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| --- | --- | --- | --- |
|  | **Differential Counts****CL – H05** | **Dept:** | Clinical Core Lab-Hematology Section |
| **Effective Date:** | July 1, 1993 |
| **Revised Date:** | February 20, 2019 |
| **Contact:** | Clinical Core Lab-Hematology Management |
| **Name & Title:** Gregory J. Pomper, MD,  Medical Director of Pathology Laboratories | **Date:** | 3/5/19 |
| **Signature:** |

1. **General Procedure Statement:**
	1. **Scope:** To provide laboratory testing personnel with instructions for performing

WBC differential counts as deemed appropriate by industry practices and regulatory agencies to assist in quality patient care.

* 1. **Responsible Department/Party/Parties:**
		1. Procedure owner: Clinical Core Laboratory Management-Hematology
		2. Procedure: Clinical Core Laboratory Personnel
		3. Procedure prepared by: Dale Dennard
		4. Supervision: Clinical Core Laboratory Management-Hematology

Clinical Core Laboratory Specialist and Designees

Medical Director Clinical Hematology

1. Implementation: Clinical Core Laboratory Management-Hematology

Clinical Core Laboratory Specialist and Designees

Medical Director Clinical Hematology

1. **Definitions:**

 CID: Container ID Number

1. **Procedure:**

**PRINCIPLE**

Differential counts are obtained automatically from the Coulter instrumentation utilizing VCS technology (flow cytometric method) and algorithms to identify different cell populations. Manual differentials are performed from blood smears stained with Modified Wright’s stain to identify normal and abnormal cell populations. The Coulter or the Bayer HealthCare Hematek Slide Stainer is used for staining smears for differentials. The Automated Differentials from the Coulter instruments may be autovalidated, reported after reviewing previous differential data or after scanning for abnormalities on any diff request.

**SPECIMEN**

1. EDTA vacutainer, MAP or microtainer tube labelled with at least 2 of the unique identifiers below.
* Patient’s first and last name (Counts as 1 identifier)
* Medical record number
* Sample accession number
* CID
1. A properly made peripheral blood smear labelled with the patient's last name and first initial, the date and CID.

Specimens should be analyzed as soon as possible for optimum accuracy. Blood for differentials should be processed within 24 hours after collection if stored at room temperature or within 48 hours after collection if stored at 2 to 80C.

**SAFETY**

* Personal protective equipment for this procedure:
	+ - Gloves worn at all times
		- Impermeable lab coats, worn closed at all times.
		- Shield and/or approved protective eyewear when removing sample caps and pushing smears and any time there is a risk of sample or reagent splashing.

**EQUIPMENT / REAGENTS**

1. Glass slide, 1X3 beveled edge
2. Pusher made from a smooth-edged hemacytometer cover glass
3. DiffSpin Slide Spinner with slide holders
4. Wright's Stain Pak/Modified Wright's Stain: Store at 180 – 250C; stable until manufacturer’s expiration date
5. Methanol Store at 180 – 250C; stable until manufacturer’s expiration date
6. DiH20
7. Hematek Automatic Stainer
8. Coulter DxH with Slide Maker and Slide Stainer
9. Capillary tube, Berol pipet or applicator sticks
10. Microscope

**QUALITY CONTROL OVERVIEW**

For Automated Differentials, Commercial Controls (Latron Control, Coulter 6C Cell Controls) are run two (2) shifts per day in the Main Lab and once per day in the Cancer Center. For Manual Differentials, the known appearance and staining properties of blood cells is used as an internal control for peripheral blood smears. Once per day, a properly pushed blood smear will be stained per stainer and evaluated for stain quality and expected reactivity with Modified Wright’s Stain. Comparisons of Automated differentials to Manual differentials are performed once (1) per month from each Coulter instrument.

**PROCEDURE**

A peripheral blood differential can only be ordered in conjunction with a CBC (CBCD-LAB293) or WBC (Differential–Add- LAB3081). Patient demographics and orders are sent via an interface from the LIS to Remisol Advance (RMH). The Coulter instruments query Remisol Advance for test orders and sends results via the interface back to Remisol Advance. Remisol provides the capabilities to auto-validate, delta check, edit and archive results. Results are processed in Remisol according to pre-defined rules and then transmitted to the LIS. Results that do not auto validate in Remisol and auto file in the LIS are held for technologist review under the Review tab in the Request List Window. After review, differentials can be manually validated or sent to the DiffPad for microscopic review. Automated Differential results will be evaluated using the following criteria:

**AUTOMATED DIFFERENTIALS**

**1. Auto-validation on Automated Differentials**

Automated Differentials will auto-validate (Remisol) and auto file (LIS) if the following criteria is met and the CBC or WBC results also auto-validate.

a. Any Normal Distribution for WBC, RBC and Platelets, with no Suspect Codes or only Definitive Codes and/or no Previous Data for comparison.

 b. Any Normal Distribution for WBC, RBC and Platelets with only an Imm Grans/Bands 1 or Imm. Ne1

 that has a Previous differential.

2. **Automated Differentials for Technologist Review**

 a. In Remisol, double click on the patient name in the Request Window under the Review tab.

 b. Evaluate the results. Results may be manually validated if the following criteria is met **and** agrees with

 previous patient results.

1. Any WBC <1.0 or an Absolute Neutrophil Count <1.0 with only a suspect code of Low Event #, Verify Diff, NRBC or Region (R) code.
2. Any Region Codes on Auto Diff parameters with a WBC ≥1.0 with only an Imm Grans or Verify Diff.
3. Any Platelet Delta Failure with no Suspect Codes that increases or stays in the same range. (ex. 350 to 150)
4. Any Platelet Delta Failure with no Suspect Codes that decreases unless ≤ 30,000 for admission or

≤ 75,000 for outpatient. **Always check for a clot before accepting**.

1. Any ≤30,000 platelet count on in-patients with no Suspect codes that are consistent with previous results. (Code VCPR)
2. Giant platelet codes or R codes on platelets with a basically normal shaped histogram and previous data. Any changes from previous data in the percentage of normal cells **and** no abnormal cells are present.

 c. To manually validate results after verifying: Highlight all results or specific results → click the thumbs up icon

Documentation of result comments (ie.VCPR, UPLT or Called, etc.) is done in Remisol. Results with comments are validated and then transmitted to the LIS. To add comments to results:

1. Highlight the result needing an appended comment .
2. In the Result Comments window, free text a comment

 OR

1. In the Result Comments window select the comment from the dropdown box then click the add (+) button

If any further documentation needs to be done once the results have been validated and archived in Remisol, it must be modified in the LIS using the Result Correction Activity.

 d. Differentials that fail Technologist Review are assigned to the DiffPad in Remisol for a Manual

 Count or Scanned Review.

 Right click the mouse → Assign to → DiffPad

 **Note:** Samples processed in the Cancer Center should be assigned to the CC Diff Pad

3. **Automated Differentials for Smear Review**

 a. Any Auto Diff parameter vote-out.

 b. Any RBC, PLT or WBC Suspect codes except Imm. Ne 1, or Dimorphic Reds.

 c. Any Basophil count ≥4 %

d. Any platelet count <30,000 for admission or ≤ 75,000 for outpatient. **Always check for a clot before**

 **accepting**.

. e. Giant platelet codes or R codes on platelets with an abnormal shaped histogram.

 f. No Previous data with an Imm. Ne 1 or Verify Diff suspect code.

 g. Any Region Codes on Auto Diff parameters with a WBC ≥1.0 that shows a significant change from

 previous results or has no previous data.

 h. If the previous diff had ≥10% Bands, ≥4% Basos, ≥5% Immature Granulocytes, ANY Pro or Blast,

 any abnormal (2+) RBC morphology, any NRBC.

**Manual Differential Scanning or Counting**

**Slide Stainer Quality Control**

The Hematek, Coulter DxH SMS uses the Modified Wright’s Romanowsky stains. This staining methodology uses a combination of Methylene Blue and Eosin. Romanowsky stains are considered polychromatic because the dyes which comprise the stain imparts multiple colors when applied to cells and cellular components. Staining takes place as a result of the ionization of the dyes when buffer is added to the stain. The following staining properties will be used to evaluate the staining of blood films for manual differential enumeration.

Cell/ Component Color

Red cells Salmon Pink

Nuclei of neutrophils Deep blue-purple

Specific granules of neutrophils, granules of Light purple or violet

lymphocytes, granules of platelets

Specific granules of basophils Deep purple

Specific granules of eosinophils Orange

Chromatin (including Howell-Jolly bodies) Purple

Dohle bodies Blue-grey

Promyelocyte granules and Auer rods Purplish-red

Cytoplasm of lymphocytes Blue

Cytoplasm of monocytes Blue-grey (ground glass appearance)

Cytoplasm of neutrophils Light pink

Cytoplasm of platelets Purple-blue to lilac

Prepare a pushed smear as outlined in the **Patient Testing** section below. Label slide as QC and the date.

1. **On the Hematek Stainer**
	* + - 1. Prime the platen by loading two to four blank slides into the spiral grooves parallel to the slide loading lines.
				2. Load the QC slide into the spiral grooves with the blood film side facing left and the feathered edge of the blood film to the back of the instrument.
				3. The slide will automatically move along the platen to be stained, rinsed and dried.
				4. Examine the smear under the microscope on 40X High Dry.
				5. Evaluate the smear for stain quality and expected staining reactivity.
				6. If cells are stained as indicated above, initial the Hematek Stainer Maintenance Log as Pass. If the smear fails QC, initial as Fail and troubleshoot the stainer. (Operator Manual, Section 7) Log in Corrective Action box.
2. **On the DxH SMS**

*Use the Stain Only Priority Procedure*

* + - 1. Load the QC slide into an empty slide basket.
			2. Open and pull out the I/O drawer. (Push button on the left side of the instrument)
			3. Place the basket in the I/O drawer in any position from 1 to 6.
			4. Press the number where the basket is placed.
			5. Push the drawer in for staining to begin.
			6. The basket will be moved by the robot arm to the staining baths.
			7. After the staining process is complete the basket is moved to through a post-stain drying cycle.
			8. Remove the slide from the basket.
			9. Examine the smear under the microscope on 40X High Dry.
			10. Evaluate the smear for stain quality and expected staining activity.
			11. If cells are stained as indicated above, initial the DxH SMS QC/Maintenance Log as Pass. If the smear fails QC, initial as Fail and troubleshoot the stainer.

**Patient Testing**

1. **Smear Preparation**

*A smear is pushed or spun and labeled with the patient's last name and first initial, the date and the CID. If a problem of disintegrated cells has been noted, a spun smear may be made or albumin may be added to an aliquot of the blood and the smear re-pushed.*

* 1. Pushed Smear
		1. Place a small drop of well mixed blood approximately 1/2" from the end of a clean glass slide.
		2. Using a clean coverslip pusher, prepare a wedge smear with a smooth "feathered" edge. Place the pusher in front of the drop of blood at an angle of about 45 degrees and allow the blood to spread to the edge of the coverslip. Push forward. The thickness and length of a smear can be controlled by the angle of the pusher.
		3. Air dry, label and stain the smear with Wright's stain on the Hematek Automatic Slide Stainer, or the DxH SMS.
	2. Spun Smear
		1. Insert a clean slide into a disposable slide holder.
		2. Position the slide holder onto the cradle in the DiffSpin.
		3. Using a Berol pipet, place one full drop of well mixed blood into each hole of the slide holder.
		4. Close the lid firmly until it latches and depress the "START" button.
		5. When the unit stops, depress the lid again to unlatch.
		6. Remove the disposable slide holder and slide.
		7. Air dry, label and stain the smear with Wright's stain on the Hematek Automatic Slide Stainer, or the DxH SMS.
	3. DxH SMS
		1. Smears are made according to established criteria. In the Automated Mode, the SMS aspirates and sends 90 µL of blood to the dispense probe.
		2. The probe moves to the drop placement position and places 4 µL of blood on the slide located on

 the smear shuttle.

* + 1. A second slide is picked up by the smear truck and spreads the drop of blood using the wedge

 technique.

1. The slide is transferred from the smear shuttle onto the print shuttle and then into the basket elevator for drying.
2. The basket is then transferred to the Stainer.

2. **Manual Differential Counting**

 a. The differential is performed using a microscope equipped with a mechanical stage and 100 X Oil

 Immersion objective.

 b. Examine the smear beginning in the feathered edge and working into the thicker portion of the

 smear. Counts should be performed in areas where the cells are uniformly distributed to allow for

 optimal cell identification.

 c. Differentials are counted in Remisol using the DiffPad or the CC DiffPad. The WBCs are examined,

 classified and counted based on the following WBC count criteria:

*WBC Count Consideration*

* <1.0 - report Auto Diff (if possible) or QNSDF (WBC Count Too Low for Accurate Differential) with the predominant cell type seen. If you report QNSDF with the predominant cell type, ZERO out the Auto Diff and result WMOR1 with QNSDF. If you agree with the Auto Diff, result WMOR1 with SCAN
* 1.0-1.9 - report diff based on 25 cells or >
* 2.0-2.9 - report diff based on 50 cells or > Result WMOR1 with MDP(Manual Diff Performed)
* ≥3.0 - report diff based on 100 cells

d. Percent (%) bands will be included in all manual differentials. If no bands are counted in the manual

 differential, zero (0) will be reported instead of “HIDE”.

3. **Manual Differential Scanning**

 a. The differential scan is performed using a microscope equipped with a mechanical stage and a 40X

 High dry or 50X Oil Immersion objective. A differential scan is based on examination and classification

 of WBCs in 20 fields.

 b. Examine the smear beginning in the feathered edge and working into the thicker portion of the smear.

 Scans should be performed in areas where the cells are uniformly distributed to allow for optimal cell

 identification.

 c. Scanned Differentials are resulted in Remisol using the Scan Diff Pad.

4. **Using the Remisol Diff Pad for Manual Differential Counting**

1. Double click the patient's name on the Smear Review tab in the Request List Window.
2. Select the microscope icon from the toolbar.
3. Make sure DiffPad is displayed in the upper left hand window.
4. Make sure the correct WBC is displayed in the upper right hand window.

 ***Note:*** *If the WBC was validated, it will automatically populate this window. If the WBC was not validated, enter the value before performing the differential. The WBC is necessary in order to calculate the absolute counts from the percentage counts*.

1. Press the keys on the keyboard that correspond to the appropriate cell types.

 ***Note:*** *The light on the Toolbar must be green for the keyboard keys to register as cell types. You can click the icon to toggle between green and red.*

1. When a count of 100 is reached, a small pop-up box is shown that indicates the count is finished. Click OK.
2. From the drop down box in the Comments field, click on Manual Diff Performed and any morphology results.
3. Click the disk icon to save the diff then close the DiffPad window.
4. The manual counts will populate the diff parameters, any morphology results will appear in the Result manual comments field and MDP will populate WMOR1.
5. Click the thumbs up icon to validate the results and send them to LIS.
6. **How to use the Remisol DiffPad for Manual Differential Scanning**
	1. Double click the patient's name on the Smear Review tab in the Request List Window.
	2. Select the microscope icon from the toolbar.
	3. Make sure Scan is displayed in the upper left hand window.
	4. Make sure a 1 is in the RMOR box (this will allow any and all reported morphology to be resulted in the LIS).
	5. Scan the smear using the criteria in #1 below; Auto Differential Scanning Interpretation.
	6. From the drop down box in the Comments field, click on “Slide Scanned Manual Diff Not Indicated” then click on any morphology results that need to be added.
	7. Click the disk icon to save. A pop-up box appears with the message “Minimal number of cells not

 reached. Are you sure you want to save?” Click “Yes”.

* 1. Any morphology results will appear in the Result manual comments field and SCAN will populate

 WMOR1.

* 1. Click the thumbs up icon to validate the Auto Diff results with morphology and send them to LIS

**REPORTING AND INTERPRETING RESULTS**

1. Auto Differential Scanning Interpretation

a. Scan the smear using a 40X or 50 Oil objective for abnormalities. Perform a manual diff if the

 following are estimated in 20 fields:

 ≥10% bands

 ≥3% basos

 ≥5% nRBCs (<5 append NRBCP to WBC if CBC only or RBC morph if Diff)

 ≥5% of metas or myelos or a combination of the two

 Any pros or blasts

 ≥10% atypical lymphs

 b. If none of the above criteria is met, report the Auto Diff with SCAN entered at WMOR1

 to indicate that a scan has been performed.

1. On manual and scanned diffs, report significant WBC, RBC and Platelet morphology using the Oil-immersion objective. These are reported as outlined in the charts that follow this procedure in the manual. RMOR and PMOR are mandatory parameters. If no abnormal RBC morphology is observed, the code RNORM should be used which translates to "red cells appear normal". If no Platelet morphology is observed then “Platelet Morphology Appears Normal” should be chosen from the dropdown box.
2. Unusual differential findings including intracellular inclusions and/or organisms, abnormal cells,

 and/or tumor cells should be correlated with findings from Microbiology or Cytology then submitted for

 Pathologist review. Other criteria for pathologist review include any of the following not previously

 known:

1. Immature granulocytes over 20%, including band neutrophils
2. Any cells suggestive of blasts, promyelocytes or unidentifiable
3. Any significant major morphological abnormalities of red cells, to include any suspected malarial forms, SC or C crystals, sickle cells, etc.
4. Any morphological abnormalities of platelets such as megakaryocytic fragments and/or megakaryoblasts
5. Metamyelocytes or myelocytes over 5%
6. Atypical lymphocytes comprising more than 10% of total lymphs
7. Any slide the technologist feels would be of interest or is unsure of, including body fluid examinations.

**The pathologist will direct any further follow-up.**

1. Platelets should be estimated on manual and scanned diffs to check the automated platelet count. If the

 estimate does not agree with the automated count, recheck the machine count, or re-push the slide to verify

 the count. Platelet morphology, such as the presence of bizarre or giant platelets, is reported under PMOR

 using the dropdown box.

1. If there are **clumped platelets** on the smear, depending on the severity of the clumping, the automated platelet count may be inaccurate. If platelets are clumped and the count can’t be verified accurately, report UPLT (Unable to give accurate plt count due to clumping), at PLT parameter of the CBC and one of the following estimate codes: APADQ (appears normal), APINC (appears increased), or APDEC (appears decreased) from the dropdown box in the Comment field. You may also add the code BLUET (suggest collecting plt sample in blue top tube) or free text, "suggest collecting platelet in a heparin tube". If there are small clumps on the smear but the automated count appears correct, report the platelet count and add “With few small clumps” to the PLT parameter.
2. If a blue top tube is received for a platelet count, run the tube through the Coulter in Pre-Dilute mode on the DxH. Enter a dilution factor of 1.1. Because of the dilution factor, the count from the blue top is multiplied by 1.1 for the reportable platelet result. The platelet count from the heparin tube may be used directly. Depending on the tube used, append the appropriate code: EDTA, HEPRN, or CITR8 to the results. Smears should be made from the blue top or heparin tube to verify the count.
3. An increased number of giant platelets can result in an erroneously low platelet and/or high WBC count on the Coulter. Use the table below as a reference to estimate the WBC count. If the estimate and the count are discrepant, have a chamber WBC count performed and reported. If the platelet count can’t be verified accurately, report UPLTG (Unable to give accurate plt count due to giant platelets) at the PLT parameter of the CBC and EPLTC (Estimated platelet count =) from the dropdown box in the Comment field with a free text numerical count utilizing the Platelet Estimation Chart below.
4. A pushed smear with ≥ 10% disintegrated cells requires that a spun smear be made in an effort to eliminate the disintegrated cells. If there are still ≥ 10% disintegrated cells on the spun smear, report the automated differential with the code DCELL (Unable to do manual diff due to disintegrated cells) from the dropdown box in the Comment field. If an automated differential is unavailable, zero out the diff and result DCELL with the cell types seen in the Comment field from the dropdown box.

Table 16-12. The Microscopic Quality Control Of

Leukocyte and Platelet Counts Using

A Well-Spread Blood Smear

|  |  |  |  |
| --- | --- | --- | --- |
| Average Number ofLeukocytes per HighPower Field | Estimated TotalLeukocyte Countx 109/L | Average Number of Platelets per High Power Oil-immersion Field | Estimated PlateletCount x 109/L |
| 2-3 | 4.0-7.0 | 2-3 | 20-40 |
| 4-6 | 7.0-10.0 | 4-6 | 40-70 |
| 7-10 | 10.0-13.0 | 7-10 | 70-120 |
| 11-20 | 13.0-18.0 | 11-20 | 120-250 |

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**Morphology Reporting Guidelines**

1. **RBC Morphology** – **Report with grading whenever present**

 a. Nucleated RBC l. Microcytes with normal MCV

 b. Hgb SC Crystals m. Hypochromia

 c. Sickle-like Cells n. Pappenheimer bodies

 d. Basophilic Stippling o. Infectious organisms

 e. Howell-Jolly Bodies p. Ovalocytes

 f. Schistocytes q. Targets

 g. Polychromasia r. Burr cells

 h. Spherocytes s. Acanthocytes

 i. Poikilocytosis t. Teardrops

 j. Macro Ovalocytes u. Rouleaux (presence only, don't grade)

 k. Macrocytes with normal MCV v. Agglutination (presence only, don't grade)

 **Report “Red cells appear normal” if no abnormal morphology is noted.**

2. **WBC Morphology** - **Report Presence only - do not grade**

 a. Toxic Granulation g. Auer rods

 b. Dohle Bodies h. Asynchrony

 c. Vacuoles i. Agranular Neutrophils

 d. Smudge Cells j. Inclusions

 e. Pelger-Huet cells

 f. Hypersegmented Neutrophils (any with 6 or more lobes)

3. **Platelet Morphology**- **Report Presence only - do not grade**

 a. Giant Platelets

 b. Bizarre Platelets

 c. Platelet clumps

 d. Platelet satellitism e. Megakaryocytic Fragments

 **Report “Platelet Morphology Appears Normal” if no abnormal morphology is noted.**

**MORPHOLOGY REPORTING TABLE**

 CHARACTERISTIC + ++ +++ ++++

 POLY 1-3/oif 4-6/oif 7-12/oif >13/oif

 POIK 2-6/oif 7-10/oif 11-20/oif >21/oif

 RBC

 INCLUSIONS <1/oif 2-4/oif 5-7/oif >7/oif

 MICRO

 MACRO 10-25% 25-50% 50-75% >75%

 HYPO

**Reference Intervals - Absolutes**

SEGS 103 /µL LYMPH 103 /µL

MALE/FEMALE RANGES MALE/FEMALE RANGES

AGE AGE

16 1.6-7.3 16 1.0-5.1

10 1.8-8.0 10 1.5-6.5

6 1.5-8.0 6 1.5-7.0

4 1.5-8.5 4 2.0-8.0

2 1.5-8.5 2 3.0-9.5

1 1.5-8.5 1 4.0-10.5

6M 1.0-8.5 6M 4.0-13.5

1M 1.0-9.0 1M 2.5-16.5

14D 1.0-9.5 14D 2.0-17.0

7D 1.5-10.0 7D 2.0-17.0

1D 5.0-21.0 1D 2.0-11.5

0 6.0-26.0 0 2.0-11.0

BAND 103 /µL MONO 103 /µL

MALE/FEMALE RANGES MALE/FEMALE RANGES

AGE AGE MALE FEMALE

ALL 0.0-1.1 ALL 0.2-0.9 0.1-0.9

EOS 103 /µL BASO 103 /µL

MALE/FEMALE RANGES MALE/FEMALE RANGES

AGE AGE

ALL 0.0-0.5 ALL 0.0-0.2

Absolute Metamyelocytes, Myelocytes, Promyelocytes, Blasts and NRBCs should be <0.0 x 103 /µL as they are not normally found in the peripheral blood.

**Reference Intervals – Percentages (applicable for WBC 4.8-10.8 x 103/µL)**

*Note: These reference intervals are not included in the result report; only absolute intervals are given.*

 **%**

**Segmented Neutrophils** *(note: tends to be lower* *in* **34-68**

*African‐American population*

**Band Neutrophils** **0-10**

**Lymphocytes 20‐47**

**Monocytes 3‐8**

**Eosinophils 0‐5**

**Basophils 0‐2**

**CRITICAL/PANIC VALUE**

Absolute Neutrophil Count - ≤ 0.5 x 103/μL - (segs + bands) on admission, as an Outpatient **OR** any drop in count after previous count of ≥ 0.5 Absolute Neutrophil Count on non-HEM/ONC and non-PED/ONC patients. Report the critical value by phone giving patient’s name, medical record number and result to nurse or physician caring for the patients. Ask that the information be read back to you. Document in the Remisol or LIS using the ANC-READB smart text codes which translates to “ <0.5 Absolute neutrophil count called to and read back by ”. The nurse or doctor’s name, date and time should be added to the comment. See the ANC Documentation flow sheet for additional guidance.

**PROCEDURE LIMITATIONS**

Variations in manual differential counts can be attributed to any of the following: sampling error such as improper or inadequate mixing at collection and/or analysis, poor quality of the blood smear and stain or technical errors in cell identification. Automated differentials are dependent upon proper operation of the instrumentation including but not exclusive of reagents, specimen sampling, and a clean flow cell.

1. **Review/Revision/Implementation:**
	1. Review Cycle: 2 years
	2. Office of Record: Department of Clinical Core Laboratory-Hematology
	3. All new procedures and procedures that have major revisions must be signed by the Laboratory Director.
	4. All reviewed procedures and procedures with minor revisions can be signed by the designated section medical director.
2. **Related Procedures:**

CL-HG02 General Information

CL-H04 CBC Using Beckman Coulter DxH 800/SMS

1. **References, National Professional Organizations, etc.:**

Davidsohn, Israel and Henry, John. Clinical Diagnosis by Laboratory Methods. Fifteenth Edition. Philadelphia: W.B. Saunders Company, 1974.

 Simmons, Arthur. Hematology: A Combined Theoretical and Technical Approach. W.B. Saunders Company, 1989

 Henry, John, M.D. Henry's Clinical Diagnosis and Management by Laboratory Methods.

 Twenty-First Edition: Philadelphia: W.B. Saunders Company, 2007

 Remisol Advance Data Manager, User Guide. Normand Info, October 2009

 College of Physicians and Surgeons of Alberta. “Blood Film Staining Effects”. ALQEP, May 2004

1. **Attachments:**

 Path Box Referral Form CL-H05-1

 ANC Documentation Flow Sheet CL-H05-2

 Path Box Referral Memo\_Dr. Beaty 4April2011

1. **Revision / Review Dates:**

|  |  |  |
| --- | --- | --- |
| **Review Date** | **Revision Date** | **Signature** |
|  | 6/11/15 | Edelina Oliphant |
|  | 12/28/17 | Edelina Oliphant |
|  | 2/20/19 | Heather Lawson |
| 3/5/19 |  | Michael Beaty |
|  |  |  |
|  |  |  |