Crenshaw Community Hospital Luverne, AL 36049 Policies and Procedures	Policy Number LAB-2-003	Effective Date June 2000
	Revision Date February 2014	Review Date February 2014
Manual: Specimen Requirements and Collection Procedures Title: Capillary Blood Collection	Laboratory Director Administrator	

Introduction to Method:
Skin puncture or capillary blood collection involves puncturing the dermis layer of the skin to access the capillary beds which run through the subcutaneous layer of the skin. Blood obtained via skin puncture is a mixture of undetermined proportions of blood from arterioles, venules, capillaries, plus interstitial and intracellular fluids. The proportion of arterial blood is greater than that of venous blood, due to the increased pressure in the arterioles leading into the capillaries versus the pressure in the venules exiting the capillaries.

Clinical Significance:
Capillary blood collection is the preferred method of blood specimen collection for newborns and infants. Clinical Laboratory Standards Institute (CLSI) recommends capillary blood collection via heelstick for infants less than one year of age. For children older than one year, capillary blood collection via fingerstick should be considered, where appropriate. Capillary blood collection may also be used for adults under certain circumstances.

Specimen Collection and Storage:
The recommended Order of Draw for capillary blood collection is different from blood specimens drawn by venipuncture. CLSI recommends the following order of draw for skin puncture:

1. Blood gases
2. EDTA tubes
3. Other additive tubes
4. Serum tubes

Reagents and Supplies:

1. Alcohol Prep
2. Gauze
3. Lancet: puncture device or incision device
4. Appropriate blood tubes for test(s) ordered
5. Bandage or tape

Procedure:
<u>General Site Selection</u>
The patient's age, accessibility of the puncture site, and the blood volume required should all be taken into consideration when selecting the skin puncture device type and puncture site. Select a site that is warm, pink and free of any calluses, burns, cuts, scars, bruises, or rashes. The site

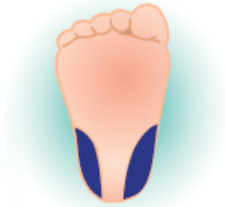
should not be cyanotic (bluish from lack of oxygen), edematous (swollen), or infected. Avoid skin areas that have evidence of previous punctures or are otherwise compromised.

Fingerstick Site Selection

The recommended site for capillary collection on adults and children over one year of age is the palmar surface of the distal (end) segment of the third (middle) or fourth (ring) finger, ideally of the non-dominant hand. Fingers on the nondominant hand are generally less calloused. The puncture should be made slightly off center from the central, fleshy portion of the fingertip and if using a blade-type puncture device, perpendicular to the fingerprint whorls. Puncturing along or parallel to the whorls may cause the blood to follow the pattern of the fingerprint, redirecting the flow and making it more difficult to collect. The index finger is often calloused and potentially more sensitive to pain due to additional nerve endings. The thumb also may be calloused and has a pulse, indicating arterial presence, and, therefore, should be avoided. The distance between the skin surface and the bone in the fifth finger also makes it unsuitable for puncture. The side and tip of the finger should be avoided, as the tissue is about half as thick as the central portion of the fingertip.

Heelstick Site Selection

The recommended site for heel punctures is the lateral (outside) or medial (inside) plantar surface of the heel. In small or premature infants, the heel bone (calcaneus) may be no more than 2.0 mm beneath the skin surface and no more than half this distance at the posterior curvature of the heel. Puncturing deeper than 2.0 mm on the plantar surface of the heel of small infants may, therefore, risk bone damage. When using incision devices, puncturing the heel at a 90' angle to the length of the foot is recommended. Such incisions create a 'gap' puncture (one which opens when pressure is applied) and further enhance blood flow.



CAPILLARY PUNCTURE PROCEDURE:

1. Select appropriate puncture site.
2. Warm the puncture site.
3. Clean the puncture site with 70% isopropyl alcohol and allow to air dry. The site must be allowed to air dry in order to provide effective disinfection.
4. Puncture the skin with the disposable lancing/incision device.
5. Wipe away the first drop of blood with a dry gauze pad
6. Collect the specimen in the appropriate container, and mix according to the manufacturer's instructions. Seal the specimen container.
7. Apply direct pressure to the wound site with a clean gauze pad and slightly elevate the extremity. Apply tape or bandage as needed.
8. Label the specimen container in direct view of the patient or guardian to verify identification, and record time of collection. Label each container individually.
9. Properly dispose of the lancet/incision device in a puncture-resistant disposal container.

Top 10 Keys to Obtaining a High Quality Capillary Blood Specimen:

1. Positively Identify the Patient. Positive identification of the patient is the most important step in specimen collection. Patient misidentification can lead to incorrect diagnosis, therapy and treatment. The consequences can be serious, even fatal to the patient.
2. Puncture Site and Lancing/Incision Device Selection. Determine the appropriate puncture site and lancing/ incision device for the patient and the tests requested. Using the wrong size lancet/incision device may result in excessive squeezing, prolonged or

incomplete collection, poor specimen quality (hemolysis, clotting) and possible redraws, as well as injury to the patient (mainly children).

3. Warming the Puncture Site. Only a limited amount of blood will easily flow from a capillary puncture. Warming the puncture site will increase blood flow up to seven times and is critical for the collection of blood gases and pH specimens. CLSI guidelines recommend warming the skin puncture site for three - five minutes with a moist towel or commercially available warming device at a temperature no greater than 42°C.
4. Cleaning the Puncture Site. Allow the alcohol to air dry. Performing skin puncture through residual alcohol may cause hemolysis and can adversely affect test results. It also may cause additional discomfort for the patient.
5. Wipe Away the First Drop of Blood. Immediately following skin puncture, platelets aggregate at the puncture site to form a platelet plug, initiating the clotting process. Without wiping away the platelet plug, bleeding may stop prior to completion of the blood collection, resulting in insufficient blood volume and redraws. In addition, the first drop of blood contains tissue fluid, which can cause specimen dilution, hemolysis and clotting.
    - ❖ NOTE: For point-of-care testing (i.e. blood glucose monitoring), use of the first drop of blood may be appropriate. Refer to the manufacturer's instructions for use.
6. Avoid Milking, Scooping or Scraping of the Puncture Site. It is recommended to touch the collector end of the container to the drop of blood. After collecting 2 or 3 drops, the blood will freely flow down the container wall to the bottom of the tube. Excessive squeezing (milking), scooping and scraping may cause hemolysis and/or tissue fluid contamination of the specimen.
7. Collect Specimen Quickly. Puncturing the skin releases thromboplastin, which activates the coagulation process. Specimens must be collected quickly to minimize the effects of platelet clumping and microclot formation (hematology testing). Specimens also should be collected quickly to avoid exposure to atmospheric air and light (blood gases and bilirubin testing).
8. Fill to the Correct Fill Volume. Fill containers to the recommended fill volume (if indicated). Underfilled containers will have higher concentrations of additives. For K2EDTA, higher concentrations may cause erroneous results for MCV and red cell indices and cause RBC and WBC morphological artifacts. Consequently, overfilled containers will have lower concentrations of EDTA and may result in clotting.
9. Mix Specimen. Microcollection tubes must be inverted the appropriate number of times to ensure that the blood and anticoagulant are sufficiently mixed. Mixing is essential to prevent the formation of microclots and platelet clumps, which can cause inaccurate or erroneous test results. Small clots can also occlude sample aspiration probes or tubing in laboratory instruments. Adequate mixing, both during and after the completion of capillary blood collection, will help minimize these occurrences.

Interpretation of Results:

Capillary blood collection may also be used for adults under certain circumstances including:

- Patients with fragile, superficial or difficult to access veins
- Patients where multiple unsuccessful venipunctures have already been performed, especially if the test(s) requested requires only a small volume of blood
- Patients with burns or scarring in venous blood collection sites
- Extremely obese patients
- Patients requiring frequent blood tests
- Patients receiving IV therapy in both arms or hands

- Patients at risk for serious complications associated with venipuncture, venous thrombosis, or deep venous puncture (e.g. deep vein puncture in infants, thrombophlebitis)
- Patients requiring only one blood test for which a capillary specimen is appropriate
- Patients whose veins are 'reserved' for intravenous therapy or chemotherapy
- Point-of-care testing where only a few drops of blood are needed

Capillary blood collection is inappropriate for:

- Severely dehydrated patients
- Patients with poor circulation
- Coagulation studies requiring plasma specimens
- Tests that require large volumes of blood (i.e. Erythrocyte Sedimentation Rate (ESR) and blood cultures)

References:

Capillary Blood Collection: Best Practices by Nancy Niwinski, MT(ASCP), LabNotes - Volume 20, No. 1, 2009, Becton, Dickinson, and Company.

Crenshaw Community Hospital Luverne, AL 36049 Policies and Procedures	Policy Number LAB-4-004	Effective Date July 2000
	Revision Date January 2014	Review Date January 2014
Manual: Manual Procedures-Hematology, Glucose, CSF, Coagulation Title: Whole Blood Glucose (POC)	Laboratory Director Administrator	

Introduction to Method:
The Accu-Chek® Inform II system quantitatively measures glucose in whole blood. The enzyme on the test strip, mutant variant of quinoprotein glucose dehydrogenase from Acinetobacter calcoaceticus, recombinant in E. coli, converts the glucose in the blood sample to gluconolactone. This reaction creates a harmless electrical DC current that the meter interprets for a glucose result. The sample and environmental conditions are also evaluated using a small AC signal. The system is used as an aid in monitoring the effectiveness of glucose control.

Clinical Significance:
Diagnosis, monitoring and treatment of disorders of carbohydrate metabolism rest in part on the measurement of blood glucose levels. Blood glucose may be abnormally high (hyperglycemia) or abnormally low (hypoglycemia), both being potentially life-threatening conditions. The most common cause of hyperglycemia is diabetes mellitus. Other conditions that may cause hyperglycemia are: Cushing's syndrome, acromegaly and hyperadrenalism. Conditions which may produce hypoglycemia include: inherited defects of carbohydrate metabolism in infants, tumors of the pancreas, hypoadrenalism, and some liver diseases.

Method:
Accu-Chek® Inform II Blood Glucose Monitor

Specimen Collection and Storage:
The Accu-Chek® Inform II test strips are for testing fresh capillary, venous, arterial, or neonatal whole blood. Cord blood samples cannot be used.

- Sample volume 0.6 µL
- Hematocrit should be between 10–65 %.
- Lipemic samples (triglycerides) in excess of 1800 mg/dL may produce elevated results.
- If peripheral circulation is impaired, collection of capillary blood from the approved sample sites is not advised as the results might not be a true reflection of the physiological blood glucose level. This may apply in the following circumstances: severe dehydration as a result of diabetic ketoacidosis or due to hyperglycemic hyperosmolar non-ketotic syndrome, hypotension, shock, decompensated heart failure, or peripheral arterial occlusive disease.
- Store all supplies at room temperature

Venous or arterial samples

The following criteria need to be met when performing a blood glucose test on venous or arterial samples.

- Caution should be taken to clear arterial lines before blood is drawn.
- To minimize the effect of glycolysis, blood glucose determination with venous or arterial blood must be performed within 30 minutes of sample collection.
- Avoid air bubbles with the use of pipettes.
- Fresh venous and arterial blood samples containing the anticoagulants EDTA, lithium heparin, or sodium heparin are acceptable.
- Refrigerated samples should be brought to room temperature slowly prior to testing.

Specimen Rejection Criteria:

Venous or arterial specimens will be rejected when:

1. Specimen is collected into the improper anticoagulant/preservative.
2. Specimen is not properly labeled.
3. Time of collection exceeds 30 minutes.
4. Specimen contains clots.

Reagents and Supplies:

- Roche Diagnostics Accu-Chek® Inform II® monitor.
- Accu-Chek® Quality Control Glucose Solutions, Level one (1) and two (2)
    - Must be dated when opened; good for 3 months after opening or until printed expiration date (whichever is earlier). Do not use expired reagents.
- Accu-Chek® Inform II® test strips
    - The strips are good until printed expiration date. Do not use expired strips.
- Alcohol wipes, gauze, bandaids or tape
- Lancets or blood drawing devices
- Gloves

Quality Control:

Quality control must be performed every day that patient tests are performed. Every 24 hours a low and high-level glucose control must be performed prior to testing patient samples. The Accu-Chek® Inform II will lock out operators from performing patient tests when the previous twenty-four hour quality control tests have expired or if QC performed fails acceptability ranges. In addition to once per 24 hours, two levels of quality control checks must be performed when:

- A new vial of test strips is opened.
- When a vial of strips has been left with the lid off.
- If the Accu-Chek® Inform II® monitor has been dropped.
- When test results contradict the clinical symptoms.

Contact the laboratory if QC repeatedly fails. The instrument will be unavailable for patient testing until quality control performance is within acceptable ranges.

Procedure:

Control Testing

1. Turn on the Accu-Chek® Inform II® meter.
2. Enter or your operator ID by means of barcode scanning, or manual entry. **DO NOT** attempt to perform tests under another operator's ID.
3. From the *Main Menu*, touch *Control Test*.
4. Select the level of control that you wish to test then scan the barcode on that bottle.

5. Confirm that the meter is coded to the same test strip code that is printed on the test strip vial by scanning the barcode on the bottle of strips you are using. Contact the laboratory if you are unable to confirm the correct test strip code.
6. The meter will display a picture of a test strip with a downward flashing arrow on the meter indicating that you are ready to insert a test strip into the meter. Remove a test strip from the vial and immediately recap the vial. Insert the test strip into the meter in the direction of the arrows and with the "ACCU-CHEK" lettering facing upward. The meter will display a flashing drop above the test strip icon when the test strip is properly inserted indicating that you are ready to apply control solution.
7. Apply control solution to the front edge of the test strip. The solution will fill the yellow sample chamber by capillary action. Do not apply sample to the top of the test strip. Once sufficient sample has been detected, the measurement begins. An hourglass icon indicates that the measurement is in progress. An error message will display if the sample is insufficient. If this occurs repeat the test.
8. The measurement is complete when the result is displayed on the meter screen.
9. Remove the test strip and dispose of it in a biohazard container.
10. Touch the comment button ( ) to enter an appropriate comment(s) if required.
11. Touch the button to confirm the result.
12. Control results are stored on the meter and printed monthly or with lot changes.

Patient Testing

*Adhere to Standard Precautions

1. Turn on the Accu-Chek® Inform II® meter.
2. Enter your operator ID by means of barcode scanning or manual entry. **DO NOT** attempt to perform tests under another operator's ID.
3. From the *Main Menu*, touch *Patient Test*.
4. Enter the patient identification in the Accu-Chek® Inform II® system by scanning the armband barcode, or manually enter by using the keypad.
5. Confirm that the meter is coded (calibrated) to the same test strip code that is printed on the test strip vial by scanning the barcode on the bottle of strips you are using. Contact the laboratory if you are unable to confirm the correct test strip code.
6. The screen will display a picture of a test strip with a downward flashing arrow indicating that you are ready to insert a test strip into the meter.
7. Remove a test strip from the vial and immediately recap the vial. Insert the test strip into the meter in the direction of the arrows and with the "ACCU-CHEK" lettering facing upward. The meter will display a flashing drop above the test strip icon when the test strip is properly inserted indicating that you are ready to apply a blood sample.
8. Collect an acceptable blood sample according to established procedures.

    - **Fingerstick or neonate heelstick samples**: Clean the intended puncture site using an alcohol pad. Allow the area to dry prior to puncture. Test immediately as the sample is collected.
    - **Venous, arterial or line draw samples:** Test as soon as possible and no later than 30 minutes following collection. Be sure they are well mixed and that line draw samples have been thoroughly cleared of line fluids. Do not allow bubbles to enter the test strip-sampling chamber.
9. For capillary sticks be sure to wipe away the 1st drop of blood with dry, clean gauze. Use the 2nd drop of blood for testing.
10. Apply blood to the front edge of the test strip. The sample will fill the yellow sample chamber by capillary action. Do not apply sample to the top of the test strip.

11. Once sufficient sample has been detected, the measurement begins. An hourglass icon indicates that the measurement is in progress.
12. After the sample has been obtained, apply gentle pressure to the puncture with a clean gauze square or cotton ball site for several minutes. If the patient is conscious and capable, enlist the patient's assistance with applying pressure.
13. The measurement is complete when the result is displayed on the screen. Depending upon how high or low the result is, it may appear in a numeric or non-numeric format.
14. Remove the test strip and dispose of it in a biohazard container.
15. Touch  to enter up to three appropriate comment(s).
16. Touch the  button to confirm the result.
17. Results may be documented in the patient chart.
18. Follow up on any results that exceed critical or reportable limits according to policy.
19. Clean and disinfect as necessary. The Accu-Chek® Inform II® meter should be cleaned and disinfected between each patient use.

Normal Ranges:
Normal fasting glucose levels: 65-110 mg/dL

Reportable Range:
10 – 600 mg/dL

Critical Values:
Physician notification following established written protocol should be done when the following test results are found:

- Adults and children: ≤46 mg/dL or ≥484 mg/dL.
- Newborns: ≤32 mg/dL or ≥326 mg/dL.

Limitations of Procedure:

- The Accu-Chek® Inform II® test strips are for testing fresh capillary, venous, arterial, or neonatal whole blood. Cord blood samples cannot be used.
- Hematocrit should be between 10–65 %.
- Lipemic samples (triglycerides) in excess of 1800 mg/dL may produce elevated results.
- If peripheral circulation is impaired, collection of capillary blood from the approved sample sites is not advised as the results might not be a true reflection of the physiological blood glucose level. This may apply in the following circumstances: severe dehydration as a result of diabetic ketoacidosis or due to hyperglycemic hyperosmolar non-ketotic syndrome, hypotension, shock, decompensated heart failure NYHA Class IV, or peripheral arterial occlusive disease.
- Blood concentrations of galactose >15 mg/dL will cause overestimation of blood glucose results.
- Intravenous administration of ascorbic acid which results in blood concentrations of ascorbic acid >3 mg/dL will cause overestimation of blood glucose results.
- As a matter of good clinical practice, caution is advised in the interpretation of neonate blood glucose values below 50 mg/dL. Follow the unit guidelines for follow-up care that have been set for critical blood glucose values in neonates. Glucose values in neonates suspect for galactosemia should be confirmed by an alternate methodology.
- This system has been tested at altitudes up to 10,000 feet.
- The performance of this system has not been evaluated in the critically ill.

Interpretation of Results:

Glucose levels below the normal range may indicate a hypoglycemic state and levels above the normal range may indicate a hyperglycemic state.

Referral Testing:
If the system fails, blood glucose testing will be performed using the automated chemistry analyzer in the laboratory.

References:

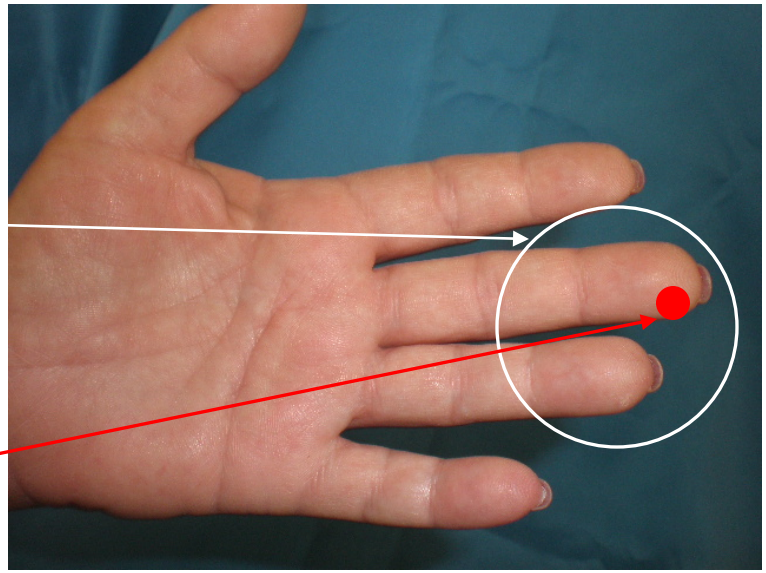
1. Roche Diagnostics, Accu-Chek™ Inform II Blood Glucose Monitoring System Operator's Manual for Healthcare Professionals Version 3.0 March 2013.
2. Roche Diagnostics Accu-Chek™ Inform II Test Strips Package Insert Cat. No. 05942861001 ©2012 Roche Diagnostics 05942934001-1012

Fingerstick Procedure

For Accurate Glucose Results

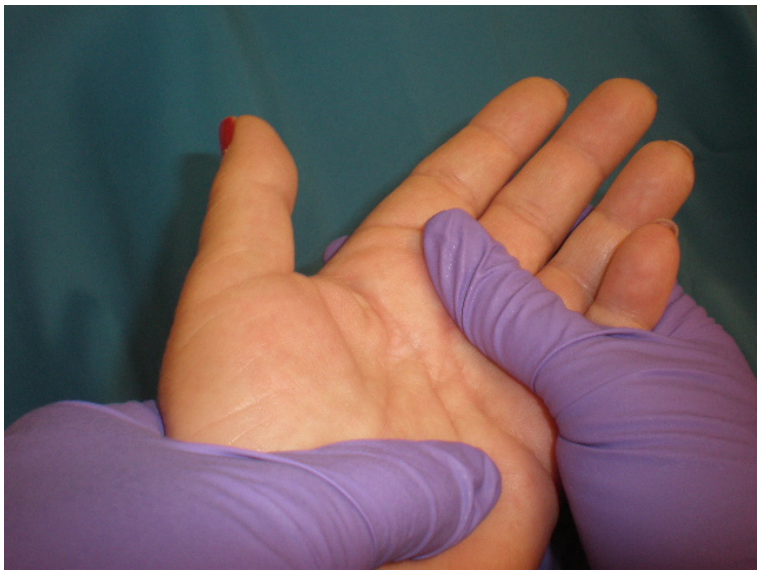
Choose the finger carefully

- Best locations for a finger stick is the 3rd and 4th fingers of the non-dominant hand.
- Avoid the 2nd and 5th fingers if possible.
- Perform the stick off to side of the center of the finger.
- NEVER use the tip or center of the finger.



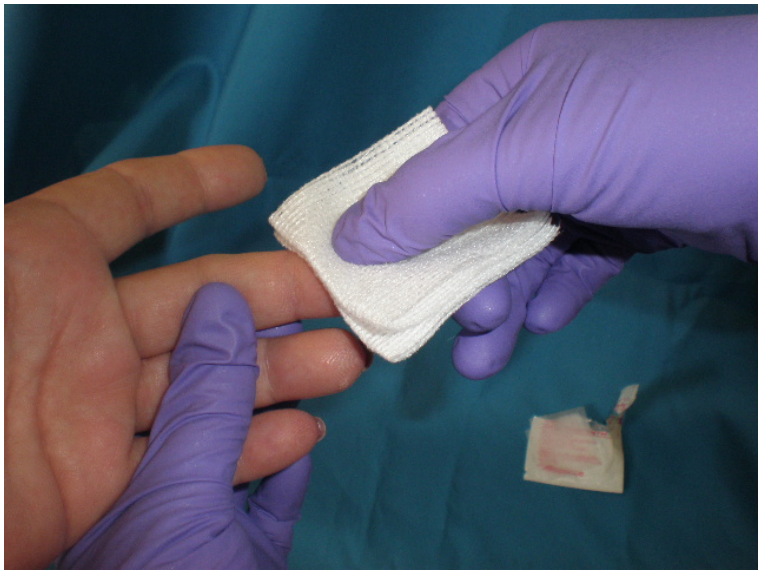
Massage or Warm the site

- Avoid fingers that are cold, cyanotic, swollen, scarred or covered with a rash.
- Massage to warm the finger and increase blood flow by gently squeezing from hand to fingertip 5-6 times.



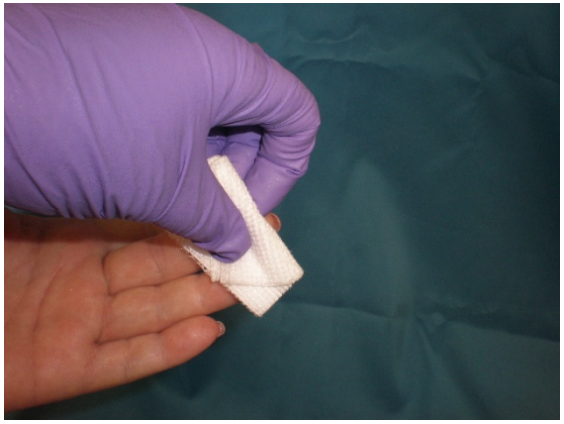
Clean and DRY the site

- Cleanse fingertip with 70% isopropyl alcohol
- **Wipe dry** with clean gauze or allow to air dry.
- ***Caution:*** *Alcohol can falsely elevate or lower blood glucose results.*



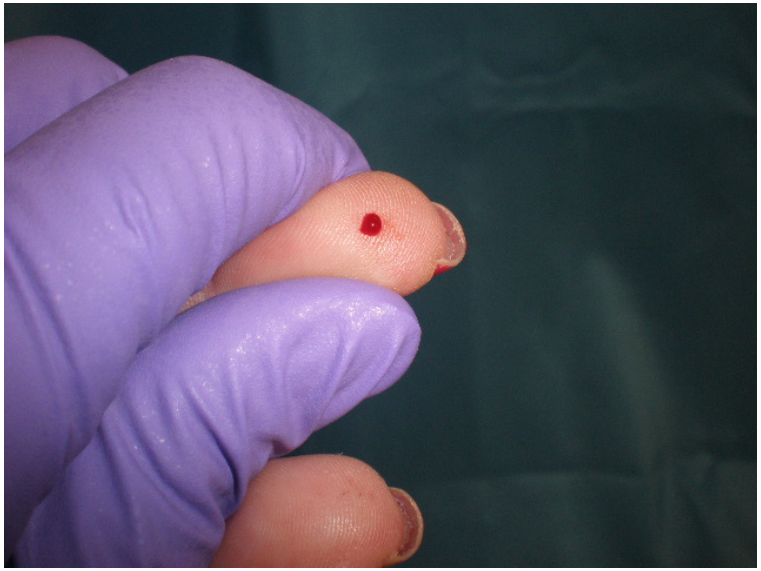
Finger Stick location

- Using a sterile lancet, make a skin puncture just off the center of the finger pad.
- Wipe away the first drop of blood (which tends to contain excess tissue fluid).

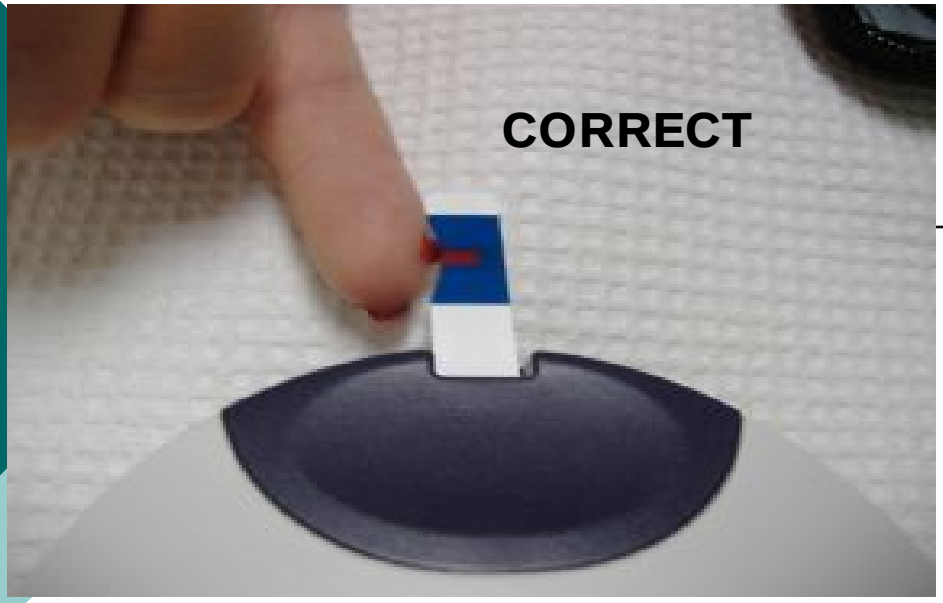


Do not milk finger

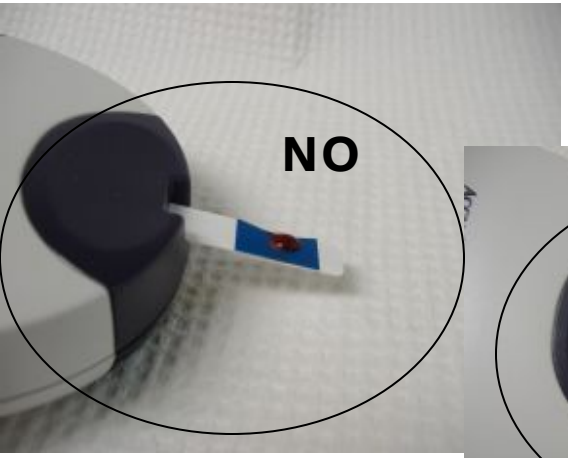
- **If necessary, apply light** pressure to the surrounding tissue until another drop of blood appears.
- Avoid "milking". The drop of blood must be big enough to fill the strip completely.
- ***NOTE:*** Do NOT squeeze or apply strong repetitive pressure to the site. This may result in hemolysis or increase tissue fluid in the blood causing incorrect glucose results.
- ***Caution:*** *Free flowing blood is necessary to obtain reliable results. Increased pressure beyond that necessary to hold the finger can result in inaccurate results.*

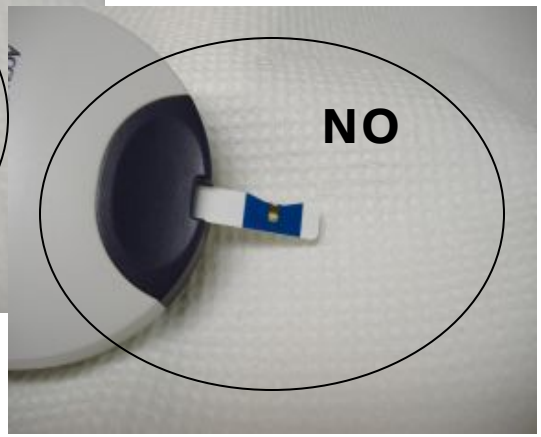


CORRECT APPLICATION OF SAMPLE



INCORRECT APPLICATION OF SAMPLE





CORRECT APPLICATION OF SAMPLE

- Place strip to the side of the drop of blood to allow the target area to fill by capillary action.
- When the hour glass appears on the meter CHECK the yellow target area to verify there is no yellow showing in the target area.
- ——————————————————

INCORRECT APPLICATION OF SAMPLE

- DO NOT apply sample to the top of the strip.
- DO NOT REPORT the glucose result, if yellow is showing in the target area of the strip and the test has begun.

CREDITS

- **PowerPoint slides developed and produced by Duke University Health System for their Point of Care Testing:**
  - http://poct.duhs.duke.edu – main page
  - http://poct.duhs.duke.edu/wysiwyg/downloads/Fingerstick_Training.ppt

CREDITS

- **Goals:**
  - To assure the safety of the patients.
  - Maintain the regulatory compliance of all laboratory test performed at the patient's bedside to meet JCAHO and other regulatory agencies.
  - Monitor all aspects of testing to insure nursing staff perform testing accurately with products proven to perform correctly.
  - Assist nursing, with any issues, questions or concerns with all aspects of POCT.