Cracking the Code

CBC Interpretation in Children and Adolescents

A Case-Based and Evidence-Based Teaching Approach

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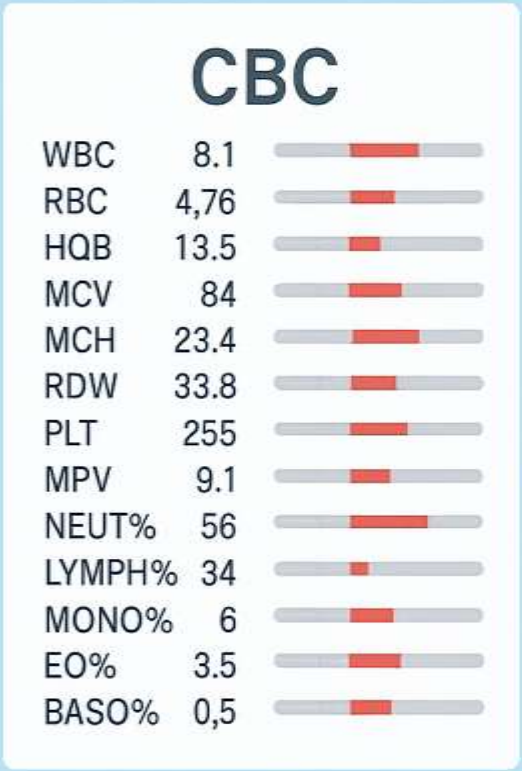

COMPLETE BLOOD CUNT (CBC) INTERPRETATION IN CHILDREN AND ADOLESCENTS

Understanding Pediatric Hematology through Cases

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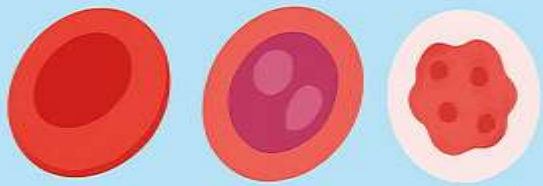
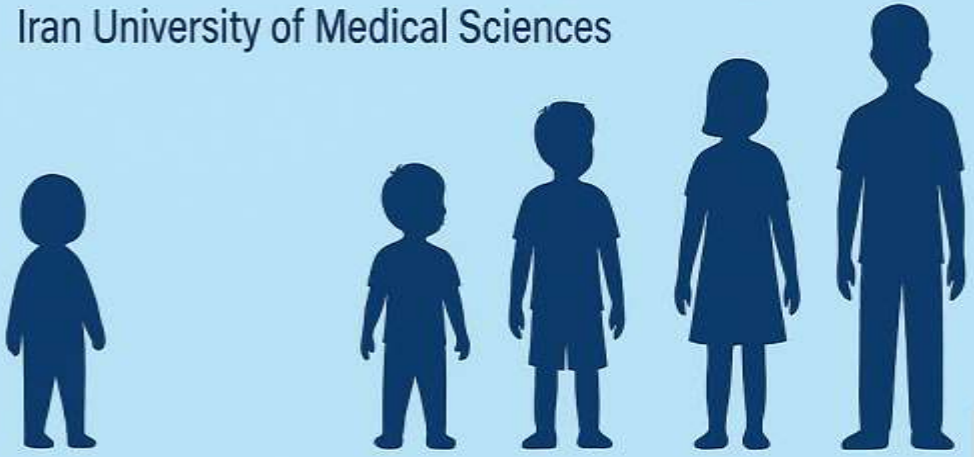




June 2025 | Pediatric Hematology Seminar Series

Interactive & Case-Based

Objectives

- Interpret pediatric CBCs across age groups
- Recognize patterns of anemia, leukocyte abnormalities, and thrombocytopenia
- Apply systematic reasoning through clinical cases

PRACTICE GAPS

- Interpretation of the complete blood count (CBC) is not a simple task.
- Laboratory reports include a variety of useful values that may be overlooked.
- It is important for all practitioners to develop an adequate foundation in CBC interpretation early in their career.
- Possessing a thorough understanding of the results reported in the CBC allows the practitioner to focus subsequent evaluation and reduce unnecessary laboratory testing.

Introduction

CBC…

- is one of the most common laboratory tests in medicine.

Typically, it includes the following:

- *White blood cell count (WBC or leukocyte count)*
- *WBC differential count*
- *Red blood cell count (RBC or erythrocyte count)*
- *Hematocrit (Hct)*
- *Hemoglobin (Hb)*
- *Mean corpuscular volume (MCV)*
- *Mean corpuscular hemoglobin (MCH)*
- *Mean corpuscular hemoglobin concentration (MCHC)*
- *Red cell distribution width (RDW)*
- *Platelet count*
- *Mean Platelet Volume (MPV)*

The Code
Why Pediatric CBCs Are Unique

- ***Age-Specific Reference Ranges***
- ***Physiological Processes***
  - Anemia of prematurity
  - Physiologic anemia of infancy
  - Benign neutropenia of childhood (especially certain ethnicities)
  - Stress leukocytosis
- ***Common Benign Variations***
  - Benign ethnic neutropenia
  - Transient reactive changes (lymphocytosis,thrombocytosis)

Cracking the Code
The Systematic Approach

- ***Step 1:***
  - Verify & Contextualize: Is the sample valid (clots, hemolysis)?
  - MOST CRITICAL: What is the patient's age? What is the clinical context (reason for test, symptoms, signs, history, medications, family history, ethnicity)?
- ***Step 2:***
  - Scan for Critical Values: Blasts? Severe pancytopenia? Severe anemia/thrombocytopenia? Extreme leukocytosis? (Flag these immediately).

Step 3

- ***Analyze Line-by-Line with Age in Mind:***
  - **RBC Line:**Anemia (Hb/Hct)? Is it microcytic (MCV low), normocytic, macrocytic (MCV high)? RDW? Reticulocyte count? (Think Iron Deficiency, Thalassemia, Hemolysis, Chronic Disease, B12/Folate).
  - **WBC Line:**Total WBC high/low? Differential is KEY: Neutrophils (ANC), Lymphocytes (ALC), Monocytes, Eosinophils, Basophils, Bands? Any atypical/abnormal cells? (Think Infection [bacterial, viral, parasitic], Inflammation, Allergy, Stress, Leukemia/Lymphoma, Benign Ethnic Variation).
  - **Platelet Line:**Thrombocytosis? Thrombocytopenia? (Think Reactive, ITP, Infection, Malignancy, Bone Marrow Failure, Artifact).

Step 4

- ***Synthesize:***
  - Does the picture fit the clinical context? Is it a single-line issue or multi-line? Is it likely reactive/benign or concerning for a primary hematologic disorder?

Step 5

- ***Next Steps:***
  - Repeat test? Further investigations (peripheral smear, iron studies, B12/folate, LDH, haptoglobin, Coombs, flow cytometry, bone marrow)? Referral? Observation?

PART 1

AGE-SPECIFIC CBC REFERENCE RANGES EVIDENCE-BASED REVIEW

WBC Count by Age

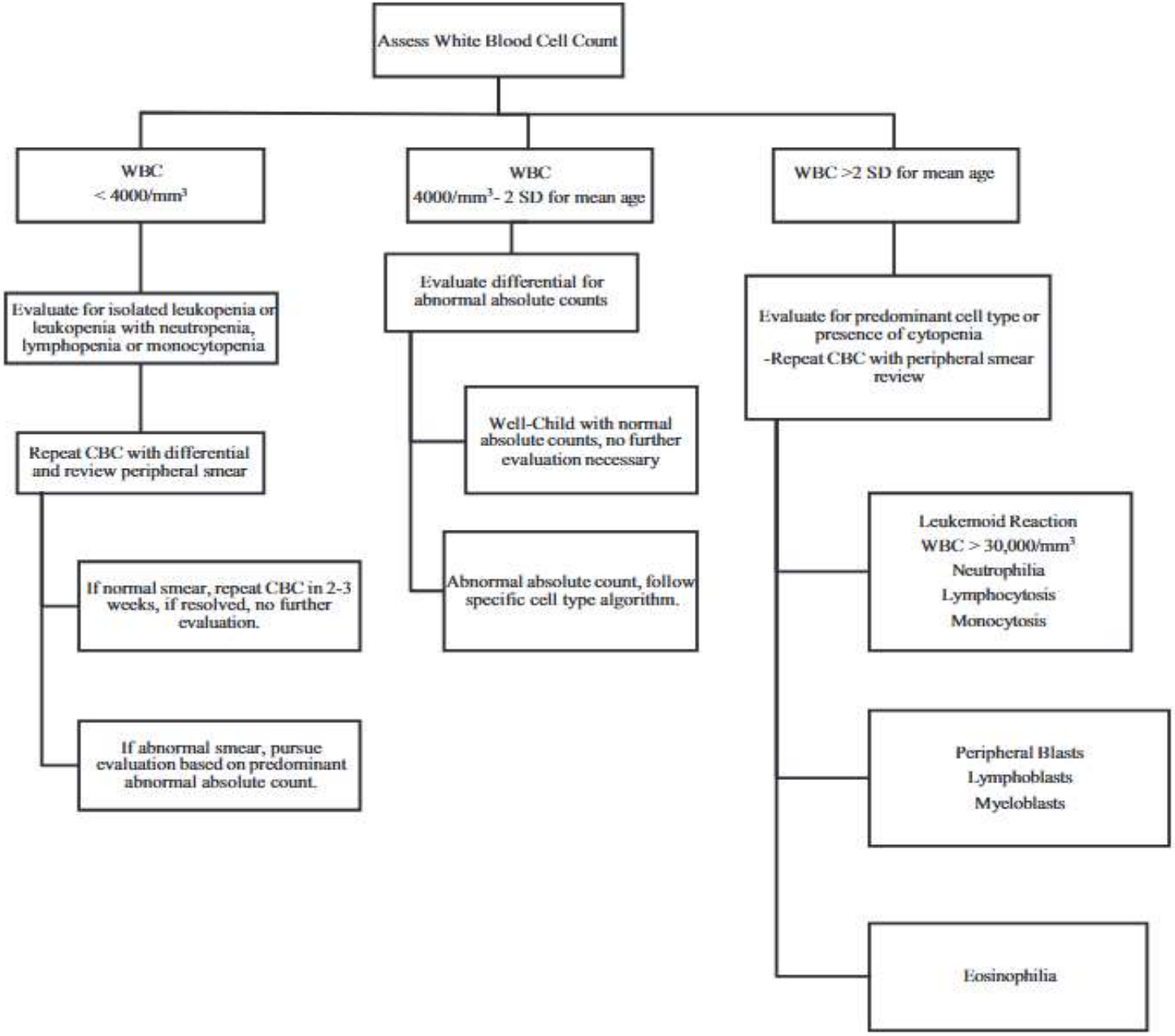
- Neonates: 9–30 x10^9/L (transient leukocytosis at birth)
- Infants (1–12 months): 6–17 x10^9/L
- Children (1–10 years): 5–14.5 x10^9/L
- Adolescents: 4.5–13.5 x10^9/L
- Note: Differential varies—neutrophil predominance after infancy

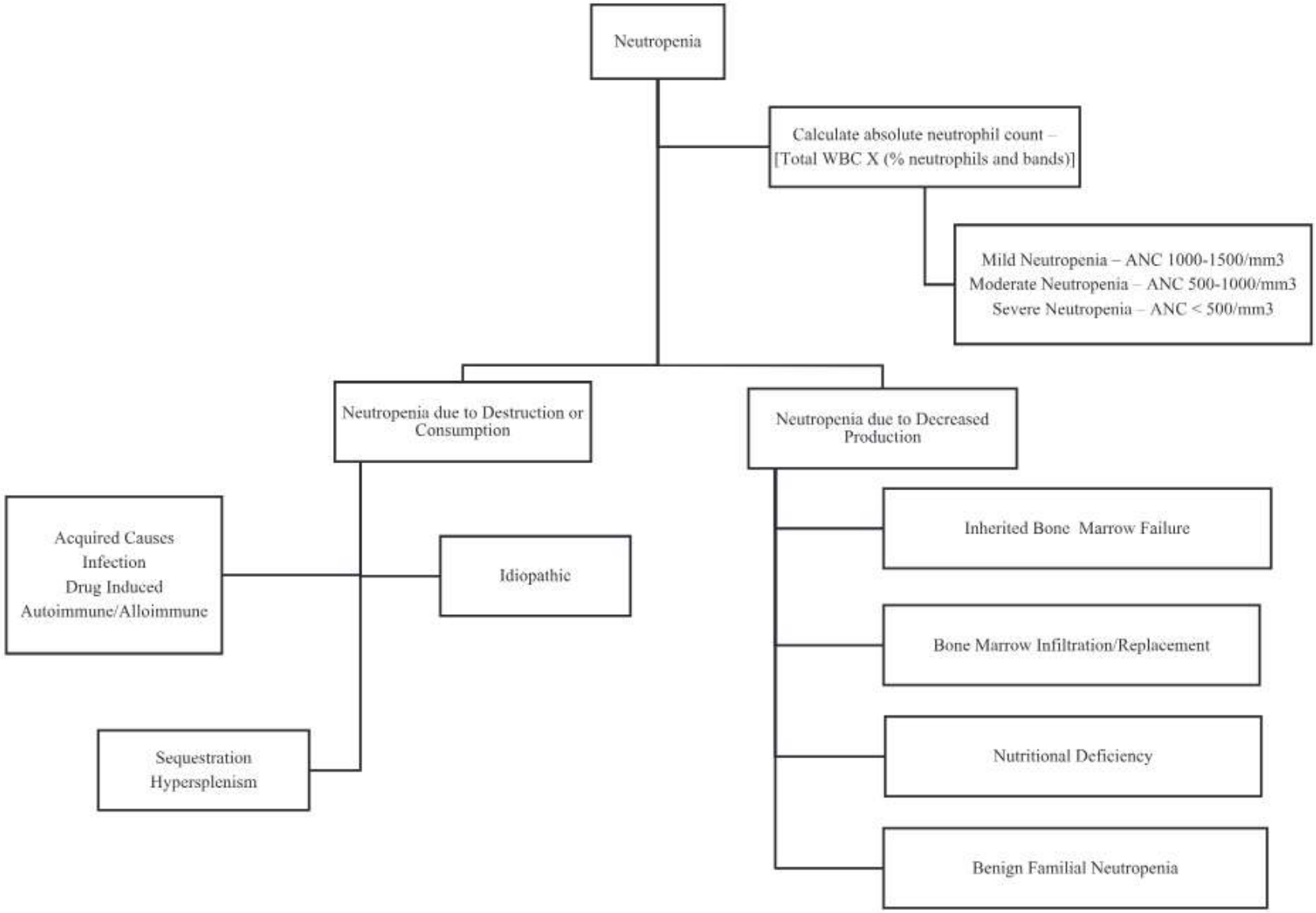
Table 3. WBC Parameters in the Pediatric Population

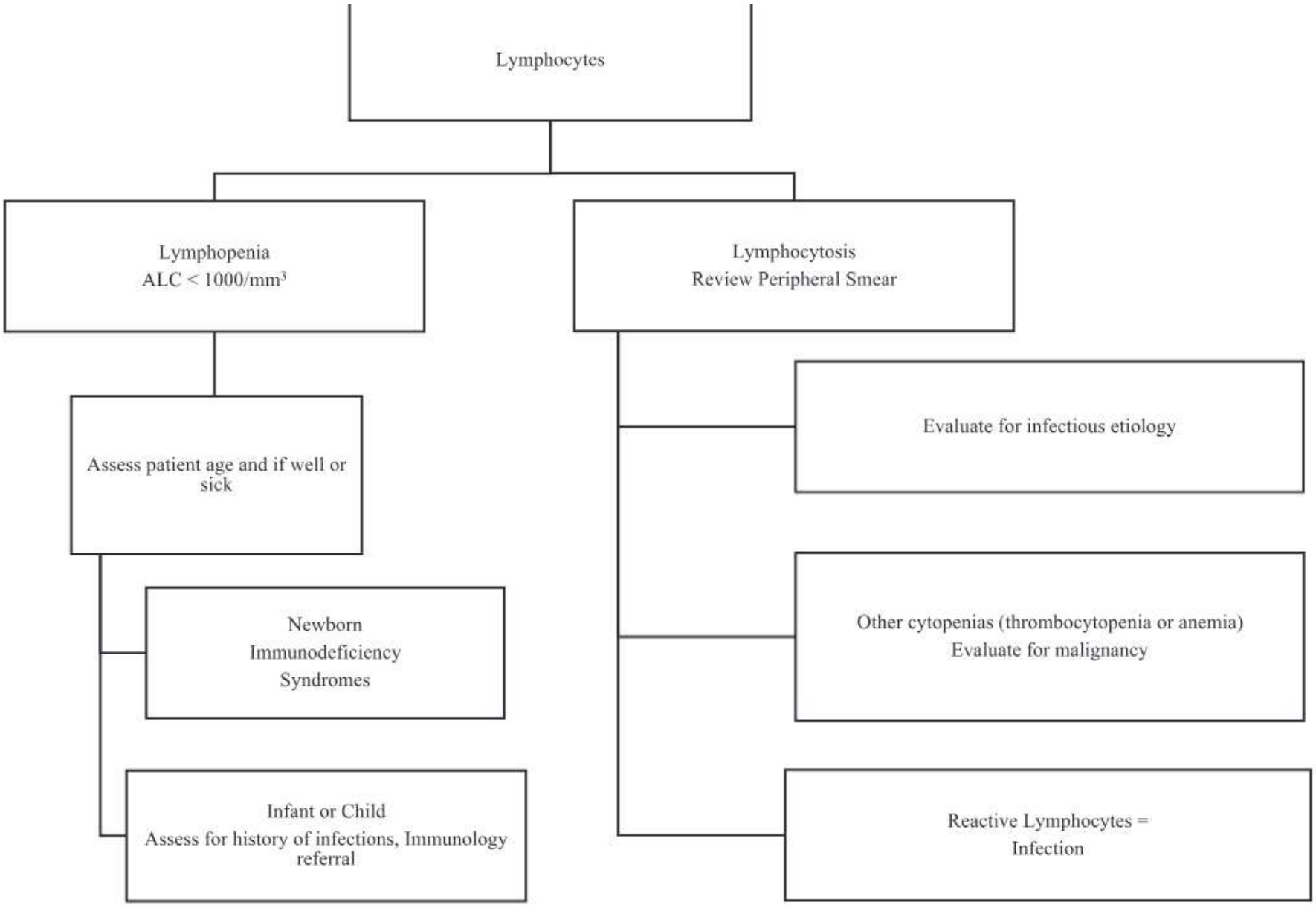
	WBC Count, $10^3/\mu L$		Neutrophil Count, $10^3/\mu L$			Lymphocyte Count, $10^3/\mu L$			Eosinophil Count, $10^3/\mu L$		Monocyte Count, $10^3/\mu L$	
Age	Mean	Range	Mean	Range	%	Mean	Range	%	Mean	%	Mean	%
Birth	18.1	9.0–30.0	11.0	6.0–26.0	61	5.5	2.0–11.0	31	0.4	2	1.1	6
12 h	22.8	13.0–38.0	15.5	6.0–28.0	68	5.5	2.0–11.0	24	0.5	2	1.2	5
24 h	18.9	9.4–34.0	11.5	5.0–21.0	61	5.8	2.0–11.5	31	0.5	2	1.1	6
1 wk	12.2	5.0–21.0	5.5	1.5–10.0	45	5.0	2.0–17.0	41	0.5	4	1.1	9
2 wk	11.4	5.0–20.0	4.5	1.0–9.5	40	5.5	2.0–17.0	48	0.4	3	1.0	9
1 mo	10.8	5.0–19.5	3.8	1.0–9.0	35	6.0	2.5–16.5	59	0.3	3	0.7	7
6 mo	11.9	6.0–17.5	3.8	1.0–8.5	32	7.3	4.0–13.5	61	0.3	3	0.6	5
1 y	11.4	6.0–17.5	3.5	1.5–8.5	31	7.0	4.0–10.5	61	0.3	3	0.6	5
2 y	10.6	6.0–17.0	3.5	1.5–8.5	33	6.3	3.0–9.5	29	0.3	3	0.5	5
4 y	9.1	5.5–15.5	3.8	1.5–8.5	42	4.5	2.0–8.0	50	0.3	3	0.5	5
6 y	8.5	5.0–14.5	4.3	1.5–8.0	51	3.5	1.5–7.0	42	0.2	3	0.4	5
8 y	8.3	4.5–13.5	4.4	1.5–8.0	53	3.3	1.5–6.8	39	0.2	3	0.4	4
10 y	8.1	4.5–13.5	4.4	1.8–8.0	54	3.1	1.5–6.5	38	0.2	2	0.4	4
16 y	7.8	4.5–13.0	4.4	1.8–8.0	57	2.8	1.2–5.2	35	0.2	3	0.4	5
21 y	7.4	4.5–11.0	4.4	1.8–7.7	59	2.5	1.0–4.8	34	0.2	3	0.3	4

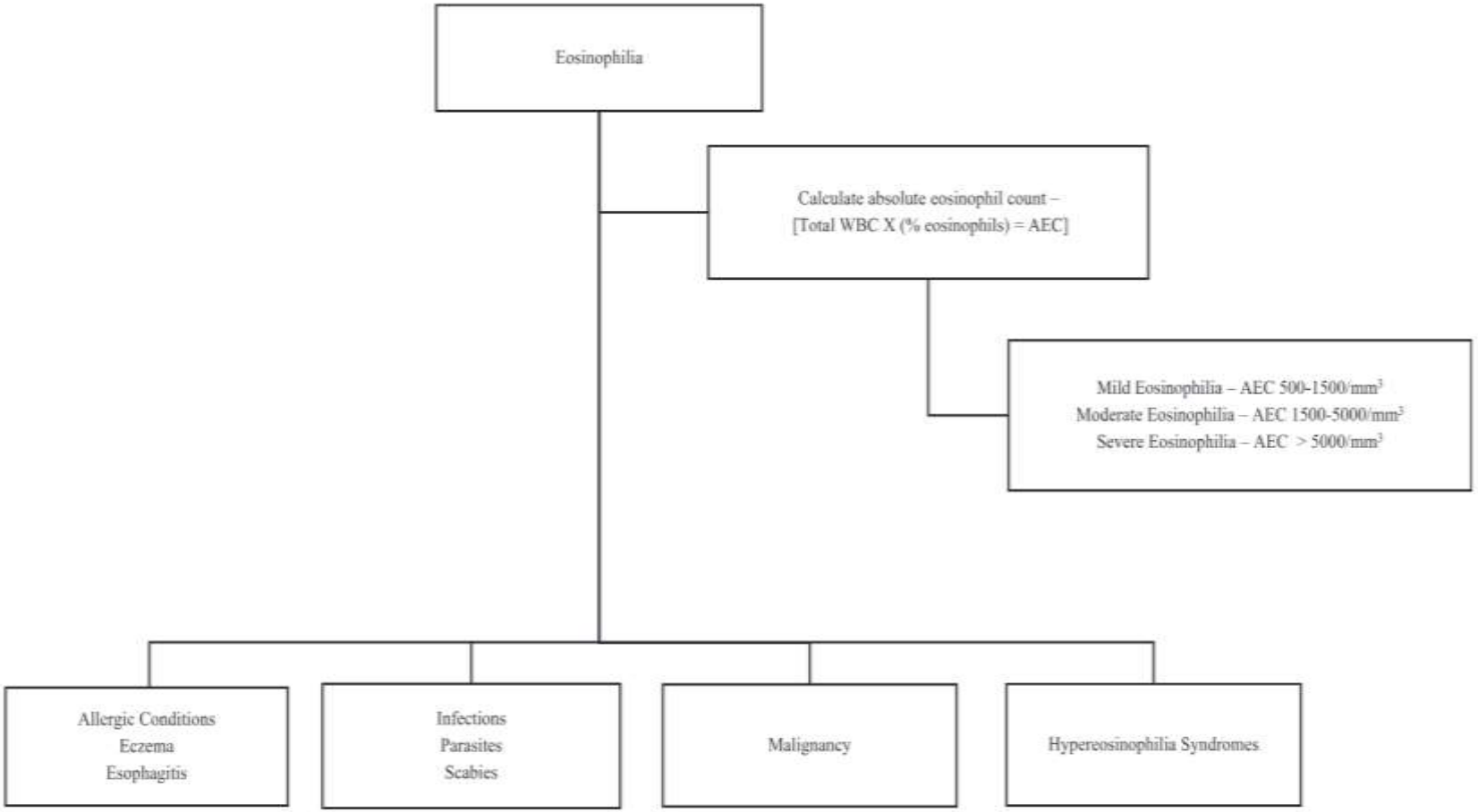
WBC=white blood cell.

[a]Recommended normal absolute neutrophil count for age in the past


Assess White Blood Cell Count
WBC
< 4000/mm3
WBC
4000/mm3 - 2 SD for mean age
WBC >2 SD for mean age
Evaluate for isolated leukopenia or leukopenia with neutropenia, lymphopenia or monocytopenia
Evaluate differential for abnormal absolute counts
Evaluate for predominant cell type or presence of cytopenia
-Repeat CBC with peripheral smear review
Repeat CBC with differential and review peripheral smear
Well-Child with normal absolute counts, no further evaluation necessary
Leukemoid Reaction
WBC > 30,000/mm3
Neutrophilia
Lymphocytosis
Monocytosis
If normal smear, repeat CBC in 2-3 weeks, if resolved, no further evaluation.
Abnormal absolute count, follow specific cell type algorithm.
Peripheral Blasts
Lymphoblasts
Myeloblasts
If abnormal smear, pursue evaluation based on predominant abnormal absolute count.
Eosinophilia


Neutropenia
Calculate absolute neutrophil count – [Total WBC X (% neutrophils and bands)]
Mild Neutropenia – ANC 1000-1500/mm3
Moderate Neutropenia – ANC 500-1000/mm3
Severe Neutropenia – ANC < 500/mm3
Neutropenia due to Destruction or Consumption
Neutropenia due to Decreased Production
Acquired Causes
Infection
Drug Induced
Autoimmune/Alloimmune
Idiopathic
Sequestration
Hypersplenism
Inherited Bone Marrow Failure
Bone Marrow Infiltration/Replacement
Nutritional Deficiency
Benign Familial Neutropenia


Lymphocytes
Lymphopenia
ALC < 1000/mm3
Lymphocytosis
Review Peripheral Smear
Assess patient age and if well or sick
Evaluate for infectious etiology
Newborn
Immunodeficiency
Syndromes
Other cytopenias (thrombocytopenia or anemia)
Evaluate for malignancy
Infant or Child
Assess for history of infections, Immunology referral
Reactive Lymphocytes =
Infection


Eosinophilia
Calculate absolute eosinophil count –
[Total WBC X (% eosinophils) = AEC]
Mild Eosinophilia – AEC 500-1500/mm3
Moderate Eosinophilia – AEC 1500-5000/mm3
Severe Eosinophilia – AEC > 5000/mm3
Allergic Conditions
Eczema
Esophagitis
Infections
Parasites
Scabies
Malignancy
Hypereosinophilia Syndromes

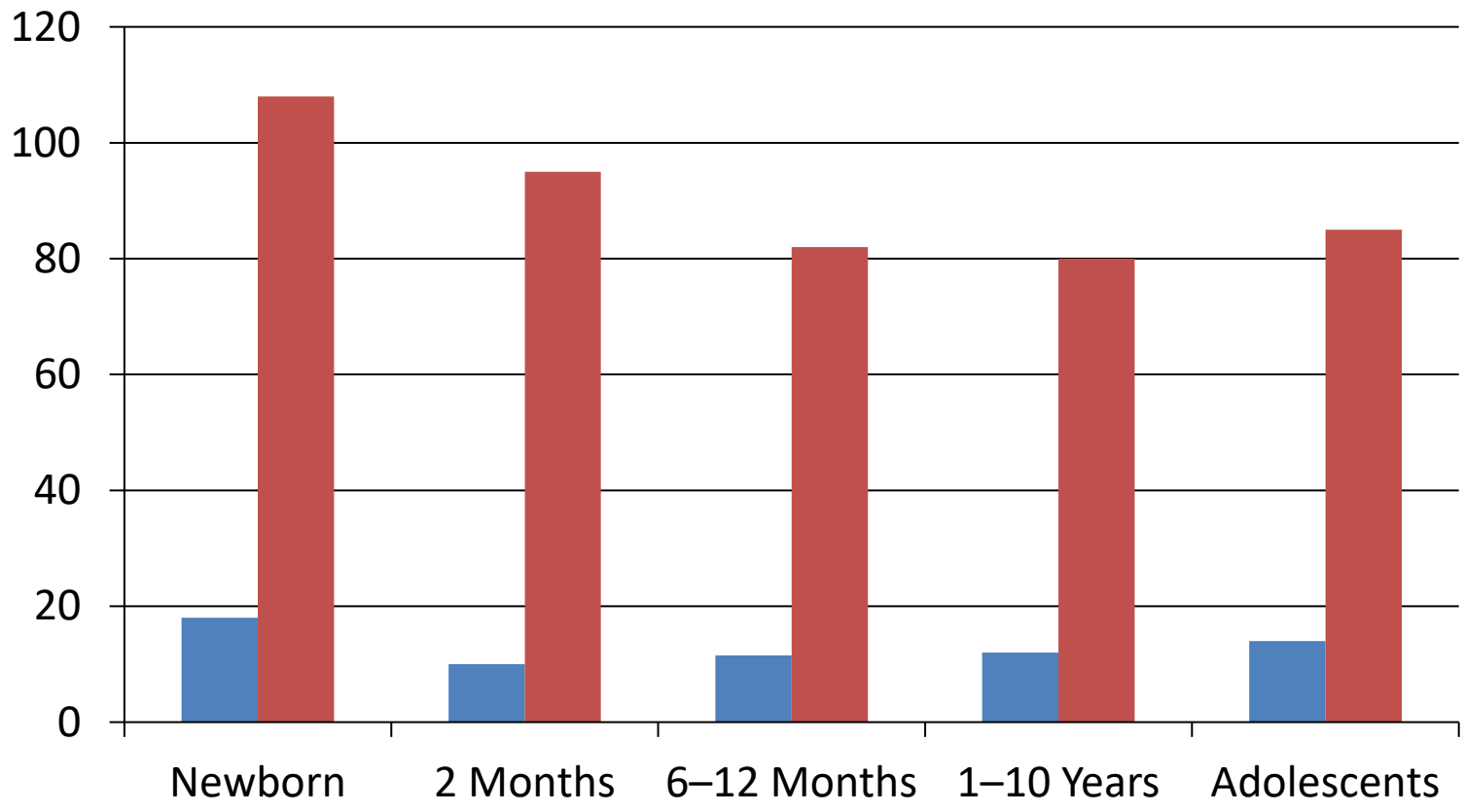
Hemoglobin & MCV by Age

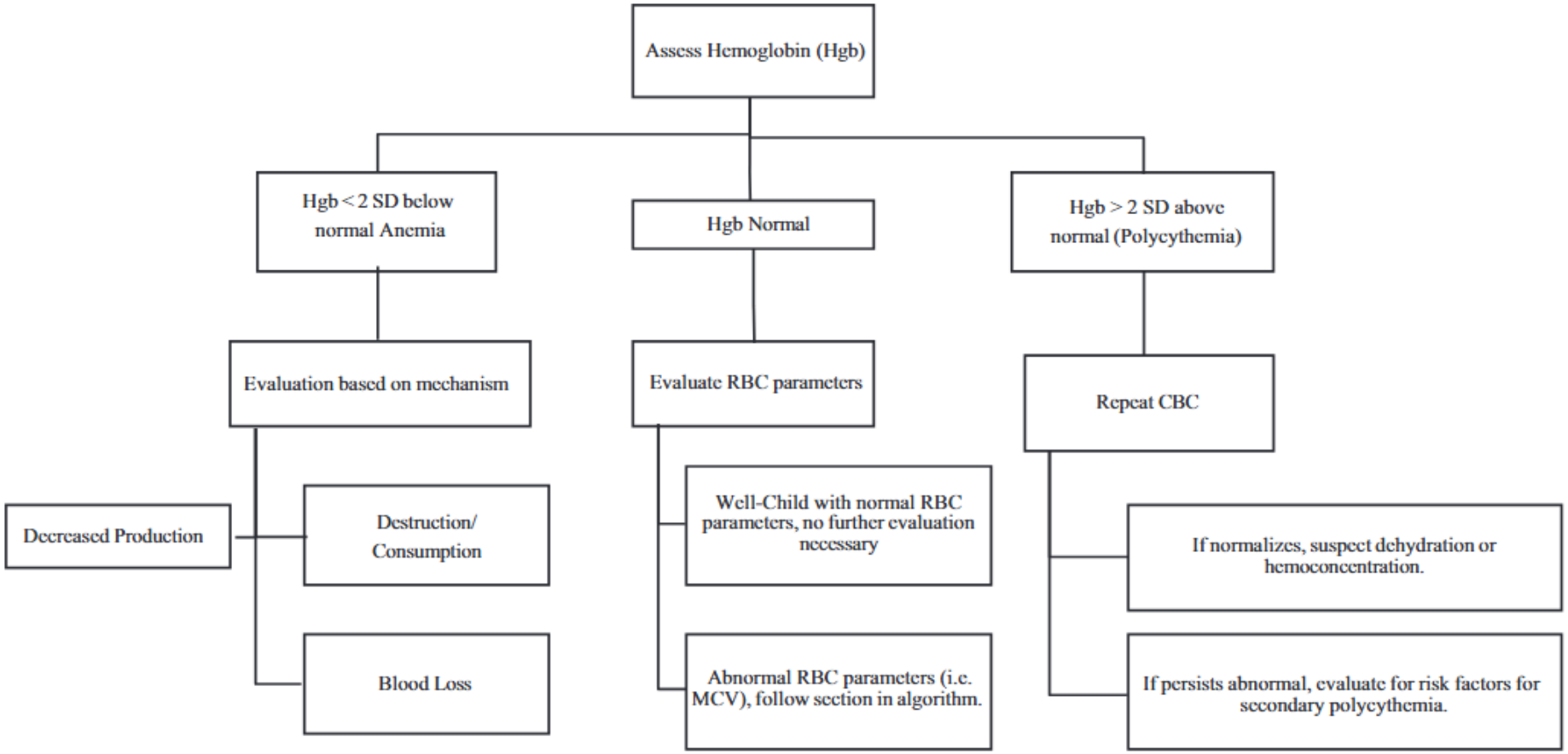
- Neonates: Hb 14–24 g/dL, MCV ~108 fL (physiologic polycythemia)
- 2 months: Hb 9–11 g/dL (physiologic nadir), MCV ~95 fL
- 6–12 months: Hb 10.5–13.5 g/dL, MCV 72–88 fL
- Adolescents: Hb 12–16 g/dL (f), 13–17 g/dL (m); MCV 80–96 fL

RBC indices

Age	Lowest Normal Hemoglobin (g/dL)	Normal RBC Size Mean Corpuscular Volume (fL)	Fetal Hemoglobin (%)	Hemoglobin A2 (%)
Birth	14.0	100–130	55–90	<1
6 months–1 year	11.0	70–85	<5	1.5–3.5
1–4 years	11.0	70–85	<2	1.5–3.5
4 years–puberty	11.5	75–90	<2	1.5–3.5
Postpubertal female	12.0	80–95	<2	1.5–3.5
Postpubertal male	14.0	80–95	<2	1.5–3.5

Normal Hemoglobin and MCV by Age




Assess Hemoglobin (Hgb)
Hgb < 2 SD below normal Anemia
Hgb Normal
Hgb > 2 SD above normal (Polycythemia)
Evaluation based on mechanism
Evaluate RBC parameters
Repeat CBC
Decreased Production
Destruction/ Consumption
Blood Loss
Well-Child with normal RBC parameters, no further evaluation necessary
Abnormal RBC parameters (i.e. MCV), follow section in algorithm.
If normalizes, suspect dehydration or hemoconcentration.
If persists abnormal, evaluate for risk factors for secondary polycythemia.

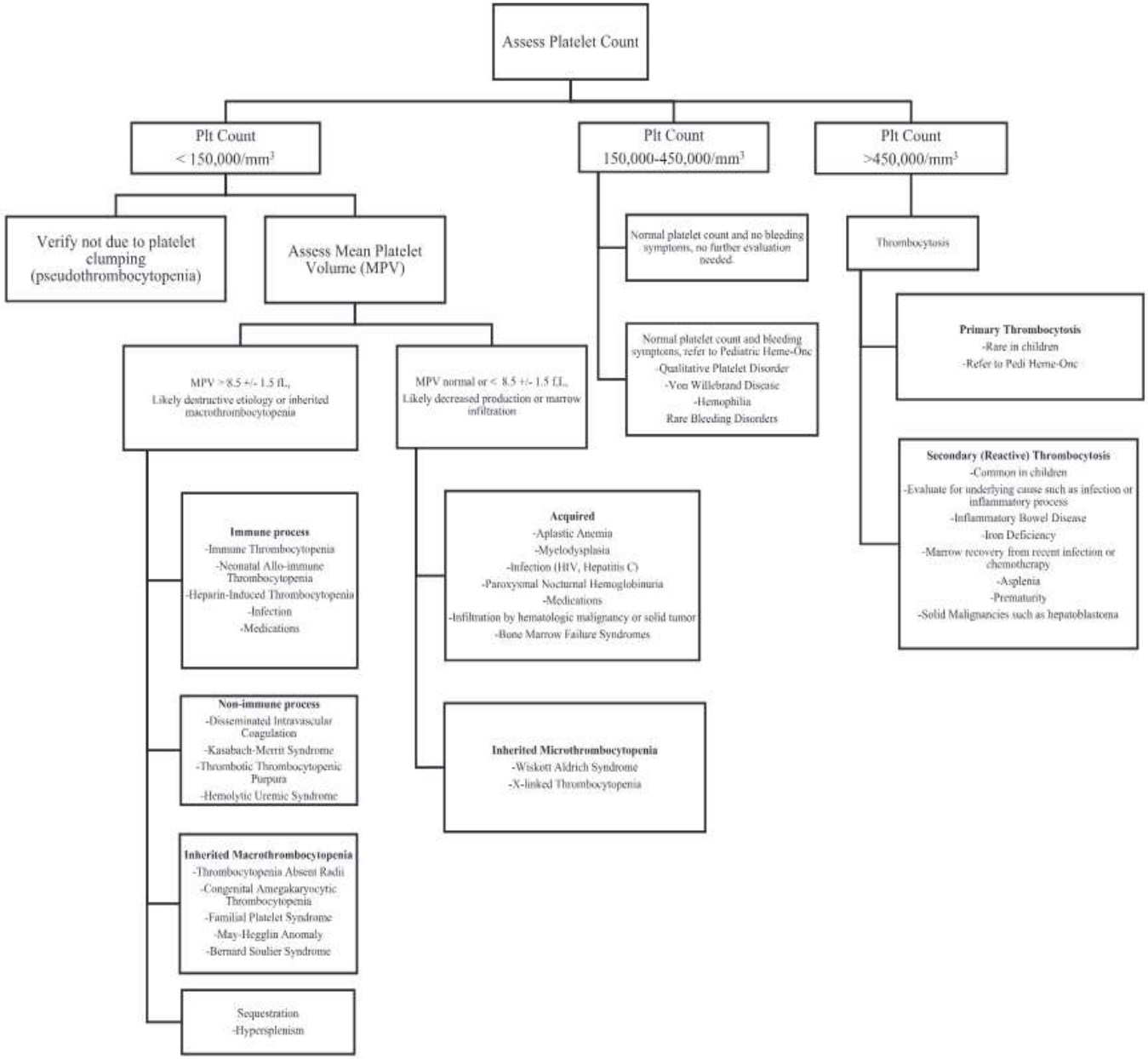
Age	Hemoglobin, g/dL		Hematocrit, %		MCV, fL		RDW, % 2 SD	RBC Count, $\times 10^6/\mu L$ Mean	MCH, pg Mean	MCHC, g/dL Mean	Reticulocytes, % Mean
	Mean	2 SD	Mean	2 SD	Mean	2 SD					
Overall											
1–3 d	18.5	14.5–22.5	56.0	45.0–67.0	108	95–121	13.0–18.0	5.3	34	33	3.0
1 wk	17.5	13.5–19.5	54.0	42.0–66.0	107	88–126	13.0–18.0	5.1	34	33	0.5
2 wk	16.5	12.5–20.5	51.0	39.0–63.0	105	86–124	13.0–18.0	4.9	34	33	0.5
1 mo	14.0	10.0–18.0	43.0	31.0–55.0	104	85–123	11.5–16.0	4.2	34	33	0.8
2 mo	11.5	9.0–14.0	35.0	28.0–42.0	96	77–115	11.5–16.0	3.8	30	33	1.6
3–6 mo	11.5	9.5–13.5	35.0	29.0–41.0	91	74–108	11.5–16.0	3.8	30	33	0.7
0.5–2 y	12.0	10.5–13.5	36.0	33.0–49.0	78	70–86	11.5–16.0	4.5	27	33	1.0
2–6 y	12.5	11.5–15.5	37.0	34.0–45.0	81	75–87	11.5–15.0	4.6	27	34	1.0
6–12 y	13.5	11.5–15.5	40.0	35.0–45.0	86	77–95	11.5–15.0	4.6	29	34	1.0
Female sex											
12–18 y	14.0	12.0–16.0	41.0	33.0–51.0	90	78–102	11.5–14.0	4.6	30	34	1.0
≥18 y	14.0	12.0–16.0	41.0	33.0–51.0	90	80–100	11.5–13.1	4.6	30	34	1.0
Male sex											
12–18 y	14.5	13.0–16.0	43.0	36.0–51.0	88	78–198	11.5–14.0	4.9	30	34	1.0
≥18 y	15.5	13.5–17.5	47.0	37.0–53.0	90	80–100	11.5–13.1	5.2	30	34	1.0

Reticulocyte Count & RDW

- Reticulocytes: Higher in neonates (up to 4–7%), normalizes to 0.5–2.5%
- RDW: Normal 11.5–14.5%, elevated in iron deficiency or recent recovery

Platelet Count by Age

- All ages: Platelets 150–450 x10^9/L
- Mild transient thrombocytosis common after infections or iron deficiency
- Neonates may show mild thrombocytopenia due to perinatal factors


Assess Platelet Count
Plt Count
< 150,000/mm3
Plt Count
150,000-450,000/mm3
Plt Count
>450,000/mm3
Verify not due to platelet clumping (pseudothrombocytopenia)
Assess Mean Platelet Volume (MPV)
Normal platelet count and no bleeding symptoms, no further evaluation needed.
Normal platelet count and bleeding symptoms, refer to Pediatric Heme-Onc
-Qualitative Platelet Disorder
-Von Willebrand Disease
-Hemophilia
Rare Bleeding Disorders
Thrombocytosis
Primary Thrombocytosis
-Rare in children
-Refer to Pedi Heme-Onc
Secondary (Reactive) Thrombocytosis
-Common in children
-Evaluate for underlying cause such as infection or inflammatory process
-Inflammatory Bowel Disease
-Iron Deficiency
-Marrow recovery from recent infection or chemotherapy
-Asplenia
-Prematurity
-Solid Malignancies such as hepatoblastoma
MPV > 8.5 +/- 1.5 fL,
Likely destructive etiology or inherited macrothrombocytopenia
MPV normal or < 8.5 +/- 1.5 fL,
Likely decreased production or marrow infiltration
Immune process
-Immune Thrombocytopenia
-Neonatal Allo-immune Thrombocytopenia
-Heparin-Induced Thrombocytopenia
-Infection
-Medications
Non-immune process
-Disseminated Intravascular Coagulation
-Kasabach-Merrit Syndrome
-Thrombotic Thrombocytopenic Purpura
-Hemolytic Uremic Syndrome
Inherited Macrothrombocytopenia
-Thrombocytopenia Absent Radii
-Congenital Amegakaryocytic Thrombocytopenia
-Familial Platelet Syndrome
-May-Hegglin Anomaly
-Bernard Soulier Syndrome
Sequestration
-Hypersplenism
Acquired
-Aplastic Anemia
-Myelodysplasia
-Infection (HIV, Hepatitis C)
-Paroxysmal Nocturnal Hemoglobinuria
-Medications
-Infiltration by hematologic malignancy or solid tumor
-Bone Marrow Failure Syndromes
Inherited Microthrombocytopenia
-Wiskott Aldrich Syndrome
-X-linked Thrombocytopenia

PART 2
CLINICAL CASES
INTERACTIVE TEACHING WITH DISCUSSION

Case 1 – Toddler with Pallor

- 2-year-old with pallor,poor appetite, irritable mood
- RED FLAGS

Lab Data

- CBC
- Hb 8.2, MCV 62 fL, high RDW
- WBC/PLT :Normal
- Retic: Low

Interactive poll

- Iron Deficiency Anemia
- Thalassemia trait
- Lead poisoning
- Sideroblastic anemia

Diagnosis

- Iron deficiency anemia

Cause	*Key Features*
Iron deficiency anemia	*Low MCV, increase RDW , low ferritin , poor diet ,pica , pallor*
Thalassemia trait	*Low MCV , normal RDW or increase RBC , family history*
Lead poisoning	*Microcytic , basophilic stippling , environmental exposure*
Sideroblastic Anemia	*Rare in children , dimorphic RBCs , ringed sideroblasts on BM*

Useful Indices

- RDW: High in iron deficiency; normal in thalassemia trait
- Mentzer Index = MCV ÷ RBC count
  - 13 → likely iron deficiency
  - <13 → likely thalassemia trait
- This child likely has high RDW and high Mentzer Index → favors iron deficiency

When to Check Lead Levels?

- If child has risk factors (old home, pica, low SES, poor nutrition)
- Consider lead level if anemia persists after iron trial, or if neuro signs are present

Next Steps in Management

- Order serum ferritin and CRP
- Trial of oral iron for 4–6 weeks
- Dietary counseling (meat, fortified cereals, reduce cow’s milk)

Teaching Points

- Most common cause of anemia in this age group
- High RDW distinguishes from thalassemia trait
- Confirm with ferritin, treat with iron and dietary guidance

Case 2
Febrile 3-Month-Old with Neutropenia

👦 *Presentation*

- Age: 3-month-old infant
- Symptoms: 38.5°C fever, irritable but feeding okay
- CBC:
  - WBC: 2.3 $\times 10^9$/L (low)
  - ANC: 400/µL (severe neutropenia)
  - Hb/Platelets: Normal

- No clear source of infection

Interactive Poll Question

- What is the most appropriate next step?

A. Discharge with oral antibiotics and follow-up

B. Start IV ceftriaxone and observe at home

C. Admit for IV broad-spectrum antibiotics

D. Bone marrow aspiration and biopsy

✅ *Correct Answer*

- C. Admit for IV broad-spectrum antibiotics
- 🧠 ***Teaching Points:***
  - This infant has severe neutropenia (ANC = 400) → high risk for serious bacterial infection (SBI).

🚨 *Fever + Neutropenia in Infants*

- <3–6 months with fever and ANC <500 → treat like immunocompromised host
- High risk of bacteremia, especially Gram-negative rods, Staph aureus, and Pseudomonas
- Workup includes: blood cultures, urine culture, LP if indicated

Initial Management

- Admit
- Start IV broad-spectrum antibiotics
- Cefepime, ceftazidime, or piperacillin-tazobactam
- Monitor for signs of sepsis or marrow suppression

⚖️ *Differential Diagnosis for Isolated Neutropenia in Infants*

- Viral suppression
- Benign ethnic neutropenia
- Congenital neutropenia
- Auto immune neutropenia

🔍 *When to Investigate Further*

- Recurrent neutropenia
- Persistent ANC <500 for >3 weeks
- Recurrent bacterial infections
- Growth failure or other cytopenias → consider bone marrow exam

Teaching Points

- Emergency in infants: admit for IV antibiotics
- Consider viral suppression vs congenital neutropenia
- ANC <500 = high risk for sepsis

Case 3
The Tired Teen with Arthritis

Presentation

- Patient: 13-year-old girl with juvenile idiopathic arthritis (JIA)
- Complaints: Fatigue, pallor, poor concentration
- Exam: Pale conjunctivae, active arthritis in wrists

🔬 *CBC*

- Hb: 9.5 g/dL
- MCV: 78 fL
- WBC/Plt: Normal
- Retic: Low
- Ferritin: 150 ng/mL (normal-high)
- CRP/ESR: Elevated

❓ *Interactive Poll*

- What is the most likely cause of her anemia?
  - A. Iron deficiency anemia
  - B. Thalassemia trait
  - C. Anemia of chronic disease
  - D. Sideroblastic anemia

✅ *Correct Answer*

- C. Anemia of chronic disease

- 🧠 Teaching Points

🎯 *What is Anemia of Chronic Disease (ACD)?*

- Also called anemia of inflammation
- Common in chronic infections, autoimmune disease (e.g. JIA, SLE), IBD, CKD
- Mild to moderate normocytic or microcytic anemia
- Caused by hepcidin-induced iron sequestration and blunted erythropoietin response

Distinguishing ACD vs Iron Deficiency

Test	Iron Deficiency	ACD
Ferritin	Low	Normal or High
TIBC	High	Low
Serum Iron	Low	Low
RDW	High	Normal
CRP/ESR	Normal	High
Retic count	Low	Low

Ferritin is an acute-phase reactant: elevated in inflammation
In mixed ACD + iron deficiency, ferritin can be misleading

🔍 *key message*

- Always assess inflammation markers (ESR, CRP) in children with anemia and chronic disease
- Iron therapy is not effective unless combined with treatment of underlying inflammation
- Newer markers (e.g., soluble transferrin receptor, hepcidin) may help in complex cases

Clinical Pearls

- ACD is often underrecognized in pediatric patients with chronic disease
- In kids with chronic arthritis and borderline anemia → think ACD
- Do not give iron routinely unless iron deficiency is confirmed

Case 4 – Adolescent with Bruising

- Case: 10-year-old with fatigue, bruising, leg pain. CBC: WBC 32,000 with 70% blasts
- Diagnosis: Acute leukemia
- Teaching Points:
  - Blasts = red flag; confirm with flow cytometry
  - Thrombocytopenia + leukocytosis + anemia = marrow failure
  - Don’t start steroids before diagnosis confirmed

Case 5 – Reactive Thrombocytosis

- Case: 11-year-old recovering from viral illness, Platelets 720,000
- Diagnosis: Reactive thrombocytosis
- Teaching Points:
  - Common and benign after viral illness or inflammation
  - Differentiate from essential thrombocythemia with smear and history
  - No intervention required unless sustained >1 million

Case 6 – Macrocytic Anemia

- Case: 15-year-old vegan adolescent, Hb 9.2, MCV 108 fL, low retic
- Diagnosis: Vitamin B12 deficiency
- Teaching Points:
  - Always consider dietary history in adolescents
  - Macrocytosis + low retic + neurologic signs = B12
  - Rule out other causes (hypothyroidism, meds, marrow disease)

Summary

- The identification of abnormal complete blood count (CBC) requires clinicians to use an appropriate set of reference ranges, acknowledging that CBC will vary based on a child's age and sex. (Based on consensus)
- Consensus recommendation now advocates against using age- race-based CBC reference ranges.
- An evidence-based approach to interpreting the CBC is critical to avoid missing important diagnoses or pursuing unnecessary evaluation and referral.

Thank You!

- 🩺 Questions & Discussion
- 💬 How do you approach a child with anemia when CBC indices are borderline?
- 📊 What is your favorite 'first step' test after seeing a low hemoglobin in a child?
- 🔎 Have you encountered mixed anemia (e.g. ACD + IDA) in practice?
- Let's discuss your experiences and insights in interpreting pediatric CBCs!

MCQ 1

- ***A 9-month-old boy, who is new to your practice, is seen for a health supervision visit. This child is exclusively breast fed and has received no other nutritional supplementation since birth. A screening hemoglobin level is low (10 g/dL [100 g/L]). You order additional laboratory studies, including a complete blood cell count. Which of the following sets of values/results would be most consistent with this clinical presentation.***

  A. Mean corpuscular volume (MCV) 5 68 mm3 (68 fL); platelet count 5 450 × 103 /mL (450 × 109 /L); reticulocytes 5 0.5%; red blood cell distribution width (RDW) 5 16.5%.

  B. MCV 5 90 mm3 (90 fL); platelet count 5 300 × 103 /mL (300 × 109 /L);reticulocytes 5 1.1%; RDW 5 11%.

  C. MCV 5 68 mm3 (68 fL); platelet count 5 450 × 103 /mL (450 × 109 /L);reticulocytes 5 1.1%; RDW 5 11%.

  D. MCV 5 68 mm3 (68 fL; platelet count 5 300 × 103 /mL (300 × 109 /L);reticulocytes 5 0.5%; RDW 5 11%.

  E. MCV 5 90 mm3 (90 fL; platelet count 5 450 × 103 /mL (450 × 109 /L); reticulocytes 5 0.5%; RDW 5 16.5%.

MCQ2

- ***You are evaluating a 3-year-old child referred to your office by the local Woman, Infants, and Children (WIC) program for anemia. On obtaining additional history, you learn that this child was born prematurely and had "some kind of intestinal surgery," as indicated by an abdominal scar on physical examination. There are no unusual dietary preferences reported. Repeated laboratory studies show the following results: hemoglobin,10.0 g/dL (100 g/L); hematocrit, 30.0%; MCV, 105 mm3 (105 fL); and reticulocytes, 0.7%. A peripheral blood smear shows megaloblasts and hypersegmented neutrophils. Based on this history and the laboratory results, nutritional deficiency of which of the following is the most likely reason for this child's anemia?***

  A. Vitamin C.

  B. Iron.

  C. Vitamin B12.

  D. Vitamin D.

  E. Vitamin E

MCQ3

- ***A 15-year-old boy has become increasingly tired/fatigued during the past 3 to 4 weeks. He denies any changes in mood or drug/alcohol use. On physical examination he exhibits cervical adenopathy, mild jaundice, and some hepatosplenomegaly. Laboratory studies confirm the suspected diagnosis of Epstein-Barr virus infection, but the patient is also noted to be anemic. Which of the following best describes the expected characteristics to be seen in the anemia in this patient?***

  A. Microcytic with a decreased reticulocyte count.

  B. Microcytic with an increased reticulocyte count.

  C. Normocytic with a decreased reticulocyte count.

  D. Normocytic with an increased reticulocyte count.

  E. Macrocytic with an increased reticulocyte count.

MCQ4

- ***A 2-year-old child is being evaluated for recurrent fevers in association with mouth ulcers and gingivitis. The parents report that she is repeatedly ill with respiratory illnesses but is currently well. She is frequently sent home from the out-of-home child care she attends. She is not taking any long-term medications, she is growing well, and there is no contributory family history.Laboratory studies (complete blood cell count) report the following results:hemoglobin, 12 g/dL (120 g/L); hematocrit, 37%; normal red blood cell indices; platelet count, 370 × 103 /mL (370 × 109 /L); white blood cell count,4,100,000/mL (4,100 × 109 /L); absolute neutrophil count, 700/mL; lymphocyte count, 3,100/mL (3.10 × 109 /L); eosinophil count, 100/mL (0.10 × 109 /L);monocyte count, 200/mL (0.20 × 109 /L). To develop the most appropriate evaluation and treatment plan, these studies should be repeated in which of the following time frames?***

  A. 2–4 wk.

  B. 4–6 wk.

  C. 6–8 wk.

  D. 10–12 wk.

  E. 12–16 wk.

MCQ5

- ***You follow in your clinic a 7-year-old girl with cerebral palsy (Gross Motor Function Classification System II) and a poorly controlled seizure disorder treated with valproic acid. Falls associated with her seizures result in easy bruising and mucosal bleeding. Laboratory studies report the following results: hemoglobin, 13.2 g/dL (132 g/L); MCV, 90 mm3 (90 fL); mean corpuscular hemoglobin, 30 pg; reticulocytes, 1%; white blood cell count,8,500/mL (8.5 × 109 /L); neutrophils, 52%; lymphocytes, 40%; eosinophils, 3%;monocytes, 5%; platelet count, 330 × 103 /mL (330 × 109 /L). Which of the following is the most likely etiology for her easy bruising and mucosal bleeding?***

  A. Autoimmune reaction.

  B. Chronic infection.

  C. Drug reaction.

  D. Functional platelet disorder.

  E. Malignancy.