EXERCISE 7: POINT OF CARE HEMOGLOBIN TESTING

Skills: 30 points

Objectives:

1. Define the following: hemoglobin, anemia, polycythemia.
2. State two possible causes of anemia and polycythemia.
3. State the principle of the procedure used by the HemoPoint H2 and the HemoCue Hb201+.
4. List 3 sample types and 2 anticoagulants which may be used for POC testing using the HemoPoint H2 or HemoCue Hb201+.
5. State which drop of blood should be used for testing following a capillary puncture for the HemoPoint® H2 and the HemoCue Hb 201+.
6. State six criteria which must be considered when setting up the HemoPoint H2 or the HemoCue Hb201+.
7. State the purpose of internal electronic checks for the HemoPoint H2 and HemoCue Hb201+.
8. State the external quality control testing which must be performed for POC hemoglobin testing and its purpose.
9. State the proper handling and storage of cuvettes.
10. State the time limit for testing once the microcuvette has been filled with a blood sample.
11. List six (6) limitations of the hemoglobin procedure for both the HemoPoint H2 and the HemoCue Hb 201+, and one that is specific to the HemoCue Hb 201+.
12. State the normal values for hemoglobin levels for adult females, adult males, children and infants.
13. State two procedures that should be followed to prevent Healthcare Associated Infections when performing POC testing.
14. List the supplies needed to perform POC Hemoglobin Testing.
15. Perform and record the required quality control procedures for either the HemoPoint H2 or HemoCue Hb 201+.
16. Evaluate the control results using predetermined criteria to determine if the instrument can be used for patient testing.
17. Perform an effective capillary puncture.
18. Perform a quantitative measurement of hemoglobin on whole blood from a capillary sample using the HemoPoint H2 or HemoCue Hb 201+ instrument.
19. Evaluate the patient results and determine whether they fall within the normal range.
20. Record the results using proper units.

Discussion

Hemoglobin (Hgb) is the protein in red blood cells that carries oxygen to the cells and returns CO₂ back to the lungs. Hemoglobin contains iron and gives red cells their color. Anemia is a decrease in hemoglobin level and may be the result of recent hemorrhage, fluid retention, or an underlying disease state. Polycythemia is an elevated hemoglobin level due to hemoconcentration from dehydration or excess production of red cells.

Point of care settings for Hemoglobin determinations include doctor’s offices, clinical labs, emergency rooms, blood donor centers, intensive care units and surgical suites. Two point of care hemoglobin systems will be discussed: the HemoPoint® H2 system and the HemoCue Hb 201+ system. Both systems have CLIA Waived status.

Exercise 7: POC Hemoglobin Testing [Nov 2018]
Principal of the Procedure

Both the HemoPoint H2 and HemoCue Hb 201+ utilize microcuvettes with short light pathways which contain the necessary dried reagents, which allows for hemoglobin testing of undiluted blood samples. The microcuvette is filled by capillary action with approximately 10 μL of whole blood. The resulting chemical reaction produces a color which is measured by the photometer when the filled microcuvette is placed in the instrument. The result is calculated and displayed.

Sample Types, Collection and Storage

Both the **HemoPoint® H2 Photometer** and **HemoCue Hb 201+ analyzer** can be used with capillary, venous, or arterial blood.

When testing capillary samples, the **HemoPoint H2** uses the *second drop of blood* which forms after a capillary puncture. The **HemoCue Hb 201+** uses the *third or fourth drop of blood* which forms following a capillary puncture. For both instruments, avoid fingers with rings on.

For venous samples, use EDTA or heparin as anticoagulants, preferably in solid form, to avoid dilutional effects. Venous and arterial blood samples may be used for testing if the blood collected is not more than 24 hours old and the samples have been stored refrigerated at 35 – 46°F (2-8°C). Refrigerated samples must be allowed to return to room temperature before testing. Sample tubes must be well mixed prior to sampling (by mechanical rotator for at least 2 minutes or hand inversion at least 10 times.)

Setting up the analyzers

For both the **HemoPoint® H2** system and the HemoCue Hb 201+ system, select a suitable place for setting up the photometer, using the following criteria:

1. Place the analyzer horizontally on a stable surface.
2. Avoid direct sunlight.
3. Avoid wet areas (i.e. wash basins)
4. Avoid strong electromagnetic fields.
5. Ensure there is adequate room for the cuvette holder to be freely accessible.
6. Avoid direct influence from ionizing radiation.
7. Avoid rapid temperature fluctuations (keep away from heaters, open windows, ventilators, fans or air conditioning, etc.)
8. Allow the photometer to reach room temperature, between 59 – 86 °F (15 - 30°C). *Changing from a cold to a warm environment, (i.e. after storage or transport) condensation can form both on the inside and the outside of the photometer. Wait at least 1 hour before you connect the photometer to a power supply.*
9. For the HemoCue Hb system, do not operate the analyzer at high humidity (>90%).

INFECTION CONTROL

Point of Care instruments have been documented to contribute to the spread of pathogens when used in the presence of patients. The transfer of microorganisms is due to hand or gloved hand contact with the instrument followed by contact with a patient. It is important to follow proper hand hygiene and to clean/disinfect the surface of the instrument to prevent Healthcare Associated Infections. Proper cleaning and disinfection should follow manufacturers recommendations and facility policy.
QUALITY CONTROL

Electronic Quality Control

Both instruments are designed to perform *internal electronic checks* to verify that the instrument is working properly. This function is sometimes referred to as internal or built-in quality control.

The **HemoPoint H2** performs an internal *AutoCheck* of the photometer's optic system every time the cuvette holder is opened. A "**Blank Reading**" must be performed at the beginning of each day to allow the instrument to check the electronics. The Blank Reading must also be performed if the cuvette holder is removed or replaced.

The **HemoCube Hb 201** will perform an automatic SELFTEST during the instrument’s startup process to verify the performance of the optronic unit. This should only take 10 seconds and an error code will display if the unit fails the SELFTEST.

External Quality Control

Laboratory Best Practices recommend the daily use of external quality controls to assure that a given procedure is performing correctly with acceptable accuracy and precision. Control solutions of known concentration are tested as patient samples and are compared to the stated expected values. This allows the laboratory to evaluate the performance of cuvettes, reagents and instrumentation.

A set of controls will be provided by your instructor consisting of different levels of control preparations. These are prepared from unfixed, stabilized human erythrocytes containing low and high levels of hemoglobin. These different concentrations can help you assess the precision of the system.

There are a variety of hemoglobin controls on the market today. See package insert for suitability of use with the HemoPoint H2 meter or the HemoCue Hb 201+.

Thoroughly mix the controls before use (see the control package insert for directions). *Compare the values obtained with the controls against the stated reference values. If the hemoglobin result falls outside the range of the controls, there is evidently a problem. Notify your instructor, so that the “Troubleshooting” portion of the User Guide can be consulted.*

Control Cuvette

Some models of the **HemoPoint H2** were supplied with a control cuvette which allows for a simple check of the photometer’s calibration. The control cuvette must be tested daily on these instruments to ensure the testing quality of the photometer. The expected Hemoglobin value and the permitted deviation of the control cuvette are stated on the control cuvette storage box label. The control cuvette is only calibrated for the instrument with which it was delivered, i.e. the expected hemoglobin value stated on the storage box label is only valid for that one photometer and could lead to completely different results on another photometer.

*Verify that the control cuvette is the correct one for the HemoPoint® H2 photometers you are using. Each HemoPoint that has a control cuvette is numbered, as is the control cuvette box. When not being used, keep the control cuvette in the original storage box, where it is optimally protected against breakage and contamination.*

Exercise 7: POC Hemoglobin Testing [Nov 2018]
Storage and Handling of Cuvettes

The most sensitive disposable component of this type of POC hemoglobin testing is the microcuvette. Unless otherwise stated, the following applies to cuvettes for both the HemoPoint H2 and the HemoCue Hb 201+.

1. Store the cuvettes in the original container at Room Temperature, 15-30 °C (59-86 °F).
2. The cuvettes are sensitive to moisture and must be kept in the original container with the supplied drying agent. DO NOT refrigerate the cuvettes.
3. Cuvettes are stable for 3 months after opening the container when stored at room temperature.
4. Write the date the vial was opened and your initials on the container label in the space provided. Best practices suggest that the expiration date based on when the container was opened should also be written on the container.
5. Only remove ONE microcuvette at a time from the container and then immediately close the lid.
6. It is crucial not to touch the optical eye of the cuvette with fingers, gloves, dirty or sharp objects.
7. The microcuvettes may only be used once and must be disposed after use as potentially infectious waste. Discard into a biohazard sharps container.
8. The reagents that coat the inner walls of the cuvette are harmful and must not be swallowed.
9. For the HemoCue Hb 201, cuvettes are also available individually packaged. They are to be stored at room temperature (59-86° F) and are stable until the expiration date printed on the package.

Limitations of the Procedure – HemoPoint H2 and HemoCue Hb 201

1. The filled microcuvette sample can be measured immediately, but it must be measured within 10 minutes to avoid false results.
2. Air bubbles in the optical eye, caused by inadequate filling of the microcuvette cavity, may cause false results. Discard the microcuvette and take another sample using a new microcuvette.
3. Ensure that you do not hold the microcuvette at its filling end, this may contaminate the optical eye preventing an accurate reading.
4. To avoid contamination of the cuvette holder, remove surplus blood from the outside of the microcuvette.
5. Always place the cuvette right side up in the holder. Placing the cuvette upside down can lead to erroneous results.
6. All results above 23.5 g/dL or equivalent must be confirmed by other laboratory methods.
7. For the HemoCue Hb 201, the cuvette must be filled within 3 minutes of being removed from the package. For this reason, you should not remove the cuvette from the package until you have cleaned the puncture site and are waiting for it to dry.

Expected Values - Normal range/Reference Values

Adult Males: 13.0 – 18.0 g/dL
Adult Females: 11.0 – 16.0 g/dL
Children (2 years to teenage): 11.0 – 16.0 g/dL
Infants (post-natal): 10 – 14 g/dL

Due to the wide range of conditions (dietary, geographical, smoking, exercise, recumbency, etc.), which affect reference values, it is recommended that each laboratory establish its own expected ranges.
LAB PROCEDURE – HemoPoint H2

Equipment and Supplies

1. HemoPoint H2 meter
2. Power supply (if the battery is not charged)
3. Control Cuvette (for older models)
4. Control Solutions
5. Vial of Cuvettes
6. Bio wipes
7. Hand warmer
8. Alcohol pads
9. Lancet
10. Gauze
11. Bandage
12. Sharps container

Power Supply

The HemoPoint® H2 may be used while plugged into a power source or may be used with the built-in rechargeable battery. The HemoPoint can be used for hemoglobin measurements while the battery is charging. Once the battery is fully charged, it can operate the instrument for approximately 100 hours. If it is not used for some time, it will switch into an energy saving, stand-by mode.

Meter Setup

Place the HemoPoint H2 on a level surface. If using the power adaptor, place the unit close to a power outlet and plug the adaptor into the power input on the back of the meter and into the power outlet.

1. Open the cuvette holder completely.
2. Wait for the text in the display to read “Add Cuvette”.
3. Perform a “Blank Reading” by closing the cuvette holder without inserting a cuvette.
4. The photometer runs internal electronic check during this “blank reading. After approximately 2 – 3 seconds the display will read “Open Holder”. The unit is ready for testing.
5. On your lab report, record that you performed the Blank reading.
6. If the instrument DOES NOT show “Open Holder”, there is possibly a malfunction. Please consult your instructor and the “Troubleshooting” portion of the User’s Guide.

Testing the Control Cuvette – only performed on those models supplied with a Control Cuvette

1. Open the cuvette holder completely and wait until the photometer displays “Add Cuvette”.
2. Take the control cuvette out of the storage box and place it in the cuvette holder with the curved flange up.
3. Close the cuvette holder completely. The photometer tests the control cuvette and shows the result after a few seconds.
4. Record the target value and expected range from the label of the control cuvette box on your lab report.
5. Compare the result with that stated on the storage box label. **The result must lie within the stated range.** Record the control result on your lab report!

6. Open the cuvette holder and return the control cuvette to its box.

7. **If the Hgb result falls outside the range of the control cuvette, there is evidently a problem. Please notify your instructor and refer to the “Troubleshooting” section of the User’s Guide.**

8. If your instrument was not supplied with a control cuvette, mark the Control Cuvette section of your lab report with NA (Not Applicable).

If the original control cuvette is lost or damaged, the photometer must be checked for proper calibration and a new control cuvette must be assayed. The photometer will need to be sent back to Stanbio Laboratory for a new control cuvette assignment. The calibration of the photometer and the re-assay of a new control cuvette is a critical and extensive process. This can be costly, so please take care of the control cuvette.

**Performing External Quality Control**

Commercial liquid controls that are recommended by the manufacturer must be used on each day of testing to assure proper functioning of the entire system. Follow the manufacturer's procedure for storage and handling of the control material.

1. Allow the vials to come to room temperature, 59-86°F for at least **20 minutes**.
2. Mix thoroughly but gently by inverting the vials and repeatedly rolling them between the palms until all cellular components are completely suspended. Do not shake the vial. Check the bottom of the vial to ensure that all cells are completely suspended and not settled in the bottom of the vial. A mechanical mixer is not recommended for the procedure but can be used to maintain the cell suspension.
3. **Record the lot number, expiration date and expected range of each control on the lab report.**
4. Expected ranges for each level are on the package insert which comes with a specific lot number of controls.
5. **Record the Lot number and Expiration Date of the Cuvettes you are using.**
6. The analyzer should be in the ready mode with the display showing “Open Holder” prior to filling the cuvette.
7. Remove a cuvette from the container, taking care not to touch the optic eye of any of the cuvettes, and immediately close the lid. Carefully lay the cuvette on a clean gauze or bio wipe.
8. Remove the cap from one of the control vials. Dispense a drop of control onto a clean NON-ABSORBENT surface such as plastic film (or the orange side of a bio wipe).
9. Holding the back of the cuvette, bring the center of the cuvette up to the drop of control and allow the cuvette to fill by capillary action. Do not fill from the side of the cuvette as this may result in air bubbles in the optic window and give erroneous results.
10. Using a clean gauze or bio wipe, remove any excess control from the outside of the cuvette by wiping the bottom of the cuvette with a gauze or bio wipe. Do not blot the center of the cuvette where it was filled to avoid removing sample from the cuvette.
11. Open the cuvette holder and place the cuvette with the curved flange up on the tray. Close the holder.
12. Control values should be read within 2 minutes after filling the control sample into the cuvette.
13. While waiting for the results, clean the threads of the vial and the vial cap with gauze. Snugly recap the vial immediately. After testing, return the vial to its proper storage.
14. **Record the results you obtained for the control in the appropriate section of the lab report.**
15. Open the holder and discard the cuvette into a bio-hazard trash or sharps container.

Exercise 7: POC Hemoglobin Testing [Nov 2018]
16. Repeat steps 7 – 15 for each level of control.
17. Evaluate the results of quality control to determine if the instrument can be used for patient testing. Record your evaluation on the lab report.
18. If the results do not fall within the established range, repeat the control test. If results still are outside of established ranges, notify your instructor. Consult the User’s Manual
   **TESTING CANNOT BE PERFORMED IF THE RESULTS OF THE CONTROLS ARE OUT OF RANGE.**

### Performing Patient Testing

1. Introduce self as student and state purpose.
2. Properly identifies patient. Record patient name and ID on lab form.
3. Ask about blood collection history and explain procedure if necessary.
4. Perform proper hand hygiene and put on gloves.
5. Select appropriate site for finger puncture; massage and warm the site as necessary.
6. Properly cleanse the site with alcohol and allow to dry.
7. Select and prepare appropriate equipment for test ordered. Remove ONE cuvette from the container and IMMEDIATELY close the lid. Take care NOT to touch the optical eye of the cuvette with your fingers. Lay the cuvette on a gauze square. Prepare the lancet for use.
8. Perform puncture across the print of selected finger (little finger side preferable). Press firmly on the fingertip with a sampling device and puncture the appropriate area of the finger.
9. Appropriately squeeze finger to form first drop of blood.
10. WIPE AWAY the first drop of blood; squeeze finger to obtain second drop of blood which is large enough to fill the cuvette completely.
11. Fill cuvette without bubbles with the second blood drop. Hold the cuvette so the tip of the cuvette meets the middle of the drop of blood; hold the cuvette steady while the cavity fills by capillary action. Visually inspect the cuvette for air bubbles in the optical eye. In case of air bubbles in the optical eye of the cuvette, discard that cuvette and take another sample using a new cuvette and a third blood drop.
12. Apply gauze to the puncture area once the cuvette is properly filled. Ask the patient to apply pressure to the puncture if possible.
13. Carefully wipe off excess blood from the cuvette to avoid contamination of the cuvette holder by gently wiping with a gauze. Do not blot the filling end of the cuvette.
   **NOTE:** The patient cuvette sample prepared this way can now be measured immediately or within **10 minutes** at the latest.
14. Carefully place the cuvette into the cuvette holder with the curved flange up and close the holder. The result will be displayed within 10 seconds to 3 minutes and will remain on the display while the cuvette holder is in the measuring position.
15. Read and record the patient results in the appropriate box on the lab report form; be sure to include appropriate units.
16. Inspect the puncture site to make sure bleeding has stopped; apply bandage if necessary.
17. Discard used materials in appropriate receptacle (sharp, biohazard, or regular trash). Remove the used cuvette from the meter and dispose in biohazard trash or in sharps.
18. Thank the patient and allow them to leave.
19. Disinfect work area with an appropriate disinfectant.
20. Remove gloves. perform proper hand hygiene.
21. Compare the patient results to the stated reference ranges in the lab material to evaluate if the results are lower, normal or higher than expected. Record your evaluation on the lab report.
**HemoPoint® H2 Maintenance - Cleaning and disinfection of the instrument after use**

### Cleaning the Housing and Touch screen
1. Disconnect the power adaptor from the electrical connection before proceeding.
2. Cleaning the housing and touch screen is best accomplished with a lint-free cloth, **lightly** dampened with clean water. For more stubborn soiling, a **mild** soap solution may be used. For disinfection, standard solutions can be used for surface disinfection provided they **do not** contain alcohol or other solvents.

### Cleaning the Cuvette Holder
1. The cuvette holder can be removed from the instrument for cleaning. Proceed as follows:
   a. Disconnect the power adaptor from the electrical connection before proceeding.
   b. Open the cuvette holder until you feel a resistance and the holder will not extend further.
   c. Press down the silver pin on the left-hand side (bottom) of the cuvette holder with a ball-point pen and draw the cuvette holder forward at the same time.
2. The cuvette holder can now be cleaned with a mild soap solution. For disinfection, standard solvent-free preparations can be used. **DO NOT** use any cleaning agent for cleaning the cuvette holder that could leave scratches on its surface.
3. Wait until the cuvette holder is completely dry before returning it to the machine. To replace the cuvette holder, gently push it in the correct position into the opening in the housing until it engages.

### Cleaning the Optical Unit
1. The optical unit is situated inside the photometer and has no direct contact with the cuvette therefore no routine cleaning is needed.
2. Cleaning the optical unit can become necessary if the measured maximum light intensity of the photometric light source no longer achieves the appropriate level required for testing. The optical unit should be cleaned when the following error message is displayed: **Dirty Optics – Use Optics Cleaner**
3. For cleaning the optical unit, the use of a special **HemoPoint® H2** optics cleaner is recommended.
4. Remove the cuvette holder following the procedure above for Cleaning the Cuvette Holder.
5. Remove the cleaner from the foil pouch and insert it (narrow tip first) carefully into the opening of the cuvette holder until you feel a smooth resistance. **THE CLEANER MUST BE USED WITHIN 10 MINUTES OF OPENING.**
6. Slowly push the cleaner deeper into the opening until it stops.
7. Wipe the optical system several times by slowly moving the cleaner in-and-out at least 5 times.
8. Remove the cleaner from the photometer.
9. If the used cleaner is dirty, repeat the procedure with a new cleaner.
10. **Wait at least 15 minutes after the optical system has been cleaned to reinsert the cuvette holder into the photometer.**
11. Dispose of all used cleaners as potentially infectious waste.
LAB PROCEDURE – HemoCue Hb201+

Equipment and Supplies

1. HemoCue Hb 201+ meter
2. Power supply (or 4 AA batteries)
3. Control Solutions
4. Vial or individual packages of Cuvettes
5. Bio wipes
6. Hand warmer
7. Alcohol pads
8. Lancet
9. Gauze
10. Bandage
11. Sharps container

Power Supply

The HemoCue will operate on AC power or on AA batteries. The supplied power adapter should be plugged into the power inlet on the back of the analyzer if AC power is available. To operate the analyzer on battery power, four (4) AA batteries (1.5 V) must be inserted into the battery compartment. If the analyzer is being operated on battery power and the battery symbol appears on the display, the batteries are running low and should be replaced as soon as possible. The instrument will continue to give accurate results even when the low battery symbol is showing on the display.

Meter Setup

Place the HemoCue analyzer on a level surface. If using AC power, place the unit close to a power outlet and plug it in. If not using AC power, the instructor will have placed batteries in the battery compartment.

1. Pull the cuvette holder out to the loading position.
2. Press and hold the left button until the display is activated (all symbols appear on the display).
3. The display shows the version number of the program, after which it will show the hourglass symbol, “Hb” and an audio symbol. During this time the analyzer will automatically verify the performance of the optronic unit by performing an automatic SELFTEST.
4. After 10 seconds, the display will show three flashing dashes and the HemoCue symbol. This indicates that the unit has passed the SELFTEST and is ready for use.
5. Record on your lab sheet that the unit performed and passed the SELFTEST.

Performing External Quality Control

Commercial liquid controls that are recommended by the manufacturer must be used on each day of testing to assure proper functioning of the entire system. Follow the manufacturer's procedure for storage and handling of the control material.

1. Allow the vials to come to room temperature 59-86°F for at least 20 minutes.
2. Mix thoroughly but gently by inverting the vials and repeatedly rolling them between the palms until all cellular components are completely suspended. Do not shake the vial. Check the bottom of the vial to ensure that all cells are completely suspended and not settled in the bottom of the vial. A mechanical mixer is not recommended for the procedure but can be used to maintain the cell suspension.

3. **Record the lot number, expiration date and expected range of each control on the lab report.**

4. Expected ranges for each level are on the package insert which comes with a specific lot number of controls.

5. **Record the Lot number and Expiration Date of the Cuvettes you are using.**

6. To perform controls, have the cuvette holder in its loading position (open). The display will show three flashing dashes and the HemoCue symbol.

7. Remove a cuvette from the container and immediately close the lid, or remove a cuvette from an individual package, taking care not to touch the optic eye of any of the cuvettes. Carefully lay the cuvette on a clean gauze or bio wipe. **The cuvette should be filled within 3 minutes after it is removed from its package.**

8. Remove the cap from one of the control vials. Dispense a drop of control onto a clean NON-ABSORBENT surface such as plastic film (or the orange side of a bio wipe).

9. Holding the back of the cuvette, bring the tip of the cuvette up to the drop of control and allow the cuvette to fill by capillary action in one continuous process.

10. Using a clean gauze or bio wipe, remove any excess control from the outside of the cuvette by wiping the bottom of the cuvette with a gauze or bio wipe. Do not blot the tip of the cuvette where it was filled to avoid removing sample from the cuvette.

11. Look for bubbles in the filled microcuvette. If present, discard the microcuvette and fill a new one. Small bubbles around the edge can be ignored.

12. Place the cuvette into the open the cuvette holder, then close the holder to start the measurement as soon as possible but no later than 10 minutes after the cuvette was filled.

13. During the measurement an hourglass symbol and 3 fixed dashes will be shown on the display.

14. The measuring time is 15 – 60 seconds for Hb values below 20 g/dL. The result will remain on the display for as long as the cuvette holder is in the measuring position. When operating on battery power, the analyzer will automatically turn off after approximately 5 minutes.

15. While waiting for the results, clean the threads of the vial and the vial cap with gauze. Snugly recap the vial immediately. After testing, return the vial to its proper storage.

16. **Record the results you obtained for the control in the appropriate section of the lab report.**

17. Open the holder and discard the cuvette into a bio-hazard trash or sharps container.

18. Repeat steps 6 – 17 for each level of control.

19. Evaluate the results of quality control to determine if the instrument can be used for patient testing. Record your evaluation on the lab report.

20. If the results do not fall within the established range, repeat the control test. If results still are outside of established ranges, notify your instructor.

**Performing Patient Testing**

1. Introduce self as student and state purpose.

2. Properly identifies patient. Record patient name and ID on lab form.

3. Ask about blood collection history and explain procedure if necessary.

4. Perform proper hand hygiene and put on gloves.

5. Select appropriate site for finger puncture; massage and warm the site as necessary.

6. Properly cleanse the site with alcohol and allow to dry.
7. Select and prepare appropriate equipment for test ordered. Remove ONE cuvette from the container and IMMEDIATELY close the lid. Take care NOT to touch the optical eye of the cuvette with your fingers. Lay the cuvette on a gauze square. Prepare the lancet for use.
8. Perform puncture across the print of selected finger (little finger side preferable). Press firmly on the fingertip with a sampling device and puncture the appropriate area of the finger.
9. Appropriately squeeze finger to form first drop of blood.
10. WIPE AWAY two or three drops of blood; squeeze finger to obtain a third or fourth drop of blood which is large enough to fill the cuvette completely.
11. Fill cuvette without bubbles with the third or fourth blood drop. Hold the cuvette so the tip of the cuvette meets the middle of the drop of blood; hold the cuvette steady while the cavity fills by capillary action. Visually inspect the cuvette for air bubbles in the optical eye. In case of air bubbles in the optical eye of the cuvette, discard that cuvette and take another sample using a new cuvette and a third blood drop.
12. Apply gauze to the puncture area once the cuvette is properly filled. Ask the patient to apply pressure to the puncture if possible.
13. Carefully wipe off excess blood from the cuvette to avoid contamination of the cuvette holder by gently wiping with a gauze. Do not blot the filling end of the cuvette.
   NOTE: The patient cuvette sample prepared this way can now be measured immediately or within 10 minutes at the latest.
14. Carefully place the cuvette into the cuvette holder correctly and close the holder. The result will be displayed in 15 – 60 seconds and will remain on the display while the cuvette holder is in the measuring position.
15. Read and record the patient results in the appropriate box on the lab report form; be sure to include appropriate units.
16. Inspect the puncture site to make sure bleeding has stopped; apply bandage if necessary.
17. Discard used materials in appropriate receptacle (sharp, biohazard, or regular trash). Remove the used cuvette from the meter and dispose in biohazard trash or in sharps.
18. Thank the patient and allow them to leave.
19. Disinfect work area with an appropriate disinfectant.
20. Remove gloves, perform proper hand hygiene.
21. Compare the patient results to the stated reference ranges in the lab material to evaluate if the results are lower, normal or higher than expected. Record your evaluation on the lab report.
HemoCue Hb 201+ Maintenance - Cleaning and disinfection of the instrument after use

**Cleaning the Housing**
1. Turn the unit off.
2. Disconnect the power adaptor from the electrical connection before proceeding.
3. Wipe off the housing with an alcohol swab. Allow to air dry.

**Cleaning the Cuvette Holder**
The cuvette holder should be cleaned after each day of use.
1. Pull the cuvette holder out to the loading position
2. While pressing the catch (with the tip of the pen) carefully rotate the cuvette holder sideways in open position as far as possible to the left.
3. Remove the cuvette holder from the analyzer, it will come off the stainless-steel pin on which it rotates.
4. Clean the cuvette holder with alcohol (20-70%) or mild detergent.
5. **Wait 15 minutes** before replacing the cuvette holder and using the analyzer. Make sure the cuvette holder is dry before inserting.

**Cleaning the Optical Parts**
The optical parts should be cleaned when directed to do so in the Troubleshooting Guide of the Operating Manual. Dirty optical parts may cause an error code. Follow the steps in Cleaning the Cuvette Holder and then clean the optical parts as follows.
1. With the cuvette holder removed from the analyzer, push the HemoCue Cleaner into the opening of the optic unit as far in as possible.
2. Move the Cleaner from side to side 5-10 times, and then push in the pull out the Cleaner 5-10 times, cleaning the cover glasses, placed to the left.
3. If the Cleaner is stained, repeat with a new Cleaner.
4. **Wait 15 minutes before replacing the cuvette holder and using the analyzer.** Make sure the cuvette holder is dry before inserting.
5. Note: as an alternative to the HemoCue Cleaner, a lint free cotton swab, non-pretreated, moistened with alcohol (20-70% without additive) or water may also be used. If a cotton swab is used, make sure it is not too wet and not too dry. Use a dry cotton swab to wipe away excess liquid in the optic house after cleaning with a moistened swab. To avoid scratches on the cover glass, only the cotton part of the swab should come in contact with the cover glasses.
EXERCISE 7: AUTOMATED HEMOGLOBIN TESTING STUDY QUESTIONS

Name________________________________   Date _____________________   Points_________/30

1. Define the following terms (1.5 points):
   a. Hemoglobin:
   b. Anemia:
   c. Polycythemia:

2. State two possible causes of anemia and polycythemia. (2 points)
   a. Anemia
      i. 
      ii. 
   b. Polycythemia
      i. 
      ii. 

3. State the principle of the HemoPoint H2 and HemoCue Hb201+ hemoglobin procedure. (2 points)

4. When performing a capillary puncture for hemoglobin testing, which drop of blood should be used for testing? (2 point)
   HemoPoint H2:
   HemoCue Hb 201+:

5. List 3 sample types which may be used for testing. (1.5 points)
   a. 
   b. 
   c. 

Exercise 7: POC Hemoglobin Testing [Nov 2018]
6. State four criteria which must be considered when setting up the HemoPoint or HemoCue analyzers. (2 points)

a. 

b. 

c. 

d. 

7. List two procedures to prevent Healthcare Associated Infections when using POC instruments. (1 point)

a) 

b) 

8. State two types of Quality Control used in POC hemoglobin testing. (2 points)

a. 

b. 

9. State the purpose of the AutoCheck and the Blank Reading for the HemoPoint H2. (2 points)

AutoCheck: 

Blank Reading: 

10. State what purpose a SELFTEST serves for the HemoCue Hb 201+. (1 point)

11. State the purpose of external Quality Control. (1 point)

12. Fill in the proper handling and storage information for cuvettes. (2 points)

<table>
<thead>
<tr>
<th>Storage temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Why must cuvettes be stored in the original container with the supplied drying agent?</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>What part of the cuvette should you avoid touching with fingers or gloves?</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>What information should you write on the cuvette container when it is first opened?</td>
</tr>
</tbody>
</table>
13. For the HemoCue Hb 201+ cuvettes, within what time limit must the cuvette be filled with the blood sample after removing the cuvette from the vial or individual package? (1 point)

14. For either the HemoPoint H2 or HemoCue Hb 201+, within what time frame must the filled cuvette be tested in the analyzer? (1 point)

15. What must be done if hemoglobin values are equal or greater than 23.5 g/dL. (1 point)

16. List 4 limitations of the hemoglobin test procedure. (2 points)
   a. 
   b. 
   c. 
   d. 

17. State the normal values for hemoglobin levels for the following patient populations. (2 points)

<table>
<thead>
<tr>
<th>Adult female</th>
<th>Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult male</td>
<td>Infants</td>
</tr>
</tbody>
</table>

18. List the supplies needed for performing POC Hemoglobin Testing. (3 points)
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EXERCISE 7: POINT OF CARE HEMOGLOBIN TESTING – HEMOPOINT H2

Phlebotomist __________________ Date __________________ Points _________ /30

1. Perform “blank reading” to correctly turn on meter. (circle one) Yes No

Quality Control

2. Run Control Cuvette if supplied with your meter
   Expected Range
   For your cuvette:
   Expected Range (g/dL)
   Value Obtained (g/dL)

   Testing of Controls
   Expiration Date
   Low: Lot #
   High: Lot #

5. Cuvettes
   Lot Number:
   Expiration Date:

6. Based on the results of the control solutions, can this machine be used? (Circle One) Yes No

Sample Collection and Testing (Check P for Performed, NP for Not Performed)

7. Introduces self as student and states purpose.
   P NP

8. Properly identifies patient; record patient name & ID number in chart below.

9. Asks about blood collection history and explains procedure if necessary.

10. Performs proper hand hygiene; put on gloves.

11. Selects appropriate site for finger puncture; massage and warm finger as necessary.

12. Properly cleanses site with alcohol; allows to dry.

13. Selects and prepares appropriate equipment for test ordered.

14. Performs puncture across the print of selected finger (little finger side preferable).

15. Appropriately squeezes finger to form first drop of blood.

16. Wipes away first drop of blood; squeezes finger to form a second drop of blood.

17. Fills microcuvette without bubbles using second blood drop.

18. Applies gauze to puncture site, asks patient to apply pressure.

19. Carefully wipes off excess blood from microcuvette.

20. Correctly places microcuvette in loading tray and inserts into the machine.

21. Reads and records results in table below.

22. Inspects puncture site to make sure bleeding has stopped, applies bandage if necessary.

23. Discards used materials in appropriate receptacle (sharps, biohazard or regular trash).

24. Thanks patient. If outpatient, allows patient to leave.

25. Disinfect work area.

26. Removes gloves, performs proper hand hygiene.

Recording and Evaluation of Results

<table>
<thead>
<tr>
<th>Patient Name</th>
<th>Patient Identification Number</th>
<th>Results in gm/dL</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28.</td>
<td>Compared the patient results to the reference ranges stated in the lab material.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Are the patient results (CIRCLE ONE) Low Normal High</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For Instructor Use Only:
All lines worth 1 point except for Line 27.
Line 26 is worth 3 points total; count off .5 if correct units are not used in the results space.
Count off .25 for each space where correct units are not used on lines 2, 3, & 4.

Exercise 7: POC Hemoglobin Testing
EXERCISE 7: POINT OF CARE HEMOGLOBIN TESTING – HemoCue Hb 201+

Phlebotomist ____________________________ Date ____________ Points ________ /30

1. Unit performed and passed the SELFTEST. (circle one) Yes No

Quality Control

<table>
<thead>
<tr>
<th>Testing of Controls</th>
<th>Expiration Date</th>
<th>Expected Range (g/dL)</th>
<th>Value Obtained (g/dL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low: Lot #</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High: Lot #</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Cuvettes Lot Number: Expiration Date:

5. Based on the results of the control solutions, can this machine be used? (Circle One) Yes No

Sample Collection and Testing (Check P for Performed, NP for Not Performed) P NP

6. Introduces self as student and states purpose.
7. Properly identifies patient; record patient name & ID number in chart below.
8. Asks about blood collection history and explains procedure if necessary.
9. Performs proper hand hygiene; put on gloves.
10. Selects appropriate site for finger puncture; massage and warm finger as necessary.
11. Properly cleanses site with alcohol; allows to dry.
12. Selects and prepares appropriate equipment for test ordered.
13. Performs puncture across the print of selected finger (little finger side preferable).
15. Squeezes finger to *form a third or fourth drop of blood.*
16. Fills microcuvette without bubbles using third or fourth blood drop.
17. Applies gauze to puncture site, asks patient to apply pressure.
18. Carefully wipes off excess blood from microcuvette.
19. Correctly places microcuvette in loading tray and inserts into the machine.
20. Reads and records results in table below.
21. Inspects puncture site to make sure bleeding has stopped, applies bandage if necessary.
22. Discards used materials in appropriate receptacle (sharps, biohazard or regular trash).
23. Thanks patient. If outpatient, allows patient to leave.
24. Disinfect work area.
25. Removes gloves, performs proper hand hygiene.

Recording and Evaluation of Results

<table>
<thead>
<tr>
<th>Patient Name</th>
<th>Patient Identification Number</th>
<th>Results in gm/dL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

26. Compared the patient results to the reference ranges stated in the lab material.

Are the patient results (CIRCLE ONE) Low Normal High

For Instructor Use Only:
All lines worth 1 point except for Line 26.
Line 26 is worth 3 points total; count off .5 if correct units are not used in the results space.
Count off .25 for each space where correct units are not used on lines 2 and 3.

Exercise 7: POC Hemoglobin Testing