



Standards and Practice Guidelines for Venous Blood Collection: Consensus Recommendations from the Korean Society for Laboratory Medicine

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High-quality specimens are essential for accurate laboratory results. Preanalytical errors due to issues, such as hemolysis, microclotting, and insufficient specimen volume, account for 60%–70% of laboratory errors and frequently result from improper blood collection techniques or negligence during the collection process. Therefore, standardized blood collection guidelines and continuous education are required. In Korea, standardized venous blood collection procedures have not yet been fully established, highlighting the need for an evidence-based protocol tailored to local requirements. The venous blood collection guideline presented here was adapted from international standards to conform to globally recognized practices and address the Korean clinical context. The guideline, developed by the Korean Society for Laboratory Medicine, outlines the critical steps in venous blood collection, from patient identification and consent to post-collection handling. Practical recommendations are provided for medical students, doctors, nurses, and medical technologists. The guideline addresses specific considerations for pediatric and older patients, as well as individuals undergoing blood culture tests, with an emphasis on minimizing errors and promoting the safety of patients and medical staff. The guideline includes practical tools, such as checklists and detailed information on sampling devices, to facilitate implementation. This initiative would help standardize blood collection practices, improve specimen quality, and enhance patient care by ensuring accurate laboratory results in clinical settings.

Key Words: Blood collection, Blood sampling, Practice guideline, Sampling device, Venipuncture, Venous blood

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INTRODUCTION

Accurate laboratory test results rely on specimen quality. Prean-

alytical errors, accounting for 60%–70% of laboratory errors, frequently result from hemolysis, microclotting, and insufficient specimen volume [1]. Quality issues in blood specimens often

originate from inappropriate collection procedures, highlighting the need for standardized collection guidelines and continuous education. In many Korean healthcare institutions, improper practices persist throughout the specimen handling process, including patient identification, barcode labeling, blood collection, specimen preprocessing, and transportation [2, 3].

The current guideline aims to provide concise, evidence-based recommendations for venous blood collection, the most frequently performed type of blood draw. Similar guidelines with comparable objectives exist. However, the present compilation is intended to support the standardization of venous blood collection techniques in Korea. Currently, a consensus-based standardized recommendation for venous blood collection in Korea is lacking. The “Basic Clinical Skills Guidelines, 3rd Edition” [4], issued by the Korean Association of Medical Colleges, offers instructional material for medical students. However, it does not reflect current international standards and recommends blood transfer methods that conflict with the Enforcement Rule of the Occupational Safety and Health Act issued by the Korean Ministry of Government Legislation.

In response, the Korean Society for Laboratory Medicine established a working group to develop a context-specific guideline by adapting established international standards. A draft was created after reviewing relevant literature and thoroughly reviewed to reach a consensus. Key sources consulted included Clinical and Laboratory Standards Institute (CLSI) guidelines [5, 6], the World Health Organization (WHO) venous blood collection guidelines [7], the European Federation of Clinical Chemistry and Laboratory Medicine (EFLM) of the Latin America Confederation of Clinical Biochemistry recommendations [8], and several additional sources [9, 10].

This guideline is designed for medical and healthcare students and professionals, including doctors, nurses, and medical technologists involved in venous blood collection. The guideline outlines standardized step-by-step procedures and provides practical strategies for addressing challenges encountered dur-

ing venipuncture. Furthermore, the guideline introduces objective and standardized evaluation tools for education and monitoring, aiming to improve the safety and efficiency of blood collection practices in clinical settings. The goal of this venous blood collection guideline is to minimize collection process errors, ensure specimen quality, and contribute to accurate diagnosis and effective treatment based on reliable test results.

GENERAL VENOUS BLOOD COLLECTION PROCESS

Venous blood is typically collected using a sampling needle (needle, blood collection needle) and a blood collection tube holder (holder, blood collection tube adapter) to directly fill the collection tube with blood [11]. Syringes, which are approved by the regulatory body for drug injections, are not recommended for blood collection because of the risk of hemolysis, microclotting, or needlestick injuries, which can occur while transferring the blood into the collection tube. Recognizing that syringes have to be used in certain unavoidable circumstances in clinical practice, this guideline addresses such exceptions as necessary.

The following steps outline the standard procedure for venous blood collection in routine clinical settings.

Greetings, self-introduction, and consent

The phlebotomist greets the patient, introduces themselves by stating their name and affiliation, and obtains consent for blood collection.

Patient identification

Confirm patient information by requesting at least two identifiers, typically the patient's name and either the medical record number or birthdate, using open-ended questions. For inpatients, identification can also be verified using an ID card or wristband (Fig. 1).

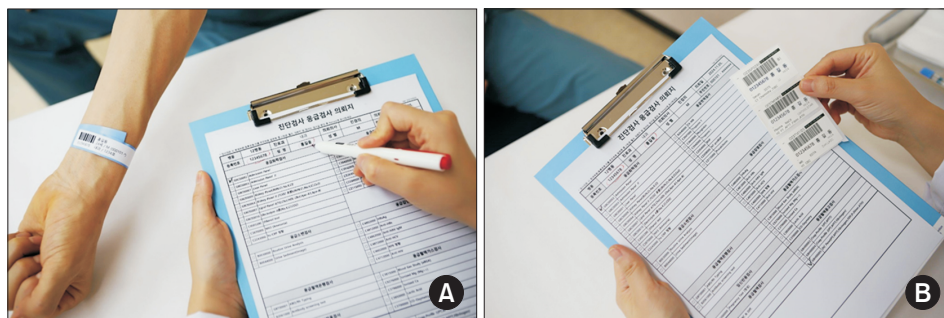


Fig. 1. Patient identification. By asking open-ended questions, such as the patient's name and date of birth or medical record number, the phlebotomist confirms the patient's identity. The phlebotomist also verifies the patient and the required tests by comparing their identification card or wristband with the test request form or computerized order.

Check for previous complications and allergic reactions

Patients must be asked to report any complications experienced during previous blood collections and to confirm relevant details. When using latex-containing consumables such as gloves or tourniquets, confirm whether a history of hypersensitivity to latex exists.

Pre-collection requirements

For tests requiring fasting, confirm the patient's fasting status. Confirm whether the test requires blood collection at a specific time, as in therapeutic drug monitoring or postprandial blood glucose testing, where timing must be strictly followed. Verify the recommended blood volume for the collection tube. Tube manufacturers typically indicate the appropriate volume on the surface or label. The correct amount is generally obtained when the internal vacuum is exhausted, particularly in tubes containing additives.

Wash hands before blood collection

Wash hands using a proper method before blood collection.

Patient positioning

The patient's position must remain unchanged during blood collection to prevent complications.

Preparation of the devices necessary for the procedure

Prepare all devices required for blood collection. The standard equipment includes a tray, gloves, blood collection devices, collection tubes, a tourniquet, disinfectant, bandages, clean gauze, and a needle disposal container.

Blood collection devices include a drawing needle with a holder or syringe. The needle must be securely assembled into the holder before initiating blood collection. Some products are

manufactured as integrated needle holder units to facilitate assembly (Fig. 2A and 2B). Devices with built-in safety features are recommended to reduce the risk of needlestick injuries. For patients with weak or difficult-to-access veins, a winged butterfly needle with a Luer adapter may be selected.

When using a syringe, the bevel and scale of the needle must face upward; the plunger must be pulled back once and then returned to confirm smooth movement and proper functionality (Fig. 2C). Collection tubes must be used within the expiration date. Expired tubes may exhibit compromised vacuum pressure, increasing the risk of insufficient blood volume and improper blood-to-additive ratios. Moreover, additives in expired tubes may degrade.

Collection tube barcoding

Attach the test barcode to the collection tube. To prevent patient identification errors, attach the barcode or confirm that the barcode information matches the patient's details in the patient's presence. When verifying barcode and patient information, use at least two identifiers, typically the patient's name and either the medical record number or date of birth.

Recommendations for when to verify and attach the barcode vary among guidelines. The WHO guidelines recommend attaching the barcode after blood collection [7], whereas CLSI GP41ED7 suggests verifying the barcode before collection and attaching it afterward in front of the patient [5]. The EFLM guidelines recommend barcode verification or attachment in the patient's presence but allow institutions to determine whether this occurs before or after collection [9]. The present guideline adopts the EFLM position; however, for clarity, we describe barcode verification and/or attachment procedures both before and after the collection process.

Ensure that the barcode is positioned and oriented correctly

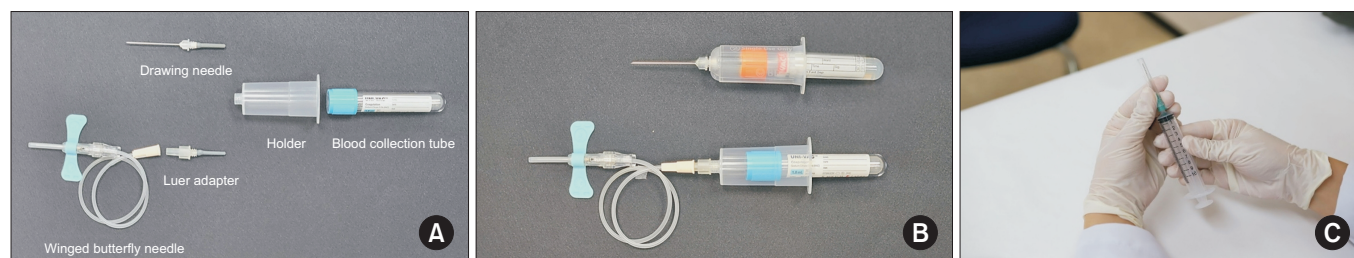


Fig. 2. Blood collection devices and preparation for syringe use. (A) Components used for venous blood collection, including a drawing needle, winged butterfly needle with Luer adapter, holder, and blood collection tube. (B) Fully assembled configurations: a drawing needle connected to a syringe and a butterfly needle connected to a holder and vacuum tube. (C) Preparation for blood collection using a syringe. Orient the syringe such that the bevel and scale face upward, facilitating accurate measurement and safe blood withdrawal. Confirm the smooth operation of the plunger by moving it back and forth before venipuncture.



Fig. 3. Examples of proper specimen label attachment. (A) A correctly affixed label ensures that all mandatory information and barcodes are legible and can be scanned. (B, C) Inappropriate attachment of labels, causing potential barcode misalignment and scanning interference.

to be accurately scanned for entry into the laboratory information system (Fig. 3).

Venipuncture site selection

Select the most prominent vein in the antecubital fossa. Commonly used veins include the cephalic, basilic, median cubital, and median antebrachial veins; the median cubital vein is used most frequently (Fig. 4). The antecubital fossa is preferred given the presence of large veins located near the skin surface. When no suitable veins are identified in this region, veins on the dorsum of the hand may be considered, although not preferred. When veins are not easily visible, a tourniquet may be briefly applied to aid identification. When applied for > 1 min, the tourniquet must be released and reapplied following disinfection of the area.

Use the index or middle finger, or both, to palpate the vein (Fig. 5A and 5B).

Protection

Wear gloves to protect the patient and phlebotomist and to prevent infection [7]. For routine venous blood collection, non-sterile gloves are appropriate; latex-free options should be used when required. For procedures requiring an aseptic environment, such as blood culture collection, sterile gloves are necessary.

Application of the tourniquet

Apply the tourniquet 7–10 cm above the planned venipuncture site. The applied tension must be sufficient to impede venous blood flow while permitting arterial flow (Fig. 6).

The tourniquet must not remain in place for more than 1 min. In patients with superficially prominent veins, tourniquet application may be unnecessary. Prolonged application can lead to hemoconcentration and falsely elevated levels of various com-

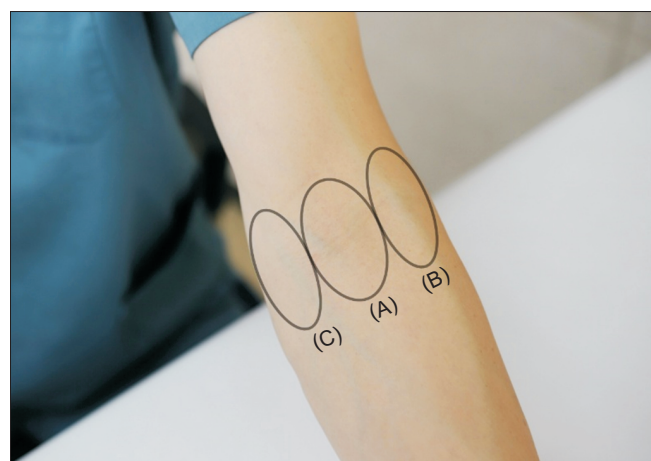


Fig. 4. Selection of the venipuncture site. The antecubital fossa contains relatively large veins, including the median cubital and cephalic veins. The median cubital vein (A), located centrally and protected by the bicipital aponeurosis, is the first priority. The cephalic vein (B) is considered the second priority. The basilic vein (C) is not recommended for initial selection due to the risk of brachial artery or nerve injury.

ponents such as albumin, calcium, potassium, red and white blood cells, Hb, Hct, glucose, triglycerides, total protein, and alkaline phosphatase, in addition to causing patient discomfort.

Reusable tourniquets can serve as reservoirs for pathogenic microorganisms, including methicillin-resistant *Staphylococcus aureus*, and require extra caution.

Patients should not be instructed to repeatedly clench or release the fist to improve vein visibility, as this may induce false hyperkalemia and alter biochemical and hematological parameters. When fist clenching is deemed necessary, patients should gently hold a few gauze pads in their palms.

Disinfection

Disinfect the venipuncture site by rubbing with 70% alcohol and



Fig. 5. Vein palpation and skin disinfection prior to venipuncture. (A) Single-finger palpation using the index or middle finger to assess vein location and resilience. (B) Two-finger palpation can also be used to evaluate the vein. (C) Disinfection of the selected venipuncture site using 70% alcohol. The area should be rubbed thoroughly and allowed to dry completely (~30 seconds). Do not touch or blow on the site to hasten drying, as this may compromise sterility.

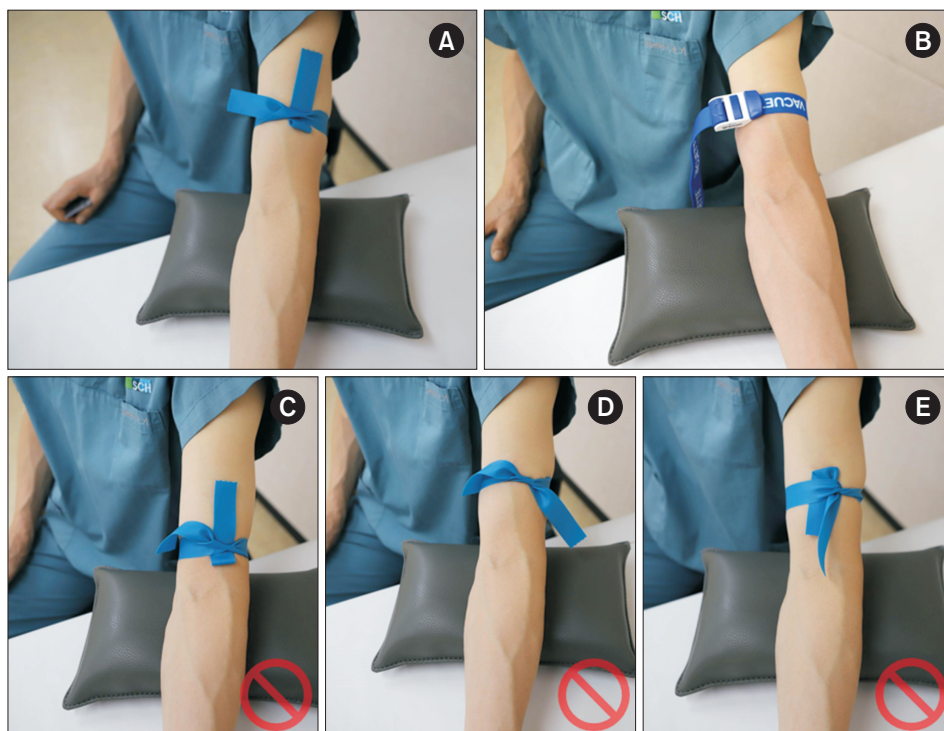


Fig. 6. Appropriate and inappropriate tourniquet application. Placement of a single-use tourniquet 7–10 cm proximal to the venipuncture site is recommended (A), as is the correct use of a reusable tourniquet (B). Placement within 7 cm of the puncture site (C), use of techniques that hinder one-handed release (D), or allowing the free end to come into contact with the puncture site (E) are considered inappropriate. The tightness should be sufficient to impede venous return without obstructing arterial inflow.

allow the area to dry completely, which typically requires approximately 30 secs [5, 7]. Do not touch or blow on the disinfected area to accelerate drying (Fig. 5C).

Needle insertion

Stabilize the vein by gently pulling the skin 2–3 cm below the venipuncture site (Fig. 7). Insert the needle at an angle of $<30^\circ$, with the bevel facing upward and aligned with the vein. Upon entry into the vein, gently lift and advance the needle to maintain a stable position. When venous access is not achieved on the first attempt, minor bidirectional adjustments may assist in localizing

the vein (Fig. 8A).

For patients with weak or difficult-to-access veins, a winged butterfly needle may be used. Before attaching the collection tube, confirm correct venous access by observing blood in the chamber. When using a winged butterfly needle, hold the wings or needle body during insertion (Figs. 8B and 9).

When using a syringe, insert the needle slowly in the direction of blood flow, align the needle with the vein, and maintain the bevel facing upward at an angle of $<30^\circ$ angle (Fig. 8C) [5, 7, 10].



Fig. 7. Vein stabilization. (A) Stabilize the vein by pressing 2–3 cm distal to the intended puncture site. (B) Applying pressure closer than 2 cm to the puncture site is improper. (C) Pressing above the puncture site is discouraged because of the elevated risk of needlestick injury.



Fig. 8. Needle insertion techniques using a drawing needle, winged butterfly needle, and syringe. (A) When using a drawing needle: (1–2) insert the needle with the bevel facing upward at an angle of $\leq 30^\circ$ for proper technique. (3) Avoid improper techniques such as holding the needle with a “pencil grip” or inserting it at an angle $> 30^\circ$. (B) When using a winged butterfly needle: (1–2) hold the needle by its wings or (3) by its body, in accordance with the manufacturer’s instructions. Before attaching the collection tube, confirm venous access by observing blood flash-back in the needle’s chamber. (C) When using a syringe: (1–2) insert the needle bevel-up at an angle of $\leq 30^\circ$ for proper technique. (3) Avoid using a “pencil grip” or inserting at an angle $> 30^\circ$. To minimize hemolysis, stabilize the needle and slowly withdraw the plunger.

Filling the collection tube with venous blood and inverting the collection tube

After needle insertion into the vein, attach the collection tube to the holder, puncturing the rubber stopper to enable blood flow into the tube. Each tube must be filled to the recommended volume (Fig. 10).

To prevent the carry-over of additives, collect blood in the

specified order. Tube stopper colors differ by additive and follow ISO 6710 standards, facilitating easy identification [12] (Table 1, Supplemental Data Figs. S1 and S2).

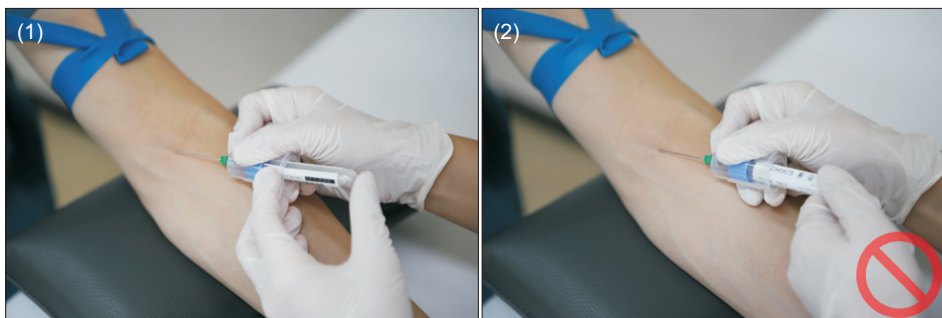
The order of the collection tubes is the same regardless of the device used (e.g., vacuum tube with needle or syringe) or tube material (e.g., plastic or glass) [5, 13, 14]. Although one study indicated minimal cross-contamination in closed systems [15], most guidelines recommend adhering to the prescribed collecting order [5, 13, 14]. The typical order includes blood culture bottles, sodium citrate tubes, serum tubes with clotting activators, heparin tubes, EDTA tubes, and tubes containing sodium fluoride/potassium oxalate for glucose testing [5, 9, 16]. When using a winged butterfly needle and collecting blood into a sodium citrate tube first, an empty, additive-free tube must precede the sodium citrate tube to expel air from the butterfly needle set and ensure proper blood volume collection. For other types of collection tubes not listed in Table 1, the order recommended by the tube manufacturer must be followed to prevent cross-contamination of additives.

After filling a tube, remove it from the holder and gently invert it 180° several times per the manufacturer's instructions before attaching the next tube. One hand must stabilize the holder at the venipuncture site to prevent needle displacement while the other performs the inversion. Avoid vigorous shaking to prevent



Fig. 9. Winged butterfly needle used for challenging or delicate veins. Visibility of blood within the tubing confirms successful venous entry.

A



B



Fig. 10. Proper stabilization of the collection tube holder during venipuncture using a drawing or butterfly needle. (A) When using a drawing needle: (1) secure the holder firmly to ensure smooth insertion of the collection tube and uninterrupted blood flow. (2) Failure to stabilize the holder may result in needle displacement or loss of venous access. (B) When using a winged butterfly needle: (1) the same hand that stabilizes the needle can support the holder during tube changes. (2) Alternatively, place the holder on a clean, stable surface (e.g., a phlebotomy table or tray) and use the free hand to safely change collection tubes.

Table 1. Order of blood draw

Order	Stopper color	Tube	Additives
1	Various	Blood culture tube	Sodium polyanethole sulfonate
2	Light blue	Coagulation tube	Sodium citrate
3	Yellow or Red	Serum tube with or without clot activators, with or without gel	Clot activator
4	Green or Brown	Heparin tube with or without gel	Lithium heparin, sodium heparin
5	Lavender	EDTA tube	K2 EDTA (dry powder), K3 EDTA (liquid)
6	Gray	Glycolytic inhibitor tube	Sodium fluoride/potassium oxalate

Abbreviations: EDTA, ethylenediaminetetraacetic acid; K2, dipotassium; K3, tripotassium.

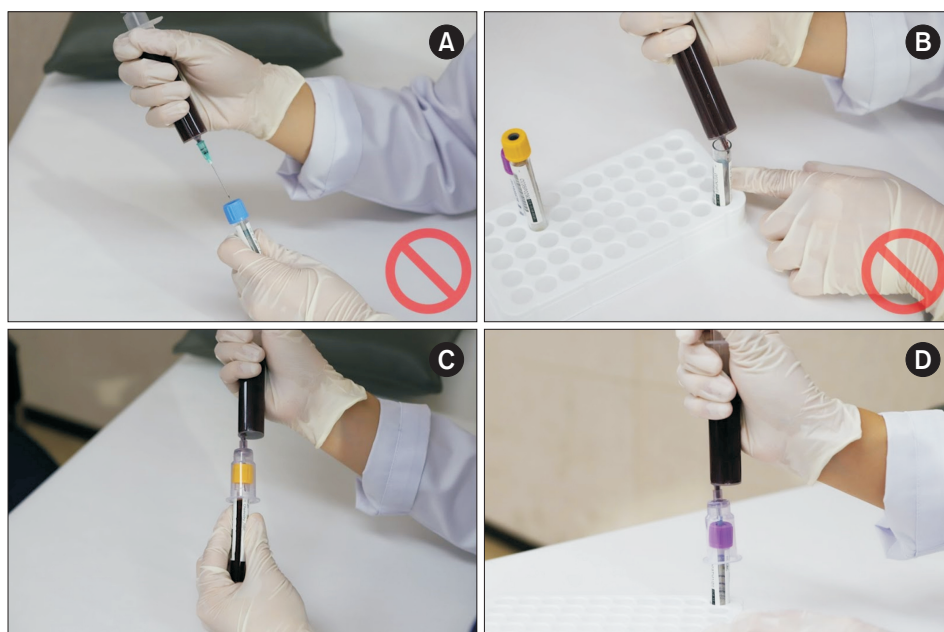


Fig. 11. Filling tubes with a safety blood transfer device. When filling tubes with a syringe, following safe practices to prevent injury and maintain sample integrity is crucial. (A) Injecting blood directly via the syringe needle poses a risk of needlestick injury. (B) Removing the needle and opening the tube cap increases the likelihood of contamination and injury; therefore, a blood transfer device is recommended. (C, D) Correct method for using a transfer device. After removing the needle, insert the syringe tip into the device hub with the syringe oriented downward. Then, insert the collection tube into the holder, ensuring that the plunger is not pressed during the transfer.

hemolysis and cellular damage. Inversion ensures adequate mixing of blood with anticoagulants or clotting activators within the tube, ensuring proper interaction between the sample and additives.

When using a syringe, pull the plunger slowly to collect the required blood volume, minimizing the risk of hemolysis. Under Article 597 of the Enforcement Rule on the Occupational Safety and Health Act, the use of syringe needles for transferring blood into collection tubes is prohibited to prevent needlestick injuries [17]. Additionally, removing the needle or opening the tube stopper during transfer introduces risks of contamination, leakage, and compromise of the closed system and is therefore not recommended. The use of a safe blood transfer device is advised to ensure safe and effective blood transfer from the syringe to the collection tube and to reduce hemolysis risk (Fig. 11, Supplemental Data Fig. S3D) [5].

Delays in blood transfer can result in microclot formation, leading to inaccuracies in tests such as red blood cell counts. Therefore, the blood should be transferred as quickly as possible. Excessive force during the transfer process must be avoided to prevent hemolysis.

Removal of the tourniquet

The tourniquet must be released before removing the needle from the venipuncture site to prevent hematoma formation and to minimize blood splashing. Keeping the tourniquet on for <1 min helps prevent hematoma formation, minimizes blood splashing, and reduces patient discomfort (Fig. 12).

Needle removal and application of pressure to the venipuncture site

After removing the final collection tube, place clean gauze over

the venipuncture site and gently remove the needle. Apply gentle pressure to the gauze to control bleeding. While the phlebotomist safely disposes of the needle, instruct the patient to press on the gauze. Avoid having the patient bend their arm at the elbow while applying pressure, as this can increase the risk of hematoma formation (Fig. 13).

When using a needle with a safety device, immediately activate the built-in safety mechanism after removing the needle to

prevent needlestick injuries.

The needle should be disposed of immediately in a dedicated sharp-waste container [18]. Contaminated needles and consumables should be discarded according to national regulations, typically in containers designed for sharp objects. In South Korea, needles used for blood collection are classified as damaging waste and should be disposed of in a synthetic resin box-shaped container. To facilitate disposal, the container should be within arm's reach. Needles should not be carried to a distant disposal container (Fig. 13).



Fig. 12. Tourniquet release. The tourniquet should be released prior to needle withdrawal following blood collection.

Cleanup and completion of blood collection

All waste materials, except the needle, must be discarded into a designated medical waste container. Clean all contaminated surfaces. When barcode confirmation has not been completed before collection, verify the barcode in the presence of the patient or ensure accurate matching with the patient's identifiers to prevent identification errors.

After confirming collection completion, inform the patient and inspect the venipuncture site for bleeding or hematoma. Apply a bandage or patch as needed.

Inverting the collection tube

To ensure proper mixing of blood with anticoagulants or clotting



Fig. 13. Needle removal and post-collection site care procedures for venipuncture. (A) When using a drawing needle: (1) after phlebotomy, a clean gauze pad is promptly applied over the puncture site. (2) The needle is discarded into a sharps container while pressure is maintained over the site to ensure hemostasis. (B) When using a winged butterfly needle: (1) after blood collection, a gauze pad is applied directly over the puncture site. (2) The butterfly needle is safely discarded into a sharps container, with continued pressure applied to the site.

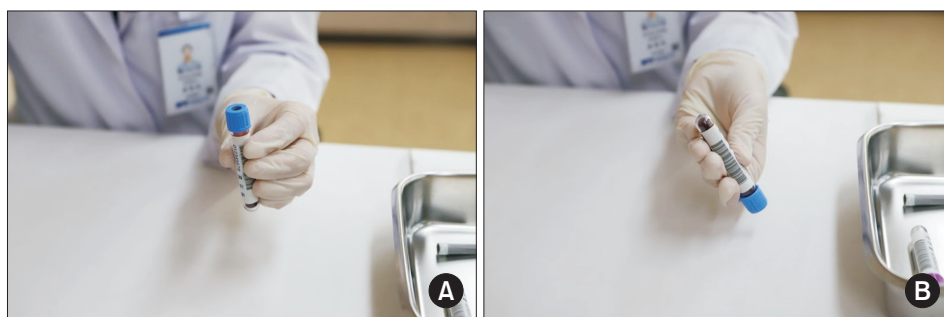


Fig. 14. Mixing blood collection tubes. Following the manufacturer's instructions, gently invert the tubes the prescribed number of times. One complete inversion involves rotating the tube 180° and returning it to the starting position (A → B → A).

activators, gently invert the collection tube 180° several times following the manufacturer's instructions. After inversion, keep the tube upright until transported to the laboratory (Fig. 14).

Transportation of the collection tube and centrifugation as necessary

Immediately after blood collection, transport the collection tube to the designated laboratory. To prevent tube breakage or blood leakage, place the tube in a sealed plastic container or use a tube rack. For tests using serum or plasma that are not conducted immediately, separate the serum as soon as possible, ideally within 2 hrs of collection. For serum separation tubes, follow the manufacturer's instructions to allow the blood to clot at room temperature for 15–30 mins before centrifugation to minimize fibrin formation. The centrifugation conditions should adhere to the tube manufacturer's guidelines.

The concentrations of biochemical substances in the blood can change depending on the duration of contact with the cell layer and on the temperature. For example, as cellular metabolism continues, glucose and oxygen levels decrease while the lactate level increases. Lowering the sample temperature slows metabolism, reducing these changes. However, slower metabolism can disrupt blood cell concentration balances, causing substances such as potassium, phosphorus, magnesium, and lactate dehydrogenase to leak into the extracellular fluid, which elevates serum or plasma levels. Additionally, certain disease-related substances may degrade over time. Centrifugation of samples within 2 hrs of collection is recommended [6].

Removal of gloves

After completing blood collection, remove gloves. The phlebotomist should change gloves before interacting with each new patient. When removing gloves, turn them inside out to avoid direct contact with the contaminated outer surface.

Wash hands after blood collection

Wash hands using a proper method before blood collection.

COMPLICATIONS DURING VENOUS BLOOD COLLECTION

During venous blood collection, various complications may occur. Phlebotomists should be well-versed in potential complications and ways to manage them. Additionally, they should receive first-aid training to assess and respond to complications that may arise during blood collection.

Subcutaneous hemorrhage and hematoma

Subcutaneous blood leakage may cause swelling or bruising at the puncture site. To prevent hematoma formation, release the tourniquet before needle removal and apply pressure to the puncture site using gauze. During blood collection, maintain correct needle positioning and disconnect the collection tube from the holder before withdrawing the needle. Avoid venipuncture at vein branches because of the increased risk of hematoma [5]. When hematoma formation is observed during blood collection, remove the needle immediately and apply direct pressure to the site. Most hematomas resolve naturally without intervention. However, symptom relief and healing can be facilitated by elevating and resting the affected limb, applying an elastic compression bandage, using cold compresses for 24–48 hrs followed by warm compresses, and prescribing analgesics such as acetaminophen. However, avoid recommending aspirin or ibuprofen within 72 hrs of collection, given the increased bleeding risk [19, 20].

Nerve damage

Symptoms including electric shock-like or intense stabbing pain, tingling, numbness, or tremors in the arm suggest potential nerve injury. In such cases, immediately remove the needle. Per-

form subsequent blood collection at an alternative site, preferably on the opposite arm. Most nerve injuries resolve within 24 hrs. However, in cases of persistent or severe symptoms, medical consultation is advised [7].

Arterial puncture

Suspected arterial puncture—indicated by rapid hematoma formation or quick tube filling—requires immediate needle removal and application of firm pressure on the puncture site for a minimum of 5 mins or until bleeding stops.

Fainting (syncope)

During blood collection, preparation for potential syncope is essential. Patients with a history of fainting during phlebotomy should be seated in a chair with leg elevation to chest level or placed in a supine position. Encourage patients to divert attention and engage in deep breathing throughout the procedure. Following blood collection, patients should remain in this position for 5–10 mins to reduce the likelihood of syncope. Upon loss of consciousness during blood collection, the procedure must be discontinued immediately, and the patient should be placed supine with the head and arms lowered. Loosen clothing and maintain this position until full recovery.

Nausea

When a patient experiences nausea, encourage deep breathing to promote relaxation. Apply a cold compress to the forehead to alleviate discomfort and help reduce nausea.

Seizures

When a seizure occurs during blood collection, immediately stop the procedure and move the patient to the floor or secure them in a chair to provide stable support. Remove any sharp objects or furniture in the vicinity to prevent injury during the seizure. Record the seizure duration to assist healthcare providers in evaluating the event. Allow the seizure to proceed naturally without attempting to restrain the patient. Maintain the patient in a comfortable position and remove any food items, such as gum or candy, from their mouth.

Infection

Phlebotomists and patients are at risk of exposure to blood-borne pathogens through contact with infected blood. These pathogens include human immunodeficiency virus, hepatitis B and C viruses, hemorrhagic fever viruses, and dengue virus. Preventing needlestick injuries and blood leakage requires the ap-

propriate use of blood collection tools and adherence to the techniques outlined in these guidelines. Phlebotomists must wear gloves, observe standard precautions, and avoid syringe-based transfers to minimize injury risk. Immediate response following a needlestick injury should align with institutional infection control protocols to reduce infection risk.

SPECIAL CIRCUMSTANCES

Pediatric and neonatal blood collection

For pediatric and neonatal blood collection, confirm the patient's identity by checking the patient's wristband or by asking the caregiver two open-ended questions to verify details, such as the patient's name and medical record number or date of birth. To prevent vein collapse, use a 23- or 25-gauge winged butterfly needle and collection tubes with a small volume (e.g., 1–5 mL) and low vacuum pressure [7]. When using a syringe for blood collection, choose a small blood collection tube with a 1–5-mL capacity (Supplemental Data Fig. S2).

Proper immobilization of pediatric and neonatal patients is essential and should involve the caregiver or a trained assistant. The person assisting should stand opposite the phlebotomist and place one arm across the examination table to support the child's head, drawing the child close in a cradling position. The assisting person should stabilize the child's elbow with one hand and secure the wrist with the other, ensuring the palm faces upward (Fig. 15). Alternatively, the child may be seated on the caregiver's lap.

The volume of blood collected within 24 hrs must not exceed 1%–5% of the child's total blood volume. For infants <8 weeks

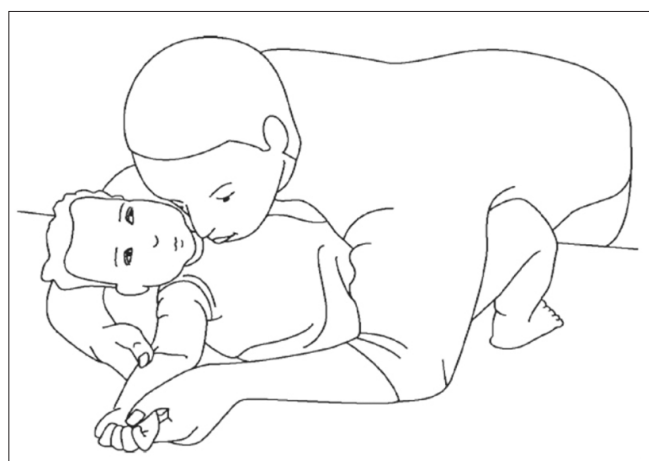


Fig. 15. Immobilize the baby or child. Reproduced with permission from [7].

of age, no more than 10% of the total blood volume should be drawn [5]. In adults, total blood volume is estimated at 65–70 mL/kg of body weight; in children, 75–80 mL/kg [5]. A healthy newborn has an estimated blood volume of 85 mL/kg, and a preterm infant has approximately 100 mL/kg [21].

Geriatric blood collection

In older patients, blood collection is often complicated by difficulty in vein localization, reduced vein elasticity, vein rotation, and vein collapse. Additionally, limited range of motion, dehydration, or hypotension may further impede venous access. Warming the puncture site may facilitate vein detection. Vein stabilization is necessary to prevent rotation during puncture. To prevent vein collapse, small-volume collection tubes with low vacuum pressure and small-lumen needles (e.g., 23-gauge) are recommended.

Venous blood collection for blood culture

Blood culture collection follows a protocol similar to general venous blood collection but requires specific disinfection techniques to prevent contamination. Detailed protocols for blood culture collection are provided separately.

When blood culture collection is performed alongside other tests, a winged butterfly needle with a Luer adapter and sterile holder should be used to direct blood flow into the culture bottles (Supplemental Data Fig. S3C (3), Fig. 16). To prevent backflow, the blood culture bottles must always be kept upright. Therefore, standard blood collection needles cannot be used.

CHECKLIST FOR PROPER VENOUS BLOOD COLLECTION

To effectively evaluate and monitor venous blood collection practices, phlebotomists require an objective and standardized assessment tool. To address this need, we have summarized the venous blood collection process and provided a checklist for assessing blood collection skills in Table 2. By using this checklist, the reliability of blood collection practices can be reinforced, and the application of the present guidelines in clinical settings can be enhanced.

USEFUL DEVICES FOR BLOOD COLLECTION

To ensure the safety of both patients and phlebotomists and to provide accurate test results, various blood collection devices have been developed and marketed. These devices are often underutilized in clinical settings because of insufficient awareness. Therefore, we introduce the major blood collection devices currently available in South Korea. By understanding the characteristics and proper usage of these tools, phlebotomists can enhance the safety and efficiency of blood collection, ultimately improving the accuracy of test results.

Blood collection tube

Blood collection tubes are single-use, disposable tubes with a preset vacuum inside, used for drawing blood from veins. The vacuum allows blood to be naturally drawn into the collection tube, making the blood collection process more convenient and safer. These tubes may contain additives and accessories depending on the type of test and should be selected according to the specific diagnostic purpose.

The ISO 6710 standard [12] specifies the requirements and

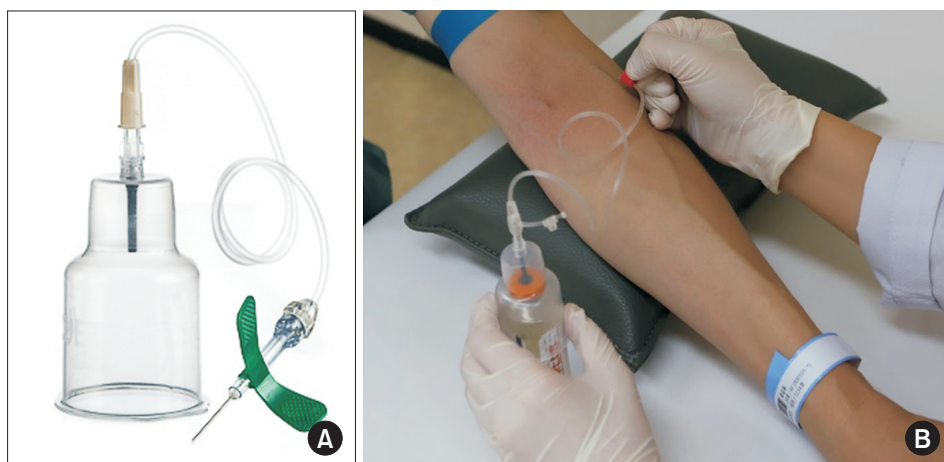


Fig. 16. Blood culture collection using a winged butterfly needle. (A) Sterile blood culture holder, assembled with a safety winged butterfly needle and a Luer adapter. (B) The device directs blood flow directly into an upright blood culture bottle.

Table 2. Checklist of good practice for venous blood collection

Questions	Yes/No
1 Did you greet the patient, introduce yourself, and ask for consent to collect blood?	
2 Did you properly identify the patient using two identifiers? Did you check the list of blood tests prescribed for the patient?	
3 Did you check if the patient had any previous complications or allergic reactions during a blood collection procedure?	
4 Did you confirm all pre-collection requirements? (e.g., fasting status, proper collection time, and recommended blood volume)	
5 Did you wash your hands?	
6 Did you ensure that the patient's posture was maintained, without sudden changes, during blood collection?	
7 Did you obtain all supplies necessary prior to blood collection? (Ensure that the needle is firmly assembled to the holder. Verify the smooth movement of the syringe. Check the expiration date of the tube.)	
8 Did you attach the barcode or confirm that the barcode information matches the patient's information in front of the patient?	
9 Did you select a vein suitable for blood collection?	
10 Did you wear gloves?	
11 Did you apply the tourniquet placed 7–10 cm above the venipuncture site? The tourniquet should be applied for no longer than 1 min.	
12 After rubbing the venipuncture site with 70% alcohol for disinfection, did you allow it to dry completely for at least 30 secs? Do not touch or blow on the disinfected area.	
13 Did you insert the needle and collect blood using the correct technique? (Insert the needle at a <30° angle with the bevel facing upward, ensuring it aligns straight with the vein.)	
14 Did you fill each tube with the recommended amount of blood? Did you follow the correct order of blood draw? After removing the tube from the holder, did you gently invert the tube vertically at 180° several times as per the manufacturer's instructions before attaching the next tube?	
15 Did you remove the tourniquet before withdrawing the needle from the venipuncture site?	
16 Did you place a clean gauze over the venipuncture site? Did you instruct the patient to apply pressure until the bleeding stopped and to avoid bending the arm?	
17 Did you dispose of the needle safely in the sharp-waste container? Did you clean up waste and verify the barcode labels on the collection tubes? Did you inform the patient that the blood draw was complete and checked for bleeding or hematoma at the venipuncture site?	
18 Did you gently invert all blood collection tubes vertically 180° several times as per the manufacturer's instructions?	
19 Were the blood collection tubes sent to the designated laboratory in the proper manner?	
20 Did you properly remove the gloves?	
21 Did you wash your hands after finishing the blood collection procedure?	

test methods for both vacuum and non-vacuum single-use venous blood collection tubes and recommends color coding for easy identification of additives and accessories. For example, blood collection tubes with coagulation activators typically have red caps, whereas those containing a gel separator and coagulation activator are usually dark yellow. Tubes containing EDTA for hematology tests have lavender-colored caps. Despite the official color code, the tone of the colors may vary slightly among manufacturers. Therefore, the specific usage instructions and selection criteria should follow the manufacturer's guidelines to ensure accurate and consistent use of the blood collection tubes (Supplemental Data Figs. S1 and S2).

Detailed descriptions of blood collection tubes from all manufacturers, including information on stopper color, material, recommended blood volume, mixing instructions, label type, addi-

tives, intended use, and additional features for each model, are provided in Supplemental Data Tables S1 and S2.

Drawing needle and Luer adapter

Drawing needles are single-use medical devices used to draw blood from veins. Various types are available to ensure safe and efficient blood collection (Supplemental Data Fig. S3A-1, 2, 4, 5, 6, 8, and 9). Details of needles and Luer adapters from all manufacturers are provided in Supplemental Data Table S3.

Needles are classified into types based on diameter (gauge), length, and design. The appropriate type should be selected appropriately depending on the patient's venous condition and the purpose of blood collection. For users unfamiliar with drawing needles, some products feature a transparent material that allows visual confirmation of proper needle insertion into the vein

as blood fills the needle chamber (Supplemental Data Fig. S3A-4).

The Luer adapter is a connector used in the blood collection process to connect the winged butterfly needle to the blood collection tube. It is available in two forms: Luer Lock and Luer Slip. The Luer Lock (Supplemental Data Fig. S3A-3, 7) is connected securely via a threaded locking mechanism, whereas Luer Slip fittings are pressed together and held by friction.

Blood collection tube holder

The holder is a tool used to securely stabilize the blood collection tube connected to the drawing needle or Luer adapter, ensuring accurate positioning during blood collection. It is available in various shapes and designs, with both single-use and reusable options, allowing selection based on the intended use and blood collection environment (Supplemental Data Fig. S3B). Details of holders from all manufacturers are provided in Supplemental Data Table S3.

Safety device

Safety devices are designed to prevent needlestick injuries and enhance safety during blood collection. Examples include the safety drawing needle, safety syringe, and safety winged butterfly needle (Supplemental Data Fig. S3C). These tools feature a safety mechanism in which, after blood collection or medication injection, the needle automatically retracts into the device or is covered with a protective cap. This design reduces the risk of infection and injury to phlebotomists and patients, as well as prevents reuse, thus enhancing overall safety. Details of safety blood collection devices from all manufacturers are provided in Supplemental Data Table S3.

Blood transfer device

A blood transfer device is used to safely and accurately transfer blood collected with a syringe into a blood collection vacuum tube (Supplemental Data Fig. S3D-1 and 3). Although the use of blood transfer devices is currently not widespread in South Korea, their use is recommended to prevent needlestick injuries and maintain a closed system (Supplemental Data Fig. S3D). In this guideline, devices designed for blood collection from vascular access devices, such as peripheral venous catheters, central venous catheters, and hemodialysis catheters, are classified as blood transfer devices (Supplemental Data Fig. S3D-2, 4, and 5). Details of blood transfer devices from all manufacturers are provided in Supplemental Data Table S3.

SUPPLEMENTARY MATERIALS

Supplementary materials can be found via <https://doi.org/10.3343/alm.2025.0022>.

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CONFLICTS OF INTEREST

None declared.

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REFERENCES

1. Chang J, Kim S, Yoo SJ, Park EJ, Um TH, Cho CR. Preanalytical errors in the central laboratory of a university hospital based on the analysis of year-round data. *Clin Lab* 2020; 66:9.
2. Choi Y, Lee K, Choi HJ, Moon SY, Lim J, Kim S. Quality status of the pre-analytical phase of clinical laboratories in Korea. *Lab Med Online* 2024;14:90–9.

3. Chang J, Lim J, Chung JW, Sohn YH, Jang MJ, Kim S. Status of pre-analytical quality management of laboratory tests at primary clinics in Korea. *Ann Lab Med* 2023;43:493–502.
4. Korean Association of Medical Colleges. Guidelines for basic clinical skills. Revised ed., 3rd ed. Korean Association of Medical Colleges (KAMC), 2020:239–47.
5. CLSI. Collection of diagnostic venous blood specimens. 8th ed. CLSI standard PRE02. Wayne, PA: Clinical and Laboratory Standards Institute, 2025.
6. CLSI. Handling, transport, processing, and storage of blood specimens for routine laboratory examinations. 1st ed. CLSI guideline PRE04. Wayne, PA: Clinical and Laboratory Standards Institute, 2023.
7. World Health Organization. WHO guidelines on drawing blood: best practices in phlebotomy. World Health Organization, 2010.
8. Simundic AM, Bölenius K, Cadamuro J, Church S, Cornes MP, van Dongen-Lases EC, et al. Joint EFLM-COLABIOCLI recommendation for venous blood sampling. *Clin Chem Lab Med* 2018;56:2015–38.
9. Cornes M, van Dongen-Lases E, Grankvist K, Ibarz M, Kristensen G, Lippi G, et al. Order of blood draw: opinion paper by the European Federation for Clinical Chemistry and Laboratory Medicine (EFLM) Working Group for the Preanalytical Phase (WG-PRE). *Clin Chem Lab Med* 2017;55:27–31.
10. Lima-Oliveira G, Brennan-Bourdon LM, Varela B, Arredondo ME, Aranda E, Flores S, et al. Clot activators and anticoagulant additives for blood collection. A critical review on behalf of COLABIOCLI WG-PRE-LATAM. *Crit Rev Clin Lab Sci* 2021;58:207–24.
11. Ministry of Food and Drug Safety. Medical device safety book and integrated information system for medical devices. <https://emedi.mfds.go.kr/portal> (Updated on Dec 2024).
12. ISO. Single-use containers for human venous blood specimen collection. 2nd ed. ISO 6710:2017. International Organization for Standardization, 2017.
13. NCCLS. Procedures for the collection of diagnostic blood specimens by venipuncture. 5th ed. NCCLS document H3-A5. Wayne, PA: The National Committee for Clinical Laboratory Standards, 2003.
14. CLSI. Procedures for the collection of diagnostic blood specimens by venipuncture. 6th ed. CLSI document H3-A6. Wayne, PA: Clinical and Laboratory Standards Institute, 2007.
15. Bazzano G, Galazzi A, Giusti GD, Panigada M, Laquintana D. The order of draw during blood collection: a systematic literature review. *Int J Environ Res Public Health* 2021;18:1568.
16. Lifshitz MS. Preanalysis. In: McPherson RA and Pincus MR, eds. *Henry's clinical diagnosis and management by laboratory methods*. 24th ed. St. Louis, MO: Elsevier, 2021:22–34.
17. Enforcement rule on the occupational safety and health act. Rule no. 597, Oct 18, 2022. <https://www.kosha.or.kr/english/legislation/occupationalSafetyAndHealth.do?mode=view&articleNo=438848&article.offset=0&articleLimit=10>
18. Ministry of the Environment. Guidelines for the separation and disposal of medical waste. (December 2023). <https://www.me.go.kr/hg/web/board/read.do?menuId=3468&boardId=1649780&boardMasterId=136&condition.hideCate=1> (Updated on Jan, 2024).
19. Cleveland Clinic. Bruises (ecchymosis). <https://my.clevelandclinic.org/health/diseases/15235-bruises> (Updated on Dec 2024).
20. University of Washington Medical Center. After your blood draw: hematoma care instructions. <https://healthonline.washington.edu/node/12139> (Updated on Dec 2024).
21. Nam M, Kim MJ, Choi SH, Hong YJ, Kim H, Hwang SM, et al. Utilization analysis of neonatal red blood cell aliquots and development of electronic issuing system. *Korean J Blood Transfus* 2016;27:122–9.