VETSCAN HN5 who she had the for Customer Training A A A A A A A A



### **TRAINING AGENDA**

- Review of instrument components
- 2 Running a blank
- 3 Sample handling and testing technique
- 4 Sample flags and histograms
- 5 Instrument Maintenance
- 6 Database storage
  - Quality control and calibration
- 8 Troubleshooting & resources





#### **VETSCAN HM5 Hematology Analyzer**



**Built-in thermal printer** LCD touchscreen Sampling door and rotor **USB** ports 12v DC power supply Mini keyboard





#### **VETSCAN HM5 Reagent Pack**

• Diluent • Cleaner

Lyse
 Lyse 2 <sup>o</sup> Rinse

Reagent Pack components differ by setup

#### **Quick Change Apparatus (QCA)**



#### 1. Zoetis VETSCAN HM5 Blue Version Operator's Manual (v2.3), pg.14

#### **Bottle Caps**





#### Sample tube adapters

- **#1** for 2-3 mL sample tubes, HemaClean, and controls
- **#2** for 1.3 mL microtainer sample tubes
- **#3** for 2 mL glass vials
- #6 for 0.6 mL vacutainer tubes or smaller



### **HM5 MAINTENANCE**

### DAILY- RUN A BLANK<sup>1</sup>

#### Why run a blank?

The blank looks for debris in the analyzer and checks to ensure the fluids from the reagent pack are flowing properly.

#### Blank results are expired! Press OK to measure a Blank first

Blank Measure

#### How do I run a blank?

The HM5 automatically prompts for a blank before testing, if needed. Follow the on-screen instructions. No sample needed.





Cancel

OK

### **HM5 MAINTENANCE**

### WHEN ARE BLANKS REQUIRED:1

- Expires after 12 hours (24hr clinics may need to run 2 per day)
- After reagent pack changes
- After soak cleaning cycle
- After self-test
- After unit is powered off/on
- After deep cleaning

### **RUN A BLANK** – 3 mins to run & then evaluate your results. Don't forget to press "**ACCEPT**"

1. Zoetis VETSCAN HM5 Blue Version Operator's Manual (v2.3), pg..43

	Mea	isure		08:13
PID SID Needle 0 (z	0 ero) mm	03/ Type	02/2016	08:13 Blank
WBC LYM MON	10% 10% 10%	1	VBC	
	Initia	lizing		
MCV MCH MCHC RDWc	fl pg g/dl	'		
RDWs PLT MPV	/0 fl 10%/I fl	1	PLT	200fi
PCT PDWc PDWs	% % fl			
Accent	Rok	alank	т	50fl
Print	Disc	card	E	Exit



### **THE BLANK**

#### ACCEPTABLE BLANK

	Mea	asure		09:06 AM
PID SID Needle 0	Blank 1 (zero) mm	03/02/2 Type	016 09:	03 AM Blank
WBC 0 LYM MON EOS 0 BAS LYM% MON% NEU% EOS%	.00 10%1 10%1 10%1 00%1 .01 10%1 10%1 % % %	26	VBC EOS	400fl
BAS% RBC 0 HGB HCT MCV MCH MCHC RDWc	% .00 10 <sup>12</sup> /I 0.0 g/dl % fl pg g/dl %	79 	RBC	400fl
RDWs PLT MPV 1 PCT PDWc PDWs	fi 4 10% 0.0 fi % % fi	29	PLT 29	200fl 50fl
Accept	Re-	blank	т	ech.
Print	Dis	scard Exit		Exit



✓ All parameters within the blank value limit

✓ No results in red

Parameter	High Blank Warning Flag	Blank Value Limit
WBC	В	0.50 x 10 <sup>9</sup> /l
EOS	х	0.20 x 10 <sup>9</sup> /l
RBC	b	0.05 x 10 <sup>12</sup> /l
HGB	н	10 g/dl
PLT	р	27 x 10 <sup>9</sup> /l



### **THE BLANK**

#### **UNACCEPTABLE BLANK**



X One or more warning flags X Some parameters outside the blank value limit

X One or more results in red

Parameter	High Blank Warning Flag	Blank Value Limit
WBC	В	0.50 x 10 <sup>9</sup> /l
EOS	х	0.20 x 10 <sup>9</sup> /l
RBC	b	0.05 x 10 <sup>12</sup> /l
HGB	н	10 g/dl
PLT	р	27 x 10 <sup>9</sup> /l



### THE BLANK

#### **BEST PRACTICES**

Accept	Re-blank	Tech.
Print	Discard	Exit

- Run a Re-blank if blank is unacceptable
  - If still unacceptable, troubleshoot per the Warning
  - Contact Technical Support for additional assistance

There are parameters with high blank values! Check the User's Manual Troubleshooting section for guidance and then repeat the blank. • If an unacceptable blank is accepted, warning flags from the blank will appear on all sample runs until an acceptable blank is performed and accepted



## **PRE-ANALYTICAL ERRORS**<sup>1,2</sup>

#### SAMPLE PREP AND HANDLING

**3** Categories

- Patient Preparation And Variables
  Sample Collection And Handling
- 3. Patient Identification Errors



1. Zoetis VETSCAN HM5 Blue Version Operator's Manual (v12.3, pg.45

2. Monti P, Archer J., BSAVA Manual of Canine and Feline Clinical Pathology, 2016, (v2.0), pgs.1-2)



#### **Dependable laboratory results require:**<sup>2</sup>

Proper and sufficient sample collection
 Superb sample handling following collection
 Client education

2. Monti P, Archer J., BSAVA Manual of Canine and Feline Clinical Pathology, 2016, v2.0, pgs 1-26



#### \*\* High Quality Sample = Optimal Results



### **SAMPLE COLLECTION AND HANDLING<sup>3,4</sup>**

Select correct needle and syringe size for patient

\*\*Avoid needles smaller than 23G

Know the amount of blood needed for appropriate test and use the smallest syringe possible to prevent high levels of suction

Select largest accessible vein for collection



3. Jack, CM; Watson, PM, Veterinary Technician's Daily Reference Guide: Canine And Feline, 2014 (v1.0), pg.16

4. Merrill, L., Textbook of Veterinary Internal Medicine Expert Consult, 2016, 301-303. (v1.0) , pg.1



### SAMPLE COLLECTION AND HANDLING<sup>3,4</sup>

#### **VENIPUNCTURE – BEST PRACTICES**

Use minimum amount of alcohol and allow skin to dry prior to venipuncture

Alcohol can cause hemolysis<sup>4</sup>

Use appropriate suction on syringe when collecting sample

Avoid applying tourniquet too early

Venous occlusion should not last >1 minute



Jack, CM; Watson, PM, Veterinary Technician's Daily Reference Guide: Canine And Feline, 2014 (v1.0), pg.16
 Merrill, L., Textbook of Veterinary Internal Medicine Expert Consult, 2016, 301-303. (v1.0), pg.1



### SAMPLE COLLECTION AND HANDLING<sup>1</sup>

#### SAMPLE TRANSFER- BEST PRACTICES

After blood is collected from patient, blood should be transferred to sample tubes

Remove needle from syringe and cover from blood tube for transfer to avoid hemolysis, if not using a vacutainer system<sup>5</sup>

Dispense blood slowly into sample tubes

Do not shake or agitate blood tube

Do not store at high temperature





1. Zoetis VETSCAN HM5 Blue Version Operator's Manual (v2.3), pg.138

### **BLOOD TUBE TYPES<sup>1</sup>**



1. Zoetis VETSCAN HM5 Blue Version Operator's Manual (v12.3), pg..40:



18

### SAMPLE COLLECTION AND HANDLING

### SAMPLE TRANSFER<sup>2</sup>

Fill each sample collection tube to recommended fill line

• Citrate (Blue top)

MUST be filled to manufacturer's recommended fill line

- **Lithium Heparin (Green top)** Fill to manufacturer's guidelines
- EDTA (Purple top)
  Fill to manufacturer's guidelines



2. Monti P, Archer J., BSAVA Manual of Canine and Feline Clinical Pathology, 2016, (v2.0) pgs. 11-26



### SAMPLE TUBE FILL ORDER<sup>2</sup>

#### TO PREVENT CONTAMINATION, ALWAYS FILL TEST TUBES IN THIS ORDER:1



1. Zoetis VETSCAN VS2 Operator's Manual (v2.3), pg.12

2. Monti P, Archer J., BSAVA Manual of Canine and Feline Clinical Pathology, 2016,. (v2.0) , pg.3-26



### **EDTA CONTAMINATION<sup>2</sup>**

If tubes are not filled in the proper order, EDTA from purple top can cause contamination of the sample for chemistry testing

Using samples that are contaminated with EDTA can severely affect the chemistry results:

- Severe spurious hypocalcemia (↓ Ca2+)
- Severe spurious hyperkalemia (↑ K+)

2. Monti P, Archer J., BSAVA Manual of Canine and Feline Clinical Pathology, 2016, (v2.0), pgs..2-26



#### **INVERTING SAMPLES**

As tubes are filled with sample, they must be inverted 10-15 times to sufficiently mix with anticoagulant, if present.<sup>5</sup>

10-15 X

If using microtainer tubes, invert >15 times

2. Monti P, Archer J., BSAVA Manual of Canine and Feline Clinical Pathology, 2016, (v2.0),pgs.2-26

5. Weiser, G., Veterinary Hematology and Clinical Chemistry, 2012, (v2.0), pgs 3-33



Blood tube rocker will not sufficiently mix samples.<sup>6</sup>

It is still necessary to invert the samples to mix them properly. <sup>1</sup>





Zoetis VETSCAN HM5 Blue Version Operator's Manual (v2.3), pg.41
 Zoetis VETSCAN VS2 Operator's Manual (v1.0), section 2

### HM5 – THE COMPLETE BLOOD COUNT<sup>1</sup>

#### AS EASY AS 1 – 2 – 3

### **Simple Operation**



Enter > Insert sample > Read results information and press Run



### ETHYLENE-DIAMINE TETRA ACETIC ACID (EDTA) TUBE – PURPLE TOP

- Fill to manufacturers recommended fill line
- High EDTA/blood ratio (under-filled tube) can shrink RBCs due to osmotic effects<sup>2,5</sup>
- To avoid clotting, thoroughly mix each sample immediately after filling the tube by gently inverting 10-15 times<sup>5</sup>
- If using microtainer tube, invert >15 times<sup>1</sup>



- 1. Zoetis VETSCAN HM5 Blue Version Operator's Manual (v2.3), pg. 40
- 2. Monti P, Archer J., BSAVA Manual of Canine and Feline Clinical Pathology, 2016,. (v2.0), pgs. 11-26
- 5. Weiser, G., Veterinary Hematology and Clinical Chemistry 2012, (v2.0), pgs.1-33



#### SAMPLE AGING

Time can cause changes on CBC

- Cellular changes can begin within hours after collection<sup>2</sup>
- Cells begin to absorb water

Could potentially lead to<sup>2</sup>

↑ MCV
 ↓ HGB
 ↑ HCT
 ↓ MCHC
 ↓ MCHC
 ↑ PLT



2. Monti P, Archer J., BSAVA Manual of Canine and Feline Clinical Pathology, 2016, (v2.0), pgs. 11-26





### **BLOOD FILM PREPARATION**

- Prepare blood film when sample is collected<sup>2</sup>
- Important for evaluating important pathologic abnormalities involving leukocytes, erythrocytes, and platelets



2. Monti P, Archer J., BSAVA Manual of Canine and Feline Clinical Pathology, 2016, (v2.0), pgs. 3-26



#### SAMPLE PROCESSING:

If not able to analyze sample within 1 hour of collection:<sup>5</sup>

- Place in refrigerator analyze within 24 hours<sup>2</sup>
- Must invert tube again 10-15 times (more if microtainer tubes) to make sure that mixed well with anticoagulant
- Must be at room temperature before analyzed by HM5
- Blood film should be made immediately

Do not freeze or heat tube - results in cell lysis

2. Monti P, Archer J., BSAVA Manual of Canine and Feline Clinical Pathology, 2016, (v2.0), pgs. .

5. Weiser, G. Veterinary Hematology and Clinical Chemistry, 2012, (v1.0), pgs. 4-39





## SAMPLE INTERFERENCE

#### **INTERFERING SUBSTANCES**

Can affect the results of biochemical and hematology assays

Some manufacturers may provide this information for diagnostic instrumentation

Certain values such as the MCHC on the HM5 may indicate a presence of hemolysis or lipemia<sup>2</sup> **HEMOLYZED** plasma and serum samples have a pink/red tint due to broken red blood cells.

Avoid hemolysis by using proper sample collection and handling techniques.<sup>1</sup>

**LIPEMIC** plasma and serum samples have a milky appearance due to a high concentration of fat in the blood.

<u>Avoid lipemia</u> by using a fasted patient sample whenever possible.<sup>1</sup> Remind clients to refrain from feeding their pets prior to their appointment.

**ICTERIC** plasma and serum samples have a yellow color due to a disease or condition that causes excess bilirubin in the blood.

2. Monti P, Archer J., BSAVA Manual of Canine and Feline Clinical Pathology, 2016, (v2.0), pgs. 11-26



### **HEMOLYSIS**

#### WHAT CAUSES HEMOLYSIS?

#### Poor sample handling

- **o** Delayed sample separation
- Dispensing sample from the syringe through needle to tube

**Immune-mediated disease** 

#### WHAT DOES HEMOLYSIS INTERFERENCE LOOK LIKE?

Falsely elevated MCH and MCHC<sup>2</sup>

Falsely decreased the RBC count and PCV

(or HCT)<sup>2</sup>

Hemolysis



2. Monti P, Archer J., BSAVA Manual of Canine and Feline Clinical Pathology, 2016, (v2.0), pgs. 11-26



### **LIPEMIA**

#### WHAT CAUSES LIPEMIA?<sup>7</sup>

**Post-prandial (after meals)** 

#### **Metabolic disturbances**

- Pancreatitis
- Diabetes mellitus/DKA
- Hepatic disease
- Hypothyroidism
- o Diet (high lipids)

Breed-specific primary lipid disorders

• Miniature schnauzers

7. Latimer, KS., Duncan & Prasse's Veterinary Laboratory Medicine, 2011, (v1.0), pgs. 474-475

#### Lipemia





### **LIPEMIA**

#### WHAT DOES LIPEMIA INTERFERENCE LOOK LIKE?

Falsely elevated HGB due to interference with the spectrophotometer

**Falsely elevated MCHC** 



2. Monti P, Archer J., BSAVA Manual of Canine and Feline Clinical Pathology, 2016, (v2.0), pgs. 11-26





#### WHAT CAUSES ICTERUS?

Due to disease, NOT sample handling

#### WHAT DOES ICTERUS INTERFERENCE LOOK LIKE?

Causes yellow plasma May affect HGB



**Icterus** 





## HM5: THE SAMPLE RUN<sup>1</sup>



- 2 Select 'Measure'
- 3 Enter in patient data (species, patient ID, name, DVM name, gender, age, etc.)
  - 4 Re-invert sample, and Run

Sample run is 3-4 minutes total<sup>5</sup> Requires 2 drops (50uL) of EDTA anti-coagulated blood<sup>5</sup>

1. Zoetis VETSCAN HM5 Blue Version Operator's Manual (v2.3) - pg.46



Slowly invert tube 10-15 times to mix well. Ensure blood moves when vial is inverted Remove Cap from the sample tube and place tube in sample adapter. Press Run to measure sample of Cancel to Exit



### WARNING FLAGS<sup>1</sup>

#### Sample Warning Flags

E, S, L, c, C, M, W, m, Y, Z

- Instrument "dirty"/clogged
- Not enough sample
- Fluids not being delivered properly, or lines swapped
- Sample handling
- Sample run under the wrong species bank

#### **Blank Warning Flags**

p, b, B, X, H

- Instrument "dirty"
- Reagent or tubing issues
- Damaged
- Electrical

#### Two types of Warning Flags

- Blank warning flags
- Sample warning flags

Capital flags - WBC Lowercase flags - RBC/PLT

	Database	01:39 PM
PID SID Needle 0 (ze	2C 03/01// 00532 Type ro) mm Warni	2016 04:20 PM Cat ng W
WBC      13.63        LYM      3.18        MON      1.02        NEU      9.07        EOS      0.35        BAS      0.01        LYM%      23.3        MON%      7.5        NEU%      66.5        EOS%      2.5        BAS%      0.1        RBC      6.21        HGB      8.5        HCT      24.06        MCV      39        MCH      13.6        MCHC      35.2        RDWc      20.7        RDWs      32.8        PLT      152        MPV      10.0        PCT      0.15        PDWc      34.0        PDWs      11.4	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	WBC
Print	Send	Tech.
Edit		Back



1. Zoetis VETSCAN HM5 Blue Version Operator's Manual (v2.3), pg.90-93

### HM5 HISTOGRAMS<sup>1</sup>

#### **HISTOGRAMS: GRAPHICAL DISPLAY OF DATA**



The Y-Axis indicates the relative cell count, and the X-Axis represents cell size.

- Graphical display of data in histograms provides information that complements numerical data
- Helps evaluate sample integrity and potential abnormalities
- With a glance, users can decide if results are meaningful or if they need to draw another sample, on the spot



1. Zoetis VETSCAN HM5 Blue Version Operator's Manual (v2.3), pg.47

### **HM5 HISTOGRAMS**





### **HISTOGRAM EXAMPLES**

### PLATELET CLUMPING



Clumped Platelets PLT Histogram (Feline)<sup>3</sup>



WBC Histogram: Increased LYM Peak relative to GRA peak and high LYM on a cat sample. Clumped PLT's are causing this LYM increase (shown by extended tail on right of histogram)

PLT Histogram: Lacks a defined peak Slopes upward and to the right Indicates presence of clumped PLTs (Normal peak shows definition and slopes Downward)



## **HM5: OTHER FEATURES**

- Automated cleaning reminders
- On-screen instructions for maintenance
- Patient trending of results
- USB loading of control values
- Barcode loading of control values
- Large 5000 entry database





## **HM5: OTHER FEATURES**

### HM5 SUPPORTS 15 SPECIES<sup>1</sup>

#### **VETSCAN HM5**

- 5 part: cat, dog, horse, cow, alpaca, llama
- **3 part:** mouse, pig, rabbit, rat, guinea pig, goat, sheep, ferret, primate\*

**\*RESEARCH PURPOSES ONLY** 

1. Zoetis VETSCAN HM5 Blue Version Operator's Manual (v2.3) pg.114

## Flexibility to analyze diverse array of species



5-part differential 3-part differential



### HM5 MAINTENANCE OVERVIEW<sup>1</sup>

CLEANING PROCEDURE	FREQUENCY TO PERFORM	USES SOFTWARE ALERT?	TIME TO RUN
Wash Head Cleaning	Weekly	Yes	1 Min
Soak Cleaning	Every other week*	Yes	10 Min
Deep Cleaning	As needed	No alert; user initiated	20 Min

\*Soak Cleaning frequency can be adjusted based on clinic sample run rate

Always run Quality Control after a soak cleaning or reagent pack change



### **HM5 MAINTENANCE: WEEKLY**

#### WASH HEAD CLEANING<sup>1</sup>

# Salt and blood can build up on the wash head over time







41

### HM5 MAINTENANCE: EVERY OTHER WEEK SOAK CLEANING<sup>1</sup>

The soak cleaning will require one new, unused tube of HemaClean

The soak cleaning cycle takes approximately 10 minutes

Soak Cleaning is now due. Cleaning must be performed prior to the next measurement. Press Next to begin or Cancel to exit.





### HM5 MAINTENANCE: AS-NEEDED (6-MONTH MAX)

#### **CHANGING A REAGENT PACK<sup>1</sup>**

# Follow the step-by-step, on-screen instructions

# Changing the reagent pack will automatically:

- Reset the reagent and waste volumes
- Reset the sample and blank run tally



## **REAGENT PACK CHANGE<sup>1</sup>**

### **DO'S AND DON'TS**

**Don't** swap the reagent tubing lines **Don't** touch the drop-down tube/dip tubes **Don't** set the tubing down on the counter **Don't** change just a single bottle at a time **Do** wear clean gloves to avoid contamination **Do** perform the back change as sterile as possible **Do** change out the entire reagent pack box; **Do** run controls after changing the reagent pack **Do** dispose of all waste in accordance with local regulations

The HM5 reagent pack expires 6 months from installation



## **HM5 MAINTENANCE OVERVIEW**

### **QUALITY CONTROL**

- Run after soak cleaning and reagent pack changes<sup>1</sup>
- Follow the on-screen instructional prompts

1. Zoetis VETSCAN HM5 Blue Version Operator's Manual (v2.3), pg..72

 The quality control vial is viable for two weeks following opening and should be stored in the refrigerator <sup>1</sup>



## **CONTROLS AND CALIBRATION**

### QUALITY CONTROL<sup>1</sup>

3 ways to input values:

- 1. Manually
- 2. USB drive
- 3. Barcode Scanner



1. Zoetis VETSCAN HM5 Blue Version Operator's Manual (v2.3), pg..53



## **CONTROLS AND CALIBRATION**

### **CALIBRATION CHANGES THE ANALYZER<sup>1</sup>**

#### How it works

- 3 individual calibration runs are performed using the normal control
- Analyzer takes an average reading and shows coefficients, or "factors" to review

#### How to calibrate

- Enter the Calibration target values from the package insert – not the QC values
- Calibration info is the smaller chart from insert

1. Zoetis VETSCAN HM5 Blue Version Operator's Manual (v2.3), pgs..61-63

				lander 1	Red Ma		Later I	
	HMS Low Control F					770-9028	Lot No.	91/31
			LINE LINE (	Control	Part No.	770-9023	Lot No.	91733
			100.2110013		1 41 140.		Lot Inc.	20.22
						Expl	ration Date:	1/23/2018
			HM5 Cont	rol Values	for Quality	Control		
	If you use these cont	rols to perfor	m quality cont	trol, please n	efer to the tar	pt and range	values in the ta	ble below.
		Low: Lo	t #81731	Normal:	Lot #91762	High: Lo	ot #91733	
	Expires:	1/23	/2018	1/23	/2018	1/23	/2018	
	Parameter	Target	Range (±)	Target	Range (±)	Target	Range (±)	Units
	WBC	3.7	±0.4	8.4	±1.0	20.2	±25	Ки
	RBC	2.47	±0.20	4.30	± 0.30	4.83	±0.40	Mµi
	HGB	5.2	±0.5	11.8	±0.7	15.5	±0.8	gid
	HCT	18.3	±2.5	38.7	±3.0	45.4	±4.0	%
	MCV	74	±6.0	90	±7.0	96	±7.0	1
	MCH	21.1	±2.6	27.A	±3.0	32.1	±3.0	P0
	MCHC	28.4	±3.5	30.5	±3.5	33.4	± 3.0	ga
	PLI	90	± 25	254	±40	566	± 70	Nµ
	PGI	0.10	±0.06	0.29	±0.12	0.66	±0.20	70
	MPV	11.4	± 3.0	11.6	±4.0	11.7	±4.0	1
	PDW-CV	28.2	±120	30.1	±6.0	30.6	±4.0	70
	RDW-SV	19.7	25.0	16.0	25.0	15.5	25.0	75
	LIM	1.2	±0.5	3.3	±0.6	11.3	±1.5	Nu
	MELL	0.2	±0.2	0.4	±0.4	1.5	±1.5	Khi
	NEU	2.1	±0.9	4.6	±1.1	7.3	±25	NU
Scan the barcade below to enter the control values above into the touchscreen/color MMS. For more information. contact Aboxis. FOR CALIBRATION								
	LO	T #91762						
	Enter the target valu	es below to e	alibrate either					
	the HMS or co	lor HMS inst	ranenis.		巖	ΗĒ		<b>税</b> 礎
	Control Parameter	Target	Units	I				
	RBC	4.30	Mµ	I	- E.	E 54	F 1 1	10.0
	MCV	90	1		1.1.1.1	210	- <b>1</b>	100
	RDWc	16.0	%		10.00	1 Y Y	- 6 P -	- (C), E
	PLT	254	Kļu		122	1.4.5		<b>1</b>
ļ	MPV	11.6	1		1.1		S MARK	된다
	HGB	11.8	ga Khi		1.1	\$ 714	3 <b>1</b> 1 1	1 - E
	FOR	4.8	Kul				1000	
	- 20		- apr	Ļ	1.5		ST 1. S.	
					6.0	西方府	6 A 1	<b>1</b>
					r.n.311		1000	



### RESOURCES

- 1. Technical Support
- 2. Diagnostic Technical Specialist
- 3. Quick Reference Guide
- 4. HM5 User Guide
- 5. On-demand courses from Zoetis Learning Solutions: ZoetisLearningSolutions.com
- 6. Online at: zoetisus.com/hm5
  - VETSCAN HM5 Sample Handling Poster
  - Understanding Platelet Counts Guide
  - Interpreting Histograms Guide
  - Macrothrombocytopenia Guide





### REFERENCES

- 1. Zoetis VETSCAN HM5 Blue Version Operator's Manual (V2.3), sections 4, 5, and 6. 790-7013 (rev E)
- 2. Monti P, Archer J. BSAVA Manual Of Canine And Feline Clinical Pathology, 2016. (V2.0). pgs. 2, 11-26
- 3. CM Jack, PM Watson: Laboratory. V Heeren *Veterinary Technician's Daily Reference Guide.* Ed 3, 2014 Wiley Blackwell Ames, IA. pg. 16
- 4. Merrill, L, Textbook Of Veterinary Internal Medicine Expert Consult, 2016, 301-303. (V1.0). Veinconsideration pg.1
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- 6. Zoetis VETSCAN VS2 Operator's Manual (V1.0), section 4. 1200-7063 (rev A)
- 7. Latimer K.S., et al. Veterinary Laboratory Medicine Clinical Pathology. 5<sup>th</sup> Ed., 2011 Blackwell Publishing, pgs 21-46, 473-475





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