

OREGON HEALTH & SCIENCE UNIVERSITY  
Hospitals and Clinics  
Point of Care

**Hemoglobin by HemoCue 201+**

Principle

The determination of whole blood hemoglobin concentrations is used for assessing the status of a patient in clinical situations such as hemorrhage, hemolysis, dehydration, and other shifts in plasma volume. The hemoglobin assay is also used as a part of a general health screen and is the first step in investigating anemia.

Red blood cells contain a mixture of hemoglobin, oxyhemoglobin, carboxyhemoglobin, and methemoglobin. When red blood cells are lysed, hemoglobin is released and can be measured using a photometer. Hemoglobin is intensely colored, and this property has been utilized in methods for measuring its concentration in the blood.

The HemoCue System consists of disposable cuvettes, which contain reagents in dried form and a photometer. When a whole blood sample is added to the cuvette, sodium desoxycholate lyses the red blood cells and releases hemoglobin. Hemoglobin is converted to methemoglobin, which together with sodiumazide gives azide-methemoglobin. The photometer follows the reaction and presents the result when the reaction stops. The absorbance is measured at 570 nm and 880 nm in the photometer. The instrument calculates the concentration of the hemoglobin and displays the result.

Specimen Requirement

1. Whole blood collected using finger stick method.
2. Whole blood, venous, arterial, or cord blood collected in a heparin syringe.
3. Whole blood, venous, arterial, or cord blood collected in a vacutainer.
4. Test samples immediately.
5. EDTA, heparin, or heparin/fluoride anticoagulated samples may be used.
6. Mix anticoagulated samples for 10 minutes before testing.
7. Anticoagulated samples must be tested within 24 hours of collection.

Interferences

1. Improper filling of the cuvette can cause erroneous results. The cuvette must be filled in one continuous sampling.
2. Bubbles in the optical window can cause erroneous results. Bubbles on the periphery of the cuvette will not interfere with the measurement of the sample.
3. Do not clotted samples.

### Analytical Measurement Range (Linearity)

1. 3.0 – 25.0 g/dL.

### Reference Range

HEMATOLOGY	Age	Male	Female
Hemoglobin g/dL	0-30 days	10.0-18.0	10.0-18.0
	1-6 mos.	9.5-14.0	9.5-14.0
	6 mo.- 2 yrs.	10.5-13.5	10.5-13.5
	2-6 yrs.	11.5-13.5	11.5-13.5
	6-12 yrs.	11.5-15.5	11.5-15.5
	12-18 yrs.	13.0-16.0	12.0-16.0
	18-150 yrs.	13.5-17.5	12.0-16.0

### Alert Values

Critical /Alert values are those results demonstrating such variance from normal as to represent a pathophysiological state with potential of being life threatening unless action is taken quickly. These results must be immediately reported to the care provider and be documented in the test record as to who was contacted, the time of contact, the person making contact, and if relevant, that the results were read back.

1. Notify provider if hemoglobin is less than 6.6 g/dL or greater than 18.9 g/dl.
2. If a patient result is greater than 18.9 g/dL or less than 6.6 g/dL (other than fetal cord blood specimen) it is recommended that an EDTA sample be collected and sent to the Core Laboratory for confirmation.

### Quality Control

1. HEMA-*Trol* High and Low Liquid Quality Controls (QC) are tested every day of patient testing and when a new bottle of test cuvettes is opened. Date the box with the opened date.
2. The HemoCue Hb 201+ analyzer has an internal electronic "SELFTEST". Every time the analyzer is turned on, it will automatically verify the performance of the optronic unit of the analyzer.
3. The "SELFTEST" is performed every second hour if the analyzer remains switched on. Upon passing the SELFTEST, the display will show the HemoCue symbol and three flashing dashes, indicating that the analyzer is ready to perform a measurement. An error code will be displayed if the SELFTEST fails.

4. To perform HEMO-*Trol* High and Low Liquid QC:
  - a. Allow QC to sit at room temperature (15°-30°C) for approximately 15 minutes before testing.
  - b. Mix the QC vials by gently inverting the vials and rolling them between the palms of your hands until all cellular components are completely suspended. Do not shake. Do not place on a mechanical rocker.
  - c. Dispense a drop of the control onto a plastic surface.
  - d. Place the test cuvette tip into the middle of the drop and allow the cuvette to fill by capillary action in one continuous process. Do not attempt to add blood after the first filling.
  - e. Wipe off the excess liquid on the outside of the cuvette tip. Make sure that no liquid is withdrawn during this part of the procedure.
  - f. Inspect the cuvette for air bubbles. Small air bubbles around the edge do not affect the result. If air bubbles appear anywhere else, recollect the sample using a new test cuvette.
  - g. Pull out the cuvette holder to the outer position.
  - h. When 'READY ---' appears on the display.
  - i. Place the filled test cuvette into the cuvette holder and push into the measuring position.
  - j. 'MEASURING - - -' appears on the display.
  - k. After 15-60 seconds, the result appears on the display.
  - l. Record the QC results in the POCT QC Logbook.
5. If SELFTEST fails, or Liquid QC tests fail, repeat the failed test.
6. If repeat test fails, do not perform patient testing. Send patient samples to the Core Laboratory until problem is resolved. Contact the HemoCue Technical Services at 1-800-426-7256, and/or, J & S Medical Associates, Inc. at 1-800-229-6000 for troubleshooting information or service. Record all action taken in POCT QC Logbook.

#### Procedure

1. Press HemoCue power switch on and pull out cuvette holder to outer position.
2. Remove a test cuvette from the bottle and replace cap immediately.
3. Collect specimen by finger stick, syringe, or vacutainer method.
4. If collecting by finger stick,
  - a. Wipe away the first drop of blood.
  - b. Make sure that the drop of blood is big enough to fill the cuvette tip completely.
  - c. Introduce the cuvette tip into the middle of the drop of blood.
  - d. Wipe off excess blood from the outside of the cuvette tip. Make sure that no blood is withdrawn during this part of the procedure.
  - e. Inspect the filled cuvette for air bubbles. If air bubbles appear in the optical window, recollect the sample using a new test cuvette.

- f. Once the cuvette is filled with blood it must be tested within 10 minutes.
  - g. Place the filled cuvette into the cuvette holder and slide into measuring position.
  - h. 'MEASURING ---' appears on the display.
  - i. In approximately 15-60 seconds, the results will appear on the display.
  - j. Record the result on the patient's chart or in the computer.
  - k. Remove and discard cuvette.
5. If testing a vacutainer or syringe specimen:
- a. Dispense a drop of well-mixed blood onto a plastic surface.
  - b. Place the test cuvette tip into the middle of the drop and allow the cuvette to fill by capillary action in one continuous process. Do not attempt to add blood after the first filling.
  - c. Wipe off excess blood from the outside of the cuvette tip. Make sure that no blood is withdrawn during this part of the procedure.
  - d. Inspect the filled cuvette for air bubbles. Small bubbles around the edge do not affect the test. If air bubbles appear anywhere else, recollect the sample using a new test cuvette.
  - e. Once the cuvette is filled with blood it must be tested within 10 minutes.
  - f. Place the filled cuvette into the cuvette holder and slide into measuring position.
  - g. MEASURING ---' appears on the display.
  - h. In approximately 15-60 seconds, the results will appear on the display.
  - i. Record the result on the patient's chart or in the computer.
  - j. Remove and discard cuvette.

### Results Reporting

1. Results are reported to one decimal place.
2. If a patient result is greater than 19.0 g/dL or less than 6.5 g/dL (other than fetal cord blood specimen), it is recommended that an EDTA sample be collected and sent to the Core Laboratory for confirmation.

### Calibration

1. The HemoCue is delivered calibrated from the manufacturer. It is calibrated against the hemoglobincyanide method (HiCN), which is the international reference method for the determination of the total hemoglobin concentration in blood.

### Calibration Verification/ Correlations

Calibration verification is performed every 6 months (rotated between instruments) using patient samples correlated with the Core Lab. CAP results from all Hemocue machines are correlated.

## Reagents

1. HEMA-*Trol* Low and High Liquid QC:
  - a. Unopened QC vials are stable refrigerated (2°-8°C) until expiration date on the vial.
  - b. Opened QC vials are stable refrigerated (2°-8°C) for 60 days or at room temperature (15°-30°C) for 30 days.
  - c. Mark all vials with the open/QC date.
  - d. Do not freeze QC vials.
  - e. Contains human source material. Handle as potentially infectious.
  
2. HemoCue Cuvettes:
  - a. Unopened cuvettes are stable at room temperature (15°-30°C) until the expiration date on box.
  - b. Opened bottles of cuvettes are stable at room temperature (15°-30°C) for 3 months.
  - c. Mark all bottles with the open/QC date.
  - d. Do not refrigerate cuvettes.
  - e. Keep cuvette containers tightly closed.
  - f. Cuvettes contain sodium desoxycholate, sodium nitrite, sodium azide, and sodium fluoresceine.

## References

1. Beutler, E., et al. Williams Hematology Fifth Edition. Library of Congress, 1995, pp 8-9.
  
2. HemoCue Hb 201+ operating manual.
  
3. HEMA-*Trol* Whole Blood Hemoglobin Control package insert. J & S Medical Associates, Inc., 2000.