

BEYOND A BETTER BOX

Hematology Case Studies

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Field Product Specialist

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OBJECTIVES

- Discuss how scattergram and histogram pictures can provide insight into abnormal hematology samples
- Utilize case studies to demonstrate how enhanced technologies can benefit the patient and clinician, as well as enhance efficiency in your hematology workflow.

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NEXT GENERATION DIAGNOSTICS

FLUORESCENT FLOW CYTOMETRY

Laser Diode, Collimator Lens, Condenser Lens, Flow Cell, Beam Stopper, Photodiode, Dichroic Mirror, Spectrom Filter, Anionizing Photodiode

Side Fluorescent Light  
DNA/RNA information

Side Scattered Light  
Cell inside structure information

Forward Scattered Light  
Cell size information

Laser Beam wavelength=633nm

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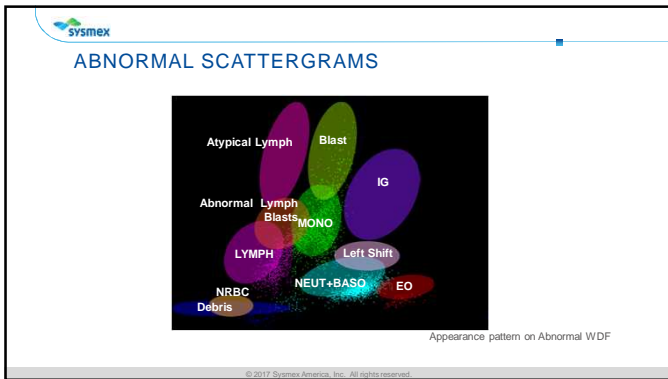
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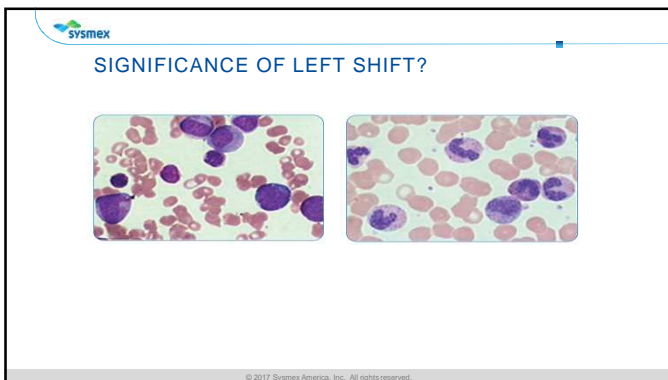
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### LEFT SHIFT FLAG

Item	Data	Unit	Item	Data	Unit
WBC	5.41	10 <sup>9</sup> /L	NEUT%	2.06	10 <sup>9</sup> /L
RBC	2.72	10 <sup>12</sup> /L	LYMP%	6.18	10 <sup>9</sup> /L
HGB	11.5	g/dL	MONO%	0.26	10 <sup>9</sup> /L
HCT	32.9	%	PLT%	0.02	10 <sup>9</sup> /L
MCV	149.0	fL	RDW%	0.00	10 <sup>9</sup> /L
MCH	32.9	pg	RDW%	82.7	%
MCHC	22.1	g/dL	RDW%	7.6	%
PLT	46	10 <sup>9</sup> /L	PLT	15.2	10 <sup>9</sup> /L
MPV	54.1	fL	PLT	15.2	10 <sup>9</sup> /L
PDW	20.0	%	PLT	15.2	10 <sup>9</sup> /L
MPV	6.06	fL	PLT	15.2	10 <sup>9</sup> /L
PLT	6	10 <sup>9</sup> /L	PLT	15.2	10 <sup>9</sup> /L

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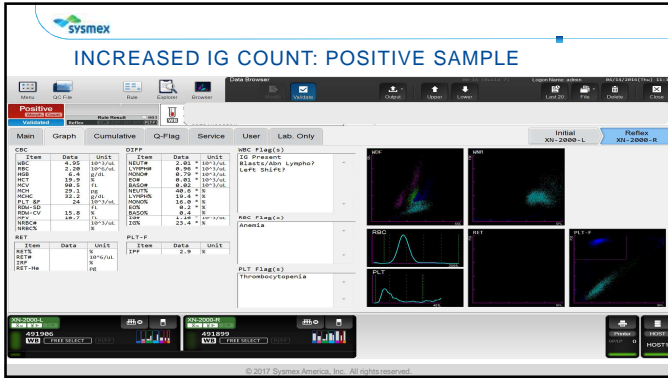
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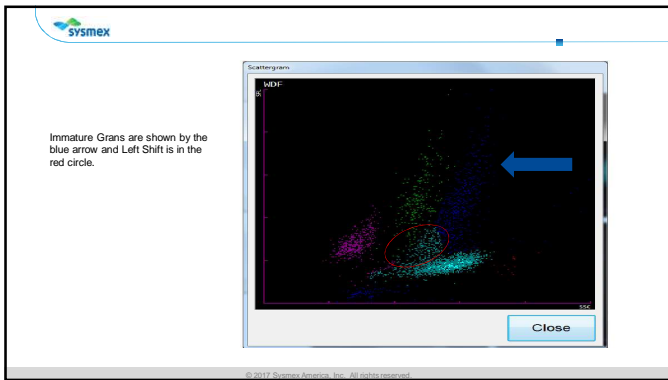
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**CASE STUDY**  
**IMMATURE GRANULOCYTES**

- Patient History: 74 year old female with complex medical history discharged 3 days prior
- Presentation: Presented to the ED with worsening cough, green sputum and fever of 102.
- Testing: Sputum culture positive, gram positive cocci
- Diagnosis: Healthcare acquired pneumonia
- Treatment: Triple antibiotic therapy initiated

Results of case studies are not predictive of other cases and results may vary. With permission from Englewood Medical Center, NJ.

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### CASE STUDY IMMATURE GRANULOCYTES

Labs	Day 1	Day 2	Day 3	Day 4	Discharge	Ranges
WBC	8.3	6.69	7.11	7.11	5.28	4.0-11.0K/uL
Neut %	59.1	64.5	64.9	59.2	55.6	40-70 %
Neut #	4.91	4.31	4.62	4.21	2.94	1.8-7.7 K/uL
IG %	<b>3.5H</b>	<b>4.2H</b>	<b>2.7H</b>	<b>2.0H</b>	<b>1.9H</b>	<b>0.0-0.5 %</b>
IG #	<b>0.29H</b>	<b>0.28H</b>	<b>0.19H</b>	<b>0.14H</b>	<b>0.10H</b>	<b>0.0-0.06K/uL</b>

**Patient Care:**

- Antibiotics started on Day 2
- IG data is the only hematology value indicating presence of left shift
- Discharged home after 5 days of antibiotic therapy

Results of case studies are not predictive of other cases and results may vary. With permission from Englewood Medical Center, NJ.

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### CASE STUDY #1

- A 71 y/o female presents to her family practitioner with increasing concerns of persistent fatigue, diffuse pain in her chest and back and "more bruising than normal". She also states that she has experienced recurring sinus and respiratory infections over the past 6 months. Upon examination, the patient was found to have an enlarged liver. Chemistry testing was unremarkable aside from a moderately elevated serum Calcium, Creatinine and Microalbumin level.
- Following is the initial CBC results
  - What concerns do you see

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The screenshot shows the Sysmex hematology software interface. The main window displays a CBC result for patient L276013047. The results are as follows:

Item	Value	Unit	Flag
WBC	8.3	K/uL	
Neut %	59.1	%	
Neut #	4.91	K/uL	
Lymph %	37.2	%	
Lymph #	3.09	K/uL	
Mon %	3.7	%	
Mon #	0.31	K/uL	
Eos %	6.3	%	
Eos #	0.52	K/uL	
Bas %	0.0	%	
Bas #	0.00	K/uL	
PLT	212	K/uL	
Hgb	12.0	g/dL	
Hct	36.0	%	
Hemc	36.0	%	
Hemc-adj	36.0	%	
MCV	100.0	fL	
MCH	30.0	pg	
MCHC	30.0	g/dL	
RDW	13.0	%	
RDW-CV	13.0	%	
RDW-S	13.0	%	
RDW-SD	40.0	fL	
PLT-FL	10.0	%	
PLT-FL-adj	10.0	%	
PLT-FL-SD	10.0	%	
PLT-FL-SD-adj	10.0	%	
PLT-FL-SD-SD	10.0	%	
PLT-FL-SD-SD-adj	10.0	%	
PLT-FL-SD-SD-SD-adj	10.0	%	

The interface also shows a scattergram plot with a red circle highlighting a cluster of cells, indicating a left shift. The plot is labeled "WBC-Abn Scattergram (Lymphocytes)".

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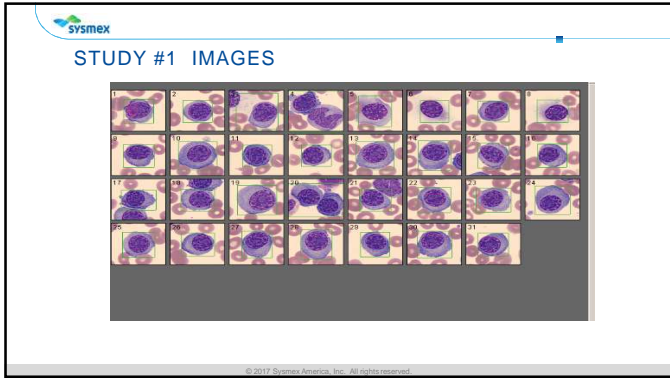
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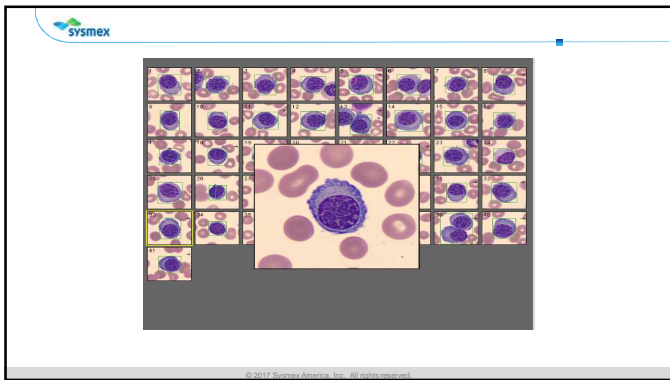
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### CASE STUDY #1 – DIAGNOSIS?

**Plasma Cell Leukemia (PCL)**

- Primary PCL is rare (1 in 1 million population). Secondary PCL affects ~ 4 out of a 100 Multiple Myeloma patients.
- 1.5x more common in men than in women
- The causes of PCL are not fully known, but risk factors such as age and exposure to industrial and environmental elements are thought to play important roles.
- Current treatments for PCL are the same as those for Multiple Myeloma and include chemotherapy drugs, Proteasome inhibitors, steroids and in younger and healthier patients, stem cell transplantation is an option.

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**CASE STUDY #2**

- A 67 y/o male presented to his family physician for a routine wellness check. The patient states that he has experienced moderate unexplained weight loss and feels more 'run down' than usual.
- Physical examination reveals swollen lymph nodes and mild bruising on extremities.
- Following is the initial CBC results
  - What concerns do you see

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Item	Data	Unit	Item	Data	Unit
WBC	11.2	10 <sup>9</sup> /L	NEUT	4.02	10 <sup>9</sup> /L
HGB	11.2	g/dL	LYMPH	2.75	10 <sup>9</sup> /L
HCT	33.2	%	MONO	1.05	10 <sup>9</sup> /L
HCV	33.2	%	EOS	0.18	10 <sup>9</sup> /L
PLT	101	10 <sup>9</sup> /L	PLT	0.92	10 <sup>9</sup> /L
RDW	14.4	%	PLT-L	42.8	%
RDW-CV	14.4	%	PLT-M	2.2	%
MPV	10.0	fL	PLT-H	1.9	%
INTEC	0.08	10 <sup>9</sup> /L	PLT-F		
INTEC-R	0.0	%	PLT-S		

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**Manual Differential**

Neutrophils (segs, bands)	24%
Lymphocytes	24%
Atypical Lymphs w/cytoplasmic projections	50%
Monocytes	2%

Absolute lymphocyte count calculated from manual differential:  $10.2 \times 10^3/uL$

**Flow Cytometry Results**  
 CD19, CD20, CD11c, CD25, CD103, CD123, Kappa light chain positive.  
 CD10, CD5 antigen negative.

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**CASE STUDY #2 – DIAGNOSIS?**

**Hairy Cell Leukemia (HCL)**

- HCL is a chronic leukemia where the bone marrow produces a surplus of B-lymphocytes, which often present with hair-like, irregular cytoplasmic projections.
- Relatively rare disorder, but one of the most successfully treated of all leukemias (median remission of 15 years).
- HCL is a very indolent disease. Progression is slow and may not be diagnosed after several months or even years of illness.
- Front-line treatment agents for HCL are Pentostatin and Cladribine.

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**CASE STUDY #3**

- A 66 y/o male presents to his family practitioner for a routine check-up.
- During the examination, the patient states he is feeling generally "ok", but when questioned further admits a recent history of :
  - Weakness
  - Fatigue
  - Extreme night sweats
  - Moderate weight loss
- Following is the initial CBC results
  - What concerns do you see?

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The screenshot shows a laboratory information system interface for Sysmex XE-3000-1-L. The 'CBC' panel is visible with the following values:

Item	Data	Unit	Diff	Item	Data	Unit	WBC Flag(s)
WBC	22.7	$10^9/L$		Leukocytes	93.00	$10^9/L$	Leukocytes (ID Present) (Leukemia Lympho?) (WBC DisP?)
HCT	38.6	%		Neutrophils	1.19	$10^9/L$	
HGB	130.0	g/L		Lymphocytes	2.79	$10^9/L$	
HCTC	32.0	%		Monocytes	2.3	$10^9/L$	
HGBM	17.3	g/dL		Platelets	23.4	$10^9/L$	
HGBM	17.3	g/dL		Platelets	23.4	$10^9/L$	
WBCDIF	8.2	$10^9/L$					
WBCDIF	8.2	$10^9/L$					
WBCDIF	8.2	$10^9/L$					

The 'WBC' value is circled in red, and the 'WBC Flag(s)' is also circled in red. The 'WBC Flag(s)' field contains the text: 'Leukocytes (ID Present) (Leukemia Lympho?) (WBC DisP?)'. The 'HGBM' value is 17.3, which is below the normal range.

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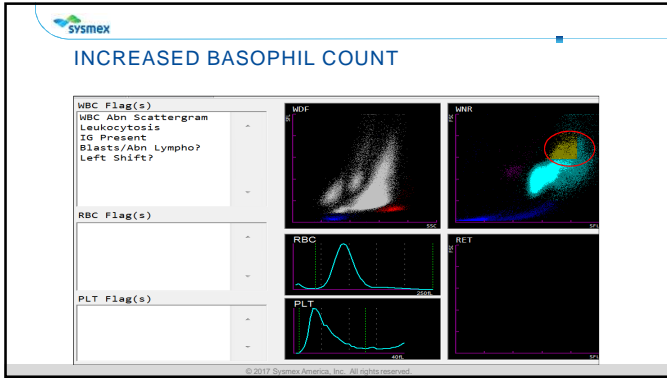
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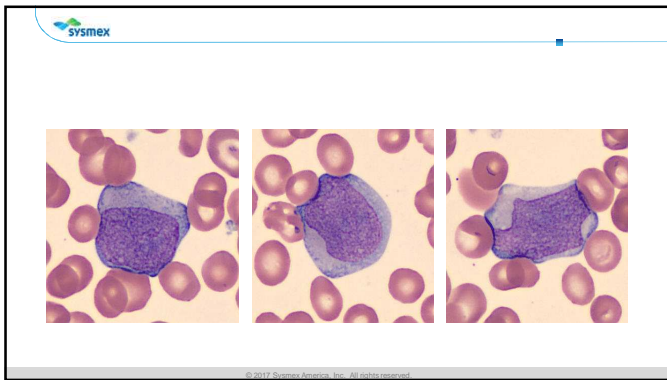
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**CASE STUDY #3 – DIAGNOSIS?**

**Chronic Myelogenous Leukemia (CML)**

- ~ 1 person in 555 will get CML in their lifetime
- Occurs mainly in adults
- Slightly more common in men than in women
- Most cases of CML start when a "swapping" of chromosomal material (DNA) occurs between chromosomes 9 and 22. This translocation gives rise to a chromosome 22 that is shorter than normal (Philadelphia Chromosome).
- The swapping of DNA between the chromosomes leads to the formation of an oncogene called *BCR-ABL*. This gene then produces the BCR-ABL protein, which is the type of protein called a *tyrosine kinase*. This protein causes CML cells to grow and reproduce out of control.

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 **CASE STUDY #3**

- CML is classified into 3 groups or phases that help predict prognosis. These phases are based mainly on the number of myeloblasts that are seen in the blood or bone marrow.
- **Chronic phase**
  - Less than 10% blasts in their blood or bone marrow.
  - Patients usually have fairly mild symptoms (if any).
  - Most patients are diagnosed in the chronic phase.

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 **CASE STUDY #3**

- **Accelerated phase**
- Patients are considered to be in accelerated phase if any of the following are true:
  - The bone marrow or blood samples have more than 10% but fewer than 20% blasts
  - **High blood basophil count** (basophils making up at least 20% of the white blood cells)
  - High white blood cell counts that do not go down with treatment
  - Very high or very low platelet counts that are not caused by treatment
- **Blast phase (also called acute phase or blast crisis)**
  - BM and/or blood samples have more than 20% blasts.
  - The blast cells often spread to tissues and organs beyond the bone marrow.

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 **CASE STUDY #4**

- A 59 y/o male patient presents to the E.R. with a complaint of increasing weakness, shortness of breath, headache and recent onset of dark-colored urine.
- The initial CBC result indicates that patient has severe anemia of unknown etiology.
- Patient is admitted and transfused with 2 units of packed RBCs.
- The following CBC result is 24 hours post transfusion.
- What 'issues' do you see with the results?

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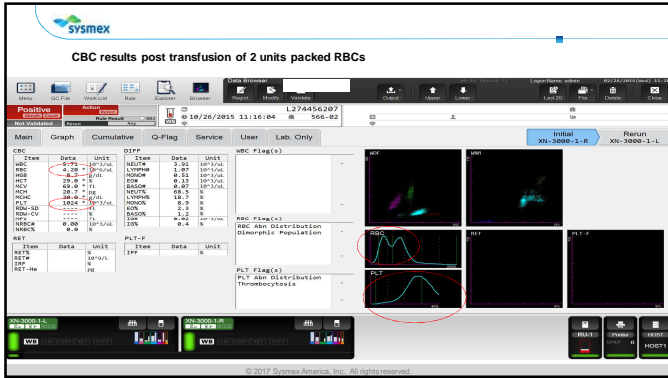
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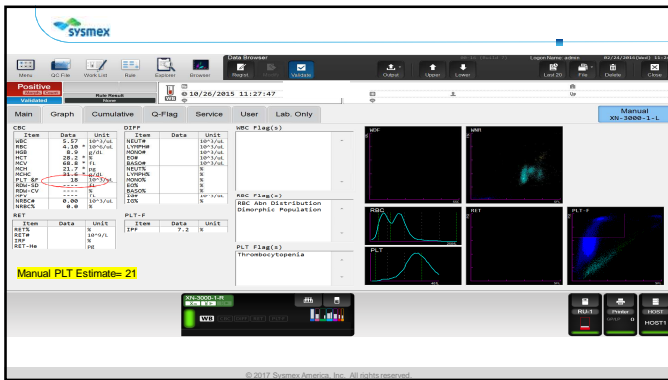
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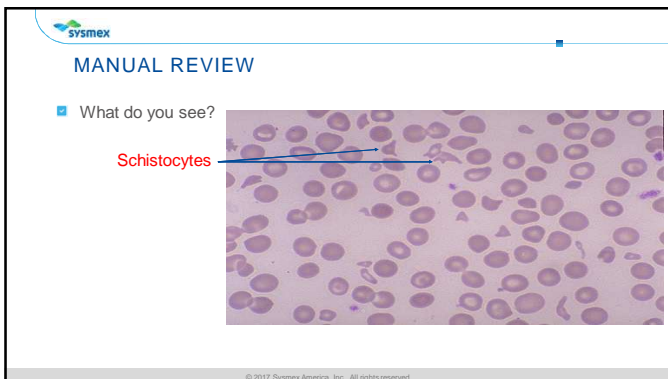
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### CASE STUDY #4 – DIAGNOSIS?

**Idiopathic Autoimmune Hemolytic Anemia**

- AIHA can be life-threatening because of its sudden onset
- It requires immediate medical attention and hospitalization
- Schistocytes were being counted as platelets by impedance counting

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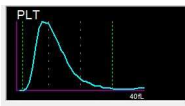
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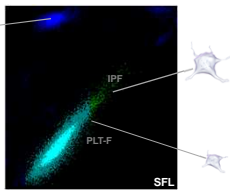
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### PLATELET RELATED CASE STUDIES



Impedance Platelet



Fluorescent Platelet

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### INTERFERENCES IN IMPEDANCE PLATELET COUNTING

**Falsely Increased**

- RBC fragments
- Microcytes
- Bacteria
- Immune complexes
- WBC fragments

**Falsely Decreased**

- Giant platelets
- Platelet clumps

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### CASE STUDY #5

- Woman arrives at L&D with contractions.
- Platelet count is 90,000
- Low platelet count complicates decision of placing a labor epidural due to risk of spinal hematoma. (plt cut-offs vary by institution).

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### CASE STUDY #5

Main Graph Cumulative Q-Flag Service User Lab. Only Manual

Item	DATA	UNITS	Item	DATA	UNITS
WBC	11.55	10 <sup>9</sup> /L	PLT	90.0	10 <sup>3</sup> /L
DIFF			PLT-H	1.1	10 <sup>3</sup> /L
NEUT	72.0	%	PLT-L	0.7	10 <sup>3</sup> /L
LYMPH	23.0	%	PLT-M	0.4	10 <sup>3</sup> /L
MONO	5.0	%	PLT-H-L	0.1	10 <sup>3</sup> /L
PLT-CL	27.2	fL	PLT-H-M	0.1	10 <sup>3</sup> /L
PLT-FL	10.1	fL	PLT-H-H	0.1	10 <sup>3</sup> /L
PLT-SD	15.0	fL	PLT-L-L	0.1	10 <sup>3</sup> /L
PLT-LV	15.0	fL	PLT-L-M	0.1	10 <sup>3</sup> /L
PLT-HV	15.0	fL	PLT-L-H	0.1	10 <sup>3</sup> /L
PLT-ADV	15.0	fL	PLT-M-L	0.1	10 <sup>3</sup> /L
PLT-RV	15.0	fL	PLT-M-M	0.1	10 <sup>3</sup> /L
PLT-RV1	15.0	fL	PLT-M-H	0.1	10 <sup>3</sup> /L
PLT-RV2	15.0	fL	PLT-H-L	0.1	10 <sup>3</sup> /L
PLT-RV3	15.0	fL	PLT-H-M	0.1	10 <sup>3</sup> /L
PLT-RV4	15.0	fL	PLT-H-H	0.1	10 <sup>3</sup> /L
PLT-RV5	15.0	fL	PLT-L-L	0.1	10 <sup>3</sup> /L
PLT-RV6	15.0	fL	PLT-L-M	0.1	10 <sup>3</sup> /L
PLT-RV7	15.0	fL	PLT-L-H	0.1	10 <sup>3</sup> /L
PLT-RV8	15.0	fL	PLT-M-L	0.1	10 <sup>3</sup> /L
PLT-RV9	15.0	fL	PLT-M-M	0.1	10 <sup>3</sup> /L
PLT-RV10	15.0	fL	PLT-M-H	0.1	10 <sup>3</sup> /L
PLT-RV11	15.0	fL	PLT-H-L	0.1	10 <sup>3</sup> /L
PLT-RV12	15.0	fL	PLT-H-M	0.1	10 <sup>3</sup> /L
PLT-RV13	15.0	fL	PLT-H-H	0.1	10 <sup>3</sup> /L
PLT-RV14	15.0	fL	PLT-L-L	0.1	10 <sup>3</sup> /L
PLT-RV15	15.0	fL	PLT-L-M	0.1	10 <sup>3</sup> /L
PLT-RV16	15.0	fL	PLT-L-H	0.1	10 <sup>3</sup> /L
PLT-RV17	15.0	fL	PLT-M-L	0.1	10 <sup>3</sup> /L
PLT-RV18	15.0	fL	PLT-M-M	0.1	10 <sup>3</sup> /L
PLT-RV19	15.0	fL	PLT-M-H	0.1	10 <sup>3</sup> /L
PLT-RV20	15.0	fL	PLT-H-L	0.1	10 <sup>3</sup> /L
PLT-RV21	15.0	fL	PLT-H-M	0.1	10 <sup>3</sup> /L
PLT-RV22	15.0	fL	PLT-H-H	0.1	10 <sup>3</sup> /L
PLT-RV23	15.0	fL	PLT-L-L	0.1	10 <sup>3</sup> /L
PLT-RV24	15.0	fL	PLT-L-M	0.1	10 <sup>3</sup> /L
PLT-RV25	15.0	fL	PLT-L-H	0.1	10 <sup>3</sup> /L
PLT-RV26	15.0	fL	PLT-M-L	0.1	10 <sup>3</sup> /L
PLT-RV27	15.0	fL	PLT-M-M	0.1	10 <sup>3</sup> /L
PLT-RV28	15.0	fL	PLT-M-H	0.1	10 <sup>3</sup> /L
PLT-RV29	15.0	fL	PLT-H-L	0.1	10 <sup>3</sup> /L
PLT-RV30	15.0	fL	PLT-H-M	0.1	10 <sup>3</sup> /L
PLT-RV31	15.0	fL	PLT-H-H	0.1	10 <sup>3</sup> /L
PLT-RV32	15.0	fL	PLT-L-L	0.1	10 <sup>3</sup> /L
PLT-RV33	15.0	fL	PLT-L-M	0.1	10 <sup>3</sup> /L
PLT-RV34	15.0	fL	PLT-L-H	0.1	10 <sup>3</sup> /L
PLT-RV35	15.0	fL	PLT-M-L	0.1	10 <sup>3</sup> /L
PLT-RV36	15.0	fL	PLT-M-M	0.1	10 <sup>3</sup> /L
PLT-RV37	15.0	fL	PLT-M-H	0.1	10 <sup>3</sup> /L
PLT-RV38	15.0	fL	PLT-H-L	0.1	10 <sup>3</sup> /L
PLT-RV39	15.0	fL	PLT-H-M	0.1	10 <sup>3</sup> /L
PLT-RV40	15.0	fL	PLT-H-H	0.1	10 <sup>3</sup> /L
PLT-RV41	15.0	fL	PLT-L-L	0.1	10 <sup>3</sup> /L
PLT-RV42	15.0	fL	PLT-L-M	0.1	10 <sup>3</sup> /L
PLT-RV43	15.0	fL	PLT-L-H	0.1	10 <sup>3</sup> /L
PLT-RV44	15.0	fL	PLT-M-L	0.1	10 <sup>3</sup> /L
PLT-RV45	15.0	fL	PLT-M-M	0.1	10 <sup>3</sup> /L
PLT-RV46	15.0	fL	PLT-M-H	0.1	10 <sup>3</sup> /L
PLT-RV47	15.0	fL	PLT-H-L	0.1	10 <sup>3</sup> /L
PLT-RV48	15.0	fL	PLT-H-M	0.1	10 <sup>3</sup> /L
PLT-RV49	15.0	fL	PLT-H-H	0.1	10 <sup>3</sup> /L
PLT-RV50	15.0	fL	PLT-L-L	0.1	10 <sup>3</sup> /L
PLT-RV51	15.0	fL	PLT-L-M	0.1	10 <sup>3</sup> /L
PLT-RV52	15.0	fL	PLT-L-H	0.1	10 <sup>3</sup> /L
PLT-RV53	15.0	fL	PLT-M-L	0.1	10 <sup>3</sup> /L
PLT-RV54	15.0	fL	PLT-M-M	0.1	10 <sup>3</sup> /L
PLT-RV55	15.0	fL	PLT-M-H	0.1	10 <sup>3</sup> /L
PLT-RV56	15.0	fL	PLT-H-L	0.1	10 <sup>3</sup> /L
PLT-RV57	15.0	fL	PLT-H-M	0.1	10 <sup>3</sup> /L
PLT-RV58	15.0	fL	PLT-H-H	0.1	10 <sup>3</sup> /L
PLT-RV59	15.0	fL	PLT-L-L	0.1	10 <sup>3</sup> /L
PLT-RV60	15.0	fL	PLT-L-M	0.1	10 <sup>3</sup> /L
PLT-RV61	15.0	fL	PLT-L-H	0.1	10 <sup>3</sup> /L
PLT-RV62	15.0	fL	PLT-M-L	0.1	10 <sup>3</sup> /L
PLT-RV63	15.0	fL	PLT-M-M	0.1	10 <sup>3</sup> /L
PLT-RV64	15.0	fL	PLT-M-H	0.1	10 <sup>3</sup> /L
PLT-RV65	15.0	fL	PLT-H-L	0.1	10 <sup>3</sup> /L
PLT-RV66	15.0	fL	PLT-H-M	0.1	10 <sup>3</sup> /L
PLT-RV67	15.0	fL	PLT-H-H	0.1	10 <sup>3</sup> /L
PLT-RV68	15.0	fL	PLT-L-L	0.1	10 <sup>3</sup> /L
PLT-RV69	15.0	fL	PLT-L-M	0.1	10 <sup>3</sup> /L
PLT-RV70	15.0	fL	PLT-L-H	0.1	10 <sup>3</sup> /L
PLT-RV71	15.0	fL	PLT-M-L	0.1	10 <sup>3</sup> /L
PLT-RV72	15.0	fL	PLT-M-M	0.1	10 <sup>3</sup> /L
PLT-RV73	15.0	fL	PLT-M-H	0.1	10 <sup>3</sup> /L
PLT-RV74	15.0	fL	PLT-H-L	0.1	10 <sup>3</sup> /L
PLT-RV75	15.0	fL	PLT-H-M	0.1	10 <sup>3</sup> /L
PLT-RV76	15.0	fL	PLT-H-H	0.1	10 <sup>3</sup> /L
PLT-RV77	15.0	fL	PLT-L-L	0.1	10 <sup>3</sup> /L
PLT-RV78	15.0	fL	PLT-L-M	0.1	10 <sup>3</sup> /L
PLT-RV79	15.0	fL	PLT-L-H	0.1	10 <sup>3</sup> /L
PLT-RV80	15.0	fL	PLT-M-L	0.1	10 <sup>3</sup> /L
PLT-RV81	15.0	fL	PLT-M-M	0.1	10 <sup>3</sup> /L
PLT-RV82	15.0	fL	PLT-M-H	0.1	10 <sup>3</sup> /L
PLT-RV83	15.0	fL	PLT-H-L	0.1	10 <sup>3</sup> /L
PLT-RV84	15.0	fL	PLT-H-M	0.1	10 <sup>3</sup> /L
PLT-RV85	15.0	fL	PLT-H-H	0.1	10 <sup>3</sup> /L
PLT-RV86	15.0	fL	PLT-L-L	0.1	10 <sup>3</sup> /L
PLT-RV87	15.0	fL	PLT-L-M	0.1	10 <sup>3</sup> /L
PLT-RV88	15.0	fL	PLT-L-H	0.1	10 <sup>3</sup> /L
PLT-RV89	15.0	fL	PLT-M-L	0.1	10 <sup>3</sup> /L
PLT-RV90	15.0	fL	PLT-M-M	0.1	10 <sup>3</sup> /L
PLT-RV91	15.0	fL	PLT-M-H	0.1	10 <sup>3</sup> /L
PLT-RV92	15.0	fL	PLT-H-L	0.1	10 <sup>3</sup> /L
PLT-RV93	15.0	fL	PLT-H-M	0.1	10 <sup>3</sup> /L
PLT-RV94	15.0	fL	PLT-H-H	0.1	10 <sup>3</sup> /L
PLT-RV95	15.0	fL	PLT-L-L	0.1	10 <sup>3</sup> /L
PLT-RV96	15.0	fL	PLT-L-M	0.1	10 <sup>3</sup> /L
PLT-RV97	15.0	fL	PLT-L-H	0.1	10 <sup>3</sup> /L
PLT-RV98	15.0	fL	PLT-M-L	0.1	10 <sup>3</sup> /L
PLT-RV99	15.0	fL	PLT-M-M	0.1	10 <sup>3</sup> /L
PLT-RV100	15.0	fL	PLT-M-H	0.1	10 <sup>3</sup> /L

Manual PLT Estimate= 141,000

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### CASE STUDY #5 - DIAGNOSIS?

**Giant Platelets due to Pregnancy**

- Giant platelets are a normal phenomenon in pregnant women
- Ability to utilize a second platelet methodology easily provided accurate platelet count of 122,000
- Epidural requires PLT >100,000
- No delay in epidural order

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### CASE STUDY #6 - IPF

48 YEAR OLD MALE WITH PANCREATIC CANCER

CBC	Cycle 1 Day 1	Cycle 3 Day 1	Cycle 3 Day 8	Units	Normal Range
WBC	5.3	4.0	2.8 Low	X10 <sup>9</sup> /µL	4-11
RBC	4.48	4.1 Low	3.97 Low	X10 <sup>6</sup> /µL	4.2-6.0
Hgb	13.1 Low	12.1 Low	10.9 Low	g/dL	13.5-18.0
HCT	36.3 Low	30.6 Low	30.6 Low	%	40-52
PLT	205	92 Low	42 Low	X10 <sup>3</sup> /µL	130-400
IPF			0.0 Low	%	0.9-7.0

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### CASE STUDY #6 - IPF

48 YEAR OLD MALE WITH PANCREATIC CANCER

CBC	Cycle 1 Day 1	Cycle 3 Day 1	Cycle 3 Day 8	Next Day	Units	Normal Range
WBC	5.3	4.0	2.8 Low		X10 <sup>9</sup> /µL	4-11
RBC	4.48	4.1 Low	3.97 Low		X10 <sup>6</sup> /µL	4.2-6.0
Hgb	13.1 Low	12.1 Low	10.9 Low		g/dL	13.5-18.0
HCT		36.3 Low	30.6 Low		%	40-52
PLT	205	92 Low	42 Low	6 Low	X10 <sup>3</sup> /µL	130-400
IPF			0.0 Low	0.0 Low	%	0.9-7.0

**Value of IPF**

- Relevant data that may contribute to treatment decisions
- Results can be obtained quickly without additional drain on resources
- Minimal cost and no discomfort compared to invasive diagnostic testing

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**CASE STUDY #7 - IPF**  
**59 YEAR OLD FEMALE WITH STAGE IV METASTATIC BREAST CANCER**

CBC	Cycle 1 Day 1	Cycle 3 Day 1	Cycle 3 Day 9	Units	Normal Range
WBC	5.7	1.5 Low	2.1 Low	$\times 10^9/\mu\text{L}$	4-11
RBC	4.3	2.93 Low	2.99 Low	$\times 10^6/\mu\text{L}$	4.2-6.0
Hgb	13.0	8.6 Low	10.6 Low	g/dL	12-16
HCT	38.1	25.2 Low	31.1 Low	%	36-47
PLT	161	39 Low	17 Low	$\times 10^3/\mu\text{L}$	150-400
IPF		6.6	50 High	%	0.9-7.0

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**CASE STUDY #7 - IPF**  
**59 YEAR OLD FEMALE WITH STAGE IV METASTATIC BREAST CANCER**

CBC	Cycle 1 Day 1	Cycle 3 Day 1	Cycle 3 Day 9	Cycle 4 Day 1	Units	Normal Range
WBC	5.7	1.5 Low	2.1 Low	2.6 Low	$\times 10^9/\mu\text{L}$	4-11
RBC	4.3	2.93 Low	2.99 Low	3.41 Low	$\times 10^6/\mu\text{L}$	4.2-6.0
Hgb	13.0	8.6 Low	10.6 Low	10.0 Low	g/dL	12-16
HCT	38.1	25.2 Low	31.1 Low	30.0 Low	%	36-47
PLT	161	39 Low	17 Low	119 Low	$\times 10^3/\mu\text{L}$	150-400
IPF		6.6	50 High		%	0.9-7.0

**Value of IPF**

- Relevant data that may contribute to treatment decisions
- Part of CBC, using the same lavender tube
- Results can be obtained quickly without additional drain on resources
- Minimal cost and no discomfort compared to invasive diagnostic testing

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**CASE STUDY #8 BURN PATIENT**

- A 27 year old male involved in an industrial accident presents at the burn center with 2<sup>nd</sup> and 3<sup>rd</sup> degree burns over 80% of his body.
- Initial CBC results showed extremely elevated platelet count.

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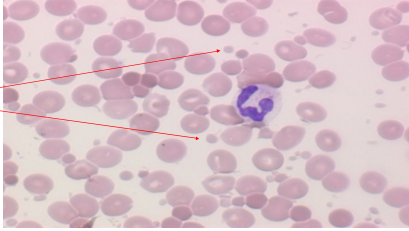
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**PLT MEASUREMENT OVER TIME IN A SEVERE BURN INJURY PATIENT**

- What concern can you see in this peripheral smear?

Micro-spherical RBCs (due to thermal injury)

- What parameter(s) do you think will be erroneously impacted?



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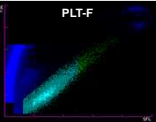
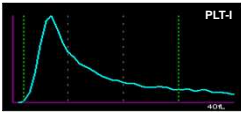
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**PLT COUNT OVER TIME IN A BURN PATIENT**

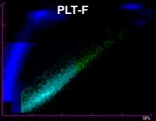
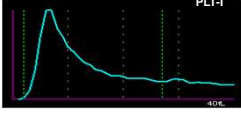
**Day 1**

PLT	( $\times 10^3/\mu\text{L}$ )	1118
PLT-I		
PLT-F		228
CD61		20.4

**Day 2**

PLT	( $\times 10^3/\mu\text{L}$ )	795
PLT-I		
PLT-F		161
CD61		15.0

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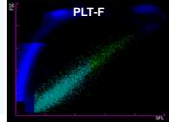
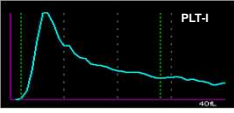
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**PLT COUNT OVER TIME IN A BURN PATIENT**

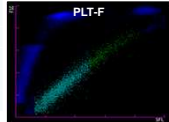
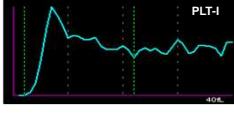
**Day 3**

PLT	( $\times 10^3/\mu\text{L}$ )	632
PLT-I		
PLT-F		116
CD61		11.5

**Day 4**

PLT	( $\times 10^3/\mu\text{L}$ )	201
PLT-I		
PLT-F		5.4
CD61		5.1

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### CASE STUDY #9

- A 35 year old man went to visit relatives for vacation. Two weeks after his return, he presented to the ER and told them he wasn't feeling well. He told them he had just returned from visiting family. Nothing out of the ordinary.
- He reported high fevers, shaking chills, and flu-like symptoms.
- Upon examination he was found to have an enlarged liver and spleen.

Did anyone ask him where his family lived?

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The screenshot shows a Sysmex software interface with a hematology panel. The panel includes a table of test results and several flow cytometry plots. The test results table is as follows:

Test	Data	Unit	Test	Data	Unit
WBC	11.08	10 <sup>9</sup> /L	LYC	20.85	%
RDW	9.72	%	LYC2	2.23	%
RDW-CV	10.2	%	LYC3	0.80	%
PLV	88.2	fL	LYC4	0.80	%
PLV-CV	12.0	%	LYC5	0.40	%
PLT	327	10 <sup>9</sup> /L	LYC6	0.12	%
PLT-CV	12.7	%	LYC7	0.12	%
PLT-FL	18.0	fL	LYC8	0.02	%
PLT-FL-CV	8.08	%	LYC9	0.02	%
IMPAKTS	0.3	#	LYC10	0.03	%

The flow cytometry plots show various parameters including RBC-FLG(s), PLT-FLG(s), and PLT-FLG(s) with corresponding histograms and scatter plots.

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### CASE #9 IMAGE A

The screenshot shows a Sysmex software interface displaying a microscopic image of a blood smear. The image shows a large number of red blood cells, many of which are enlarged and have a central pallor, characteristic of spherocytes. The background is a light pink color, and the cells are stained with a pinkish-red dye.

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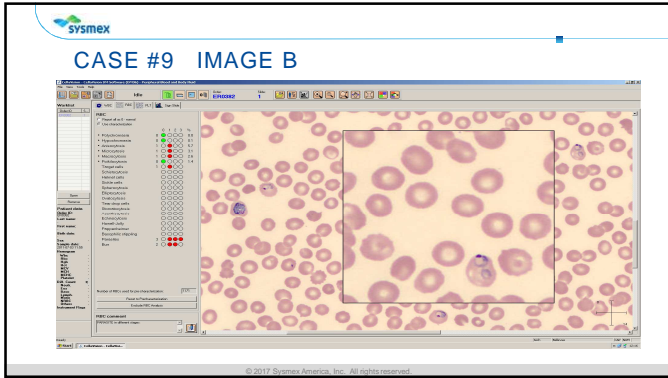
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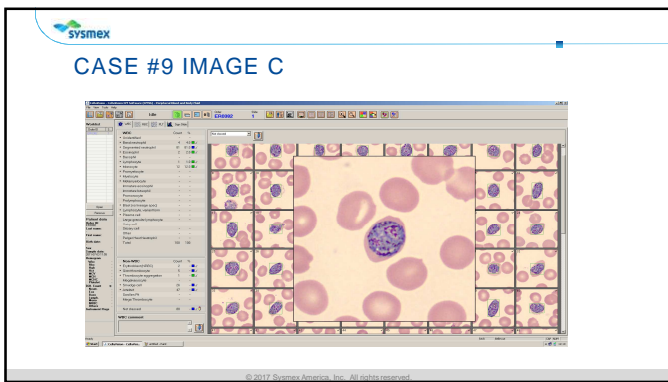
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**CASE STUDY #9 – DIAGNOSIS?**

**Plasmodium Vivax**



- Malarial parasites work by digesting red cell proteins and making the RBC membrane less deformable, causing hemolysis, increased splenic clearance, and anemia.
- P. Vivax makes up 16% of cases reported in US
- Not found in West Africa as no Duffy Antigen, which is required for entry in to the RBC.
- Characterized by:
  - Low to Normal Platelet Count
  - Anemia
  - White blood cell (WBC) counts during malaria are generally characterized as being low to normal, a phenomenon that is widely thought to reflect localization of leukocytes away from the peripheral circulation and to the spleen and other organs, rather than actual depletion or stasis.
  - In P.Vivax it is common to see more than one stage in the life cycle at the same time in the Peripheral Blood.

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### CASE STUDY #10

- A 38 year old; HIV positive man presented at the clinic with a chronic cough, bloody sputum, fever, night sweats and recent weight loss.
- The MD ordered chest films as well as bacterial, fungal, and AFB cultures on the sputum.
- CBC values were unremarkable except for a WBC count of 17.2

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Item	Unit	Value	Ref. Range	Abn. Flag(s)
WBC	10 <sup>9</sup> /L	17.2	4.0-10.0	WBC-H
Hemoglobin	g/dL	12.1	12.0-16.0	
Hematocrit	%	35.7	37.0-47.0	Hct-L
MCV	fL	101.7	80.0-100.0	MCV-H
MCH	pg	99.5	27.0-34.0	MCH-H
MCHC	g/dL	28.9	32.0-36.0	MCHC-L
RDW-CV	%	13.2	11.5-14.0	
RDW-SD	fL	43.4	35.0-46.0	
MPV	fL	8.3	7.0-10.0	
PLT	10 <sup>9</sup> /L	213	150-400	
PLT-P	%	2.8	0-10	

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### CASE # 10 CELL IMAGES

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### CASE STUDY #10 – DIAGNOSIS?

**Monocytosis**

- Monocytosis itself is not a disease, but a symptom.
- Inflammatory conditions such as infection or autoimmune disturbances are primary causes of monocytosis. Some of the common types of infection that might lead to this condition include tuberculosis, syphilis and Rocky Mountain spotted fever. Autoimmune disorders such as lupus or rheumatoid arthritis might also lead to monocytosis.
- Some blood disorders might lead to a high number of monocytes as well.
- In this particular case, Tuberculosis was the diagnosis

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### CASE STUDY #11

- 53 year old woman from Connecticut, no recent travel
- Fatigue, malaise, loss of appetite
- Occasional fever
- Elevated ESR
- Liver function tests: Elevated TBil, LDH, and liver transaminases

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The screenshot displays a Sysmex software interface for a Complete Blood Count (CBC) analysis. The main window shows the following data:

Item	Data	Unit	Item	Data	Unit
WBC	4.26	10 <sup>9</sup> /L	MCV	2.66	fL
RBC	5.24	10 <sup>12</sup> /L	LYMPH	6.82	10 <sup>9</sup> /L
HGB	15.0	g/dL	NEUT	6.23	10 <sup>9</sup> /L
HCT	44.4	%	PLT	6.16	10 <sup>9</sup> /L
MCV	100.8	fL	MONO	6.82	10 <sup>9</sup> /L
MCH	148.8	pg	LYMPH	28.8	%
MCHC	11.8	g/dL	NEUT	5	%
PLT	112	10 <sup>9</sup> /L	PLT	1.0	10 <sup>9</sup> /L
RDW	17.2	%	MONO	6.82	10 <sup>9</sup> /L
RDW-CV	11.4	%	LYMPH	6.82	10 <sup>9</sup> /L
MPV	11.2	fL	PLT	6.16	10 <sup>9</sup> /L
PDW	6.88	10 <sup>9</sup> /L	PLT	6.16	10 <sup>9</sup> /L
MPV-FL	6.8	fL	PLT	6.16	10 <sup>9</sup> /L

The flow cytometry plots show a high percentage of monocytes (6.82%) and a corresponding histogram for PLT-FL (platelet fluorescence) showing a peak at 6.16 x 10<sup>9</sup>/L.

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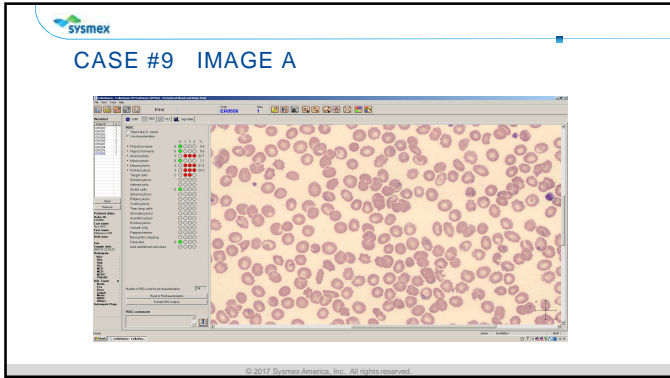
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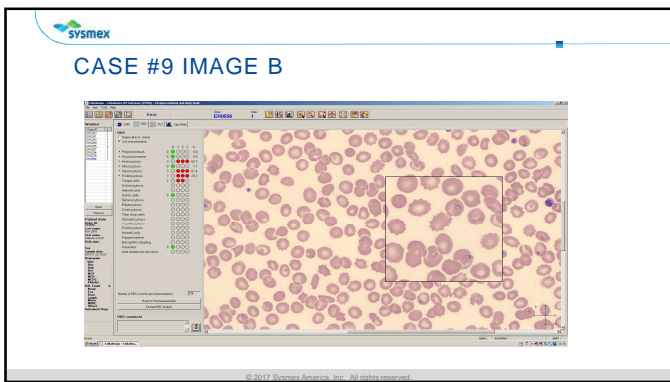
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**CASE STUDY #9 – DIAGNOSIS?**

**Babesiosis**

- **Where do most of the cases of babesiosis occur in the United States?**
  - Tickborne transmission of *B. microti* primarily occurs in the Northeast and upper Midwest, particularly in parts of New England, New York State, New Jersey, Wisconsin, and Minnesota.
  - There are over 100 different species of Babesia, but only a few are known to cause illness in humans
- **Other possible ways of becoming infected with Babesia include:**
  - Receipt of a contaminated blood transfusion (no tests have been licensed yet for donor screening); or
  - Transmission from an infected mother to her baby during pregnancy or delivery.
- The Centers for Disease Control and Prevention have issued a warning about babesiosis. According to the CDC the illness is transmitted through blood transfusions and has infected at least 122 people since 2000. This was released on Sept. 7, 2011.




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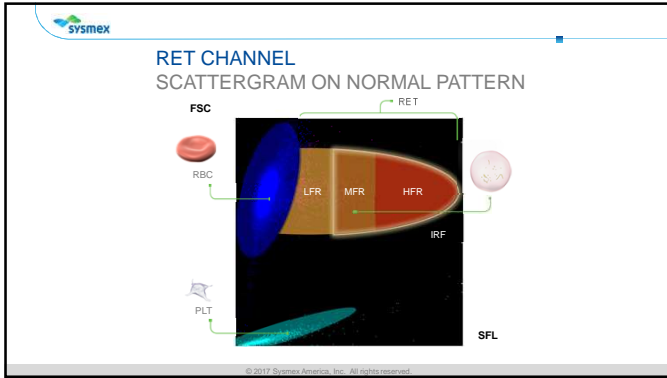
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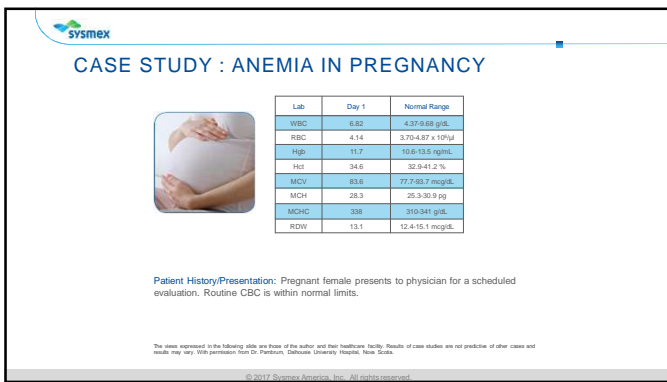
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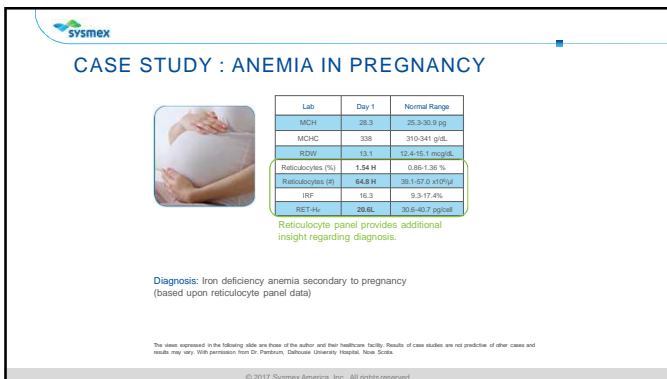
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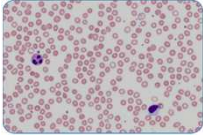
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### SMEAR REVIEW & FERRITIN RESULTS



- Smear Review no evidence of IDA
- Ferritin Results confirms diagnosis of IDA

Ferritin	6.8 L	g/dL	12.0-140
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### CASE STUDY : INFANT WITH LETHARGY



Lab	Day 1	Normal Range
RBC	4.01	3.43-4.89 x 10 <sup>12</sup> /L
Hgb	7.0 L	9.6-12.4 mg/dL
HCT	23.7 L	28.6-37.2 %
MCV	59.1 L	74.1-87.5 mcg/dL
MCH	17.5 L	24.4-28.9 pg
MCHC	295 L	319-344 g/dL
RDW	19.3 H	12.4-15.3 %

**Patient History/Presentation:** 5 month old presents to ER with lethargy and decreased appetite

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### CASE STUDY : INFANT WITH LETHARGY



Lab	Day 1	Normal Range
MCH	17.5 L	24.4-28.9 pg
MCHC	295 L	319-344 g/dL
RDW	19.3 H	12.4-15.3 mcg/dL
Reticulocyte (%)	0.68 L	1.55-2.70%
Reticulocyte (#)	27.3 L	48.2-88.2 x 10 <sup>9</sup> /L
IRF	4.8L	13.4-23.3 %
RET-Hc	11.9 L	27.6-36.7 pg/dL

Reticulocyte panel provided additional data that enhanced plan of care

**Diagnosis:** Severe iron deficiency anemia secondary to poor intake and nutrition  
**Treatment Plan:** Started on oral therapy and instructed to see pediatrician in 7 day for repeat labs and evaluation

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### CASE STUDY : INFANT WITH LETHARGY



Lab	Day 1	Day 7	Normal Range
RBC	4.01	2.96	3.43-4.89 x 10 <sup>12</sup> /µl
Hgb	7.8 L	7.28 L	9.5-12.4 mg/dL
HCT	23.7 L	24.1 L	28.6-37.2 %
MCV	59.1 L	60.9 L	74.1-87.5 fL
MCH	17.6 L	18.2 L	24.4-28.9 pg
MCHC	295 L	299 L	319-344 g/dL
RDW	19.3 H	23.3 H	12.4-15.3 %
Reticulocyte (%)	0.68 L	2.15	1.55-2.70 %

Is therapy working?  
Caregiver noncompliance vs non-responder to therapy

What is the next step?  
Admit to hospital for intravenous iron therapy  
Recommend gastrointestinal consult to rule out a malabsorption issue

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### CASE STUDY : INFANT WITH LETHARGY



Lab	Day 1	Day 7	Normal Range
MCH	17.6 L	18.2 L	24.4-28.9 pg
Hgb	7.8 L	7.28 L	9.5-12.4 mg/dL
HCT	23.7 L	24.1 L	28.6-37.2 %
Reticulocyte (%)	0.68 L	2.15	1.55-2.70 %
Reticulocyte (fl)	27.3 L	85.1	48.2-88.2 x 10 <sup>9</sup> /µl
RF	4.9 L	45.5 H	13.4-20.3 %
RET-Hc	11.9 L	24.6 L	27.6-36.7 pg/µl

Reticulocyte panel provided clinically significant data that enhanced care

Is therapy working?  
Yes - RET-Hc shows an appropriate increase

What is the next step?  
Continue on oral iron therapy with routine follow up

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