American Society for Clinical Laboratory Science
Arizona/Nevada Chapter, ASCLS Region X, March 13, 2014

PROGRAM OBJECTIVES

At the end of the session, the participant will be able to:

• Compare and contrast the five part and the six part differential

• List scenarios where the automated diff can be accepted when the 6 part diff is used, but would require a manual diff when the 5 part diff is used.

• Understand how the IG count is a better definition for left shift than the band.
Peripheral Blood Smear submitted for Path Review
- Metamyelocytes present
- Criteria based on Hematology Analyzer with a 5-Part Diff

<table>
<thead>
<tr>
<th>LABORATORY</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC</td>
<td>33 H</td>
</tr>
<tr>
<td>Diff Type</td>
<td>MANU</td>
</tr>
<tr>
<td>Segs%</td>
<td>67% H</td>
</tr>
<tr>
<td>Bands%</td>
<td>3%</td>
</tr>
<tr>
<td>Meta%</td>
<td>3% H</td>
</tr>
<tr>
<td>Myelo%</td>
<td>0%</td>
</tr>
<tr>
<td>Pro%</td>
<td>0%</td>
</tr>
</tbody>
</table>
CASE #1

New Hematology Analyzer has 6-Part Diff
• Automated differential identifies Metas, Myelos and Pros as Immature Granulocytes (IG)
• IG = 6-Part Diff!

Day 1

Day 5
CASE #1

34 year old woman with multiple medical problems, treated with steroids for autoimmune disease. Increasing WBC, but mature neutrophilia. I think its demargination secondary to the steroids. What do you think?

Her IG was mildly elevated on admission and is increasing. I think she has an infection.

There are no clinical features of infection. I think it is demargination.

Infection. Demargination.

Infection. Demargination.
CASE #1

• Day 5
  – ID Consult obtained
  – Sputum culture taken
  – Placed on empiric antibiotics
• Day 7
  – WBC and IG decreasing
  – Discharged
• Day 9
  – Sputum positive for H. influenzae

Infection. Present on admission. NOT a Hospital Acquired Infection.

<table>
<thead>
<tr>
<th>LABORATORY</th>
<th>Day 1</th>
<th>Day 3</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC</td>
<td>13 H</td>
<td>19 H</td>
<td>33 H</td>
</tr>
<tr>
<td>AUTO</td>
<td>AUTO</td>
<td>AUTO</td>
<td></td>
</tr>
<tr>
<td>Segs%</td>
<td>65% H</td>
<td>65% H</td>
<td>67% H</td>
</tr>
<tr>
<td>IG%</td>
<td>1.1% H</td>
<td>2.3% H</td>
<td>3.3% H</td>
</tr>
<tr>
<td>CBC</td>
<td>Day 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WBC</td>
<td>33 H</td>
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</tr>
<tr>
<td>Bands%</td>
<td>3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meta%</td>
<td>3% H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myelo%</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pro%</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Which Lab results would you prefer?
Cellavision

Our Set Up

XE-5000

Reflex
- IPF
- RET-He
- NRBCs

Cellavision

WAM

Flag for smear review

Release Results

Autoverification

Cerner
Automated Differential

Previous Analyzer
5 Part Diff

Monocyte  Basophil  Eosinophil  Neutrophil  Lymphocyte

Current Analyzer
6 Part Diff

Monocyte  Basophil  Eosinophil  IG  Neutrophil  Lymphocyte
What can cause a Left shift?

- Infection: Bacterial and other organisms
- Toxemia, including ketoacidosis, acute porphyria, poisoning, medications (e.g. lithium), etc.
- Normal pregnancy
- Pre-eclampsia
- Acute hemorrhage
- Acute hemolysis
- Physical exercise
- Myeloproliferative disease
How does IG compare to Band Count?

- Band Count is poorly reproducible
- Criteria for Bands is subjective
  - Three different definitions
  - “How pinched is the nucleus?”

**IG is better than the Band**
Peripheral Blood Smear

BLAST PRO MYELO META

Left Shift? Left Shift?

Band Seg

Immature Granulocyte (IG)

Absolute Neutrophil count
Peripheral Blood Smear

BLAST  PRO  MYELO  META  BAND  SEG

Left Shift?

Immature Granulocyte (IG)

Absolute Neutrophil count
Manual Diff is Subjective

<table>
<thead>
<tr>
<th></th>
<th>Manual Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segs%</td>
<td>21%</td>
</tr>
<tr>
<td>Bands%</td>
<td>11%</td>
</tr>
<tr>
<td>Metas%</td>
<td>1%</td>
</tr>
<tr>
<td>IG%</td>
<td></td>
</tr>
</tbody>
</table>

100 cells counted

SEPSIS ALERT!
Manual Diff is Subjective

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<td>3%</td>
</tr>
<tr>
<td>Metas%</td>
<td>1%</td>
<td>0%</td>
</tr>
<tr>
<td>IG%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

100 cells counted

100 cells counted

SEPSIS ALERT!
Manual Diff is Subjective

Maybe 3% IG should trigger the sepsis alert?

<table>
<thead>
<tr>
<th></th>
<th>Manual Diff</th>
<th>Manual Diff</th>
<th>Automated Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segs%</td>
<td>21%</td>
<td>30%</td>
<td>32%</td>
</tr>
<tr>
<td>Bands%</td>
<td>11%</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td>Metas%</td>
<td>1%</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>IG%</td>
<td></td>
<td></td>
<td>1%</td>
</tr>
</tbody>
</table>

100 cells counted  100 cells counted  32,000 cells counted
What is **ITR**?

*Immature Neutrophil to Total neutrophils*

Based on MANUAL cell count of 100 cells

**Immature Neutrophils**

(BAND+Meta+Myelo+Pro)

---

**Total Neutrophils**

(Seg+BAND+Meta+Myelo+Pro)

---

= **ITR**

**Seg+BAND** = **ANC**

(Absolute Neutrophil Count)

Double dipping into the imprecise Band Count!
**ITR and Neonatal Infection**

- **The band count is not sensitive** enough to predict sepsis
- **Pediatric Literature on ITR**
  - Used to determine which infants that present with fever are at **low risk** for severe bacterial infection (**SBI**)
  - Patient population: *0-1 month, healthy appearance*
- **ITR Reference ranges are controversial**
  - Generally accepted reference range ≤ 0.2
  - 0-24 hours < 0.16; 60-120 hours <0.13; 5-28 days <0.12 (*Manroe, 1979*)
  - Study of healthy neonates at 4 hours: Range 0.05 – 0.27 (*Schelonka, 1994*)

<table>
<thead>
<tr>
<th>Babies with fever MDiff performed by 4 Techs &amp; 1 Pathologist</th>
<th>Band% Range</th>
<th>ITR Range</th>
<th>IG%</th>
<th>Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient A</td>
<td>6 – 18%</td>
<td>0.09 - 0.25</td>
<td>0.1%</td>
<td>No infection</td>
</tr>
<tr>
<td>Patient B</td>
<td>17-27%</td>
<td>0.33 - 0.67</td>
<td>2.8%</td>
<td>Salmonella</td>
</tr>
<tr>
<td>Cut off</td>
<td>≥13% Left Shift</td>
<td>≤0.2 low risk SBI</td>
<td>&gt;1.0% Left Shift</td>
<td></td>
</tr>
</tbody>
</table>
Immature Neutrophils (BAND+Meta+Myelo+Pro) = ITR

Total Neutrophils (Seg+BAND+Meta+Myelo+Pro)

\[
\begin{align*}
\frac{11+1}{21+11+1} &= 0.36 \text{ H} \\
\frac{3}{30+3} &= 0.09 \\
\frac{1}{32+1} &= 0.03
\end{align*}
\]

Subjective Imprecise

100 cells

Objective Precise

32,000 cells
Join the Crusade to Ban the BAND!
Automated 6-Part Differential

- **Identifies & Quantifies Immature Myeloid cells**
  - *Immature Granulocyte (IG)*
    - Early screen for sepsis
      - Better indicator for infection than WBC
      - IG >1% indicates a left shift
      - IG >3% may predict positive blood cultures.
    - Detects myeloproliferative disorders
- **Counts 32,000 cells**
- Flags if atypical cells possibly present and reflexes to slide review
How do we get from here...

5-Part Diff

6-Part Diff

To here?
Need to align criteria for Manual Diff and Path Review with Analyzer’s Ability to perform a 6-Part Diff

WHERE TO START?

PILOT Study

New Criteria for Determining Differential Type and Requirement for Path Review using New Hematology Analyzer (Sysmex XE-5000) which Reports a 6-Part Differential
PILOT Study

• Performed at two Hospitals
  – Banner Baywood Medical Center
  – Banner Estrella Medical Center

• Methodology
  – All PBS in December 2013
  – Evaluated two ways:
    • **Pilot Criteria** (New Analyzer with 6-Part Diff)
    • **Previous Criteria** (Old Analyzer with 5-Part Diff)
  – To determine:
    • **Diff Type:** Automated versus Manual
    • **Path Review:** Required versus Not Required
- Determined by Analyzer & Middle Ware
- No changes for Pilot Study

Is a PBS indicated?

PILOT Study

Is a Manual Diff required?

- YES
  - Manual Diff
- NO
  - Auto Diff

Is a Path Review required?

- YES
  - No Path Review
- NO
  - Autoverified
Is a PBS indicated?

- Determined by Analyzer & Middle Ware
- No changes for Pilot Study

Is a PBS indicated?

PBS Review

PILOT Study

Is a Manual Diff required?

- YES: Manual Diff
- NO: Auto Diff

Is a Path Review required?

- YES: No Path Review
- NO: Autoverified
PILOT Study

Is a Manual Diff required?

- YES: Manual Diff
- NO: Auto Diff

Is a Path Review required?

- YES: Path Review
- NO: No Path Review

Hypothesis

- ✓ Can increase the number of Automated Diffs reported by changing Manual Diff Criteria to reflect the Analyzer’s ability to report an Automated 6-Part Diff
- ✓ Can decrease number of non-value added Path Reviews by changing Path Review Criteria to reflect the Analyzer’s ability to report an Automated 6-Part Diff

*** IGs and NRBCs make the difference! ***
Is a PBS indicated?
Is a PBS indicated?

- Determined by settings on Analyzer and Middle Ware
  - No changes made for Pilot Study
- International Society for Laboratory Hematology (ISLH) Consensus Guidelines
  - Suggested Criteria for Action Following Automated CBC and WBC Differential Analysis

<table>
<thead>
<tr>
<th>Check Specimen Integrity/follow SOP</th>
<th>Multiple Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slide Review</td>
<td>Multiple Reasons</td>
</tr>
<tr>
<td>Manual Diff</td>
<td>One Reason: <em>No diff or incomplete diff</em></td>
</tr>
<tr>
<td>Path Review</td>
<td>Not Discussed</td>
</tr>
</tbody>
</table>
Is a Manual Diff required?


(LDC = Leukocyte Differential Count = Diff)
Criteria requiring Manual Diff
Previous Analyzer (5-Part Diff)

**Is a Manual Diff required?**

**CLINICAL**
- Age < 1 year old
- Physician ordered Path Review

**ANALYZER**
- Could not perform Auto Diff
- WBC Counts:
  - WBC counts ≤1,000 (first time)
  - If the WBC cell line has a 50% or greater change, then a manual differential must be performed.

**NEW RULE with NEW ANALYZER**
WBC >25.0 & IG% >5%

**PBS SCAN**

- **Significant Abnormality**
  - *(Cells not identified by Auto Diff)*
  - Bands >15%
  - META >1%
  - MYELO ANY
  - PRO ANY
  - BLASTS ANY
  - nRBC’s >1
  - Abnormal (atypical) lymphs >1%
  - Reactive lymphs ANY
  - Plasma Cells >1%
  - Abnormal cells suspicious for malignancy ANY

- **Smudge Cells:**
  - >10% of all cells present
**Question #1**
Was Sysmex able to perform an AUTO DIFF?

- **YES**

**Question #2**
Are abnormal cells which are not part of 6-Part Diff present? E.g. Blasts or abnormal cells suspicious for malignancy.

- **NO**

**Question #3**
- >20 band cells* present?
- >20 mononuclear smudge cells*?

- **NO**

**Questions #4**
Do the cell counts on SCAN correlate with 6-Part AUTO DIFF percentages? (40-20-5 Rule)

- **YES**

*Cellavision evaluates more than 100 cells, often 115-130. These are number of cells seen on Cellavision, not percentages.*
### WBC Cell Count Correlation
#### Sysmex to Cellavision Acceptable Ranges (40-20-5 Rule)

<table>
<thead>
<tr>
<th>Sysmex % AUTO Diff</th>
<th>Cellavision # of Cells</th>
<th>Acceptable Range</th>
<th>Example</th>
</tr>
</thead>
</table>
| %Neut              | #Segs + #Bands         | +/- Forty Cells  | Sysmex Neut% = 65%
|                    |                        |                  | Cellavision: Number of cells classified as Segs+Bands from 25 to 105 is acceptable. |
| %Lymph             | #Lymph (includes Reactive and Plasmacytoid lymphs) | +/- Twenty Cells | Sysmex Lymph% = 30%
|                    |                        |                  | Cellavision: Number of cells classified as Lymphs from 10 to 50 is acceptable. |
| %Mono              | #Mono                 |                  |         |
| %Auto NRBCs        | #NRBC                |                  |         |
| %IG                | #Metas + #Myelos + #Pros | +/- Five Cells  | Sysmex IG% = 6%
<p>|                    | #Eos                 |                  | Cellavision: Number of cells classified as Metas+Myelos+Pros from 1 to 11 is acceptable. |
| %Basos             | #Basos               |                  |         |</p>
<table>
<thead>
<tr>
<th>Diff. Count</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutr.</td>
<td>74.1</td>
</tr>
<tr>
<td>Eos</td>
<td>0.0</td>
</tr>
<tr>
<td>Baso</td>
<td>0.6</td>
</tr>
<tr>
<td>Lymph</td>
<td>7.2</td>
</tr>
<tr>
<td>Monos</td>
<td>4.1</td>
</tr>
<tr>
<td>NRBC</td>
<td>0.0</td>
</tr>
<tr>
<td>Others</td>
<td>14</td>
</tr>
</tbody>
</table>

No Eos, Basos or NRBCs seen on Cellavision

“Others” on Cellavision Screen = 1G% from Sysmex Auto Diff

Can Accept AUTO Diff!
### PILOT Study - Diff Type

<table>
<thead>
<tr>
<th>Peripheral Blood Smear</th>
<th>944 PBS performed</th>
<th>Previous Analyzer (5-Part Diff)</th>
<th>New Analyzer (6-Part Diff)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td># Auto/Manual Diffs</td>
<td>482/462</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% Auto/Manual Diffs</td>
<td>51%/49%</td>
</tr>
</tbody>
</table>
PILOT Study - Diff Type

Comparison of Reporting Automated WBC Differentials (BBMC)

Leveraging the 6-Part Differential

➡ Automated Diffs increased 36%
294 of the 944 (31%) cases with Manual Diff using 5-Part Diff Criteria due to the presence of Immature Granulocytes (Metas, Myelos and/or Pros)
Is a Manual Diff required?

**Criteria requiring Manual Diff**

**Previous Analyzer (5-Part Diff)**

**NEW RULE with NEW ANALYZER**

WBC > 25.0 & IG% > 5%

**CLINICAL**

- Age < 1 year old
- Physician ordered Path Review

**ANALYZER**

- Could not perform Auto Diff
- **WBC Counts:**
  - WBC counts ≤ 1,000 (first time)
  - If the WBC cell line has a 50% or greater change, then a manual differential must be performed.

**PBS SCAN**

- **Significant Abnormality**
  (Cells not identified by Auto Diff)
  - Bands > 15%
  - META > 1%
  - MYELO ANY
  - PRO ANY
  - BLASTS ANY
  - nRBC’s > 1
  - Abnormal (atypical) lymphs > 1%
  - Reactive lymphs ANY
  - Plasma Cells > 1%
  - Abnormal cells suspicious for malignancy ANY

- **Smudge Cells:**
  - > 10% of all cells present
Criteria requiring Manual Diff

Current Analyzer (6-Part Diff)

Is a Manual Diff required?

**ANALYZER**
- Could not perform Auto Diff

**PBS SCAN**
- Significant Abnormality
  (Cells not identified by Auto Diff)
  - BLASTS ANY
  - Abnormal cells suspicious for malignancy ANY

**QUANTITY**
- Cells on SCAN do not correlate with Auto Diff (40-20-5 Rule)
What’s the Diff?

Manual Differential
- Subjective
- Not reproducible
- 100 cells counted
- Time consuming
- Should only replace automated diff when
  1. Auto Diff could not be performed
  2. ABNORMAL (malignant) cells present.

Automated Differential
- Objective
- Reproducible even for low numbers of cells
- Counts 32,000 cells
- Fast

*Rapid, Accurate, Precise*
Is a Path Review required?
Is a Path Review required?

Purpose and Criteria for Blood Smear Scan, Blood Smear Examination, and Blood Smear Review

Gene Gulati, Ph.D., Jefferson Medical College and Thomas Jefferson University Hospital. Ann Lab Med 2013;33:1-7

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Adults</th>
<th>Intants</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC (× 10^9/L)</td>
<td>Initial* &gt; 30</td>
<td></td>
</tr>
<tr>
<td>RBC (× 10^12/L)</td>
<td>Initial &gt; 6.0 (Female) or &gt; 6.5 (Male)</td>
<td></td>
</tr>
<tr>
<td>Hb (g/dL)</td>
<td>Initial ≤ 6 or &gt; 18</td>
<td>&lt; 14 (newborn)</td>
</tr>
<tr>
<td>(mmol/L)</td>
<td>Initial ≤ 3.7 or &gt; 11.2</td>
<td></td>
</tr>
<tr>
<td>PLT (× 10^9/L)</td>
<td>Initial &lt; 50 or &gt; 999</td>
<td></td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>Initial &lt; 60 or &gt; 110</td>
<td>&lt; 85 (newborn)</td>
</tr>
<tr>
<td>C. Based on manual Diff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blasts or other abnormal/unclassifiable cells</td>
<td>Any</td>
<td></td>
</tr>
<tr>
<td>Promyelocytes</td>
<td>Initial ≥ 3%</td>
<td></td>
</tr>
<tr>
<td>Myelocytes</td>
<td>Initial ≥ 5%</td>
<td></td>
</tr>
<tr>
<td>Metamyelocytes</td>
<td>Initial ≥ 10%</td>
<td></td>
</tr>
<tr>
<td>Reactive Lymphocytes</td>
<td>Initial ≥ 10%</td>
<td></td>
</tr>
<tr>
<td>NRBC (per 100 WBC)</td>
<td>Initial over 2 (&gt; 7 days old)</td>
<td>over 50 (&lt; 7 days old)</td>
</tr>
<tr>
<td>Significant morphologic abnormalities (Initial) of: RBC, WBC, and PLT (see Table 3)</td>
<td>Any</td>
<td></td>
</tr>
<tr>
<td>Organisms</td>
<td>Any</td>
<td></td>
</tr>
</tbody>
</table>
Is a Path Review required?

**Purpose and Criteria for Blood Smear Scan, Blood Smear Examination, and Blood Smear Review**

Gene Gulati, Ph.D., Jefferson Medical College and Thomas Jefferson University Hospital. Ann Lab Med 2013;33:1-7

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<tr>
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</tr>
<tr>
<td>Myelocytes</td>
<td>Initial ≥ 5%</td>
</tr>
<tr>
<td>Metamyelocytes</td>
<td>Initial ≥ 10%</td>
</tr>
</tbody>
</table>

**PBS Scan**
### Using OLD criteria, would a Manual DIFF or Auto DIFF be Accepted?

1. Age < 1 year old
2. WBC counts =< 1,000 (1.0 mm³), perform a manual differential the first time.
   - Subsequent orders, a scan is to be performed when the WBC cell line has NOT changed more than 50% within a 24-hour period.
   - If the WBC cell line has a 50% or greater change, then a manual differential must be performed.
3. Significant Abnormalities: If any of the following exist, a Manual Diff will be done:
   - Bands > 15%
   - META > 1%
   - MYELO ANY
   - PRO ANY
   - BLASTS ANY
   - nRBC’s > 1
   - Abnormal (atypical) lymphs ANY
   - Reactive lymphs > 5%
   - Plasma Cells > 1%
4. Smudge cells > 10% of all cells present. Prepare albumin slide and perform Manual Diff under microscope (Cannot place on Cellavision).
5. WBC > 25.0 & IG% > 5.0: MDIFF & path review if indicated.
6. If “path review” is ordered, perform an MDIFF

### Using OLD criteria would the findings require a PATH Review?

- The abnormalities BOLDED below must be left for review on first samples only including new encounters. All others (unbolded) may be sent for path review at the technologist’s discretion.

#### WBCs
- WBC < 1,000.
- WBC > 25,000 with IG% > 7.5 immature cells, (Metas or younger) and no previous Path review within 90 days.
- WBC > 25.0 and IG% > 7.5% (Path review if indicated, if no previous path review within 90 days.)
- WBC > 25.0 & IG% > 5.0: MDIFF & path review if indicated.

#### Lymphocytosis:
- > 60% Lymphs with a total WBC > 7,000 in adults.
- > 75% in pediatrics
- Lymph% > 59.9 and WBC > 6.9 (Path review if indicated).

#### Eosinophils:
- > 20%

#### Basophils:
- > 4% Basophils in context of an elevated WBC (WBC > 10,000).

#### Abnormal Cells
- BLAST: Presence of any (unless previously reported).

#### Granulocytes:
- Immature cells (myelos or younger)
- Abnormal segmentation (hypo/hyper)
- Abnormal granulation or inclusions other than toxic granulation or Dohle bodies.

#### Lymphocytes:
- Any immature lymphocytes
- Any abnormal lymphocytes, excluding atypical or reactive lymphocytes.

#### Plasma Cells:
- Presence of any plasma cells (Reactive plasmacytoid lymphs not included).

#### Monocytes:
- > 20% Atypical or Immature.

### NRBCs
- Automated NRBC result is > 20% from Manual NRBC.
- Manual NRBC differs by more than 20% from the automated NRBC’s, a path review is required.

### RBCs
- NRBC% > 10 & age is > 30 days, Path review if indicated.
- NRBC: > 10 nucleated RBC per 100 WBC with dysplastic forms (except in newborns).

### Plts
- PLTs: < 20,000 or > 1,000,000

### Abnormal Cells
- Megakaryocytes
- Megakaryoblasts.

### Other
- Significant abnormalities in size, shape, granulation.

#### Pancytopenia
When 2 of the cell lines are decreased:
- WBC < 4.0
- HGB < 8.0
- PLT < 100

### Exceptions
- Does not require Path review
  - Differentials from patients on chemotherapy may be excluded from pathologist review unless a significant change has occurred.
  - A slide that has been previously reviewed by the pathologist, unless there are significant changes.

### Requested
- Physician requested
- Tech requested Any and all other questions and problems
- Pathologist requested
- Client requested Any slide requested to be returned to the client.

### Other
- Any marked variation in daily differentials.

### Discorance between PILOT and OLD Procedure?
- No
- Yes
Note Discorances
**PILOT Study – Path Review**

<table>
<thead>
<tr>
<th></th>
<th>Previous Analyzer (5-Part Diff)</th>
<th>New Analyzer (6-Part Diff)</th>
</tr>
</thead>
<tbody>
<tr>
<td># Path Reviews</td>
<td>278</td>
<td>50</td>
</tr>
<tr>
<td>% Path Reviews</td>
<td>29%</td>
<td>5%</td>
</tr>
</tbody>
</table>

**Percent of PBS Requiring Path Reviews**

![Bar chart showing decreases in Path Reviews](chart.png)

Leveraging the 6-Part Differential

- **Path Reviews decreased 24%**
Majority of PBS sent for Path Review due to presence of Immature Granulocytes (Metas, Myelos and/or Pros) – Most in low numbers (E.G. 3 Metas)
Reasons for Path Review following New Analyzer (6-Part Diff) Procedures

Fewer PBS sent for Path Review due to presence of Immature Granulocytes (Metas, Myelos and/or Pros) when higher threshold used. Higher thresholds possible because IG identified by Auto Diff.
Pilot Study Summary

• Side by side comparison of criteria used on Previous Analyzer (5-Part Diff) to updated criteria for New Analyzer (6-Part Diff)

• Scan of PBS slide confirms presence of
  – Metas, Myelos and Pros, confirming IGs (Immature Granulocytes) identified by the Auto Diff.
  – NRBCs, confirming Auto NRBC count.

• Leveraging the 6-Part Diff
  – Increased Automated Diffs by 36%
  – Decreased Pathology Reviews by 24%
Case #2

- History of lung cancer treated with surgery and chemotherapy, 2009
- Chronic renal failure
- Present to initiate hemodialysis
- Cough with abnormal chest x-ray, IV antibiotic
- Adrenal insufficiency, continue prednisone

<table>
<thead>
<tr>
<th>WBC</th>
<th>6.4</th>
<th>Normal WBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bands%</td>
<td>0%</td>
<td>Normal Band%</td>
</tr>
<tr>
<td>IG%</td>
<td>3.8% H</td>
<td>Elevated IG%</td>
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</table>
Does this patient have an infection?

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<th>LABORATORY</th>
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<th>07/11/2013 3:07 MST</th>
<th>07/10/2013 19:10 MST</th>
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<tr>
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<td>3.80 L</td>
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<td>Hct</td>
<td>40.0</td>
<td>39.1 L</td>
<td>37.7 L</td>
</tr>
<tr>
<td>MCV</td>
<td>102 H</td>
<td>103 H</td>
<td>102 H</td>
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<td>MCH</td>
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<td>138</td>
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<tr>
<td>MPV</td>
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<td>11.1 L</td>
<td>10.8 L</td>
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<td>Platelet Estimate</td>
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<td>MANU</td>
</tr>
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<td>Segs</td>
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<tr>
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<td>13</td>
<td>7 L</td>
<td>21</td>
</tr>
<tr>
<td>Monos</td>
<td>12</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
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<td>5</td>
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<tr>
<td>Basos</td>
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<td></td>
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<tr>
<td>Metas</td>
<td>1 H</td>
<td>2 H</td>
<td>1 H</td>
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<tr>
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<td>Eos#</td>
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<td></td>
</tr>
<tr>
<td>Baso#</td>
<td></td>
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</tbody>
</table>
**Diagnosis:** Infection

- ✓ Elevated IG
- ✓ Blood culture grew E. coli
- X WBC count lagged behind IG
- X Band count not useful
- X IG confirms that it is NOT a Hospital Acquired Infection
### Example CBC Report

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<tr>
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<td>13.2 H</td>
<td>17.9 H</td>
<td>16.7 H</td>
<td>18.6 H</td>
<td>21.0 H</td>
<td>24.5 H</td>
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<td>20.0 * H</td>
<td>16.0 H</td>
<td>14.7 H</td>
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<td>MANU</td>
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<td>Immature Granulocyte % (IG%)</td>
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<td>1.6 * H</td>
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<td></td>
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<td>3 H</td>
</tr>
</tbody>
</table>

- Change is difficult
- Peripheral Blood Smear slide made when instrument detects potentially abnormal cells
- If no abnormal (malignant) cells identified on smear, can accept 6 part automated differential
- Need to let go of manual differential
• **Compare and contrast the five part and the six part differential**
  
  ✅ If metas, myelos, and/or pros are present without blasts or cells suspicious for malignancy, then

<table>
<thead>
<tr>
<th>Diff Type</th>
<th>Path Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-Part Diff</td>
<td>Manual</td>
</tr>
<tr>
<td>6-Part Diff</td>
<td>Automated</td>
</tr>
</tbody>
</table>

• **List scenarios where the automated diff can be accepted when the 6 part diff is used, but would require a manual diff when the 5 part diff is used.**
  
  ✅ Infection: Bacterial and other organisms; Toxemia, including keto-acidosis, acute porphyria, poisoning, medications (e.g. lithium), etc.; Normal pregnancy; Pre-eclampsia; Acute hemorrhage; Acute hemolysis; Physical exercise

• **Understand how the IG count is a better definition for left shift than the band.**
  
  ✅ Automated; Objective; Reproducible even for low numbers of cells; Counts 32,000 cells; Fast; Rapid, Accurate, and Precise.
Evolution of the Complete Blood Count

**Early Technology**

**Updated Technology**

**21st Century CBC**

DIFF Scattergram (Abnormal)
References


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- Gene L. Gulati, PhD, et al. *Automated Lymphocyte Counts vs Manual Lymphocyte Counts in Chronic Lymphocytic Leukemia Patients.* LABMEDICINE, Volume 42 Number 9, September 2011 *Department of Pathology, Thomas Jefferson University Hospital, Philadelphia, PA, Physicians Regional Medical Center, Naples, FL*

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- Schelonka, R MC, USAF. *Peripheral leukocyte leukocyte indexes in term infants count and healthy newborn,* J PEDIATR 1994;125:603-6