native blood
  -  Citrate blood
  -  Heparin blood
  -  EDTA blood
  -  Fluoride blood

If blood is to be collected from a venous catheter or needle already in situ, a Multi-adapter (Art. No. 14.1205) is available for direct connection of the S-Monovette® to the Luer adapter of the venous catheter or to a three-way-stopcock already attached (as used on central venous catheters, for example).



If blood is to be collected by directly puncturing the vein, the Safety-Needle (Art. No. 85.1162.200) and Safety Multifly® (Art. No. 85.1638.235) safety systems can be directly connected to the S-Monovette®. These safety systems are provided with a special needle protection device for safe and reliable protection of the phlebotomists against accidental needle-stick injuries after venipuncture.

For combined blood collection with S-Monovettes and Luer systems (e.g. Blood Gas Monovette®) a membrane adapter (Art. No.: 14.1112) is available that can be used with both the Multi-Adapter and the Safety-Needle and Safety-Multifly® safety systems.



### 1.2.1. General preparations

#### 1.) Assemble the material required on the Safety-Tray:

- Swabs
- Disinfectant
- Disposable pad (waterproof to protect clothing and/or the patient's bed linen)
- Tourniquet
- Multi-Adapter, Safety-Needles, Safety-Multifly®
- Sample tubes (S-Monovettes, blood culture flasks, etc.)
- For collection from venous catheters already in situ: prepared syringes with a sterile, physiological sodium chloride solution to flush the catheter after venipuncture as well as caps with integral Luer cone or mandarins to seal the venous catheter
- Multi-Safe disposal box
- Adhesive dressing



#### 2.) Identify the patient.

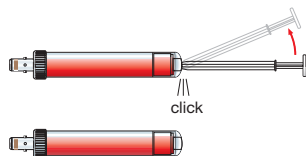
#### 3.) Inform the patient about the purpose and procedure of blood collection.



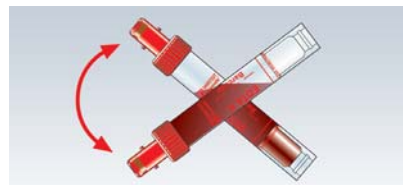
## 1.2.2.a) Blood collection from a venous catheter

### 1.) Blood collection from a peripheral indwelling cannula (extremities)

- Disinfect your hands.
- Ask the patient to sit up or lie down (risk of collapse).
- Wear disposable gloves.
- Disinfect the Luer connection of the line already in situ and assemble with a Multi-Adapter.
- Position the extremity below heart level on a waterproof disposable pad.
- Attach the tourniquet 10 to 15 cm above the line already in situ. Be aware that only a short venous constriction provides enhanced filling of the vein (The pulse must still be palpable distal to the constriction.).
- Attach the S-Monovette® to the Multi-Adapter and lock into place by twisting clockwise.
- Release the constriction and slowly withdraw the plunger of the S-Monovette® until it locks into the S-Monovette® base (Caution: Withdrawing the plunger too quickly may cause haemolysis). If the blood flow stops, briefly interrupt the aspiration and continue withdrawing the plunger after a short pause. If required, tighten the tourniquet once again to support the vein to fill.
- Detach the S-Monovette® from the Multi-Adapter by twisting anti-clockwise. For multiple sampling, attach a new S-Monovette® and proceed as described above. If the patient has received an infusion prior to blood collection, discard the first S-Monovette® to avoid any adverse effect on the laboratory results which may be caused by infusion residues.
- Remove the Multi-Adapter and discard into the Multi-Safe disposal box.
- Withdraw the plunger of the filled S-Monovettes into the 'click' position and break off.



- Flush line already in situ with a physiological sodium chloride solution, disinfect the Luer adapter (remove residual blood with a swab drained with disinfectant) and seal with either a cap with integral Luer cone or mandarin, or continue the infusion therapy.
- Mix the S-Monovettes prepared with anticoagulants thoroughly but carefully.



- Store S-Monovettes Serum and Serum-Gel for at least 30 minutes in an upright position to prevent 'sausage' formation resulting in a very low serum recovery.



- Discard all materials used in accordance with your institutional guidelines.
- Disinfect your hands.
- Make sure to transfer blood samples to the laboratory for analysis.
- Enter the procedure on the patient's file.

### 2.) Blood collection from a central venous catheter

- Disinfect your hands.
- Ask the patient to sit up or lie down (risk of collapse).
- Wear disposable gloves.

- Disinfect the Luer connection of the central venous catheter or proximal three-way stopcock and assemble with a Multi-Adapter.
- Attach the S-Monovette® to the Multi-Adapter and lock into place by twisting clockwise.
- Slowly withdraw the plunger of the S-Monovette® until it locks into the S-Monovette® base (Caution: Withdrawing the plunger too quickly may cause haemolysis). Discard the first S-Monovette® to avoid any adverse effect on the laboratory results which may be caused by infusion residues.
- Detach the S-Monovette® from the Multi-Adapter by twisting anti-clockwise. For multiple sampling, attach a new S-Monovette® and proceed as described above.
- Remove the Multi-Adapter and discard into the Multi-Safe disposal box.
- Withdraw the plunger of the filled S-Monovettes into the 'click' position and break off.
- Flush venous catheter with a physiological sodium chloride solution, disinfect the Luer adapter (remove residual blood with a swab drained with disinfectant) and seal with a cap with integral Luer cone, or continue the infusion therapy.
- Mix the S-Monovettes prepared with anticoagulants thoroughly but carefully.
- Store S-Monovettes Serum and Serum-Gel for at least 30 minutes in an upright position to prevent 'sausage' formation resulting in a very low serum recovery.
- Discard all materials used in accordance with your institutional guidelines.
- Disinfect your hands.
- Make sure to transfer blood samples to the laboratory for analysis.
- Enter the procedure on the patient's file.

### 1.2.2.b) Venipuncture

In routine practice, directly puncturing a superficial vein is the most common method of blood collection. Preferred puncture sites are superficial veins on the upper extremities as well as instep or scalp veins (e.g. of infants).

#### Procedure:

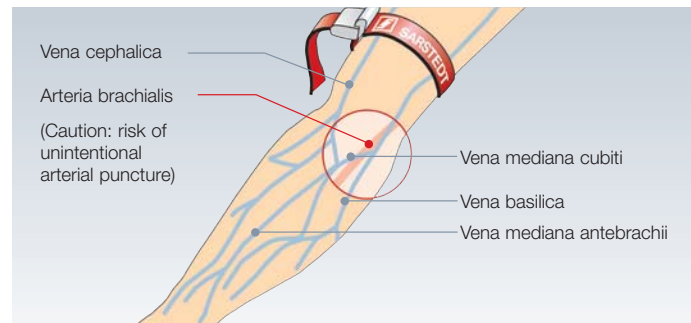
- Disinfect your hands.
- Ask the patient to sit up or lie down (risk of collapse).
- Wear disposable gloves.
- Position the extremity below heart level on a waterproof disposable pad.
- Attach the tourniquet 10 to 15 cm above the line already in situ. Be aware that only a short venous constriction distal provides enhanced filling of the vein (The pulse must still be palpable distal to the constriction.).
- Difficult vein conditions: Ask the patient to clench his fist. Gently tap the vein or cover puncture sites with a warm cloth.

#### Caution:



- 'Pumping' the fist to enhance blood flow leads to a rise in  $K^+$  and  $Mg^{2+}$  due to increased muscle activity.
- Extended constriction changes parameters like  $K^+$  or  $\gamma$ -GT and leads to haemo-concentration resulting in a change of various other parameters.

Important veins for blood collection on the inner side of the forearm and in the bend of the elbow:



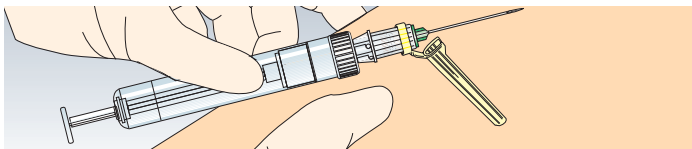
- Puncture the selected vein and loosen the tourniquet. Veins best suited for venipuncture are well palpable, bounce slightly when touched with a finger, are easily visible and, preferably, branched for optimal fixation.

### 1.) Venipuncture with the Safety-Needle

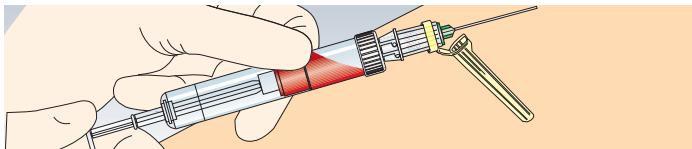
- Disinfect the puncture site. Apply disinfectant and leave to dry. Attach the tourniquet again. For hygienic reasons, do not touch the puncture site again.
- Attach the Safety-Needle to the S-Monovette® by slightly twisting clockwise.



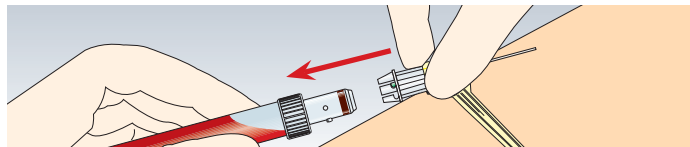
- Use the thumb of your free hand to tighten the skin and hold the vein in place. 'Warn' the patient and puncture the vein at a 30° angle with the needle bevel and opening showing upwards.



- Loosen the tourniquet and slowly withdraw the plunger of the S-Monovette® until the blood flow stops. When using needles with a small diameter do not withdraw the plunger too quickly to prevent haemolysis. If the blood flow stops, briefly interrupt aspiration and gently continue withdrawing the plunger after a short pause. If required, reposition the needle tip or tighten the tourniquet again to support the vein to fill.



- Remove the S-Monovette® from the Multi-Adapter by twisting anti-clockwise. For multiple sampling, attach a new S-Monovette® and proceed accordingly.



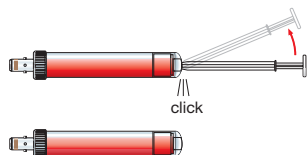
- After removing the last S-Monovette® use a swab to cover the puncturing site. Hold the Safety-Needle at the adapter and withdraw from the vein. Press a swab on the puncture site and ask the patient to press down on the site for 5 minutes to prevent any residual blood flow. Inform the patient that the arm should not be bent, but instead, extended and held well above heart level in order to avoid haematomas local to the puncture site. Once the blood flow has stopped, apply adhesive dressing to the puncture site, if required.
- Place the needle protector of the Safety-Needle on a stable, flat surface and press downward to lock the needle inside with a noticeable and audible 'click'.



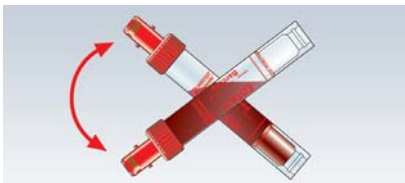
- After activating the needle protector, dispose of the needle in accordance with your institutional guidelines.



- Withdraw the plunger of the filled S-Monovettes into the 'click' position and break off.



- Mix the S-Monovettes prepared with anticoagulants thoroughly but carefully.



- Store S-Monovettes Serum and Serum-Gel for at least 30 minutes in an upright position to prevent 'sausage' formation resulting in a very low serum recovery.



- Discard all materials used in accordance with your institutional guidelines.
- Disinfect your hands.
- Make sure to transfer blood samples to the laboratory for analysis.
- Enter the procedure on the patient's file.

## 2.) Venipuncture with the Safety-Multifly®

- Disinfect the puncture site, apply disinfectant and leave to dry. Attach the tourniquet again. For hygienic reasons, do not touch the puncture site again.
- Use the thumb of your free hand to tighten the skin and hold the vein in place. 'Warn' the patient and puncture the vein at a 30° angle with the needle bevel and opening showing upwards. A noticeable loss of resistance and blood entering the Safety-Multifly® tubing confirms that venipuncture has been successful.
- Attach the S-Monovette® to the adapter of the Safety Multifly® by slightly twisting clockwise.



Please bear in mind that the air contained in the tube will be aspirated into the first S-Monovette® and lead to a wrong mixing ratio for ESR and coagulation. Therefore, discard the first tube to avoid incorrect results.

- Loosen the tourniquet and slowly withdraw the plunger of the S-Monovette® until the blood flow stops. When using needles with a small diameter do not withdraw the plunger too quickly to prevent haemolysis. If the blood flow stops, briefly interrupt aspiration and gently continue withdrawing the plunger after a short pause. If required, reposition the needle tip or tighten the tourniquet again to support the vein to fill.
- Remove the S-Monovette® from the Multi-Adapter by twisting anti-clockwise. For multiple sampling, attach a new S-Monovette® and proceed accordingly.
- After removing the last S-Monovette® use a swab to cover the puncture site. Hold the Safety-Multifly® at its back end between your thumb and forefinger and withdraw the Safety Multifly® needle from the vein by slightly pressing the tubing against the palm of your hand. Press a swab on the puncture site and ask the patient to press down on the site for 5 minutes to prevent any residual blood flow.

Inform the patient that the arm should not be bent but, instead, extended and held well above heart level in order to avoid haematomas local to the puncture site. Once the blood flow has stopped, apply adhesive dressing on the puncture site, if required.

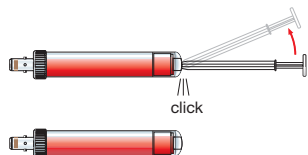
- Hold the needle protector of the Safety-Multify® between your thumb and forefinger and push the needle protector over the needle until the needle is noticeably and visibly locked in the protective casing.



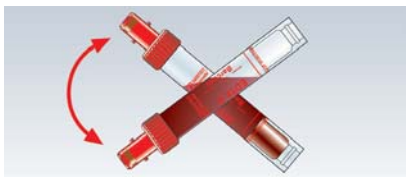
- After activating the needle protector, dispose of the Safety-Multify® in accordance with your institutional guidelines.



- Withdraw the plunger of the filled S-Monovettes into the 'click' position and break off.



- Mix the S-Monovettes prepared with anticoagulants thoroughly but carefully.



- Store S-Monovettes Serum and Serum-Gel for at least 30 minutes in an upright position to prevent 'sausage' formation resulting in a very low serum recovery.



- Discard all materials used in accordance with your institutional guidelines.
- Disinfect your hands.
- Make sure to transfer blood samples to the laboratory for analysis.
- Enter the procedure on the patient's file.

## 2. Tips, techniques and traps in pre-analytics

Pre-analytics encompasses any and all procedures prior to laboratory work, i.e. prior to analysis. During this stage, analysis results are exposed to a multitude of risk factors both during the preparation of blood collection, the collection procedure itself and the storage or transport of the blood samples. While errors in pre-analytics generally have a significant impact on the measured results, errors in laboratory analytics usually involve only minor changes to the measured results. It is therefore strongly recommended to check the pre-analytical working steps for errors whenever spurious results are seen.



Errors in **pre-analytical** work are the figures **in front of** the decimal point.  
Errors in **laboratory analytics** are the figures **behind** the decimal point.

### 2.1. Identification

#### 1.) Patient

Correct patient identification is a major issue in laboratory analytics and must always include a patient's surname, first name/s and date of birth.

Depending on a facility's rules of procedure, the admission number or patient identification number and, in hospitals, the ward and room number are added to complement the patient's file.

Please be aware that mistakes do not only occur with common names and may probably lead to a critical misinterpretation of analysis results. Therefore, a patient's identity should always be confirmed immediately prior to blood collection by directly addressing the patient. Rhetorical questions like 'You are Mr. Miller, aren't you?' do not serve the intended purpose because partially/completely deaf or cognitively impaired patients might erroneously answer such questions with an affirmative nod. Also, a person sitting on the edge of the bed might just as well be a visitor.

## 2.) Sample

To avoid the risk of specimen mix-up, sample tubes without a clear identification cannot be analysed at the laboratory and must always be clearly marked to ensure smooth processing. For reasons of safety, the identification should be provided on the primary tube, never on the lid, the outer packing or transport container. In routine practice, barcode labels are the method of choice for reliable sample identification throughout all working steps involved and will avoid errors likely to be caused by illegible, handwritten information on a sample tube.

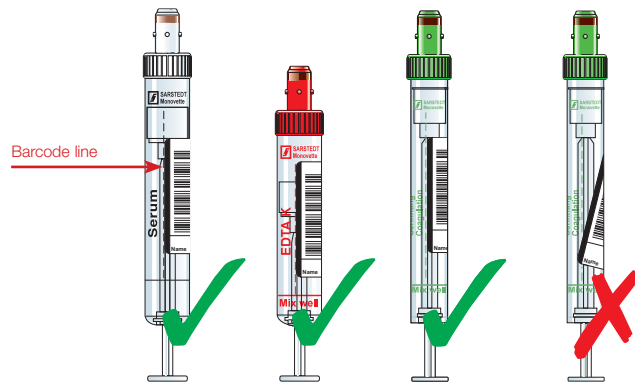
Sample tubes are correctly labelled, provided:

- they enable unrestricted visibility of the tube content,
- they enable control of the filling volume,
- the screw cap can be easily removed,
- the tube and label do not get jammed or stick together in the centrifuge.



Mark the tube and request form to clearly indicate that the material is known to be infectious and to protect Third Parties against inherent risks of infection.

## Barcode Labelling



## 3.) Request form

Apart from the information on parameters to be analysed, the request form should also include the ordering doctor's identity along with his telephone or mobile phone number to facilitate further enquiries by the laboratory staff in case of, for example:

- illegible requests,
- erroneous requests (e.g. prostata phosphatase for a female patient),
- restriction to essential parameters in the event of small sample volumes.

Also, the phlebotomist's identity should be ascertainable for each sample taken and, if possible, also noted on the request form. This is the only way to settle questions concerning the time and type of blood collection, problems, if any, during sampling, the patient's condition and other important issues in the event of unclear analysis results efficiently and without undue delay.

## 2.2. Timing of blood collection

As blood analyses are frequently intended to monitor the course of selected laboratory parameters, it is recommended to always collect blood at the same time of the day. This standardised procedure accounts for the fact that many laboratory parameters are known to submit to circadian fluctuations and that, in the majority of cases, the corresponding standard ranges were determined for blood collection in the morning and before the first meal or administration of medicine. Consequently, regular blood collection should be carried out:

- between 7:00 and 9:00 a.m., before the patient has had breakfast, and following a period of 12 hr fasting,
- before the patient has taken his morning medication.

Excluded from standardised blood collection are parameters that are to be analysed for emergency diagnostics or intended for more meticulous diagnostics and therapy monitoring.

### Food and drink

Food has a significant influence on a multitude of laboratory parameters. Glucose and triglyceride concentrations, in particular, are known to increase quickly after food intake. Consequently, 12hr fasting prior to blood collection is recommended whenever this appears advisable for clinical diagnostics. The analysis of particular parameters may require long-term starvation so that, in case of doubt, the laboratory in charge should be consulted for more detailed information.

A variety of other parameters such as, for example, alkaline phosphatase and its isoenzymes, alanine, aminotransferase, inorganic phosphate, bilirubin, cholesterol, dopamine, iron, proteins, unbound fatty acids, folic acid, gastrin, uric acid, urea, insulin, potassium, calcium, catecholamines, cortisol, copper, leucocytes, magnesium, sodium, parathyroid hormone, somatotropin, zinc, etc., are also subject to food-induced alterations so that fasting prior to blood collection is advisable whenever such sensitive parameters are to be determined. As far as coagulation analysis is concerned, food intake does not have any adverse effect on the measured results. While the patient may only have a light breakfast if isolated coagulation parameters are to be determined, low-fat food should be served in order to avoid plasma turbidity in the analysis to follow.

### Medication

The measured values of a multitude of laboratory parameters are affected by medication prior to blood collection. Provided the patient's clinical picture justifies this decision, the administration of drugs should be postponed until after blood collection or discontinued several days before in order to prevent any adverse effect on the measured results.

Monitoring drug-induced blood levels generally involves the measurement of bottom values of pharmaceutical drugs in blood to reflect drug concentration immediately prior to administering the next dosage (minimal steady state concentration). Consequently, this medication should not be administered before blood collection has been completed.

Exceptions to this rule are measurements taken whenever overdosing or intoxication with pharmaceutical drugs is suspected, as well as the analysis of peak values immediately after administering a particular drug. As a matter of fact, however, these cases are restricted to a limited number of very special clinical issues.

### Physical exercise and diagnostic-therapeutic processes

A number of diagnostic-therapeutic procedures as well as physical exercise prior to blood collection may interfere with the analysis results so that it is advisable to carry out all laboratory tests required before such procedures are initiated.

Such diagnostic measures include, for example, prostate palpation which may contribute to increase acid phosphatase, or any surgical intervention likely to have an adverse effect on the blood sedimentation rate (ESR) by increasing acute phase proteins. Intra-muscular injections may cause muscular enzymes such as CK or myoglobin to increase as a result of the damage inflicted on the cells.

Likewise, any prior physical activity of the patient may have an adverse effect on the analysis results. Temporary fluid fluctuation from the intravascular to the interstitial compartments is very likely to occur, leading to a percentage increase in proteins and blood cells in the vessel diameter. After excessive physical strain, patients are likely to react with an increase in muscular enzymes such as, for example, CK, AST (GOT) and LDH, which is likely to lead to misinterpretation of the relevant analysis results.

Consequently, patients should be requested to maintain an upright or supine position 10 minutes prior to sampling and refrain from any prior excessive physical activity. To ensure precise and indicative analysis results, diagnostic-therapeutic procedures should therefore be postponed until after blood collection.

## Notes

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