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COMMUNITY ONCOLOGY PROGRAM

UPCON
Uniting Primary Care and Oncology

Blood Disorders Day 2016

FOR Health Professionals

The ABCs of the CBC

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Disclosures

FINANCIAL DISCLOSURE RELEVANT TO THIS PRESENTATION:

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Speaker bureau/Honoraria: None

Consulting fees: None

Objective

To develop an efficient approach to interpret the information contained in the CBC in assessing hematological and systemic diseases

Elements of the Complete Blood Count

Healthy 71 year old male

WBC	7.1×10^{9}/L (4.5-11)		
Hb	155 g/L (130-180)	RBC	5.1×10^{12}/L (4.4-5.9)
Hct	.455 (.4 -.52)	MCV	90 fL (80-98)
MCH	30.6 pg (26-34)	MCHC	340 g/L (320-365)
RDW	12 (11.4-14.4)		
Plt	310×10^{9}/L (140-440)		
MPV	11 fL (10-14)		

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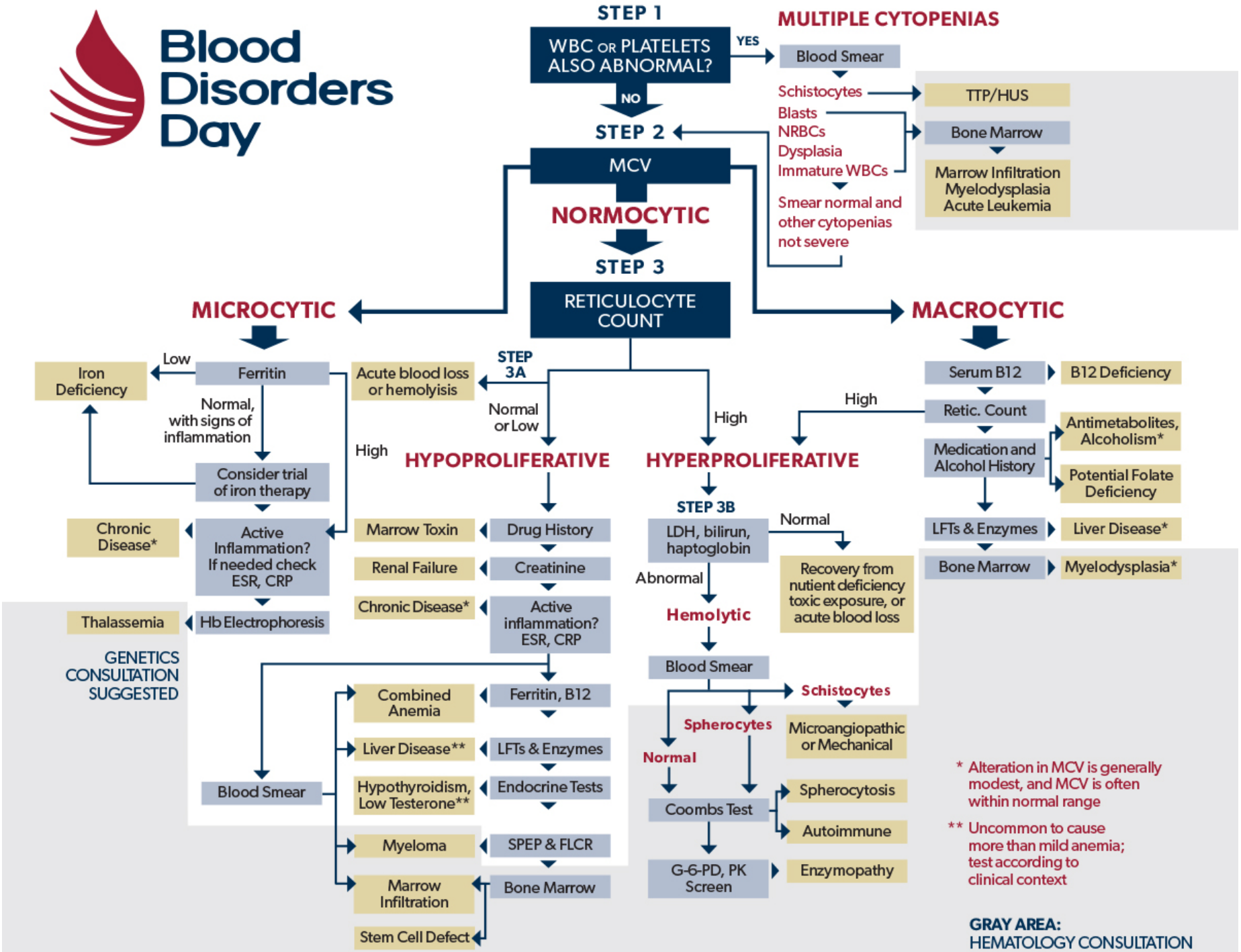
MCH	30.6 pg (26-34)	MCHC	340 g/L (320-365)
RDW	12 (11.4-14.4)		
Plts	310×10^9/L (140-440)		
Neut	57.7%	4.1×10^9/L	
Lymh	33.8%	2.4×10^9/L	
Mono	5.6%	0.4×10^9/L	
Eos	1.4%	0.1×10^9/L	
Baso	1.4%	0.1×10^9/L	

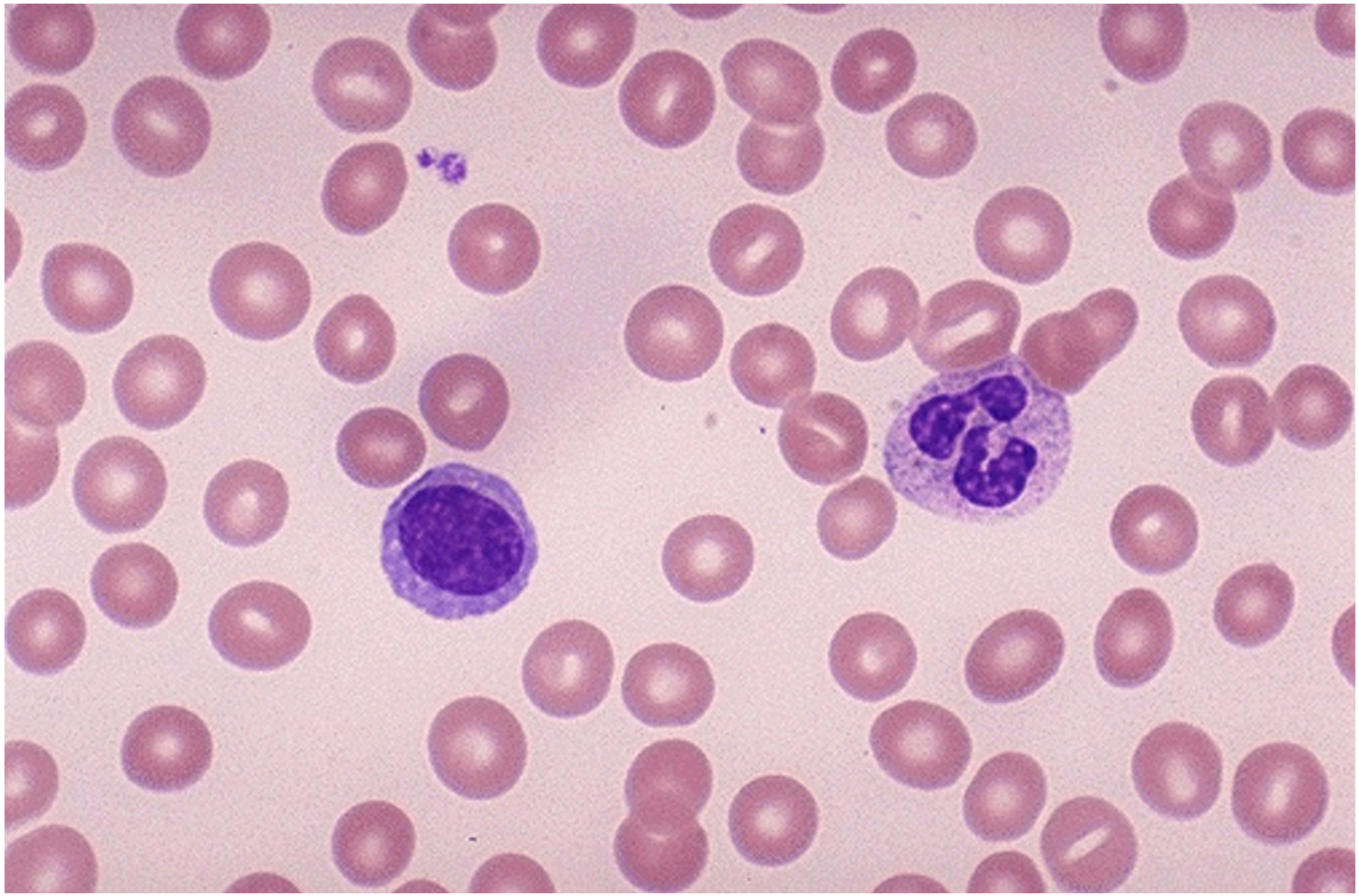
Forgive the rant…

- Manitoba Health regulations prohibit the ordering of laboratory tests in panels
  - e.g. liver enzymes must be ordered separately:
  - AST, ALT, alk phos, GGT
- EVEN THOUGH all the CBC results are generated by the instrument automatically, MB Health does not permit private labs to report anything you didn't order
- SO UNTIL WE CAN FIX THIS, please order Hb, WBC, platelets, red cell indices (ie. MCV), and auto diff every time. IT COSTS NO EXTRA

Blood Disorders Day



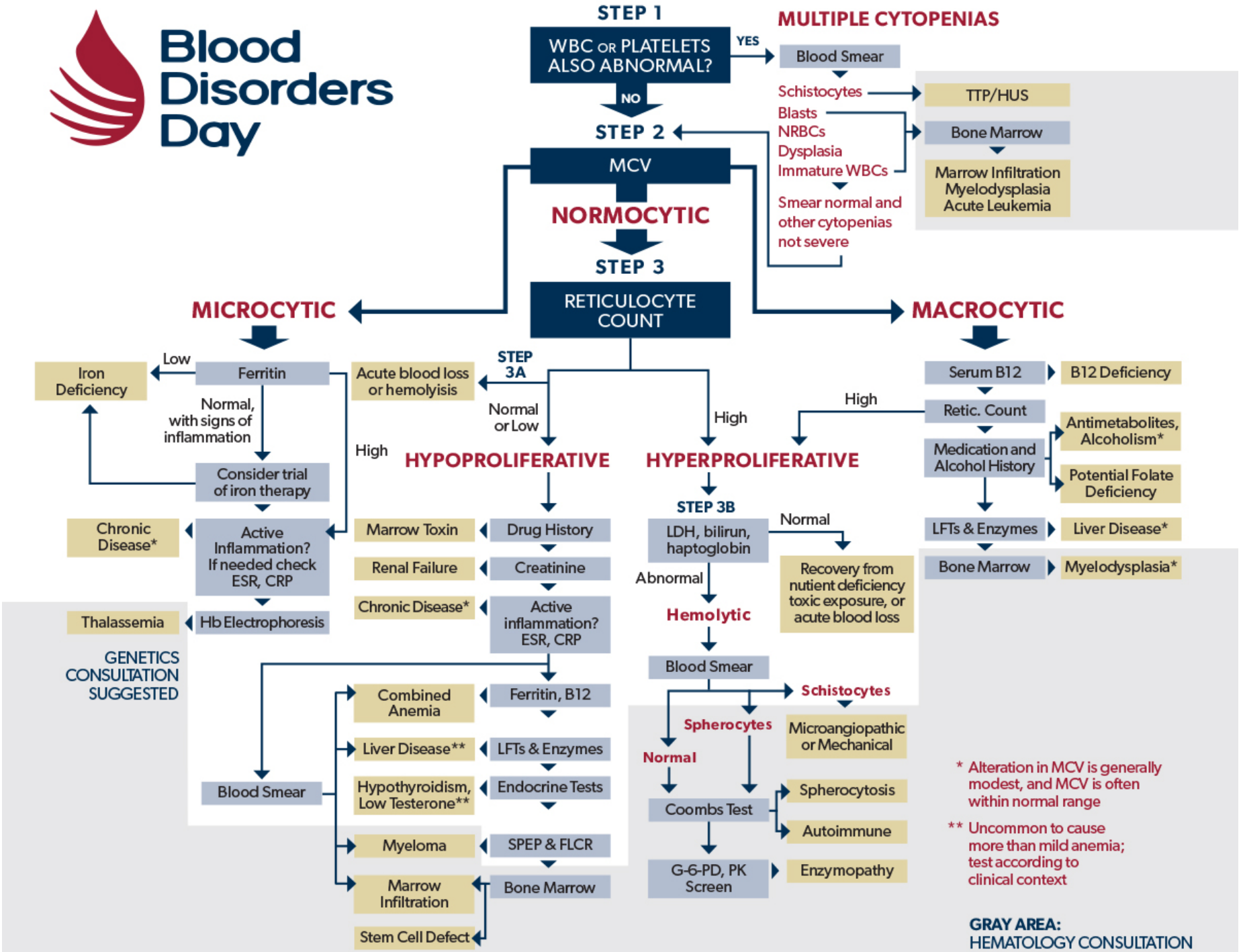
Peripheral Blood Smear - normal



Case 1: 44 y.o. man with fatigue and easy bruising

WBC	1.1×10^{9}/L
Hb	55 g/L
RBC	1.6×10^{12}/L
Hct	.162
MCV	99 fL
MCH	33.7 pg
MCHC	340 g/L
RDW	12
Plts	13×10^{9}/L

Blood Disorders Day



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Plts	13×10^{9}/L

This man may have:

A. AML
B. Aplastic anemia
C. CHOP chemotherapy 12 days earlier
D. Myelodysplastic syndrome
E. Multiple myeloma
F. Burkitt's lymphoma
G. Alcohol?
H. Any of the above

Rule of thumb #1:

look at all the values in the CBC

In this case …

Pattern = pancytopenia (WBC, Hgb, platelets all low)

Interpretation:

- Probable marrow disorder, toxicity or infiltration
- Of the list, the least likely would be chemotherapy. With acute myelosuppression, hemoglobin would fall more slowly

Which of the following would you do next?

- CT chest and abdomen
- Blood smear
- Bone marrow biopsy
- LFTs
- Serum protein electrophoresis
- B12 level
- ferritin

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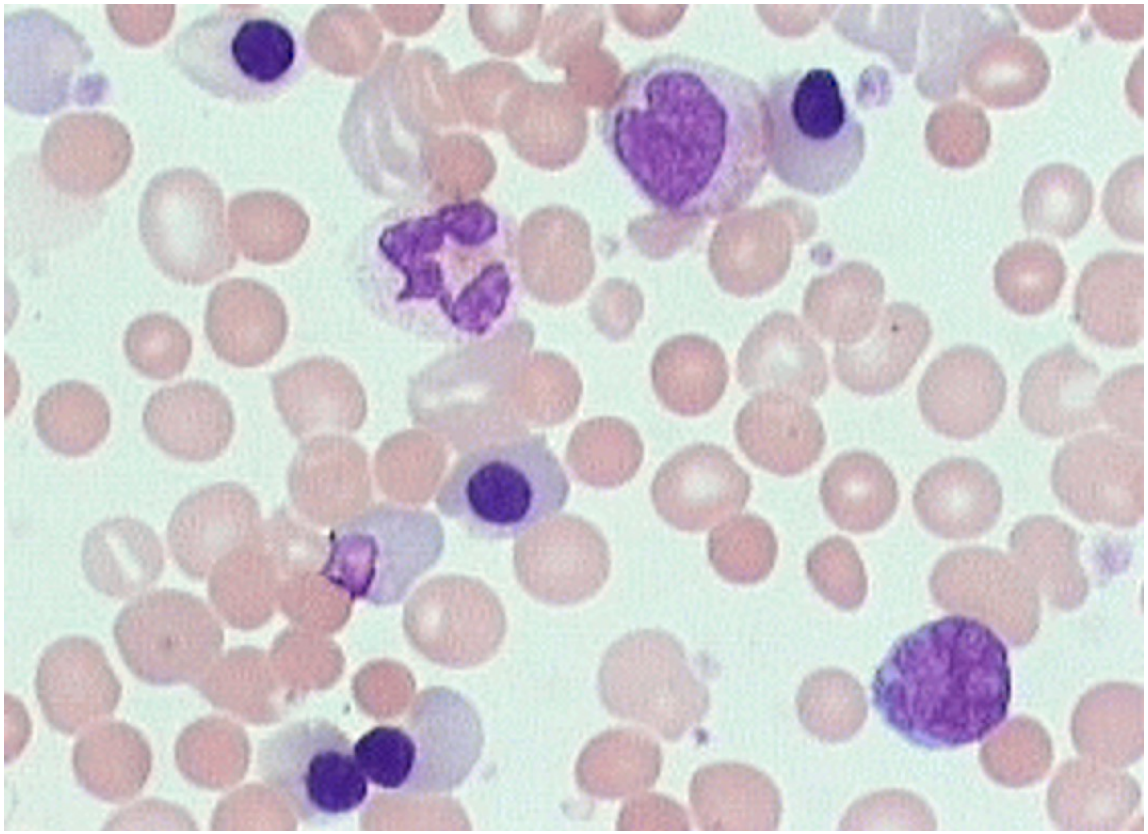
What would you do next?

- Blood smear
- Bone marrow biopsy
- LFTs
- Serum protein electrophoresis
- B12 level
- ferritin

What if the blood film looks like this?



"Peripheral blood smear reveals abundant nucleated red blood cells, and marked left shift including myelocytes, promyelocytes and blasts"

Rule of thumb #2

The peripheral smear can add a large amount of information in setting of:

- Pancytopenia
- Hemolytic anemia
- Marrow failure anemia
- Thrombocytopenia

- Peripheral smear is NOT useful in microcytic anemias (unless there is some other cytopenia or other problem going on).

Case 2

23 year old woman, feeling well

WBC	7.1 x 10^9/L		
Hb	86 g/L (130-180)	RBC	4.1 x 10^{12}/L (4.4-5.9)
Hct	.29 (0.40-0.52)	MCV	71 fL (80-98)
~~MCH~~	21.3 pg	MCHC	300 g/L (320-365)
RDW	17 (11.4-14.4)		
Plts	440 x 10^9/L		

This woman is most likely to have:

A. Thalassemia trait
B. Anemia of chronic disease
C. Iron deficiency
D. Aplastic anemia

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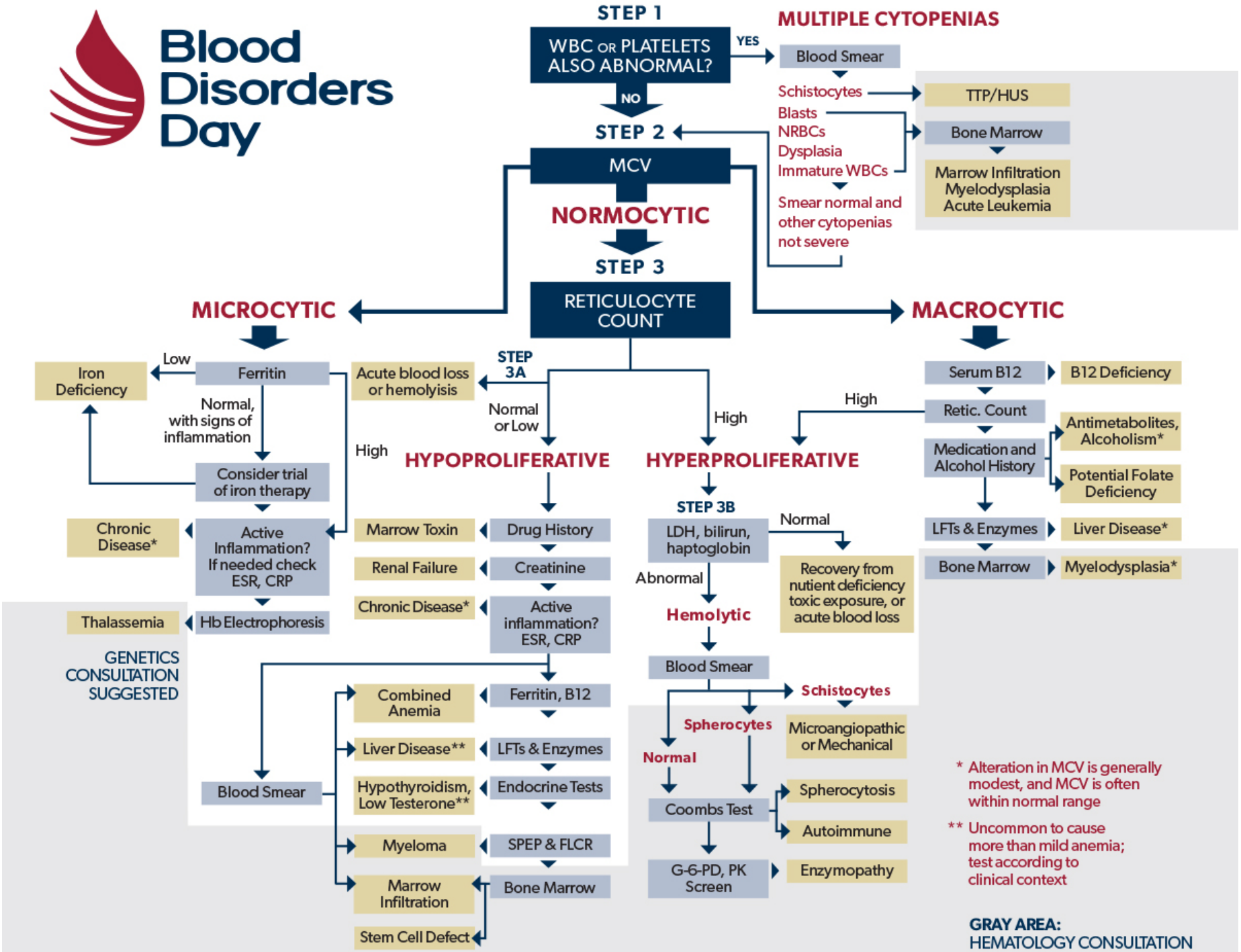

Rule of thumb #3

Pay attention to the MCV

All microcytic anemias are caused by impaired hemoglobin synthesis:

- Iron deficiency
- Thalassemia
- Anemia of inflammation (due to iron sequestration => hypoferremia)
- Congenital sideroblastic anemia (for the zebra-lovers among you)

What investigation will you do now?

1. Serum Ferritin
2. Serum iron and TIBC
3. Hemoglobin electrophoresis
4. CRP
5. Referral for gastroscopy and colonoscopy

Case 3

23 year old woman, feeling well

WBC	7.1 x 10^9/L		
Hb	116 g/L (130-180)	RBC	5.4 x 10^{12}/L (4.4-5.9)
Hct	.39 (0.40-0.52)	MCV	69 fL (80-98)
MCH	21.3 pg	MCHC	300 g/L (320-365)
RDW	15 (11.4-14.4)		
Plts	240 x 10^9/L		

This woman is most likely to have:

A. Thalassemia trait
B. Anemia of chronic disease
C. Iron deficiency
D. Aplastic anemia

Rule of thumb #4

Pay attention to the RBC count (concentration)

A microcytic anemia with elevated RBC can be due to:

- Polycythemia with iron deficiency
- Thalassemia

Another common feature of iron deficiency anemia is that the platelet count is often elevated or high-normal

What investigation will you do now?

1. Serum Ferritin
2. Serum iron and TIBC
3. Hemoglobin electrophoresis
4. Review previous blood counts in eChart
5. Referral for gastroscopy and colonoscopy

Rule of thumb #5

The best biopsy is a chart biopsy

- The evolution of hematological variables tells a lot about what pathology is involved
- For example the microcytosis in thalassemia trait does not vary, while iron deficiency does
  - A previously normal MCV rules out thalassemia trait as effectively – and much more cheaply – than specialized tests

Case 4

63 year old woman complains of fatigue, and stiff shoulders in the mornings. A CBC a year earlier was normal.

WBC	8.1 x 10^9/L		
Hb	103 g/L	RBC	4.14 x 10^{12}/L
Hct	.33	MCV	80.3 fL
MCH	24.9 pg	MCHC	310 g/L
RDW	14		
Plts	403 x 10^9/L		

This woman is most likely to have:

A. Thalassemia trait
B. Anemia of chronic disease
C. Iron deficiency
D. Myelodysplastic syndrome

Case 4

Iron Deficiency Anemia	Anemia of inflammation or chronic disease
Decreased serum iron	Decreased serum iron
Increased TIBC (=transferrin)	Decreased TIBC (=transferrin)
Decreased ferritin	Increased ferritin
Decreased marrow storage iron	Increased marrow iron in macrophages

Rule of thumb #6 (of sorts…)

Anemia of inflammation is most often normocytic or borderline microcytic, but hypochromic

- Inflammatory (mainly through IL-6) increases levels of hepcidin, and hepcidin causes sequestration of iron in macrophages, lowering serum iron, thus starving erythroid progenitors
- Since red cells last ~100 days, microcytosis takes months to occur (though reticulopenia occurs quickly).

Case 5

78 year old man complains of shortness of breath with walking, and stumbles often

WBC	3.7 x 10^9/L		
Hb	70 g/L	RBC	1.58 x 10^{12}/L
Hct	.20	MCV	130 fL
MCH	44.2 pg	MCHC	340 g/L
RDW	19		
Plts	103 x 10^9/L		

Which test(s) would be most useful?

A. Serum folate
B. Serum B12
C. Reticulocyte count
D. Blood smear
E. A look at the DPIN

Rule of thumb #7

MCV very high = megaloblastic anemia: check B12 and DPIN

Differential diagnosis

- B12 deficiency
- Folate deficiency, outside North America
- Antimetabolite drug therapy
    - Hydroxyurea, AZT, azathioprine, MTX

Neutrophils show hypersegmentation

All cell lines will go down but anemia is most pronounced

Case 6

67 year old woman who is pale and jaundiced

WBC	4.7 x 10^9/L		
Hb	97 g/L	RBC	2.85 x 10^{12}/L
Hct	.29	MCV	104 fL
MCH	35.6 pg	MCHC	340 g/L
RDW	15		
Plts	203 x 10^9/L		

What is the difference diagnosis here?

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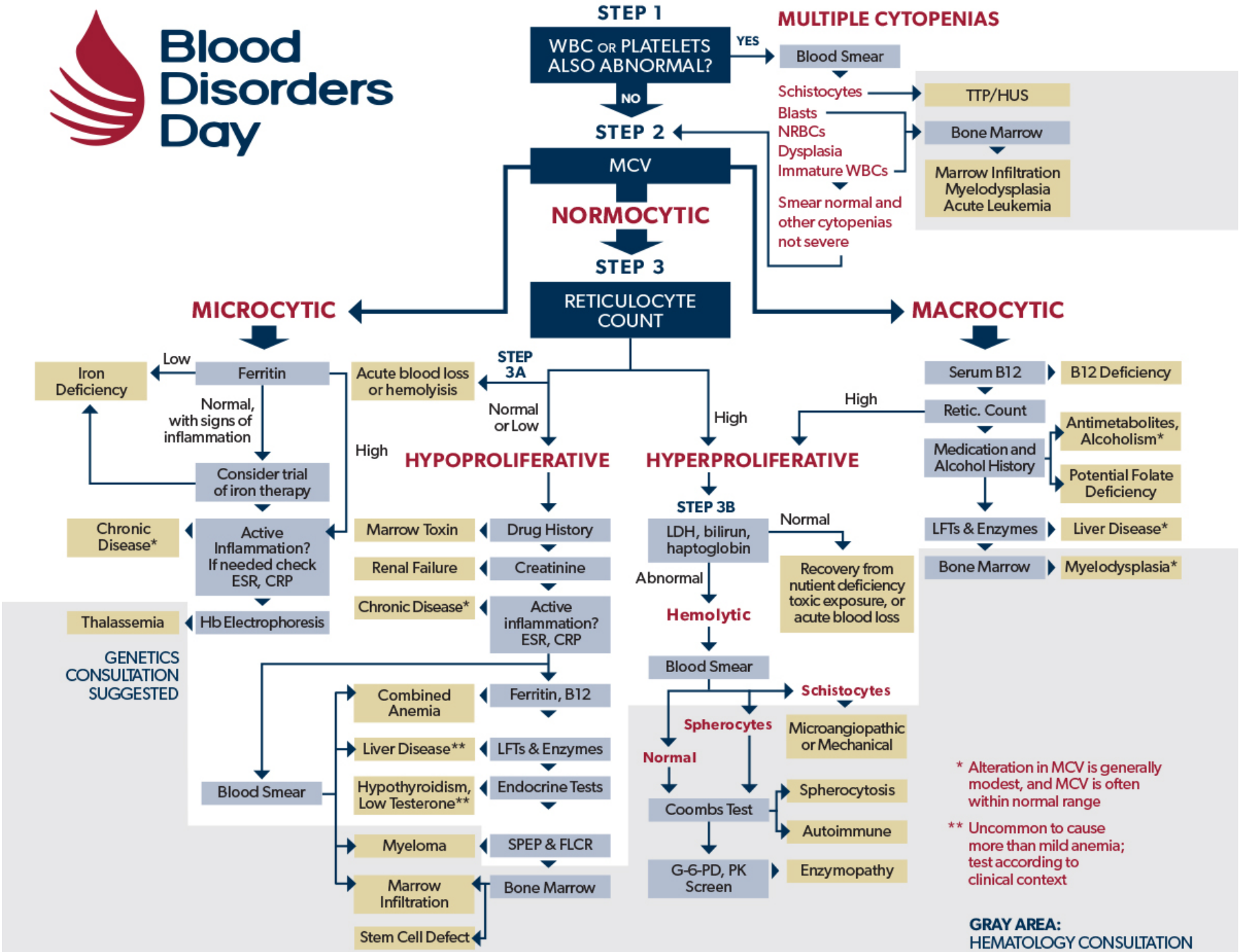


Rule of thumb #8

Mild macrocytosis has a broader differential diagnosis

- Early megaloblastic anemia
- Hemolysis (because reticulocytes are large)
- Myelodysplasia
- Liver disease (not necessarily anemic)
- Alcohol
- Some cases of myeloma, aplastic anemia, etc
- Hypothyroidism is on this list in some text books, but I've never seen it

Case 6

67 year old woman who is pale and jaundiced

WBC	4.7 x 10^9/L		
Hb	97 g/L	RBC	2.85 x 10^{12}/L
Hct	.29	MCV	104 fL
MCH	35.6 pg	MCHC	340 g/L
RDW	15		
Plts	203 x 10^9/L		

Which test(s) would be most useful?

A. Bone marrow
B. Serum B12
C. Reticulocyte count
D. Blood smear
E. Liver enzymes

Case 7

37 year old woman who is pale and jaundiced

WBC	6.7 x 10^9/L		
Hb	67 g/L	RBC	2.85 x 10^{12}/L
Hct	.20	MCV	95 fL
MCH	31.8 pg	MCHC	340 g/L
RDW	16		
Plts	303 x 10^9/L		

Which test(s) would be most useful?

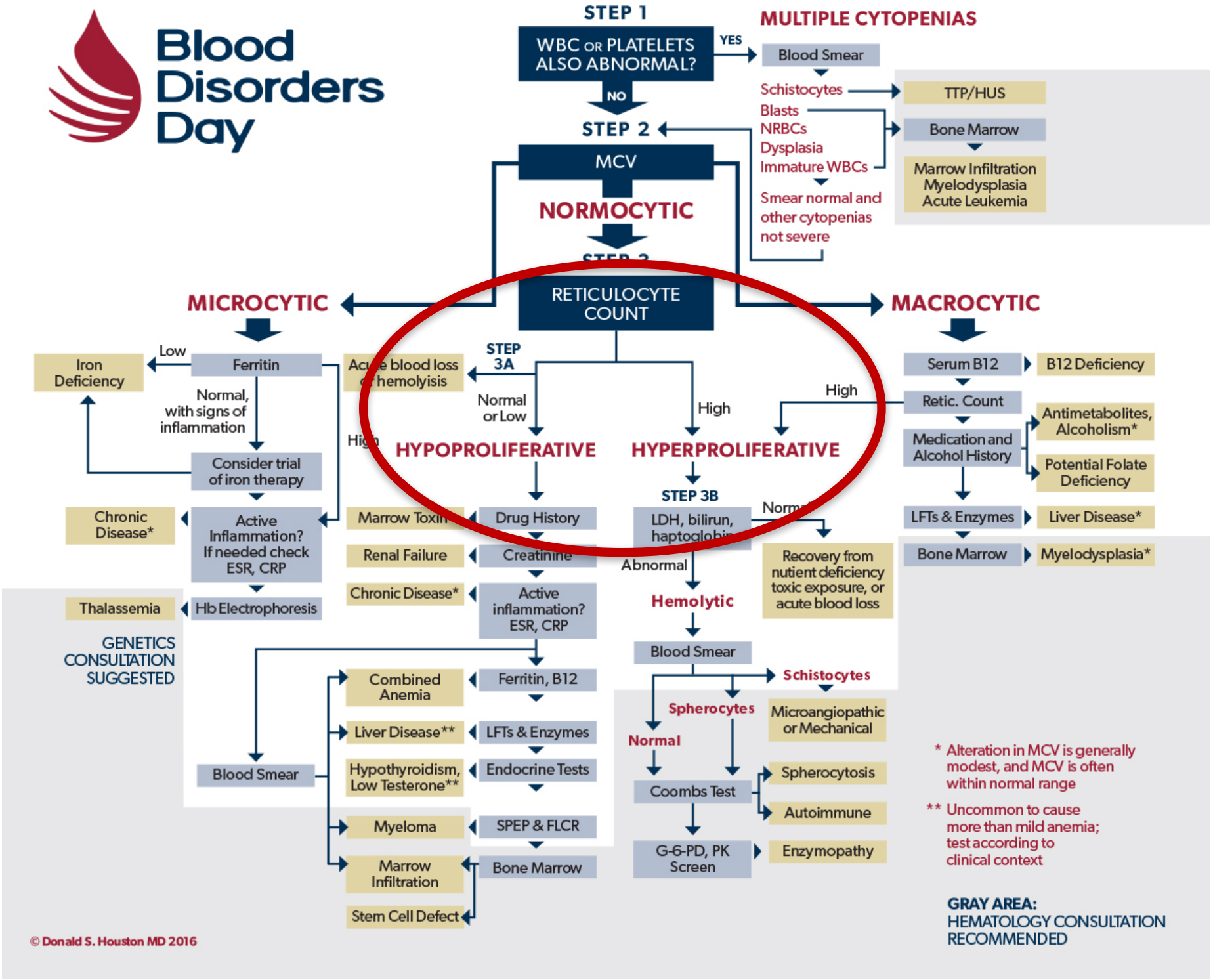
A. Bone marrow
B. Serum B12
C. Reticulocyte count
D. Blood smear
E. Liver enzymes

Rule of thumb #9

In normocytic anemia (and mildly macrocytic anemia), check the reticulocyte count AND get a blood smear

- Retic count distinguishes hemolytic from hypoproliferative anemias
- Blood smear sheds information about the specific process

Blood Disorders Day



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Case 7

37 year old woman who is pale and jaundiced

WBC	6.7 x 10^9/L		
Hb	67 g/L	RBC	2.10 x 10^{12}/L
Hct	.20	MCV	95 fL
MCH	31.8 pg	MCHC	340 g/L
RDW	16		
Plts	303 x 10^9/L		
Retics	**330 x 10^9/L**		

Which test(s) would be most useful?

A. Direct bilirubin
B. Total bilirubin
C. Haptoglobin
D. Blood smear
E. LDH

Rule of thumb #10

(*Especially) **if reticulocyte count is elevated, check LDH, direct & total bilirubin, and haptoglobin**

- **Can be useful for normocytic anemia without a discernable cause)**

Elevated retic count can be due to:

- Hemolysis
- Recover from
  - Acute blood loss
  - Nutrient deficiency (iron, B12)
  - Myelosuppression

Case 8

23 year old woman complains of bruising

WBC	6.7 x 10^9/L		
Hb	130 g/L	RBC	4.1 x 10^{12}/L
Hct	.38	MCV	90 fL
MCH	30.6 pg	MCHC	340 g/L
RDW	13		
Plts	3 x 10^9/L		

What is the differential?

What do you want to know?

A. LDH
B. Retic count
C. Recent new medications
D. Blood smear

Rule of thumb #11

In *severe*, isolated thrombocytopenia, first

- Rule out platelet clumping (pseudothrombocytopenia)

Then consider

- Medications including tonic water
  - (p.s….its never the medication)
- ITP

Case 9

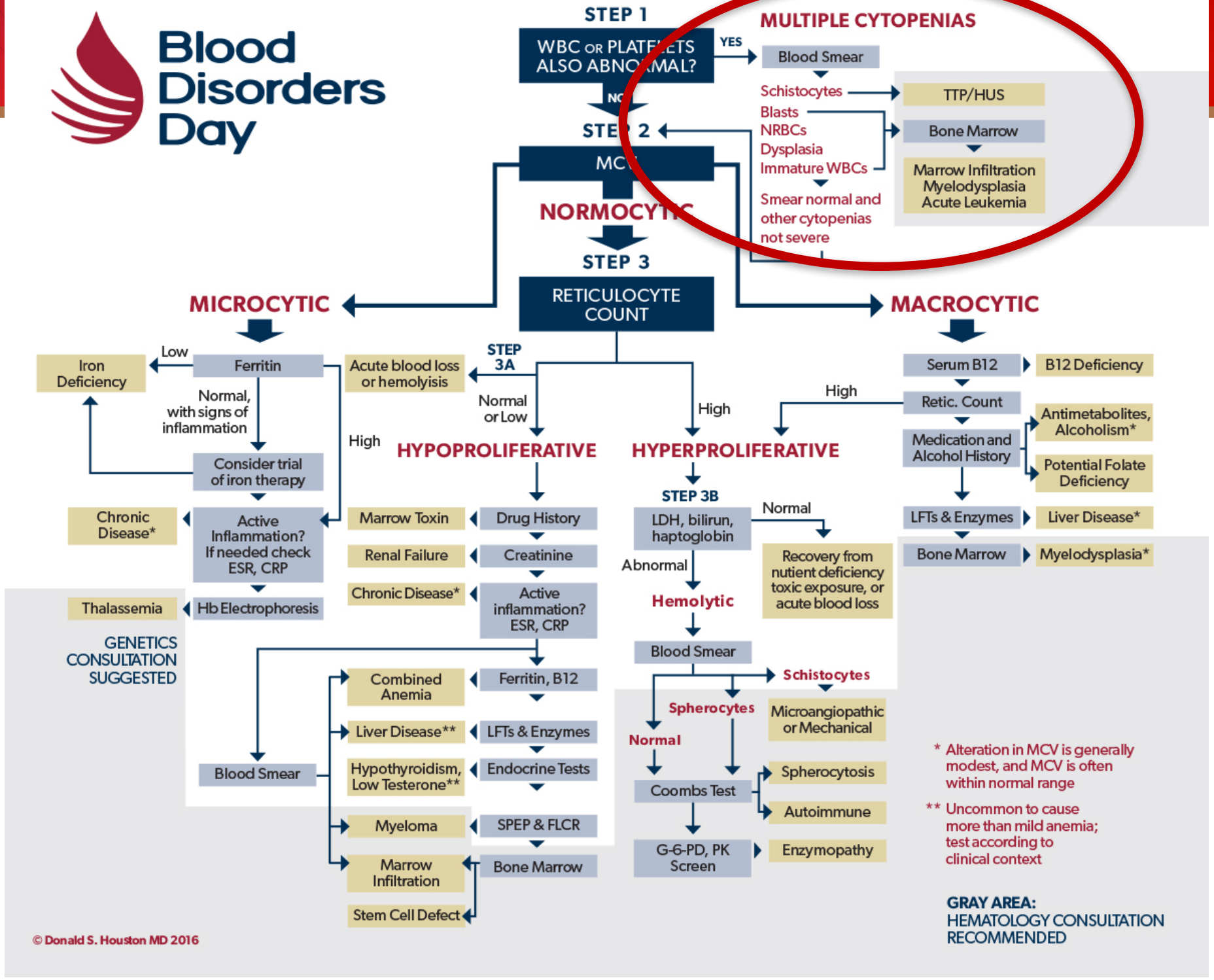
23 year old woman complains of bruising

WBC	6.7 x 10^9/L		
Hb	83 g/L	RBC	2.71 x 10^{12}/L
Hct	.24	MCV	90 fL
MCH	30.6 pg	MCHC	340 g/L
RDW	15		
Plts	43 x 10^9/L		

What do you want to know?

A. LDH
B. Retic count
C. Recent new medications
D. Blood smear
E. Creatinine

Blood Disorders Day



Rule of thumb #12

When platelets and hemoglobin are both low, consider:

- Microangiopathy (TTP, HUS)
  - Rule out by blood film
- Thrombocytopenia-exacerbated bleeding with acute blood loss

Case 10

58 year old man complains of bruising

WBC	3.7 x 10^9/L		
Hb	143 g/L	RBC	4.23 x 10^{12}/L
Hct	.43	MCV	102 fL
MCH	33.8 pg	MCHC	331 g/L
RDW	15		
Plts	83 x 10^9/L		

What could be going on here??

What would you like to do?

Case 10

58 year old man complains of bruising

WBC	3.7 x 10^9/L		
Hb	143 g/L	RBC	4.23 x 10^{12}/L
Hct	.43	MCV	102 fL
MCH	33.8 pg	MCHC	331 g/L
RDW	15		
Plts	83 x 10^9/L		

What do you want to know?

A. Medical History (?infection)
B. Physical exam!
C. Medications
D. Liver enzymes and INR
E. Blood smear

Rule of thumb #13

When platelets and WBC are both moderately low, think about hypersplenism

Objective

To develop an efficient approach to interpret the information contained in the CBC in assessing hematological and systemic diseases

Take Home Messages

1. Awesome medical diagnoses (not just hematologic ones) can be made just starting with the CBC

2. Order all components of the CBC, all of the time

3. Rid yourself of the MCH (and MCHC for the most part) and consider the algorithm provided

4. Focus on absolute values and not percents (%)

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Questions?

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1. A 23 year old Nigerian man has the following CBC:

WBC	5.1×10^{9}/L
Hb	96 g/L
RBC	4.5×10^{12}/L
Hct	.32
MCV	71 fL
MCH	21.3 pg
MCHC	300 g/L
RDW	14.5
Plts	13×10^{9}/L

What is the likely diagnosis?

A. Thalassemia
B. Iron deficiency
C. ITP
D. TTP
E. There must be more than one diagnosis

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WBC	5.1×10^9/L
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