Advanced Hematology

Reading between the lines, connecting the dots, and adding a microscope

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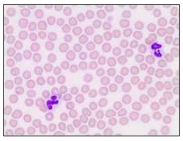
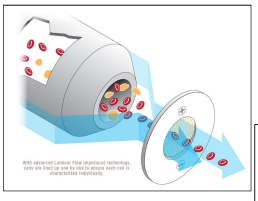
METZGER ANIMAL HOSPITAL
AAHA ACCREDITED REFERRAL

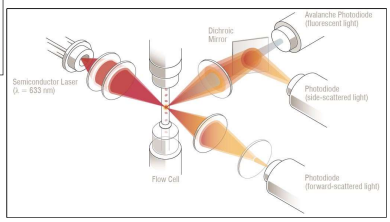
Automated hematology analyzers

- Provide rapid and useful information
- Common problems:
  - Clumped cells
  - Nucleated red blood cells
  - Morphology changes

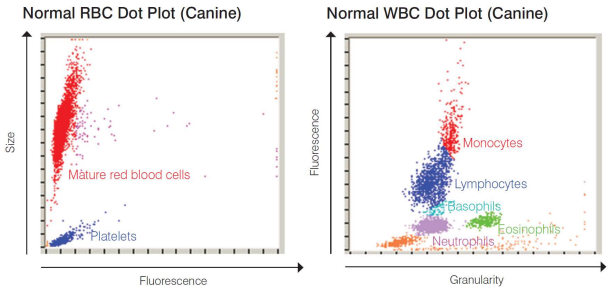


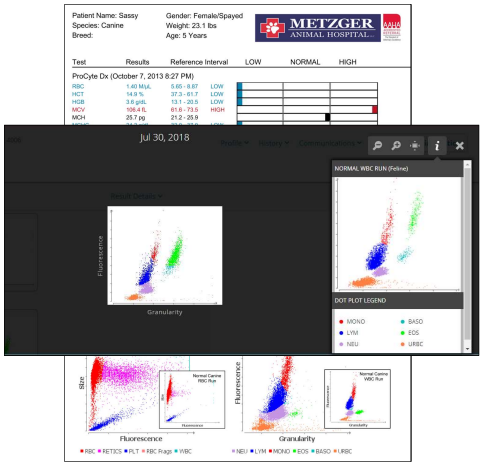
Hematology analyzer technologies





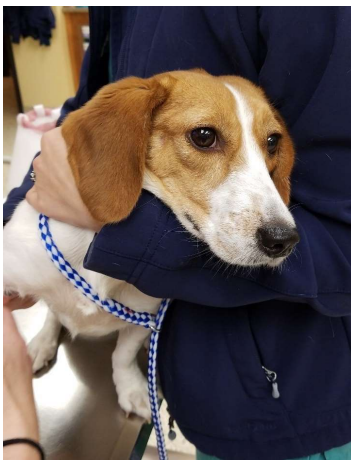
ProCyte Dx dot plots





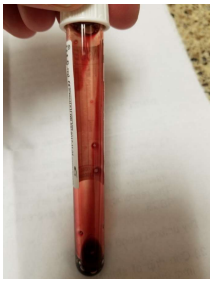
Alli

2y F Beagle



Alli

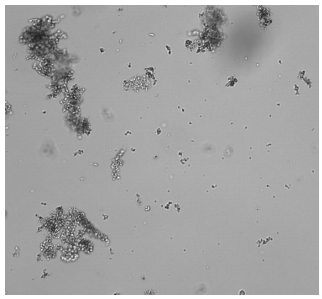
- Presents for “dripping blood from back end”



Alli

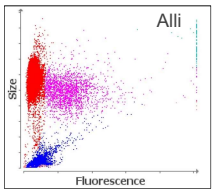
UA (September 30, 2016 9:34 AM)	
Collection	Cystocentesis
Color	Red
Clarity	Opaque
Specific Gravity	> 1.060

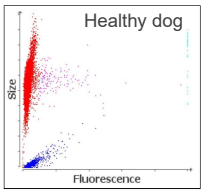
SediVue Dx (September 30, 2016 9:28 AM)	
WBC	None to rare
RBC	None to rare
EPI	
Squamous	None to rare
Non-squamous	None to rare
Casts	
Hyaline	None to rare
Non-hyaline	>1 /LPF
Crystals	
Unclassified	1 - 5 /HPF
CaOx Di	None to rare
Struvite	None to rare



Alli — Urine

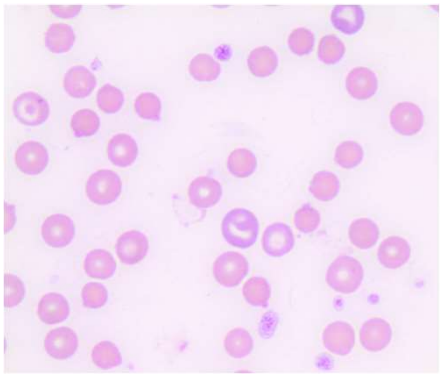
Alli



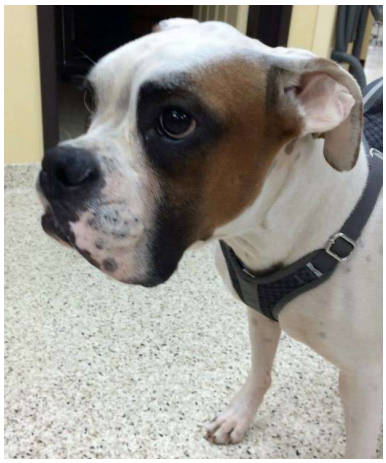


Test	Results	Reference Interval	LOW / NORMAL / HIGH
ProCyte Dx (September 30, 2016 9:20 AM)			
RBC	3.12 M/µL	5.65 - 8.87	LOW
HCT	23.3 %	37.3 - 61.7	LOW
HGB	7.8 g/dL	13.1 - 20.5	LOW
MCV	74.7 fL	61.6 - 73.5	HIGH
MCH	25.0 pg	21.2 - 25.9	
MCHC	33.5 g/dL	32.0 - 37.9	
RDW	18.0 %	13.6 - 21.7	
%RETIC	10.9 %		
RETIC	338.8 K/µL	10.0 - 110.0	HIGH

Alli — Blood film



Maxi
1y M/N Boxer



Maxi

METZGER ANIMAL HOSPITAL

Patient Check-In information: 10:13 AM 8/26/2015

Maxi's Medical Exam Report

History: Patient has history of meningitis. Is here to update vaccines and to have BMP. MM pale on presentation.

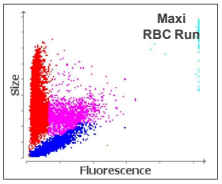
Is **Maxi** on any medications? ☑ Yes ☐ No
If Yes, what medications? Prednisone 20 mg- give 1 tablet once daily for 2 days then skip one day, and repeat cycle.

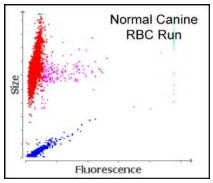
Maxi

ProCyte Dx (August 26, 2015 10:32 AM)

Test	Results	Reference Interval	LOW / NORMAL / HIGH	7/17/15 10:32 AM
RBC	* 2.75 M/µL	5.65 - 8.87	LOW	6.24 M/µL
HCT	* 11.2 %	37.3 - 61.7	LOW	41.1 %
HGB	3.3 g/dL	13.1 - 20.5	LOW	14.7 g/dL
MCV	* 40.7 fL	61.6 - 73.5	LOW	65.9 fL
MCH	* 12.0 pg	21.2 - 25.9	LOW	23.6 pg
MCHC	* 29.5 g/dL	32.0 - 37.9	LOW	35.8 g/dL
RDW	* 34.2 %	13.6 - 21.7	HIGH	18.7 %
%RETIC	* 8.7 %			2.3 %
RETIC	* 239.5 K/µL	10.0 - 110.0	HIGH	141.6 K/µL
RETIC-HGB	* 13.0 pg	22.3 - 29.6		25.1 pg
WBC	* 9.78 K/µL	5.05 - 16.76		8.61 K/µL
%NEU	* 73.3 %			69.1 %
%LYM	* 13.7 %			15.3 %
%MONO	* 8.7 %			8.9 %
%EOS	* 4.3 %			6.5 %
%BASO	* 0.0 %			0.2 %
NEU	* 7.17 K/µL	2.95 - 11.64		5.94 K/µL
LYM	* 1.34 K/µL	1.05 - 5.10		1.32 K/µL
MONO	* 0.85 K/µL	0.16 - 1.12		0.77 K/µL
EOS	* 0.42 K/µL	0.06 - 1.23		0.56 K/µL
BASO	* 0.00 K/µL	0.00 - 0.10		0.02 K/µL
nRBC	* Suspected			
PLT	* 635 K/µL	148 - 484	HIGH	464 K/µL

Maxi

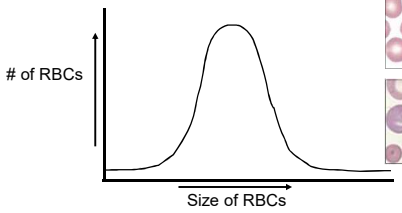


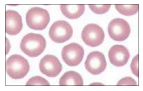


Test	Results	Reference Interval	LOW	NORMAL	HIGH
ProCyte Dx (August 26, 2015 10:32 AM)					
RBC	* 2.75 M/µL	5.65 - 8.87	LOW		
HCT	* 11.2 %	37.3 - 61.7	LOW		
HGB	3.3 g/dL	13.1 - 20.5	LOW		
MCV	* 40.7 fL	61.6 - 73.5	LOW		
MCH	* 12.0 pg	21.2 - 25.9	LOW		
MCHC	* 29.5 g/dL	32.0 - 37.9	LOW		
RDW	* 34.2 %	13.6 - 21.7	HIGH		
%RETIC	* 8.7 %				
RETIC	* 239.5 K/µL	10.0 - 110.0	HIGH		

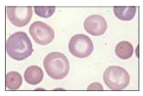
Red cell distribution width (RDW)

- Coefficient of variation of the red cell volume distribution
- Index of variation in size of RBC population (anisocytosis)





RDW = 16.2%
(14.7 – 17.9)

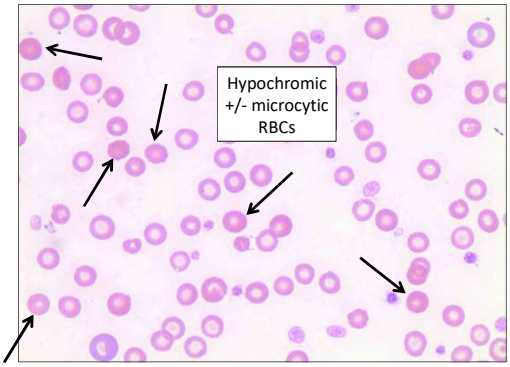


RDW = 23.6%
(14.7 – 17.9)

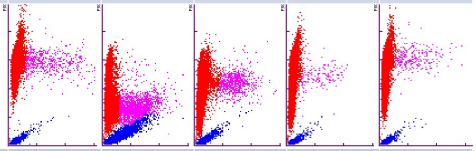
Maxi

Test	Results	Reference Interval	LOW	NORMAL	HIGH
ProCyte Dx (August 26, 2015 10:32 AM)					
RBC	* 2.75 M/µL	5.65 - 8.87	LOW		
HCT	* 11.2 %	37.3 - 61.7	LOW		
HGB	3.3 g/dL	13.1 - 20.5	LOW		
MCV	* 40.7 fL	61.6 - 73.5	LOW		
MCH	* 12.0 pg	21.2 - 25.9	LOW		
MCHC	* 29.5 g/dL	32.0 - 37.9	LOW		
RDW	* 34.2 %	13.6 - 21.7	HIGH		
%RETIC	* 8.7 %				
RETIC	* 239.5 K/µL	10.0 - 110.0	HIGH		
WBC	* 9.78 K/µL	5.05 - 16.76			
%NEU	* 73.3 %				
%LYM	* 13.7 %				
%MONO	* 8.7 %				
%EOS	* 4.3 %				
%BASO	* 0.0 %				
NEU	* 7.17 K/µL	2.95 - 11.64			
LYM	* 1.34 K/µL	1.05 - 5.10			
MONO	* 0.85 K/µL	0.16 - 1.12			
EOS	* 0.42 K/µL	0.06 - 1.23			
BASO	* 0.00 K/µL	0.00 - 0.10			
nRBC	* Suspected				
PLT	* 635 K/µL	148 - 484	HIGH		

Maxi



Maxi

Date	07/17/15	08/26/15	09/08/15	11/10/15	12/22/15
HCT (%) (37.3 – 61.7)	41.1	11.2	25.4	25.4	41.6
MCV (fL) (61.6 – 73.5)	65.9	40.7	44.7	52.2	60.3
RETIC (K/µL) (10 – 110)	141.6	239.5	171.0	51.11	72.5
					
RETIC-HGB (pg) (22.1 – 29.5)	25.1	13.0	17.5	19.6	26.7

RETIC-HGB (Reticulocyte hemoglobin)

1. Biomarker for Iron Deficiency
   - Sensitive
   - Specific
2. Decreases earlier than MCV/MCHC
   - MCV/MCHC changes require time – mean values
   - RET-He changes in 2-4 days – reticulocyte production
3. Measure of both absolute and functional deficiency
   - Fe loss or deficiency
   - Fe availability – inflammation and chronic disease

Bella

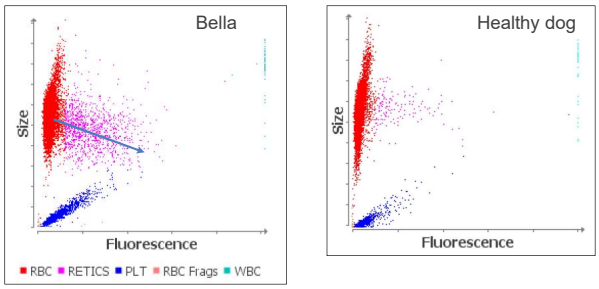
9y F/S Doodle

Bella – Reticulocytosis without anemia

ProCyte Dx (April 17, 2018 11:29 AM)

Test	Results	Reference Interval	LOW	NORMAL	HIGH
RBC	6.50 M/µL	5.65 - 8.87			
HCT	42.1 %	37.3 - 61.7			
HGB	13.9 g/dL	13.1 - 20.5			
MCV	64.8 fL	61.6 - 73.5			
MCH	21.4 pg	21.2 - 25.9			
MCHC	33.0 g/dL	32.0 - 37.9			
RDW	17.8 %	13.6 - 21.7			
%RETIC	4.6 %				
RETIC	301.0 K/µL	10.0 - 110.0	HIGH		
WBC	10.38 K/µL	5.05 - 16.76			
%NEU	77.2 %				
%LYM	12.6 %				
%MONO	7.3 %				
%EOS	2.4 %				
%BASO	0.5 %				
NEU	8.01 K/µL	2.95 - 11.64			
LYM	1.31 K/µL	1.05 - 5.10			
MONO	0.76 K/µL	0.16 - 1.12			
EOS	0.25 K/µL	0.06 - 1.23			
BASO	0.05 K/µL	0.00 - 0.10			
PLT	294 K/µL	148 - 484			

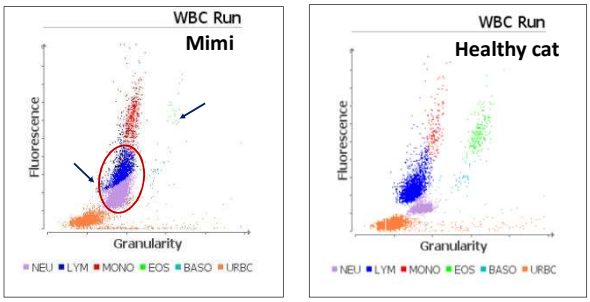
Bella – RBC dot plot



Mimi

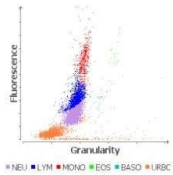
7m F/S DSH

ProCyte WBC dot plot



Mimi – Leukon evaluation

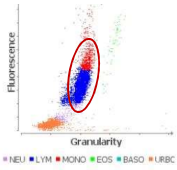
Test	Results	Reference Interval	LOW	NORMAL	HIGH
ProCyte Dx (May 10, 2016 12:52 PM)					
WBC	8.33 K/µL	2.87 - 17.02			
%NEU	64.1 %				
%LYM	28.2 %				
%MONO	7.1 %				
%EOS	0.2 %				
%BASO	0.4 %				
NEU	5.34 K/µL	1.48 - 10.29			
LYM	2.35 K/µL	0.92 - 6.88			
MONO	0.59 K/µL	0.05 - 0.67			
EOS	0.02 K/µL	0.17 - 1.57	LOW		
BASO	0.03 K/µL	0.01 - 0.26			



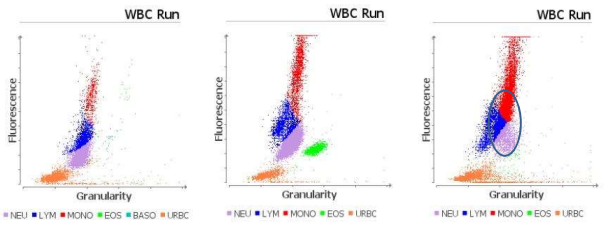
Mimi – The following day

Test	Results	Reference Interval			
WBC	6.52 K/µL	2.87 - 17.02			8.33 K/µL
%NEU	* 5.5 %				64.1 %
%LYM	* 79.0 %				28.2 %
%MONO	* 14.1 %				7.1 %
%EOS	1.1 %				0.2 %
%BASO	0.3 %				0.4 %
NEU	* 0.36 K/µL	1.48 - 10.29	LOW		5.34 K/µL
BAND	* Suspected				
LYM	* 5.15 K/µL	0.92 - 6.88			2.35 K/µL
MONO	* 0.92 K/µL	0.05 - 0.67	HIGH		0.59 K/µL
EOS	0.07 K/µL	0.17 - 1.57	LOW		0.02 K/µL
BASO	0.02 K/µL	0.01 - 0.26			0.03 K/µL

Band neutrophils suspected



Recognizing left shift/inflammation

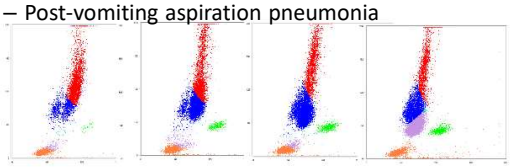


Mimi | Skywalker | SpongeBob

C-Reactive Protein (CRP)

Panzer

– Post-vomiting aspiration pneumonia



	2/21/18	2/23/18	2/24/18	2/26/18
CRP	18.4	13.4	4.9	4.5

{RI 0-1.0 mg/dL; >3.0 mg/dL → significant inflammation}

Mac
12y M/N
Greyhound mix

Mac

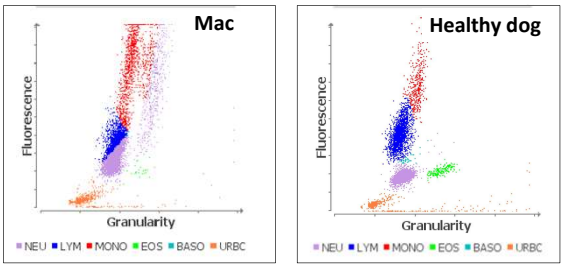
- Referred for "irregular spleen, possible lymphoma"
- Hx
  - Anorexia, lethargy
- PE
  - In prayer position in exam room
  - Uncomfortable on abdominal palpation

Mac — CBC

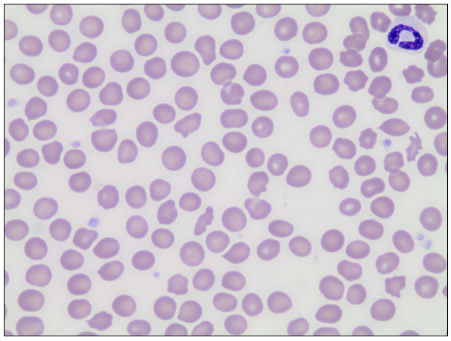
Test	Results	Reference Interval	LOW	NORMAL	HIGH
ProCyte Dx (January 22, 2018 8:38 AM)					
RBC	6.47 M/µL	5.65 - 8.87			
HCT	42.9 %	37.3 - 61.7			
HGB	14.3 g/dL	13.1 - 20.5			
MCV	66.3 fL	61.6 - 73.5			
MCH	22.1 pg	21.2 - 25.9			
MCHC	33.3 g/dL	32.0 - 37.9			
RDW	19.8 %	13.6 - 21.7			
%RETIC	0.9 %				
RETIC	56.9 K/µL	10.0 - 110.0			
WBC	11.20 K/µL	5.05 - 16.76			
%NEU	* 60.6 %				
%LYM	* 25.6 %				
%MONO	* 13.4 %				
%EOS	0.3 %				
%BASO	0.1 %				
NEU	* 6.79 K/µL	2.95 - 11.64			
BAND	* Suspected				
LYM	* 2.87 K/µL	1.05 - 5.10			
MONO	* 1.50 K/µL	0.16 - 1.12	HIGH		
EOS	0.03 K/µL	0.06 - 1.23	LOW		
BASO	0.01 K/µL	0.00 - 0.10			
PLT	199 K/µL	148 - 484			
MPV	10.5 fL	8.7 - 13.2			
PDW	14.3 fL	9.1 - 19.4			
PCT	0.21 %	0.14 - 0.46			

WBC Abnormal Distribution

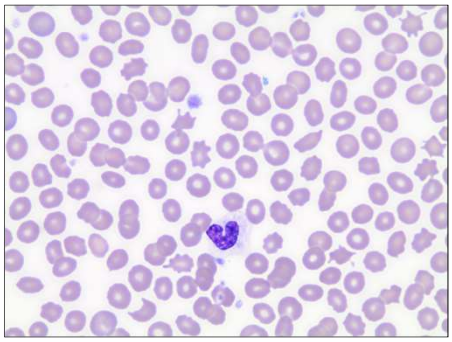
Mac — WBC Run



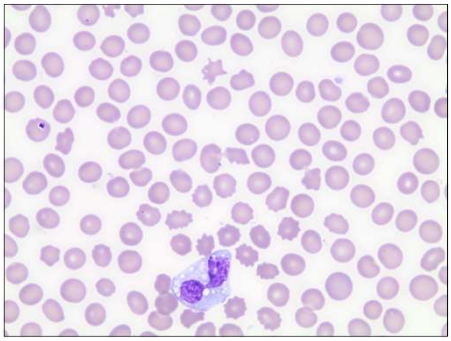
Mac — Blood film



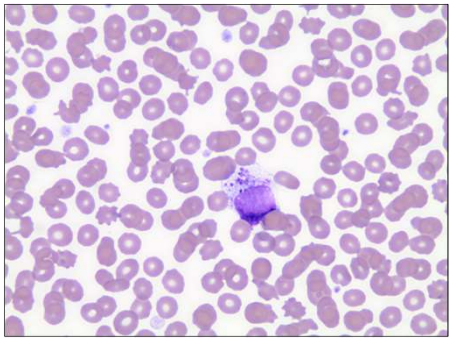
Mac — Blood film



Mac — Blood film

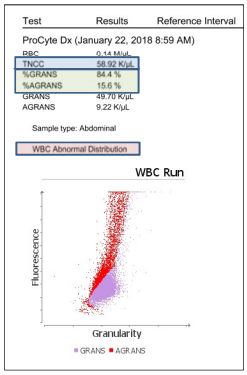


Mac — Blood film



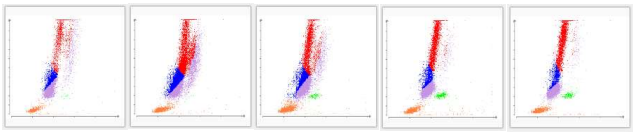
Mac — Abdominal ultrasound

Mac — Fluid analysis



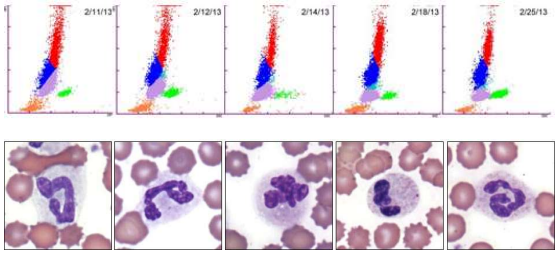
Mac — Splenectomy

Mac — Trending CBC dot plots



1/22 1/23 1/24 1/25 1/26

Trending dot plots vs. toxic change



Mac — Monitoring via VetConnect Plus

IDEXX VetConnect PLUS

Hematology	2/12/18 11:26 AM	2/5/18 11:39 AM	1/29/18 7:55 AM	1/26/18 5:58 AM	1/25/18 12:41 PM	1/24/18 7:20 AM
WBC	10.12	22.71	41.34	19.55	18.92	26.1