Confirmation of results may be required if the following occur:

- Rule of three does not agree
  - $3 \times \text{Hgb} \neq \text{HCT} \pm 2$ or $3 \times \text{RBC} \neq \text{Hgb}$
- Associated with RBC pathology
- Indices are out of range
- WBC, RBC or PLT grossly out of range
- Instrument flags

Possible Factors Causing Erroneous Results Discussed

- Turbidity
- Cell clumping
- Leukocytosis
- Leukopenia
- Thrombocytosis
- Thrombocytopenia
- Anemia
- Polycythemia
- Immature cells
- Abnormal cells
- Other underlying medical treatment or disease
  - Leukemia
  - Vitamin Deficiency
  - Malignancy
  - Etc.

Measured Parameters

- WBC, RBC, and Platelet counts
- Hemoglobin
- Mean Corpuscular Volume (MCV)
- WBC differentials
- NRBC enumeration
- Reticulocyte enumeration
Calculated Parameters

- **HCT** = RBC x MCV ÷ 10
- **MCH** = Hgb x 10 ÷ RBC
- **MCHC** = Hgb x 100 ÷ HCT
- **MCHC** = Hgb x 100 ÷ (RBC x MCV ÷ 10)

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Case #1: 67 Y Male with Poor Nutrition (data from Abbott Sapphire)

- **WBC** 6.97 K/uL
- **RBC** 1.26 M/uL
- **NE** 74.2 %
- **HGB** 5.2 g/dL
- **LY** 24.4 %
- **HCT** 15.7 %
- **MO** 0.6 %
- **MCV** 125 fl
- **EO** 0.8%
- **MCH** 41.6 pg
- **BA** 0.0%
- **MCHC** 33.1 g/dL
- **RDW** 27.2 %
- **PLT** 159 K/uL
- **MPV** 9.4 fL

Suspect/Definitive Messages/Flags
- VARLYM
- ASYM

---

Case #1: 67 Y Male with Poor Nutrition (data from Abbott Sapphire)

- **WBC** 6.97 K/uL
- **RBC** 1.26 M/uL
- **NE** 74.2 %
- **HGB** 5.2 g/dL
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- **MCH** 41.6 pg
- **BA** 0.0%
- **MCHC** 33.1 g/dL
- **RDW** 27.2 %
- **PLT** 159 K/uL
- **MPV** 9.4 fL

- **RBC histogram abnormal**
  - Rule of 3 violated
  - **MCV** = 125 fl
  - **MCH** = 41.6 pg
  - **RDW** = 27.2 %
  - Confirm macrocytosis and anisocytosis

- **WBC flagging**
  - Confirm VARLYM with slide review
Case #1: RBC Morphology: normochromic, polychromasia, macrocytes, oval macrocytes, RBC fragments, anisocytosis

Case #1: Hypersegmented Neutrophils – 5 or more lobes

Case #1: Hypersegmented Neutrophils and Macrocytes
Case #1: Hyperseg or Pizza?

Case #1: 67 Y Male with Poor Nutrition

- **Manual Differential**
  - Neutrophils 80%
    - Majority are hypersegmented
  - Lymphocytes 18%
  - Monocytes 2%

- **RBC Morphology**
  - normochromic, polychromasia, macrocytes, oval macrocytes, RBC fragments, anisocytosis

- **Plt Morphology** - normal

- **Diagnosis:**
  - Megaloblastic anemia due to Vitamin B₁₂ deficiency
Case #2: 73 year old patient with high fever and chills (data from Abbott Sapphire)

- **WBC** 13.3 K/uL
- **NEU** 93.0 %
- **LYM** 4.1%
- **MONO** 2.2 %
- **EOS** 0.7 %
- **BASO** 0.1 %
- **PLT** 70 K/uL
- **MPV** 7.7 fL

**Suspect/Definitive Messages/Flags**
- □ BAND
- □ IG

- **RBC** 4.15 M/uL
- **HGB** 14.4 g/dL
- **HCT** 41.9 %
- **MCV** 101 fL
- **MCH** 34.7 pg
- **MCHC** 34.4 g/dL
- **RDW** 12.4 %

Case #2: 73 year old patient with fever and chills (data from Abbott Sapphire)

- □ Abnormal WBC
  - Slightly elevated WBC > 11.0 K/uL
  - % NEU > 90%
  - Suspect flags: BANDS, IG

- □ Screen stained smear
  - Perform manual WBC differential if > 10%
  - Bands / or Immature Granulocytes

- □ No Clot
- □ RBC and PLT histograms are normal
  - Report hemogram and plt count

Case #2: Banded neutrophil with toxic granulation
Case #2: Band neutrophil with vacuolation and toxic granulation

Case #2: Band neutrophil with toxic granules and Döhle bodies

Case #2: Neutrophil with toxic granules and Döhle bodies

Case #2: Giant Platelet and Metamyelocyte with toxic granulation and slight vacuolation
Case #2: Metamyelocyte with toxic granulation and vacuolation

Case #2: Metamyelocyte with toxic granulation and slight vacuolation

Case #2: 73 year old patient with fever and chills (data from Abbott Sapphire)

- Manual differential
  - Neutrophils 54%
  - Bands 37%
  - Lymphocytes 2%
  - Monocytes 2%
  - Metamyelocyte 3%
  - Myelocytes 2%
  - PMN toxic granulation 2+
  - PMN vacuolation 1+
  - PMN Döhle bodies 1+

- Reactive left shift with slight leukocytosis
- Smear review to determine if band and/or immature granulocyte population is >10% since granulocyte population is >90%
- Band/IG estimate >10%; therefore manual differential was performed
- Diagnosis:
Case #2: 73 year old patient with fever and chills (data from Abbott Sapphire)

- Manual differential
  - Neutrophils 54%
  - Bands 37%
  - Lymphocytes 2%
  - Monocytes 2%
  - Metamyelocyte 3%
  - Myelocytes 2%
  - PMN toxic granulation 2+
  - PMN vacuolation 1+
  - PMN Döhle bodies 1+
- Reactive left shift with slight leukocytosis
- Smear review to determine if band and/or immature granulocyte population is >10% since granulocyte population is >90%
- Band/IG estimate >10%; therefore manual differential was performed
- Diagnosis:
  - Pyelonephritis

Case #3: 101 year old ER patient referred (data from Abbott Sapphire)

- WBC 30.3 K/uL
- SEG 36.4 %
- LYMPH 12.9 %
- MONO 49.9 %
- EOS 0.6 %
- BASO 0.2 %
- PLT 41 K/uL
- RBC 2.44 M/uL
- HGB 7.6 g/dL
- HCT 24.0 %
- MCV 98.5 fl
- MCH 31.0 pg
- MCHC 31.4 g/dL
- RDW 15.0 %

Suspect Flags:
- BAND
- IG
- BLAST

Case #3: 101 year old ER patient (data from Abbott Sapphire)

- RBC histogram normal
- RBC rule of 3 agrees but patient is anemic
- Report hemogram
- PLT histogram normal
- Plt count <100 K/uL
- Check for clot
- Confirm low plt count microscopically
Case #3: 101 year old ER patient (data from Abbott Sapphire)

- WBC scattergram abnormal
  - Large cluster of cells in large WBC region – dark blue cluster
  - Large WBC region may include monocytes, blasts and other precursor white cells.
- Perform manual differential

**Case #3: Promonocytes**

**Case #3: Promonocytes and neutrophil**

**Case #3: Large platelets, lymphocyte, promonocyte, RBC macrocytes**
Case #3: Promonocytes, lymphocyte, and RBC macrocytes

Case #3: Promonocytes and monoblast

Case #3: Monoblast

Case #3: Monoblast and lymphocyte
Case #3: 101 year old ER patient

- **Manual Differential**
  - Neutrophils 20%
  - Bands 9%
  - Lymphocytes 20%
  - Monocytes 9%
  - Abnormal 42%
- **RBC Morphology**
  - Polychromasia few
  - Macrocytes 1+
- **PLT estimate** low

- Abnormal cells were referred to a pathologist and identified as a mix of monoblasts and promyelocytes.

- **Diagnosis:**

Case #4: 54 year old Male with abdominal tumor
(data from Abbott Sapphire)

- **WBC** 1.2 K/μL
- **NE** 46.7 %
- **LY** 42.9 %
- **MO** 9.0 %
- **EO** 1.4 %
- **BA** 0.0 %
- **RBC** 3.27 M/μL
- **HGB** 9.0 g/dL
- **HCT** 29.2 %
- **MCV** 89.5 fl
- **MCH** 27.5 pg
- **MCHC** 30.7 g/dL
- **RDW** 14.8 %
- **PLT** 269 K/μL
- **MPV** 6.0 fl

- **Suspect/Definitive Messages/Flags**
  - BAND
  - IG
  - BLAST
  - VARLYM

- **RBC** 3.27 M/μL
- **HGB** 9.0 g/dL
- **HCT** 29.2 %
- **MCV** 89.5 fl
- **MCH** 27.5 pg
- **MCHC** 30.7 g/dL
- **RDW** 14.8 %
- **PLT** 269 K/μL
- **MPV** 6.0 fl

- **Suspect/Definitive Messages/Flags**
  - BAND
  - IG
  - BLAST
  - VARLYM

- **Diagnosis:**

- Abnormal cells were referred to a pathologist and identified as a mix of monoblasts and promyelocytes.

- **Diagnosis:**

- Abnormal cells were referred to a pathologist and identified as a mix of monoblasts and promyelocytes.
Case #4: 54 year old Male with abdominal tumor (data from Abbott Sapphire)

- **RBC histogram**
  - Normocytic, hypochromic and distributed symmetrically as a single population with a normal RDW
  - Report hemogram

- **Platelet histogram**
  - Unremarkable
  - Report platelet count

Case #4: 54 year old Male with abdominal tumor (data from Abbott Sapphire)

- **WBC scattergram**
  - WBCs markedly decreased with the various lineages separating as discrete populations into expected areas
  - Flagging for BAND, IG, BLAST and VARLYM
  - Screen smear to verify WBC automated differential or perform manual

Case #4: Lymphocytes, neutrophil, monocyte

Case #4: Acanthocyte, echinocytes, target cells, hypochromic RBCs
Case #4: 54 year old Male with abdominal tumor

- Microscopic findings:
  - WBCs:
    - Microscopic review verifies the WBC automated differential. There are no significant WBC morphological abnormalities. No blasts were observed.
    - Absolute neutropenia present: $1.2 \text{ K/ul} \times 46.7\% = 560/\text{ul}$
  - RBCs:
    - Target cells: $1+$
    - Echinocytes: $1+$
    - Acanthocytes: few
    - Hypochromasia: $2+$

Discussion:
- Absolute neutropenia:
  - Primary causes include acute leukemia or myelodysplasia
  - No blasts – acute leukemia not likely
  - No hypogranular PMNs or giant band forms – myelodysplasia not likely
- Normocytic hypochromic anemia:
  - Primary causes include acute blood loss, hemolysis or anemia of inflammation/chronic disease
  - No history of acute blood loss
  - No schistocytes or spherocytes – hemolysis is unlikely
  - Anemia of inflammation/chronic disease is most probable in light of his underlying abdominal tumor

Discussion continued:
- Echinocytes increased:
  - Usually a laboratory artifact, but are also observed in critically ill patients with multiorgan failure including liver and renal failure
  - Most commonly observed with liver disease
  - Or hyposplenism/post-splenectomy
- Acanthocytes increased:
- Target cells increased:
  - Caused by an imbalance between hemoglobin and RBC membrane
  - Patient hemoglobin is low: $9.0 \text{ g/dL}$ due to chronic disease
  - Normocytic hypochromic hypoprotective anemia; likely anemia of inflammation/chronic disease

Case #5: 67 year old Male complaining of fatigue (data from Abbott Sapphire)

- WBC: $268 \text{ K/ul}$
- NE: $1.3\%$
- LY: $97.1\%$
- MO: $0.9\%$
- EO: $0.4\%$
- BA: $0.3\%$
- Suspect/Definitive Messages/Flags
  - BLAST
  - VARLYM
- RBC: $2.90 \text{ M/ul}$
- HGB: $9.6 \text{ g/dL}$
- HCT: $30.7\%$
- MCV: $106 \text{ fl}$
- MCH: $33.1 \text{ pg}$
- MCHC: $31.3 \text{ g/dL}$
- RDW: $15.1\%$
- PLT: $87 \text{ K/ul}$
- MPV: $6.8 \text{ fl}$
Case #5: 67 year old Male complaining of fatigue
(data from Abbott Sapphire)

- **WBC**: 268 K/μL
- **NE**: 1.3 %
- **LY**: 97.1 %
- **MO**: 0.9 %
- **EO**: 0.4 %
- **BA**: 0.3 %

- **Suspect/Definitive Messages/Flags**
  - BLAST
  - VARLYM
  - WBC above assay range

- **RBC**: 2.90 M/μL
- **HGB**: 9.6 g/dL
- **HCT**: 30.7 %
- **MCV**: 106 fL
- **MCH**: 33.1 pg
- **MCHC**: 31.3 g/dL
- **RDW**: 15.1 %
- **PLT**: 87 K/μL
- **MPV**: 6.8 fL

**WBC** histogram
- MCV = 106 fL
- Macrocytic, hypochromic and distributed symmetrically as a single population shifted to the right
- Smear review of RBC morphology

**Platelet** histogram
- Platelet count low – no clot detected
- Platelet curve normal
- Report platelet count

**WBC** scattergram abnormal
- WBC > assay range of 250 K/μL
  - Perform 1:2 dilution with filtered sterile saline and re-analyze
  - Report: WBC = 139 x 2 = 278 K/μL
- 2 Large clusters of cells in lymphocyte region extending to large WBC region – teal green clusters
- Large WBC region may include monocytes, blasts and other variant white cells.
- Scant clusters of cells in granulocyte region
  - Perform manual differential

Case #5: 67 year old Male complaining of fatigue
(data from Abbott Sapphire)

- Many lymphocytes, smudge cells, variant lymphocyte, monocyte

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Case #5: Albumin treated; no smudge cells, many lymphocytes, variant lymphs, monocyte, neutrophil

Case #5: Lymphocytes, variant lymph, eosinophil, hypochromic macrocytes, low plt count

Case #5: Lymphocytes, monocyte, hypochromic macrocytes, low plt count

Case #5: Lymphocytes, hypochromic macrocytes, low platelet count
Case #5: 67 year old Male with fatigue

WBC differential:
- SEG 1%
- LYMPH 89%
- MONO 1%
- EOS 1%
- VARLYM 8%

RBC morphology
- Macrocyes 1+
- Hypochromasia 2+

Platelets
- Normal morphology
- Low count confirmed

Diagnosis:
- Chronic lymphocytic leukemia

Case #6: 86 year female inpatient

WBC: 4.9 K/µL
- NE: 46.7%
- LY: 39.8%
- MO: 11.4%
- EO: 1.8%
- BA: 0.3%

Suspect/Definitive Messages/Flags
- Variant LY
- WBC Interference
- Platelet clumps
- Check for lipemia/cold agglutinin as per policy

RBC: 0.85 M/µL
- HGB: 10.1 g/dL
- HCT: 9.1%
- MCV: 106.7 fl
- MCH: 101.0 pg
- MCHC: 111.0 g/dL
- RDW: 16.0%
- PLT: 167 K/µL
- MPV: 8.3 fl
Case #6: 86 year female inpatient
(data from Gen•S)

- Optional smear review:
  - Probable strong cold agglutinin
  - Warm whole blood specimen for 15 minutes
  - Re-analyze

MCHC > 37 g/dL

- Warm for 15-30 min
- Re-analyze

- Values Corrected
- Values NOT Corrected
- Release “Warmed” Results
- Do Spun Hct

- Lipemic
- Not Lipemic

Report: WBC, RBC, PLT, Auto Diff
Spin Hct and/or Corrected Hgb

Case #6: 86 year female inpatient
(data from Gen•S “warmed” specimen)

- WBC 5.7 K/uL
- NE 53.2 %
- LY 34.4 %
- MO 10.2 %
- EO 2.1 %
- BA 0.1 %
- RBC 3.26 M/uL
- HGB 10.1 g/dL
- HCT 30.1 %
- MCV 98.2 fL
- MCH 31.0 pg
- MCHC 33.6 g/dL
- RDW 16.1 %
- PLT 153 K/uL
- MPV 8.3 fL

- Suspect/Definitive Messages/Flags

Case #6: 86 year female inpatient
(data from Gen•S “warmed” specimen)

- WBC scattergram normal
- No flags
- Release “warmed” results
- PLT histogram normal
- No flags
- Release “warmed” results
- RBC histogram shows second small population of cells at 180 fl = 2 RBCs
- RDW remains at 16 %
- Smear review RBC morphology
Case #6: 86 year female inpatient
(data from Gen\$ “warmed” specimen)

- Smear review RBC morphology
  - Rare rouleaux
  - Normocytic normochromic
- Release “Warmed” hemogram results
- Diagnosis:
  - Normocytic normochromic anemia
  - Presence of cold agglutinin secondary to Mycoplasma infection

Case #7: 63 year old Male Outpatient
(data from MAXM)

- WBC 19.2 K/uL
- NE : : : : :
- LY : : : : :
- MO : : : : :
- EO : : : : :
- BA : : : : :
- Suspect/Definitive Messages/Flags
  - Abnormal WBC Pop
  - Abnormal Plt Pop

- RBC 4.63 M/uL
- HGB 18.2 g/dL
- HCT 40.2 %
- MCV 86.9 fl
- MCH 39.4 pg
- MCHC 45.3 g/dL
- RDW 11.0 %
- PLT 265 K/uL
- MPV 8.5 fl

- RBC Histogram
  - Normal shape, MCV, and RDW; RBC pathology is unlikely
  - Rule of 3 does not agree suggesting analytic error in RBC, Hgb, and/or Hct
  - MCH and MCHC elevated

- Platelet Histogram
  - Unremarkable
  - Report platelet count
MCHC > 37 g/dL

- Warm for 15-30 min
- Re-analyze
  - Values Corrected
  - Values NOT Corrected
    - Release “Warmed” Results
    - Do Spun Hct
    - Lipemic
      - Report: WBC, RBC, PLT, Auto Diff
      - Spun Hct and/or Corrected Hgb
    - Not Lipemic
      - Report: WBC, Spun Hct, Hgb, PLT, Auto Diff

Case #7: Specimen Grossly Lipemic

- 63 year old Male Outpatient (data from MAXM)
- Values did not correct after warming specimen
- Spun Hct = 39%
- Plasma grossly lipemic
  - Lipemic plasma falsely elevated Hgb result due to turbidity interference
  - MCH and MCHC is much higher than normal due to a falsely increased Hgb that is represented in the numerator of both the MCH and MCHC indices

RBC 4.58 M/uL
HGB 13.5 g/dL
HCT 40.7 %
MCV 88.9 fL
MCH 29.4 pg
MCHC 33.2 g/dL
RDW 11.8 %
HCTM 39 %

Report values if rule of 3 agrees and indices are normal
Case #7: 63 year old Male Outpatient (data from MAXM)

- WBC Scattergram
  - Pattern abnormal suggesting random light scatter by lipids in plasma
  - 5 part differential voted out
  - Perform manual differential

Case #7: Neutrophils, normal RBCs and Platelets

Case #7: Monocyte, Lymphocyte, normal RBCs, few large platelets

Case #7: Lymphocyte, Neutrophil, normal RBCs and Platelets
Case #7: 63 year old Male Outpatient
(data from MAXM)

- Manual Differential
  - Neutrophils 73%
  - Bands 3%
  - Lymphocytes 15%
  - Monocytes 8%

- RBC & Plt
  - Morphology: normal

Diagnosis:
- Metabolic lipid disorder secondary to diabetes

Case #8: 53 year old male oncology patient
(data from CD1800)

- WBC 8.1 K/uL
- LYM 27.2%
- MID 9.3%
- GRAN 63.5%
- PLT 197 K/uL
- MPV 11.4 fL
- RBC 7.50* M/uL
- HGB 17.0 g/dL
- HCT 52.9* %
- MCV 70.5 fL
- MCH 22.6* pg
- MCHC 32.1* g/dL
- RDW 15.6 %

*MID cells may include less frequently occurring and rare cells correlating to monocytes, eosinophils, basophils, blasts and other precursor white cells.

*RBC Outside Reportable Range
Case #8: 53 year old male oncology patient (data from CD1800)

- WBC 8.1 K/uL
- LYM 27.2 %
- MID 9.3 %
- GRAN 63.5 %
- PLT 197 K/uL
- MPV 11.4 fL

MID cells may include less frequently occurring and rare cells correlating to monocytes, eosinophils, basophils, blasts and other precursor white cells.

- RBC 7.50* M/uL
- HGB 17.0 g/dL
- HCT 52.9 %
- MCV 70.5 fL
- MCH 22.6* pg
- MCHC 32.1* g/dL
- RDW 15.6 %

*RBC Outside Reportable Range

Case #8; Neutrophil, Normal RBC & Platelets

- RBC 3.78 M/uL
- HGB 8.63 g/dL
- HCT 26.5 %
- MCV 70.5 fL
- MCH 22.6 pg
- MCHC 32.1 g/dL

- RBC resultant value of 3.78 is corrected for dilution = 7.56 M/uL
- HGB resultant value of 8.63 is corrected for dilution = 17.3 g/dL
- HCT resultant value of 26.5 is corrected for dilution = 53.0 %
- MCV, MCH, MCHC are not affected by dilution

FINAL RBC REPORTABLE RESULTS

- RBC 7.56 M/uL
- HGB 17.3 g/dL
- HCT 53.0 %
- MCV 70.5 fL
- MCH 22.6 pg
- MCHC 32.1 g/dL
Case #8: Lymphocyte, Normal RBC & Platelets

- **Laboratory Findings**
  - RBC count elevated (6-12 K/µL)
  - Hgb elevated (17 – 24 g/dL)
  - Blood viscosity high and difficult to prepare good blood films
  - ESR is low
  - Normal arterial oxygen saturation (≥ 92%)
  - Splenomegaly
  - Increased serum vitamin B₁₂ (>900 ug/L)

- **Diagnosis:**

---

Case #8: Normal RBC and Platelets

- **Laboratory Findings**
  - RBC count elevated (6-12 K/µL)
  - Hgb elevated (17 – 24 g/dL)
  - Blood viscosity high and difficult to prepare good blood films
  - ESR is low
  - Normal arterial oxygen saturation (≥ 92%)
  - Splenomegaly
  - Increased serum vitamin B₁₂ (>900 ug/L)

- **Diagnosis:**
  - Polycythemia Vera

---

Case #8: 53 year old male oncology patient (data from CD1800)

- **Laboratory Findings**
  - RBC count elevated (6-12 K/µL)
  - Hgb elevated (17 – 24 g/dL)
  - Blood viscosity high and difficult to prepare good blood films
  - ESR is low
  - Normal arterial oxygen saturation (≥ 92%)
  - Splenomegaly
  - Increased serum vitamin B₁₂ (>900 ug/L)

- **Diagnosis:**

---

Case #8: 53 year old male oncology patient (data from CD1800)
Case #9: 8 year old female patient
(data from CD1800)

- WBC 13.6 K/uL
- LYM 69.7 %
- MID 6.8 %
- GRAN 23.5 %
- PLT 627 K/uL

URI = upper region interference with Plt

MID cells may include less frequently occurring and rare cells correlating to monocytes, eosinophils, basophils, blasts and other precursor white cells.

- RBC 5.67 M/uL
- HGB 10.7 g/dL
- HCT 32.1 %
- MCV 56.7 fL
- MCH 18.9 pg
- MCHC 33.3 g/dL
- RDW 15.5 %

- RBC histogram
  - Lym % > Gran %; normal pediatric ratio
  - Report auto differential

- Platelet histogram
  - Platelet count high and flagged upper region interference (URI)
  - Second population of cells (e.g. microcytic RBCs or giant platelets) beginning at 20 fL; no baseline at 20 fL
  - Review smear before reporting Plt count

- RBC histogram
  - Rule of 3 does not agree and indices are low
  - Widened peak (elevated RDW = 15.5 %)
  - Peak shifted to left (decreased MCV = 56.7 fL)
  - Confirm RDW, RBC morphology, and hemogram with slide review
Case #9: Lymphocytes, Neutrophil, Anisocytes, Poikilocytes, Microcytes, Hypochromasia, 33 Plts/HPF

Case #9: Lymphocyte, Anisocytes, Microcytes, Hypochromasia

Case #9: Anisocytes, Poikilocytes, Microcytes, Hypochromasia

Case #9: 8 year old female patient (data from CD1800)

- **Laboratory findings**
  - Serum iron normal
  - Serum TIBC normal
  - Reticulocytes normal
  - Hgb present: A>A2>F
  - Platelet count increased
- **Platelet count**
  - Normal morphology
  - Falsely elevated due to microcytic RBCs counted as platelets = URI flag
  - Report platelet estimate of 33/HPF x 15 = 495 K/uL

- **RBC Morphology**
  - 2+ anisocytosis
  - 1+ poikilocytosis
  - 3+ microcytosis
  - 2+ hypochromasia
  - Few target cells
- **Hemogram and RDW confirmed**
- **Diagnosis:**
Case #9: 8 year old female patient (data from CD1800)

- Laboratory findings
  - Serum iron decreased
  - Serum TIBC increased
  - TIBC saturation < 15%
  - Reticulocytes decreased
  - Hgb's present: A>A₂>F
  - Platelet count increased

- Platelet count
  - Normal morphology
  - Falsely elevated due to microcytic RBCs counted as platelets = URI flag
  - Report platelet estimate of 33/HPF x 15 = 495 K/µL

- RBC Morphology
  - 2+ anisocytosis
  - 1+ poikilocytosis
  - 3+ microcytosis
  - 2+ hypochromasia
  - Few target cells

- Hemogram and RDW confirmed

- Diagnosis:
  - Alpha thalassemia minor

Case #10: 48 year old female Hematology Clinic patient (data from Abbott Sapphire)

- WBC 30.6 K/µL
- NE 85.9 %
- LY 4.6 %
- MO 10.3 %
- EO 0.2%
- BA 0.0 %
- NRBC 12.8 %

- Suspect/Definitive Messages/Flags
  - IG

- RBC 2.42 M/µL
- HGB 8.63 g/dL
- HCT 23.4 %
- MCV 96.7 fL
- MCH 35.7 pg
- MCHC 36.9 g/dL
- RDW 30.8 %
- PLT 278 K/µL
- MPV 8.9 fL

- WBC scattergram
  - WBC markedly increased with the various lineages separating as discrete populations
  - NRBC > 5 %
  - IG flagging
  - Perform manual differential per protocol to confirm automated differential and NRBC count
Case #10: 48 year old female Hematology clinic patient (data from Abbott Sapphire)

- **RBC histogram**
  - Remarkable due marked anisocytosis
  - Elevated RDW due to mix of microcytic, normal red cells and macrocytes
  - Rule of 3 does not agree indicating a red cell pathology
  - Decreased RBC count, Hgb, and Hct indicating anemia
  - Confirm RBC morphology with smear review

- **PLT histogram**
  - Unremarkable; release result

Case #10: NRBCs, neutrophils, sickle cells, Howell Jolly bodies, macrocytes, microcytes, target cells

Case #10: Neutrophils, lymphocyte, large and normal platelets, sickle cells, polychromatophilic RBCs, macrocytes, microcytes, Holly Jolly bodies

Case #10: Neutrophil, monocytes, sickle cells, target cells, polychromasia, macrocytes, microcytes
Case #10: Neutrophil, lymphocyte, monocyte, sickle cells, polychromasia, macrocytes, microcytes, large and normal platelets

Case #10: Lymphocyte, polychromatophilic macrocytes, microcytes, sickle cells, normal platelets

Case #10: NRBC, sickle cells, macrocytes, Howell Jolly body

Case #10: Howell Jolly body, sickle cells, macrocytes, microcytes
Case #10: Macrocyte with Pappenheimer bodies

Case #10: Polychromatophillic RBC with Pappenheimer bodies

Case #10: 48 year old female Hematology clinic patient (data from Abbott Sapphire)

- **Manual Differential**
  - Neutrophils 80%
  - Bands 3%
  - Lymphocytes 9%
  - Monocytes 8%
  - NRBC 10%

- **RBC morphology**
  - 2+ sickle cells
  - 1+ microcytosis
  - 2+ macrocytosis
  - 1+ polychromasia
  - 1+ Holly jolly bodies
  - 1+ Pappenheimer bodies

- **Report manual differential, hemogram and platelet count**

- **Laboratory findings**
  - Reticulocyte count increased
  - Iron and TIBC normal
  - Ferritin level increased

- **Clinical characteristics**
  - Previously transfused
  - Splenomegaly

- **Diagnosis:**
  - Sickle cell disease in crisis

---

Case #11: 54 year old female outpatient (data from CD1800)

- **WBC** 8.9 K/uL
- **LYM** 46.0 %
- **MID** 10.3 %
- **GRAN** 43.7 %
- **PLT** 71 K/uL
- **MPV** 15.4 fl

- **RBC** 5.11 M/uL
- **HGB** 14.1 g/dL
- **HCT** 42.9 %
- **MCV** 84.0 fl
- **MCH** 27.6 pg
- **MCHC** 32.9 g/dL
- **RDW** 13.3 %

*MID cells may include less frequently occurring and rare cells correlating to monocytes, eosinophils, basophils, blasts and other precursor white cells.*
Case #11: 54 year old female outpatient
(data from CD1800)

- WBC 8.9 K/μL
- LYM 46.0 %
- MID 10.3 %
- GRAN 43.7 %
- PLT 71 K/μL
- MPV 15.4 fL

MID cells may include less frequently occurring and rare cells correlating to monocytes, eosinophils, basophils, blasts and other precursor white cells.

- RBC 5.11 M/μL
- HGB 14.1 g/dL
- HCT 42.9 %
- MCV 84.0 fL
- MCH 27.6 pg
- MCHC 32.9 g/dL
- RDW 13.3 %

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WBC histogram
- Subpopulation of cells (e.g. giant platelets, platelet clumps, lyse resistant RBCs, NRBCs, etc) between 35-50 fL counted as WBCs left of the lymphocyte peak
- Increased lymphocyte population and markedly less granulocytes; reverse lymph:gran ratio for adult
- Perform manual differential and WBC estimate

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RBC histogram
- Unremarkable
- Rule of 3 agrees
- Report hemogram

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Platelet histogram
- Abnormal shape
- Large population of platelets larger than 20 fL
- Low platelet count
- Confirm platelet count and morphology with slide review

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Case #11: Giant and Large Platelets
Case #11: Large and Giant Platelet

- Manual differential:
  - Neutrophils 42%
  - Lymphocytes 48%
  - Monocytes 8%
  - Eosinophils 2%
  - WBC estimate = 6.3 K/ul

- RBC morphology:
  - normal

- Platelets:
  - Platelet estimate = 83 K/uL
  - Automated count not clinically different from platelet estimate
  - Some giant platelets counted as WBC
  - Many large and giant platelets present

- Optional test: manual platelet count

- Diagnosis:
  - Immune thrombocytopenia

Case #11: Giant and Large Platelets; platelet estimate is decreased

- Platelet estimate = 83 K/uL
- Automated count not clinically different from platelet estimate
- Some giant platelets counted as WBC
- Many large and giant platelets present
- Optional test: manual platelet count

Diagnosis:
- Immune thrombocytopenia

Case #12: 78 year old female patient outpatient
(data from CD1700)

- WBC 9.8 K/uL
- LYM 26.2%
- MID 6.9%
- GRAN 66.9%
- PLT 79 K/uL
- RBC 4.23 M/uL
- HGB 12.5 g/dL
- HCT 37.1%
- MCV 87.7 fL
- MCH 29.6 pg
- MCHC 33.7 g/dL
- RDW 13.0%

MID cells may include less frequently occurring and rare cells correlating to monocytes, eosinophils, basophils, blasts and other precursor white cells.
Case #12: 78 year old female patient outpatient (data from CD1700)

- **WBC** 9.8 K/uL
- **LYM** 26.2%
- **MID** 6.9%
- **GRAN** 66.9%
- **PLT** 79 K/uL

MID cells may include less frequently occurring and rare cells correlating to monocytes, eosinophils, basophils, blasts and other precursor white cells.

- **RBC** 4.23 M/uL
- **HGB** 12.5 g/dL
- **HCT** 37.1%
- **MCV** 87.7 fL
- **MCH** 29.6 pg
- **MCHC** 33.7 g/dL
- **RDW** 13.0%

**WBC histogram**
- Unremarkable
- Report automated differential

**RBC histogram**
- Unremarkable
- Rule of 3 agrees
- Report hemogram

**Platelet histogram**
- Low count
- Large platelets >20 fl detected
- Specimen not clotted
- Review smear to confirm count and morphology

Case #12: Platelet satellites around neutrophils
Case #12: Platelet satellites around neutrophils

Platelet satellitism
- Platelets rosette around neutrophils or rarely around other cells. The satellite platelets are not counted by automated cell counters, resulting in spurious thrombocytopenia.
- Platelet satellitism is caused by EDTA-dependent antiplatelet and antineutrophil IgG antibodies in the patient’s plasma.
- This condition is considered benign, drug induced and/or transient.

Case #12: 78 year old female patient outpatient (data from CD1700)

- Do not report automated platelet count.
- Platelet count appears adequate upon slide review.
- Many large platelets seen.
- Optional test: Manual platelet count performed from a new specimen not drawn into an EDTA collection tube.
Summary of Potential Causes of Erroneous Results with Automated Cell Counters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Causes of Increase</th>
<th>Causes of Decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC</td>
<td>Nucleated red cells</td>
<td>Clotting</td>
</tr>
<tr>
<td></td>
<td>Platelet clumping</td>
<td>Specimen stability exceeded</td>
</tr>
<tr>
<td></td>
<td>Unlysed red cells</td>
<td></td>
</tr>
<tr>
<td>RBC</td>
<td>Giant platelets</td>
<td>Autoagglutination</td>
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<tr>
<td></td>
<td>High WBC (&gt;250 K/uL)</td>
<td>Clotting</td>
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<tr>
<td></td>
<td></td>
<td>Microcytic red cells</td>
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<tr>
<td>Hemoglobin</td>
<td>High WBC (&gt;250 K/uL)</td>
<td>Clotting</td>
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<tr>
<td></td>
<td>Lipemia</td>
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<td>Hematocrit</td>
<td>Giant platelets</td>
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</tr>
<tr>
<td></td>
<td>Hemolysis</td>
<td>Clotting</td>
</tr>
<tr>
<td></td>
<td>White cell fragments</td>
<td>Platelet clumping</td>
</tr>
</tbody>
</table>

In Conclusion

- Much of this presentation is based on good laboratory practice.
- For specific information regarding individual hematology setups, consult with the manufacturer for further guidance.
- Follow manufacturer’s guidelines and your laboratory procedures.
- Wishing you success in reducing errors!

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