SUPPLEMENTAL DATA



## S1. Facilitator Guides

Group 1

1. What methodology do you use when initially reviewing a peripheral blood smear?
    a. How do slides come to you for review? (availability/consult patients vs intentional curriculum/slide collection)
    b. What media do you use for review? (digital v light microscopy)
    c. How much time do you typically spend reviewing each slide?
        i. How much variability is there in time spent per slide?
    d. How much of the slide do you typically review?
        i. Is there a minimum amount of the slide you feel should be reviewed?
        ii. If not, how would you recommend a novice “know” they have reviewed enough
2. What morphology do fellows struggle the most identifying?
3. What are the most crucial diagnoses a graduating fellow should be able to make on PBS review?
4. How do you balance education on common yet relatively benign conditions, and rare yet relatively morbid conditions?
5. What defines competency at graduation?

Group 2

Review of session 1

1. Method of Review
    a. Most agree that trainees should learn a thorough, systematic method for review
    b. Many report systematic approaches including specifics around of where to start on the slide, what power to use, how to systematically evaluate each cell line
    c. A few note that they gestalt the smear more often using remote platforms when the setting is less formal, this may impact the degree of learner education.
2. Logistical Considerations
    a. most utilize slides from patients for whom they have provided direct care
    b. some use a "slide library" and argue that de-novo evaluation without vignette is important for early learners to pay attention to detail
    c. many fondly recounted having these flashcards and still have them. However, this appears to not be a method currently used

    d. a few mention that virtual review is not good when large areas of slide require review
    e. some noted their time spent on review, and area of slide covered directly vary with their concern for an diagnosis that dictated urgent discovery (ie APL)
3. Disease specific discussion
    a. Discussion of TMA and acute leukemia dominated the discussion
    b. only 10% discussion on PLT disorders
    c. Most focused on diagnosing TMA through identification of schistocytes
    d. Many also commented that differentiating other causes of hemolytic anemia was important
    e. Nearly all discussion of white blood cell morphology focused on either distinguishing reactive from malignant
4. Systems Based Practice
    a. Most agreed that trainees should be able to identify diseases that would otherwise result in acute decompensation and death
    b. Many noted that diagnosis is made on smear immediately, and before confirmatory send out testing results
    c. most agree that distinguishing malignant from non malignant conditions with similar morphology is incredibly important (reactive cells)
    d. Some mentioned there is difficulty assigning appropriate value to regional diseases (tick borne -USA) vs arboroinfections worldwide (Malaria)

Focus group 2 discussion

1. There is a general agreement trainees should use systematic evaluation. What methodologic tips or best practices should be used to minimize error?
2. What are the highest yield WBC morphologies AND disorders of WBCs to identify?
3. What are the highest yield RBC morphologies AND disorders of RBCs to identify?
4. What are the highest yield PLT morphologies AND disorders of PLTs to identify?
5. What are the common, but more benign diagnoses that trainees need to be able to identify? ie those that are low risk but commonly occurring
6. How do we reconcile the supposition that academic hematologists use PBS most - when they are in the most resource rich environment with fastest turn around time? In contrast community physicians have generally slower turn around time, and less resources, are thought to not utilize this skill.

## S2. List of pre-identified hematopathologic morphology

| **WBC** |
| --- |
| Atypical lymphocyte (reactive) |
| Band |
| Basophil |
| Blast (undiferentiated) |
| Dysplastic neutrophil |
| Eosinophil |
| Hairy Cell |

Hypersegmented neutrophil
Hypogranular neutrophil
LGL
Lymphocyte (mature)
Metamyelocyte
Monocyte vs. monoblast
Myeloblast with Auer Rod
Myelocyte
Neutrophil
Neutrophil with toxic granulation
Plasma Cell
Promyelocyte
Sezary Cell
Dohle bodies
Morula (inclusion)

**RBC**

Acanthocyte
agglutination (RBC)
Basophilic stippling
Bite Cell
Blister Cell
Burr Cell
Heinz Body
Howell-Jolly Body
Hypochromia
Macrocytic
Microcyte
Nucleated RBC
Ovalocyte
Pappenheimer Bodies
Polychromatophil
Ring form - malaria
Schistocyte
Sickle Cell
Spherocyte
Stomatocyte
Target cell
Teardrop
tetrad - babesia

**PLT**

Platelet (Giant)
Platelet (Hyogranular)
Platelet (normal)
Platelet clumping (satellitism)
Thrombocytopenia

## S3. List of pre-identifed hematologic diagnoses

| Diagnosis |
|---|
| Acute Leukemia |
| Acute Leukemia - AML vs ALL |
| Acute promyelocytic anemia |
| Anaplasmosis / Ehrlichiosis |
| Anemia - AIHA |
| Anemia - iron deficiency |
| Anemia - megaloblastic |
| Atypical Lymphocytosis |
| Babesiosis |
| CLL |
| CML |
| Dimorphic RBC population (prior transfusion) |
| Hairy Cell Leukemia |
| ITP |
| Malaria |
| Mantle Cell Lymphoma (Leukemic Phase) |
| May-Hegglin |
| MDS |
| Myelophthisic Anemia |
| Normal Monocytes (vs Monocytic AML) |
| Platelet Clumping |
| Reactive leukocytosis |
| Sickle Cell |
| T Cell Leukemia |
| Thalassemia |
| TMA / MAHA |

## S4. Quantitative Statement Coding

| Thematic Categories | N | % of statements* |
|---|---|---|
| Benefit provided by PBS review | 31 | 23.7% |
| Cell lineage | 43 | 32.8% |
| Medium used for PBS review | 17 | 13.0% |
| Procedure of PBS Review | 12 | 9.2% |

| | | |
|---|---|---|
| Source of Slide | 22 | 16.8% |
| Specific diagnoses | 52 | 39.7% |
| Specific morphology | 34 | 26.0% |

* Does not sum to 100% as statements can be coded to multiple dimensions

| 1) | **Benefit provided by PBS review** | N | % of category | |
|---|---|---|---|---|
| | Total | 31 | - | |
| | Aid dx | 10 | 32.3% | of benefit provided by PBS review |
| | Cant miss (can result in death) | 8 | 25.8% | '' |
| | Common | 2 | 6.5% | '' |
| | Guides decision making | 9 | 29.0% | '' |
| | Not Important | 2 | 6.5% | '' |

| 2) | **Cell lineage** | N | % of category | |
|---|---|---|---|---|
| | Total | 43 | - | |
| | RBC | 18 | 41.9% | of cell lineage |
| | WBC | 21 | 48.8% | '' |
| | PLT | 4 | 9.3% | '' |

| 3) | **Medium used for PBS review** | N | % of category | |
|---|---|---|---|---|
| | | 17 | - | |
| | Digital platorm used | 17 | N/A | N/A |

| 4) | **Procedure of PBS review** | N | % of category | |
|---|---|---|---|---|
| | | 12 | - | |
| | Abbreviated-systematic | 1 | 8.3% | of procedure of PBS review |
| | Gestalt | 2 | 16.7% | '' |
| | Other | 3 | 25.0% | '' |
| | Thorough - systematic | 6 | 50.0% | '' |

| 5) | **Source of slide** | N | % of category | |
|---|---|---|---|---|
| | | 22 | - | |
| | Codex (collated slides) | 3 | 13.6% | of source of slide |
| | Flashcard | 7 | 31.8% | '' |
| | Service patient (clinical context) | 12 | 54.5% | '' |

| 6) | **Specific diagnoses** | N | % of category | |
|---|---|---|---|---|
| | | 52 | - | |
| | Disorders of RBCs | 16 | 30.8% | of all specific diagnoses |
| | Macrocytic anemia | 1 | 6.3% | of disorders of red blood cells |
| | Megaloblastic anemia | 3 | 18.8% | '' |

| | | | | |
|---|---|---|---|---|
| | Hemoglobinopathies | 1 | 6.3% | '' |
| | Other Hemolytic anemias | 4 | 25.0% | '' |
| | TMA | 7 | 43.8% | '' |
| | | | | |
| | Infections | 7 | 13.5% | of all specific diagnoses |
| | Anaplasmosis | 2 | 28.6% | of infections |
| | Babesiosis | 1 | 14.3% | '' |
| | EBV | 1 | 14.3% | '' |
| | Leukocytosis | 2 | 28.6% | '' |
| | Monocytosis | 1 | 14.3% | '' |
| | | | | |
| | Malignancies | 23 | 44.2% | of all specific diagnoses |
| | CML | 1 | 4.3% | of malignancies |
| | Hairy Cell Leukemia | 1 | 4.3% | '' |
| | CLL | 1 | 4.3% | '' |
| | Burkitt Lymphoma | 3 | 13.0% | '' |
| | APL | 4 | 17.4% | '' |
| | Acute Leukemias | 9 | 39.1% | '' |
| | MPN/MDS | 2 | 8.7% | '' |
| | Mantle Cell Lymphoma | 2 | 8.7% | '' |
| | | | | |
| | Pancytopenia | 2 | 3.8% | of all specific diagnoses |
| | | | | |
| | PLT disorders | 4 | 7.7% | of all specific diagnoses |
| | ITP | 1 | 25.0% | of malignancies |
| | May-Hegglin | 1 | 25.0% | '' |
| | TP NOS | 2 | 50.0% | '' |
| | | | | |
| **7** | **Specific morphology** | N | % of category | |
| | | 34 | - | |
| | RBC Morphology | 18 | 48.6% | of all specific morphology |
| | Agglutination | 1 | 2.7% | of all RBC morphology |
| | Bite cell | 1 | 2.7% | '' |
| | Dimorphism | 2 | 5.4% | '' |
| | Hypochromia | 2 | 5.4% | '' |
| | Macrocytosis | 3 | 8.1% | '' |
| | Microcytosis | 1 | 2.7% | '' |
| | Schistocyte | 4 | 10.8% | '' |
| | Spherocyte | 4 | 10.8% | '' |
| | | | | |
| | WBC Morphology | 13 | 35.1% | of all specific morphology |
| | Atypical lymphocyte | 2 | 5.4% | of all WBC morphology |
| | Auer Rod | 1 | 2.7% | '' |

| | | | |
|---|---|---|---|
| Blast | 3 | 8.1% | '' |
| Cup Cell | 1 | 2.7% | '' |
| Promyelocyte | 2 | 5.4% | '' |
| Dysplasia | 1 | 2.7% | '' |
| Pelger-Huet | 3 | 8.1% | '' |
| Maturation (WBC) | 2 | 5.4% | '' |
| Dohle bodies | 1 | 2.7% | '' |
| PLT Morphology | 3 | 8.1% | of all specific morphology |
| Clumping (PLT) | 2 | 66.7% | of all PLT morphology |
| Large (Giant) PLT | 1 | 33.3% | '' |

## S5. Participant rating – level of training at skill acquisition

| TITLE | 1 | 2 | 3 | 4 | 5 | Mean | STD | High | Low | Spread |
|---|---|---|---|---|---|---|---|---|---|---|
| Atypical lymphocyte (reactive) | 2 | 1 | 5 | 0 | 0 | 2.38 | 0.86 | 3 | 1 | 2 |
| Band | 8 | 0 | 0 | 0 | 0 | 1.00 | 0.00 | 1 | 1 | 0 |
| Basophil | 7 | 0 | 1 | 0 | 0 | 1.25 | 0.66 | 3 | 1 | 2 |
| Blast (undiferentiated) | 6 | 0 | 2 | 0 | 0 | 1.50 | 0.87 | 3 | 1 | 2 |
| Dysplastic neutrophil | 1 | 1 | 5 | 0 | 1 | 2.88 | 1.05 | 5 | 1 | 4 |
| Eosinophil | 7 | 1 | 0 | 0 | 0 | 1.13 | 0.33 | 2 | 1 | 1 |
| Hairy Cell | 1 | 0 | 7 | 0 | 0 | 2.75 | 0.66 | 3 | 1 | 2 |
| Hypersegmented neutrophil | 5 | 1 | 2 | 0 | 0 | 1.63 | 0.86 | 3 | 1 | 2 |
| Hypogranular neutrophil | 1 | 1 | 5 | 1 | 0 | 2.75 | 0.83 | 4 | 1 | 3 |
| LGL | 1 | 0 | 6 | 0 | 1 | 3.00 | 1.00 | 5 | 1 | 4 |
| Lymphocyte (mature) | 8 | 0 | 0 | 0 | 0 | 1.00 | 0.00 | 1 | 1 | 0 |
| Metamyelocyte | 3 | 0 | 3 | 0 | 2 | 2.75 | 1.56 | 5 | 1 | 4 |
| Monocyte vs. monoblast | 0 | 0 | 5 | 0 | 3 | 3.75 | 0.97 | 5 | 3 | 2 |
| Myeloblast with Auer Rod | 5 | 1 | 2 | 0 | 0 | 1.63 | 0.86 | 3 | 1 | 2 |
| Myelocyte | 3 | 0 | 3 | 0 | 2 | 2.75 | 1.56 | 5 | 1 | 4 |
| Neutrophil | 8 | 0 | 0 | 0 | 0 | 1.00 | 0.00 | 1 | 1 | 0 |
| Neutrophil with toxic granulation | 2 | 4 | 2 | 0 | 0 | 2.00 | 0.71 | 3 | 1 | 2 |
| Plasma Cell | 5 | 0 | 2 | 0 | 1 | 2.00 | 1.41 | 5 | 1 | 4 |
| Promyelocyte | 4 | 0 | 3 | 0 | 1 | 2.25 | 1.39 | 5 | 1 | 4 |
| Sezary Cell | 1 | 0 | 5 | 0 | 2 | 3.25 | 1.20 | 5 | 1 | 4 |
| Dohle bodies | 1 | 3 | 4 | 0 | 0 | 2.38 | 0.70 | 3 | 1 | 2 |
| Morula (inclusion) | 1 | 2 | 3 | 0 | 2 | 3.00 | 1.32 | 5 | 1 | 4 |
| Acanthocyte | 3 | 2 | 3 | 0 | 0 | 2.00 | 0.87 | 3 | 1 | 2 |
| agglutination (RBC) | 6 | 0 | 2 | 0 | 0 | 1.50 | 0.87 | 3 | 1 | 2 |
| Basophilic stippling | 1 | 1 | 5 | 0 | 1 | 2.88 | 1.05 | 5 | 1 | 4 |
| Bite Cell | 5 | 1 | 2 | 0 | 0 | 1.63 | 0.86 | 3 | 1 | 2 |
| Blister Cell | 3 | 0 | 4 | 0 | 1 | 2.50 | 1.32 | 5 | 1 | 4 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Burr Cell | 4 | 2 | 2 | 0 | 0 | 1.75 | 0.83 | 3 | 1 | 2 |
| Heinz Body | 2 | 1 | 5 | 0 | 0 | 2.38 | 0.86 | 3 | 1 | 2 |
| Howell-Jolly Body | 3 | 2 | 3 | 0 | 0 | 2.00 | 0.87 | 3 | 1 | 2 |
| Hypochromia | 5 | 1 | 2 | 0 | 0 | 1.63 | 0.86 | 3 | 1 | 2 |
| Macrocytic | 6 | 1 | 1 | 0 | 0 | 1.38 | 0.70 | 3 | 1 | 2 |
| Microcyte | 6 | 1 | 1 | 0 | 0 | 1.38 | 0.70 | 3 | 1 | 2 |
| Nucleated RBC | 8 | 0 | 0 | 0 | 0 | 1.00 | 0.00 | 1 | 1 | 0 |
| Ovalocyte | 2 | 2 | 4 | 0 | 0 | 2.25 | 0.83 | 3 | 1 | 2 |
| ***** Pappenheimer Bodies** | **1** | **0** | **4** | **1** | **2** | **3.38** | **1.22** | **5** | **1** | **4** |
| Polychromatophil | 4 | 1 | 2 | 1 | 0 | 2.00 | 1.12 | 4 | 1 | 3 |
| Ring form - malaria | 2 | 5 | 1 | 0 | 0 | 1.88 | 0.60 | 3 | 1 | 2 |
| Schistocyte | 7 | 1 | 0 | 0 | 0 | 1.13 | 0.33 | 2 | 1 | 1 |
| Sickle Cell | 8 | 0 | 0 | 0 | 0 | 1.00 | 0.00 | 1 | 1 | 0 |
| Spherocyte | 7 | 0 | 1 | 0 | 0 | 1.25 | 0.66 | 3 | 1 | 2 |
| Stomatocyte | 2 | 1 | 4 | 0 | 1 | 2.63 | 1.22 | 5 | 1 | 4 |
| Target cell | 6 | 1 | 1 | 0 | 0 | 1.38 | 0.70 | 3 | 1 | 2 |
| Teardrop | 5 | 1 | 2 | 0 | 0 | 1.63 | 0.86 | 3 | 1 | 2 |
| tetrad - babesia | 1 | 4 | 2 | 0 | 1 | 2.50 | 1.12 | 5 | 1 | 4 |
| Platelet (Giant) | 2 | 0 | 6 | 0 | 0 | 2.50 | 0.87 | 3 | 1 | 2 |
| ***** Platelet (Hyogranular)** | **0** | **0** | **4** | **2** | **2** | **3.75** | **0.83** | **5** | **3** | **2** |
| Platelet (normal) | 8 | 0 | 0 | 0 | 0 | 1.00 | 0.00 | 1 | 1 | 0 |
| Platelet clumping (satellitism) | 6 | 1 | 0 | 0 | 1 | 1.63 | 1.32 | 5 | 1 | 4 |
| Thrombocytopenia | 5 | 1 | 2 | 0 | 0 | 1.63 | 0.86 | 3 | 1 | 2 |
| Acute Leukemia | 5 | 1 | 2 | 0 | 0 | 1.63 | 0.86 | 3 | 1 | 2 |
| ***** Acute Leukemia - AML vs ALL** | **1** | **0** | **4** | **0** | **3** | **3.50** | **1.32** | **5** | **1** | **4** |
| Acute promyelocytic anemia | 3 | 0 | 5 | 0 | 0 | 2.25 | 0.97 | 3 | 1 | 2 |
| Anaplasmosis / Ehrlichiosis | 0 | 3 | 3 | 1 | 1 | 3.00 | 1.00 | 5 | 2 | 3 |
| Anemia - AIHA | 3 | 2 | 3 | 0 | 0 | 2.00 | 0.87 | 3 | 1 | 2 |
| Anemia - iron deficiency | 6 | 1 | 1 | 0 | 0 | 1.38 | 0.70 | 3 | 1 | 2 |
| Anemia - megaloblastic | 6 | 1 | 1 | 0 | 0 | 1.38 | 0.70 | 3 | 1 | 2 |
| Atypical Lymphocytosis | 2 | 1 | 5 | 0 | 0 | 2.38 | 0.86 | 3 | 1 | 2 |
| Babesiosis | 1 | 3 | 3 | 0 | 1 | 2.63 | 1.11 | 5 | 1 | 4 |
| CLL | 4 | 0 | 4 | 0 | 0 | 2.00 | 1.00 | 3 | 1 | 2 |
| CML | 3 | 0 | 5 | 0 | 0 | 2.25 | 0.97 | 3 | 1 | 2 |
| Dimorphic RBC population (prior transfusion) | 0 | 2 | 5 | 0 | 1 | 3.00 | 0.87 | 5 | 2 | 3 |
| Hairy Cell Leukemia | 1 | 0 | 6 | 1 | 0 | 2.88 | 0.78 | 4 | 1 | 3 |
| ITP | 3 | 0 | 5 | 0 | 0 | 2.25 | 0.97 | 3 | 1 | 2 |
| Malaria | 1 | 6 | 1 | 0 | 0 | 2.00 | 0.50 | 3 | 1 | 2 |
| ***** Mantle Cell Lymphoma (Leukemic Phase)** | **1** | **0** | **5** | **1** | **1** | **3.13** | **1.05** | **5** | **1** | **4** |
| ***** May-Hegglin** | **0** | **0** | **6** | **1** | **1** | **3.38** | **0.70** | **5** | **3** | **2** |
| ***** MDS** | **1** | **0** | **5** | **1** | **1** | **3.13** | **1.05** | **5** | **1** | **4** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Myelophthisic Anemia | 2 | 0 | 6 | 0 | 0 | 2.50 | 0.87 | 3 | 1 | 2 |
| ***** Normal Monocytes (vs Monocytic AML)** | **0** | **0** | **5** | **0** | **3** | **3.75** | **0.97** | **5** | **3** | **2** |
| Platelet Clumping | 6 | 1 | 1 | 0 | 0 | 1.38 | 0.70 | 3 | 1 | 2 |
| Reactive leukocytosis | 2 | 3 | 3 | 0 | 0 | 2.13 | 0.78 | 3 | 1 | 2 |
| Sickle Cell | 7 | 1 | 0 | 0 | 0 | 1.13 | 0.33 | 2 | 1 | 1 |
| ***** T Cell Leukemia** | **1** | **0** | **3** | **1** | **3** | **3.63** | **1.32** | **5** | **1** | **4** |
| Thalassemia | 5 | 1 | 2 | 0 | 0 | 1.63 | 0.86 | 3 | 1 | 2 |
| TMA / MAHA | 6 | 0 | 2 | 0 | 0 | 1.50 | 0.87 | 3 | 1 | 2 |

*** Denotes attending level skill