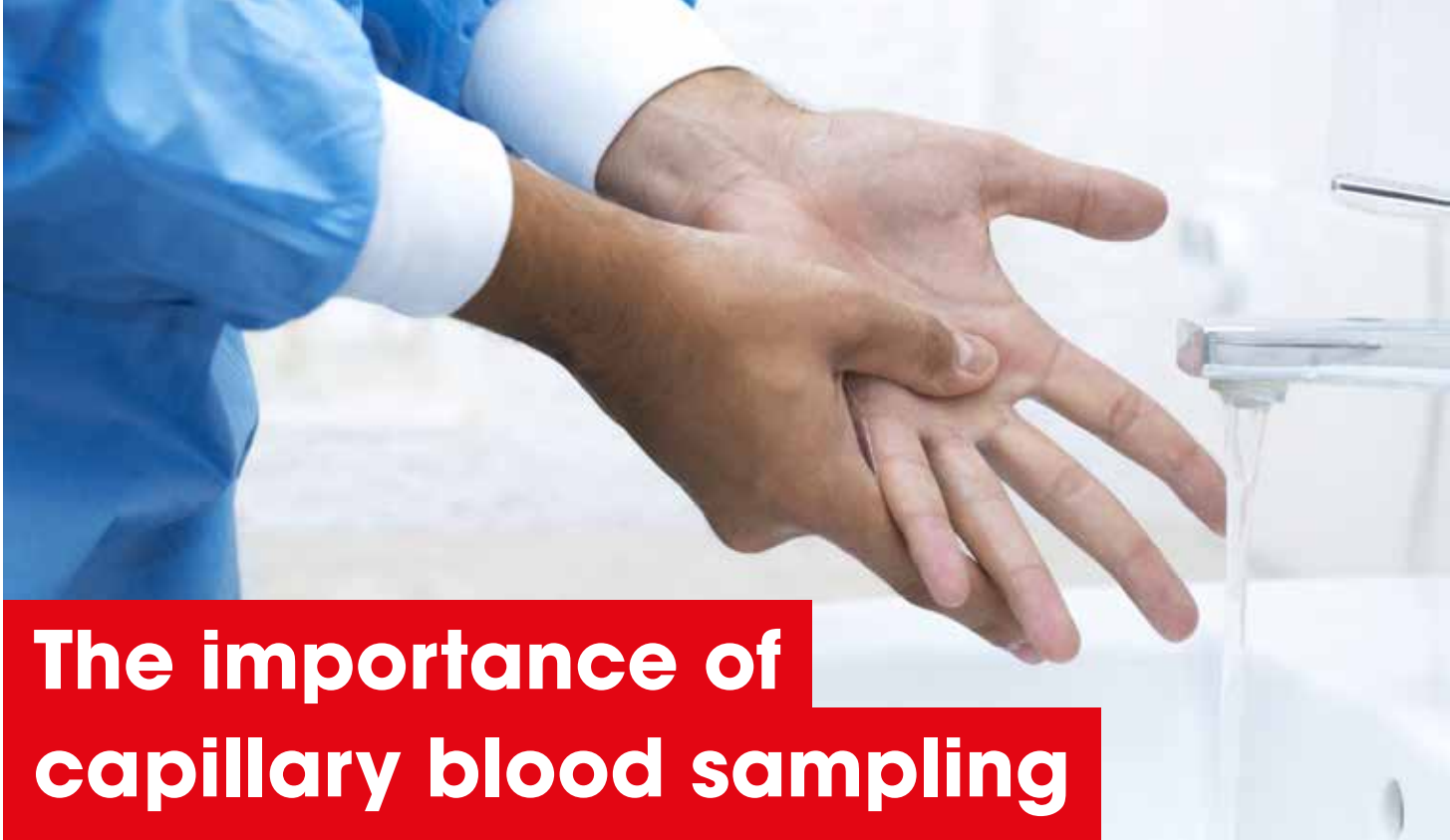




Capillary sampling and its relevance for correct hemoglobin results



The importance of capillary blood sampling

Capillary blood (fingerstick) sampling is increasingly being used worldwide due to the growing availability of point-of-care (POC) testing.

With anemia affecting about 25% of the global population and much higher prevalence in the developing countries, hemoglobin is the most frequently performed test in POC hematology, also being used routinely by blood collection services to ensure safe donations.

At the same time, hemoglobin (Hb) values are among the parameters most prone to being affected by pre-analytical errors so, in order to avoid generating variant and misleading Hb results, health care personnel drawing blood must adhere to strict and standardized blood sampling techniques to ensure accurate and consistent POCT results that are comparable to laboratory techniques.

This brochure aims to provide a quick guide to capillary sampling best practice to help health care professionals understand common causes of pre-analytical errors and reduce their impact on the hemoglobin result.

Did you know?

Detailed capillary sampling guidelines have also been published by both the Clinical and Laboratory Standards Institute and the World Health Organization (WHO).^{1,2}

Why is it important to have good capillary blood sampling procedures for hemoglobin testing?

- Increasing use of capillary blood sampling worldwide as POCT develops
- Hemoglobin is the most frequently performed test in POC hematology³
- Hemoglobin results are prone to be affected by pre-analytical errors⁴
- Incorrect capillary blood sampling is the most common reason leading to inaccurate POC hemoglobin results⁴

Understanding common causes of pre-analytical errors

Variability in reported hemoglobin values can be caused by a number of physiological factors like dehydration, smoking behavior or altitude, and it can be significantly affected by pre-analytical errors arising due to incorrect capillary blood sampling technique. Detailed below are some of the most common sources of error that occur that healthcare workers should be aware of.

- **Correct choice of lancet** - The lancet must make a sufficiently deep puncture to ensure an adequate flow of blood. 1.85 to 2.25mm is recommended for adults, depending on the thickness of the skin. For children aged below

8 years, the penetration depth should not exceed 1.5 mm.²

- **Correct selection of puncture site -**
The middle or ring finger should be used, ideally of the non-dominant hand, as they are generally less calloused and less sensitive to pain compared to the index finger or thumb. The thumb should also be avoided due to its pulse (arterial presence). In the fifth finger the distance between the skin surface and the bone is too small.²

The puncture should be made slightly off center from the central, fleshy portion of the fingertip - near the side where the skin is thinner with fewer nerve endings and less pain sensation, but not on the very side of the finger. Selecting the right finger and puncture site will ensure best chance of good consistent blood flow and minimize pain for the patient.



- **Cleaning, disinfection and drying -**
Cleaning and disinfection of the puncture site is essential to remove any potential contaminants that could affect the reading or jeopardize patient safety. The puncture site must also be dried completely, after cleaning, to remove any remnants of alcohol solution that will dilute the blood sample and cause false low readings.

- **Applying too much pressure around the puncture site -** The finger can be massaged gently before and after the puncture to stimulate blood circulation, but not going past the first knuckle. Maintaining a light pressure at the moment of puncture ensures effective penetration. However, the finger should not be pressed too hard as this will push fluid from the tissue into the blood and cause false low readings.

The importance of time and blood flow

Another key factor that influences Hb measurement is capillary flow. Typically for hemoglobin, the first 1-3 drops after puncture show a higher degree of variability of the Hb concentration independent of the analytical device used for the test. It is for this reason that these first few drops of blood should be wiped away.

The highest accuracy is generally reached from the 4th drop after puncture, with good capillary flow occurring for a period of 30-45 seconds. After this time, coagulation will occur where blood clotting would lead to inaccurate Hb results if blood is sampled then.

Figure 1 demonstrates the ideal capillary blood sampling window.

The most important factor to reduce pre-analytical errors is the presence of a free spontaneous blood flow, especially as neither the size of the drop nor the time of collection following the puncture is well defined and manufacturers' recommendations on this subject vary.

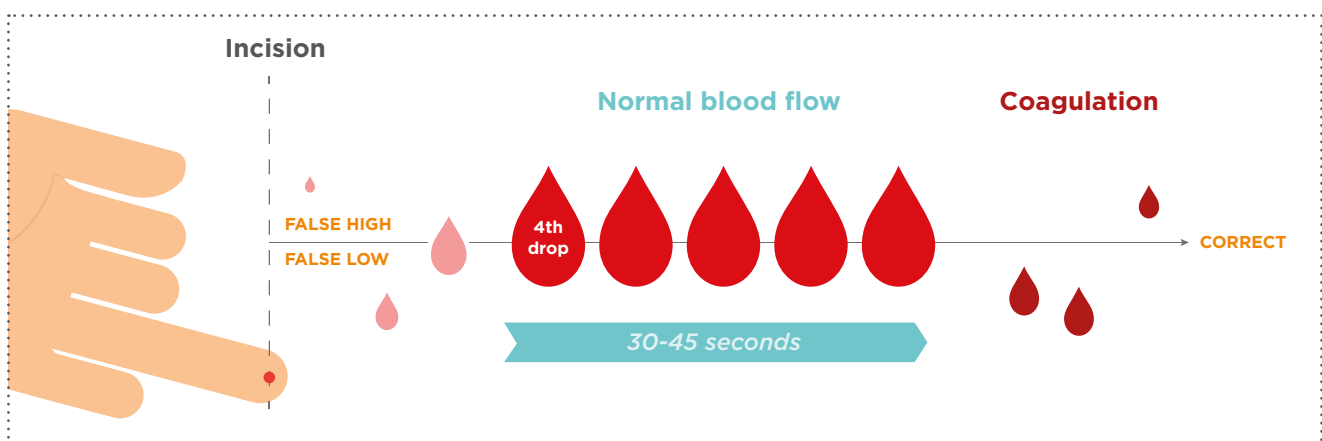


Figure 1 - The effect of time and capillary blood flow on hemoglobin results

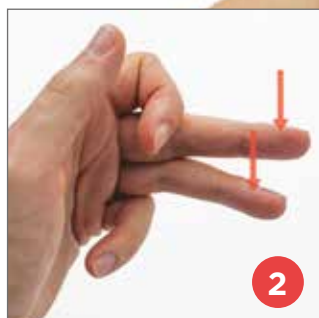
A step-by-step guide for best practice capillary sampling

The following steps demonstrate how to take a proper capillary blood sample to ensure accurate POC Hb measurements.



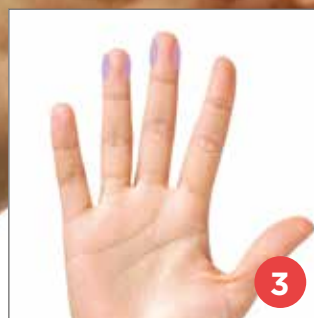
Perform hand hygiene and then put on well-fitting non-sterile gloves.

Make sure all items for capillary sampling and performing the test are available and close to hand.



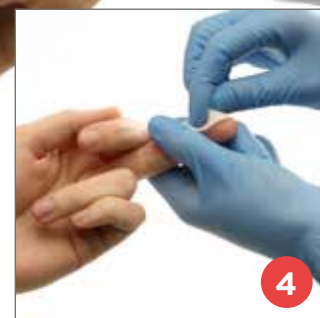
Select the middle or ring finger, ideally of the non-dominant hand.

The patient must not wear a ring on the finger as this may obstruct the blood circulation.



Ensure the patient's hand is warm and relaxed and ensure the patient is comfortably seated.

The puncture should be made slightly off center from the fleshy portion, near to the side of the fingertip.



Disinfect and thoroughly dry the puncture site.



Gently massage the finger towards the tip to increase blood flow. Avoid going past the first knuckle.



Make the incision on the upward-facing side of the fingertip, to facilitate filling of the hemoglobin cuvette.

Apply only light pressure towards the fingertip until a blood drop appears.

Don't press or milk the finger! It may take a few seconds after the puncture until the blood flow starts.



Wipe away the first 2-3 drops and make sure there is a free blood flow before filling the cuvette.

Release the grip on finger when wiping off a drop.



Be sure to have a sufficient sized blood drop to fill the cuvette. Fill the cuvette completely in one go.

Do not refill and avoid air bubbles.

Always refer to the Instructions for Use provided by the manufacturer of the hemoglobin analyzer.

References

1. Ernst DJ, Balance LO, Calam RR, McCall R, Szamosi DI, Tyndall L. Procedures and Devices for the Collection of Diagnostic Capillary Blood Specimens. 6th ed. Approved Standard GP42-A6. Wayne, Pa: Clinical and Laboratory Standards Institute, 2008. Available at: <https://clsi.org/standards/products/general-laboratory/documents/gp42/>. Accessed July 6, 2017.
2. Dhingra N, Diepart M, Dziekan G, et al. "Capillary Sampling," in WHO Guidelines on Drawing Blood: Best Practices in Phlebotomy. Geneva, Switzerland: World Health Organization, 2010. Available at: www.ncbi.nlm.nih.gov/books/NBK138654. Accessed July 6, 2017.
3. Briggs C et al, Where are we at with point-of-care testing in haematology? British Journal of Haematology, 2012, 158, 679-690
4. Massimo Daves et al, Evaluation of capillary haemoglobin determination for anaemia screening in blood donation settings Blood Transfus. 2016 Sep; 14(5): 387-390.