I. Collecting and Processing of Specimens
   A. Arterial Punctures
      1. Specimen Types
         a. Arterial Blood
            Test performed in ABG
            \( pO_2 \) – oxygen
            \( pCO_2 \) – carbon dioxide
            pH

         Complications
         Hematoma
         Arteriospasm
         Thrombosis

         Site Selection
         Radial artery – only one we use
         Brachial artery
         Femoral artery – Dr. draw
         Temporal artery
         Dorsalis pedis artery

         b. Capillary (newborn)

      2. Arterial Blood Collection Equipment
         a. Kits – Complete with supplies needed for one (1) arterial puncture

         b. Standard Supplies
            Antiseptics – alcohol and iodine
            Local anesthesia (optional) – depends on institution
            \( 1\% \) procaine – 0.5 cc (mL)
            \( 1\% \) tylocaine – 0.5 cc (mL)
            Needles – hypodermic used with syringe sizes
            *20 gauge – tough, roly arteries
            *21, 22, 23 gauge – standard (22g, 1½ in.)
            *25 gauge – infants (may need slight suction)
            *5/8”- 1½” length
Syringes – glass or plastic coated with heparin
Heparin (Na or Li-1000 units/mL)
Preparation of syringe
Fill air space – hub of needle
Capping device
Gel filled – anaerobic conditions
Use resheathing safety device
Gauze (sterile)
Pressure held on puncture – 5 minutes
Pressure bandage applied

Labels and Forms
ID syringe prior to placing in ice water
Time of transportation – do not delay
Ice water – if a delay in over 30 minutes until testing
1-5°C – immerse syringe
Slows metabolism of WBCs
Leukemic patients – specimen tested written 5 minutes

3. Arterial Puncture Procedure
a. Purpose
Primary reason for performing arterial puncture is to obtain blood for evaluation of arterial blood gases (ABGs), and the body’s ability to compensate for adverse conditions and to oxygenate the tissues.

ABG evaluation is used in the diagnosis and management of respiratory disease, also provides valuable information about a patient's oxygenation, ventilation, and acid-base balance status.

b. Preparation of:
1. Allen Test
   1) Patient’s hand closed – tight fist
   2) Apply pressure to both radial and ulnar arteries
   3) Rapid opening and closing of hand – blanched
   4) Leave hand open – release ulnar artery
   5) Observe hand
   6) Blood returns to hand (15 sec.) – “pinks” positive
      means ulnar is filling capillary bed
      negative = no collateral circulation
DO NOT use radial artery (closest to thumb)
positive = use radial artery
2. Reassure patient – explain procedure – alleviate anxiety
3. Local anesthesia

c. Patient information
1. Record temperature
2. Oxygen concentration from respirator
3. Respiratory rate
4. Allergies? (iodine or lidocaine)
d. Preparation of Syringe
Individually packaged kits can be purchased that contain the heparinized syringe and needle.
e. Arterial puncture procedure
1. Aseptically clean the site.
2. Stretch the skin at prepared site and stick the pulsating artery at a high angle, no less than 45°. Hold syringe like a dart.
3. Blood will pulse into syringe quickly. When enough sample is obtained (about 1 mL), remove needle quickly and apply pressure for at least five minutes to puncture site with gauze.

DO NOT SUBSTITUTE FIVE MINUTES MANUAL PRESSURE WITH A PRESSURE BANDAGE. USE A PARTNER OR ASK A NURSE FOR ASSISTANCE.
4. Cap syringe and label.
5. Immerse in ice water if delay in testing.
6. Check puncture site for hematoma – partner leaves for lab with specimen to be tested.
7. After five minutes, if bleeding has stopped, apply pressure bandage.
f. Capillary Gases – Cap gases
Capillary Blood Mixture – most like arterial
Capillary blood contains blood from arterioles, venules, and capillaries, along with interstitial and intracellular fluids. Pre-warming the site will increase the arterial blood concentration 7x and ensures good blood flow.
Capillary blood gas analysis is often collected from babies and small children for whom arterial punctures are too dangerous.
CBGs are collected at the usual areas of the body as other capillary samples.

Because sample is exposed to room air, pO₂ values are unreliable.
Sample drawn in heparinized capillary tube (no air bubbles) minimum volume of 100 µL. Seal ends.
Sample is mixed with metal “flea” and magnet to mix the heparin coating along the sides of the tube with the specimen.
Transport on ice and analyzed immediately.
g. Chemical concentrations altered
   1. Glucose – decreased
   2. K, Total Protein, and Ca\(^{2+}\) - increased
   3. ABG – infants = pH and CO\(_2\)
      1) Unreliable – 1st hour of life or heart/lung disease
      2) pO\(_2\) – unreliable, room air contamination
   4. WBCs – infants – excessive crying/exercise
      1) Returns to baseline in 1 hour
      2) Preferred specimen – resting baby
      3) Use consistent site
   5. Coagulation products
      1) Similar in all three sources
      2) Technique more important than source

h. Complications
   1. Osteomyelitis
   2. Osteochondritis
   3. Abscesses

Sometimes ABGs are analyzed by the respiratory department. Either way, you are responsible for knowing the collection and processing procedures.

B. Test Interferences/Sources of Error

Vacuum Collection
   Hemolysis can occur, especially if tough draw

Coagulation
   Coagulation process triggered by stick and by contact with glass
   Avoid exposure to heat
   Avoid tissue fluids – can initiate clotting

Chemistry
   Bilirubin – light sensitive
   Glycolytic action of RBCs – rapid breakdown (e.g. glucose, enzymes, etc.);
   separation of serum/cells must occur in less than 2 hours
   ABG – air tight, in ice water, no air bubbles
   Hemolysis
   Lipemia – affects any method

Microbiology
   Transport immediately – or possible organism death
   Proper containment – avoid contamination
Improper antiseptic collection technique can lead to contamination

**General**

- Edematous tissue – diluted specimen
- Lymphositis
  - (Mastectomy) – unreliable concentration
  - Capillary for coagulation studies – unreliable for coagulation studies
- Hemolysis –
  - Potassium – increased
  - RBCs/Hgb – decreased
  - Enzymes – elevated
  - Fe – increased
- Temperature – avoid extremes
- Time – do not delay specimen processing
  - Store at appropriate temperature if testing is delayed
- Treatment –
  - Never shake – gentle mixing by inversion
  - Tubes in upward position – promote clot formation

**C. Blood Smear Preparation**

Blood smears are used to study morphology of cells – WBCs, RBCs, and platelets.

**Sources of blood** –

- Fresh blood from finger/heel stick
  - Do not squeeze excessively to obtain drop of blood
  - Only touch drop of blood to slide, not finger (may transfer oils, etc.)
- EDTA blood, preserves cellular morphology
  - Prepare smear within 2 hours

**Types of Smears**

- **Coverslip** –
  - Can examine more of the prepared film
  - However, these are:
    - More time-consuming
    - More difficult to perform correctly
    - Requires more care in handling the preparation
- **Wedge** – (slide, push-wedge)
  - Most frequently used
- **Cytocentrifuge** –
  -Eliminates cellular destruction and artifacts
  -Cells are evenly distributed and less distorted
  -Prepares mono-layer of cells
Procedure:

1. Dispense a small drop of blood from capillary onto the slide about ½ to ¾ inch from frosted end.
2. Place the end of an unchipped spreader slide in from of the drop of blood at a 30-35° angle. (see diagram below)
3. Pull the spreader slide back into the drop of blood and allow blood to spread along three-fourths of the width of the spreader.
4. Keeping an even pressure, push the spreader slide forward with a quick, steady motion.
5. Look at the slide and examine for feathered edge. (see diagram below)
6. Repeat procedure until a satisfactory smear is obtained.
7. Allow smear to air dry.

Acceptable smears:
- Should have border along the sides of smear
- Should fill about ½ to ¾ of the slide
- Feathered edge with iridescent appearance, and shape of fingernail

(from Linne & Ringsrud's Clinical Laboratory Science)
Unacceptable smears:

A = ragged spreader slide
B = uneven movement while spreading
C = not allowed to spread out enough first
D = too short, too small a blood drop, angle too steep
E = not allowed to spread across slide
F = dirty slide (or fat in specimen, just after meal)
G = one side of spreader slide has lifted up while spreading
H = blood drop has partially dried before spreading