Secrets of the CBC . . .
What's the diff??

Kathleen Vollman
ADVANCING NURSING THROUGH KNOWLEDGE & INNOVATION

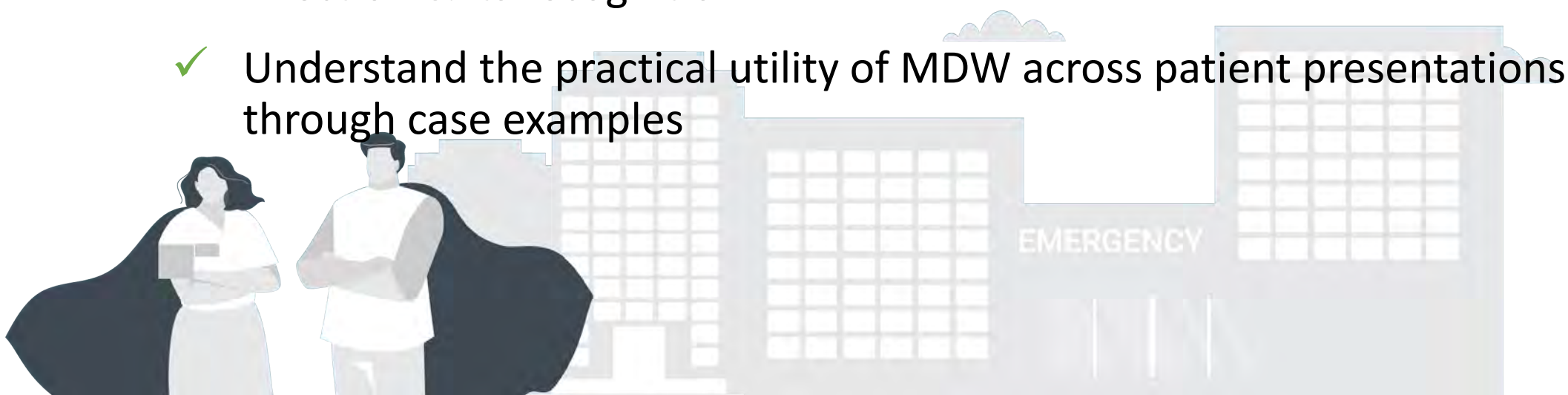
Kathleen M. Vollman MSN, RN, CCNS, FCCM, FCNS, FAAN
Clinical Nurse Specialist / Educator / Consultant
ADVANCING NURSING
kvollman@comcast.net
Northville, Michigan
www.vollman.com

Disclosures for Kathleen Vollman

- Consultant-Michigan Hospital Association Keystone Center
- Subject matter expert HRET: CAUTI, CLABSI, HAPI, Sepsis, Safety culture for HRET
- Consultant and speaker bureau:
  - Stryker Sage
  - Potrero Medical
  - Beckman Coulter
- Baxter Healthcare Advisory Board

Objectives

- ✓ Explain the consequences of severe infection and sepsis if gone unrecognized early, particularly important in patient presenting with vague signs and symptoms.
- ✓ Identify how the components of the CBC with Diff can help you understand your patient's condition
- ✓ Differentiate the use of the WBC vs. the Monocyte in the type of infection & its recognition
- ✓ Understand the practical utility of MDW across patient presentations through case examples



Sepsis is a Public Health Problem

- Affects **>1.7 million** Americans per year
- Sepsis occurs in just **10% of U.S. hospital patients**, but it contributes to as many as half of all hospital deaths
- **3rd leading cause of death** in the US
- **$41.5 billion** spent on sepsis inpatient care and skilled nursing for Medicare beneficiaries in 2018
- **1-week mortality** for Medicare beneficiaries with sepsis is **18% vs 4.1%** with no sepsis
- **87%** of all adult sepsis cases begin outside the hospital

700 people die each day from sepsis in the U.S.

One every 2 minutes

Rhee C, et al. *JAMA.* 2017;318(13):1241-1249.
Angus DC, et al.. *Crit Care Med* 2001;29:1303-10.
Buchman TG, et al. Crit Care Med. 2020;48(3):276-288.
Novosad SA, et al. CDC Morbidity and Mortality Weekly Report., 2016;65(33):864-869
Buchman TG, et al. Crit Care Med. 2020;48(3):276-288

Sepsis (Severe Sepsis) and septic shock are medical emergencies, and we recommend that treatment and resuscitation begin immediately

2021 Surviving Sepsis Guidelines Best Practice Statement

Evans L, Rhodes A, Alhazzani W, et al Crit Care Medicine.;49(11):e1063-e1143.

8% FOR EVERY HOUR DELAYED

Mortality from sepsis increases by as much as **8% for every hour** that **treatment is delayed**.[1]

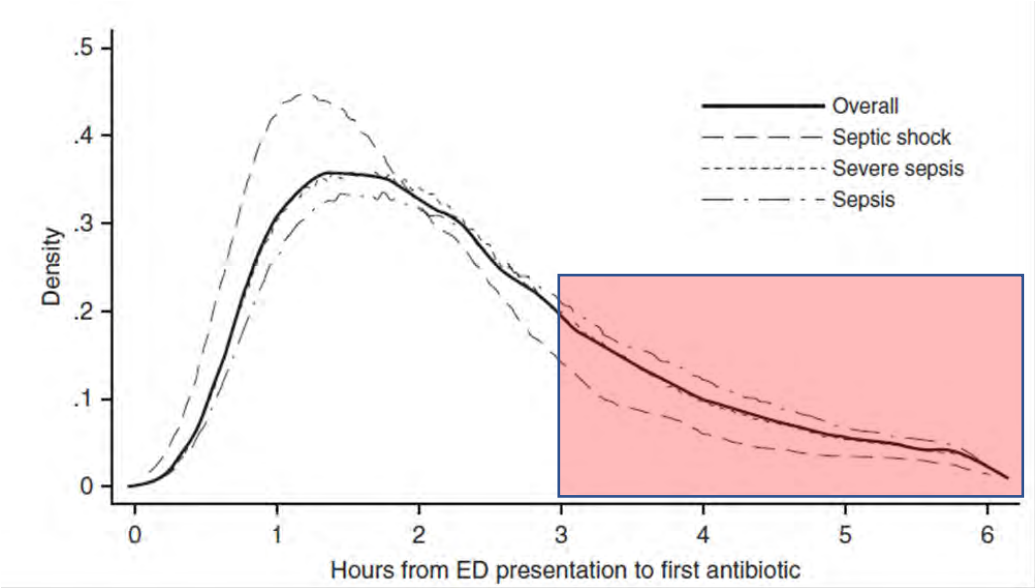
Adverse effects on secondary end points (LOS, AKI, ALI, and organ injury assessed by SOFA Score) **increases with increasing delays**. [2-3]

1.Kumar, Anand, et al. Critical Care Medicine, vol. 34, no. 6, 2006, pp. 1589-1596
2.Zhang. Crit Care Med. 2015:43:21332140
3.Bagshaw. Intensive Care Med. 2009;35:871881

Mortality from sepsis increases by as much as **8%** for every hour that **treatment is delayed**.[1]
Adverse effects on secondary end points (LOS, AKI, ALI, and organ injury assessed by SOFA Score) **increases with increasing delays**. [2-3]

Timing Is Important And Mortality Is High

Less Symptomatic Patients Dominate Net Mortality

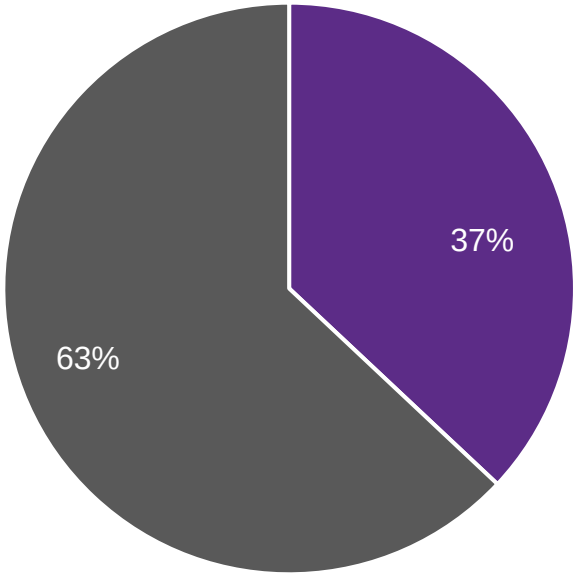


Episode Severity	# patients	1st lactate mmol/L	Time to 1st lactate, h	Time to Abx, h	Hospital Mortality, %	# Dead
Sepsis	12,122 (35%)	1.3 (1.0-1.5)	1.1 (0.6-2.6)	2.3	3.9%	**473**
Severe Sepsis	18,210 (52%)	2.2 (1.5-2.7)	0.9 (0.6-2.0)	2.1*	8.8%	**1602**
Septic Shock	4,668 (13%)	4.6 (4.0-5.9)	0.8 (0.5-1.7)	1.7	26.0%	1213

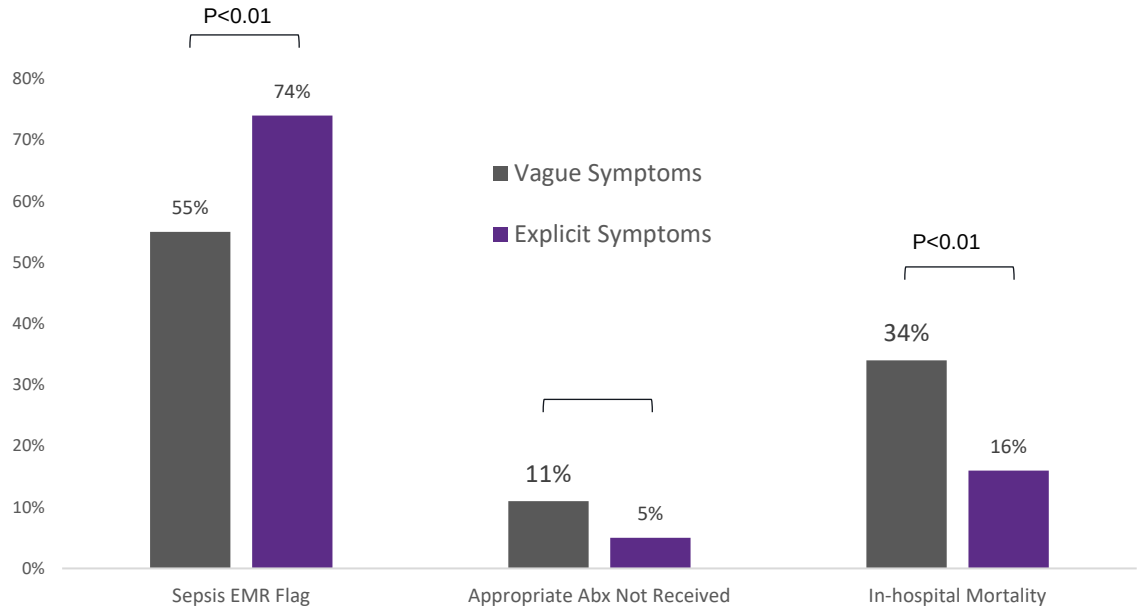
V. Liu et al., Am J Respir Crit Care Med 2017;196:856-863.

Failure To Recognize Sepsis Early Contributes To Adverse Outcomes

Septic Shock Cases by Type of Presenting Symptoms (n=654)



Select Observations, Treatments and Outcomes in Patients with Septic Shock Based on Symptoms at Presentation



Vague symptoms of infection: fatigue, weakness, and abdominal pain without fever, without explicit symptoms
Explicit symptoms of infection: ever, chills, or rigors, cough with productive sputum, dysuria, reported skin redness or concern for soft-tissue infection, or referral for specific infection diagnosis

M. Filbin et al, Crit Care Med 2018; 46:1592–1599

Early Detection is the Key

- Detection of **infection** is typically delayed by

8 HRS+ in approximately

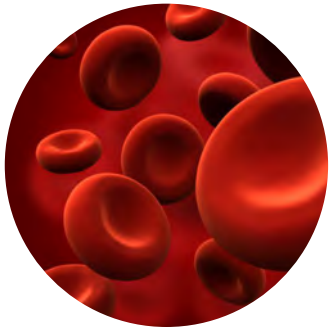
30% of cases

presenting to the Emergency Department.

Seymour C.W., JAMA 2016; 315: PP. 762-774
Filbin Crit Care Med 2014; 42: pp. 528-535

What’s In A Complete Blood Count With Differential?

What's in a complete blood count with differential?



RBC

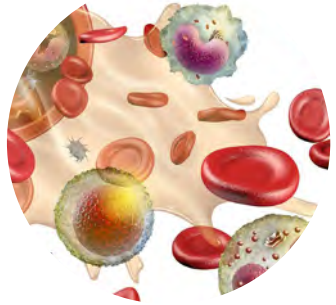
- Number of red blood cells
- Average size of red blood cells
- Hgb concentration
- RBC morphology
- 44% of Blood volume

WBC

- Number of white blood cells
- Together with platelets 1% of blood volume

PLT

- Number of platelets
- Average size of platelets
- 1% of blood volume



DIFFERENTIAL

- Types of white cells: # & %
- Any immature cells?

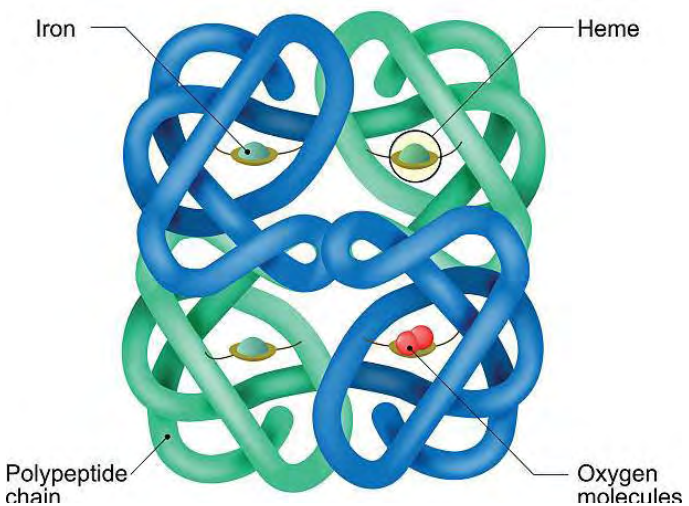
Polling Question

When you check the CBC with Diff, which values do you routinely examine?

- ❑ HGB & HCT
- ❑ HGB, HCT and WBC
- ❑ HGB, HCT & WBC, platelets
- ❑ RBC count, HGB, HCT, WBC & neutrophils
- ❑ HGB, HCT, WBC, neutrophils & platelets

Red Blood Cells

- Called erythrocytes
- Bi-concave disc
- Special protein-Hemoglobin
- Hgb contains iron which gives the cell its red color
- What is the Rule of Three or H&H check
  - Multiple the RBC x 3,
    and the result should equal
    the HGB +/-3.
    Then multiply the HGB x 3
    and the result should equal
    the HCT +/-3.



Hemoglobin & Hematocrit

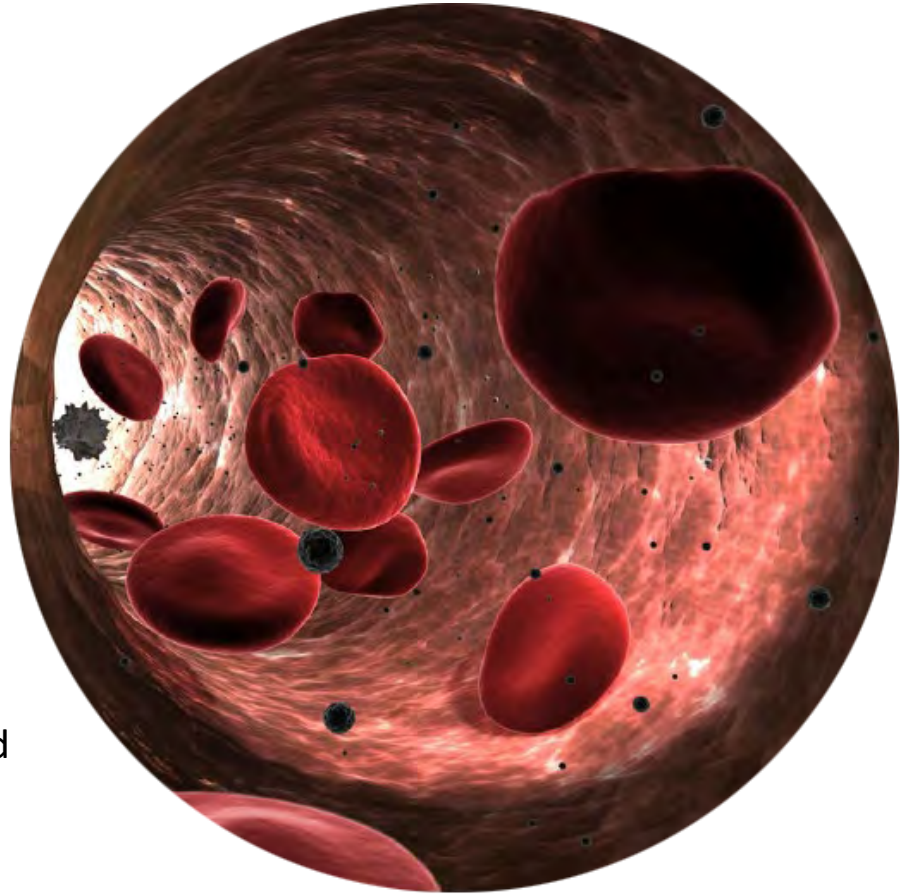
- Hemoglobin
  - A protein (globin) that contains iron (Heme) inside red blood cells that carries oxygen from the lungs to tissues and organs in the body and carries carbon dioxide back to the lungs.
- Hematocrit
  - The ratio of the volume of red blood cells to the total volume of blood as determined by separation of red blood cells from the plasma. It depends on the number and size of red blood cells.
  - It may be used to check for conditions such as anemia, dehydration, malnutrition, and leukemia.

More than just HCT and HGB

MCV: Mean Corpuscular Volume

Average red cell size

Can help diagnose bone marrow health and anemia



MCHC: Mean Corpuscular Hemoglobin Concentration

Low levels: challenge with carrying oxygen

High levels: autoimmune hemolytic anemia

MCH: Mean Corpuscular Hemoglobin

Average amount in each of your red blood cells of hemoglobin

Low levels: iron deficient anemias

High levels: macrocytic anemia (B12 deficiency)

RDW: Red Cell Distribution Width

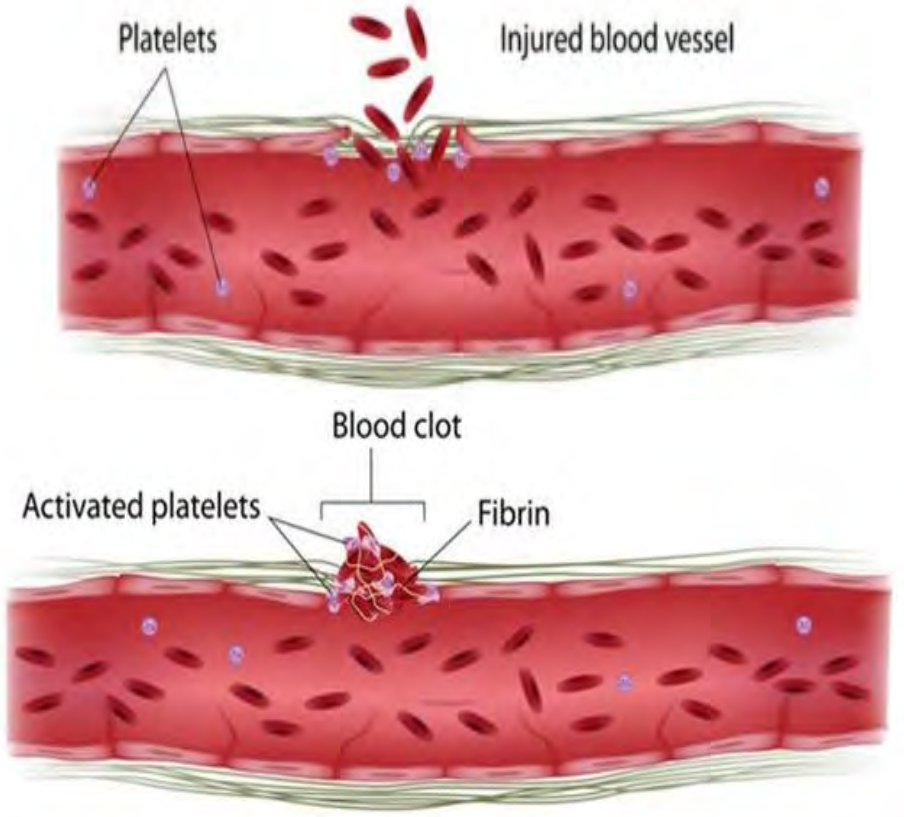
If there is a greater variation in red cell size the RDW increases

May help dx anemias

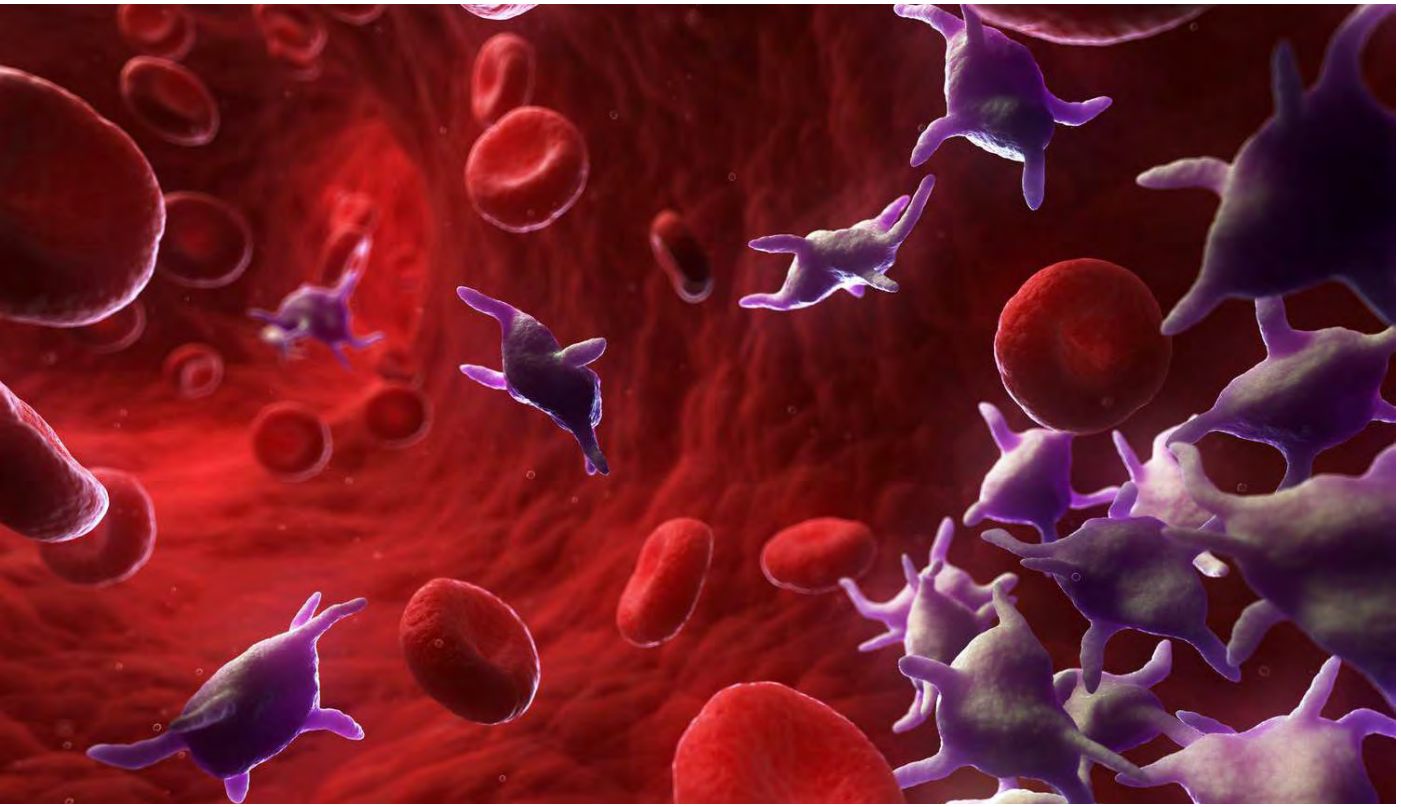
American Society of Hematology, Blood Basics: Https:www.hematology.org/patients/basics
National Center for Biotechnology information, U.S. National Library of Medicine, Chapter 1 Blood and the Cells it contains: Https://www.ncbi.nln.nih.gov/books/NBK2263

Platelets

Forms a clot with fibrin to stop blood loss



Additional Platelet Information

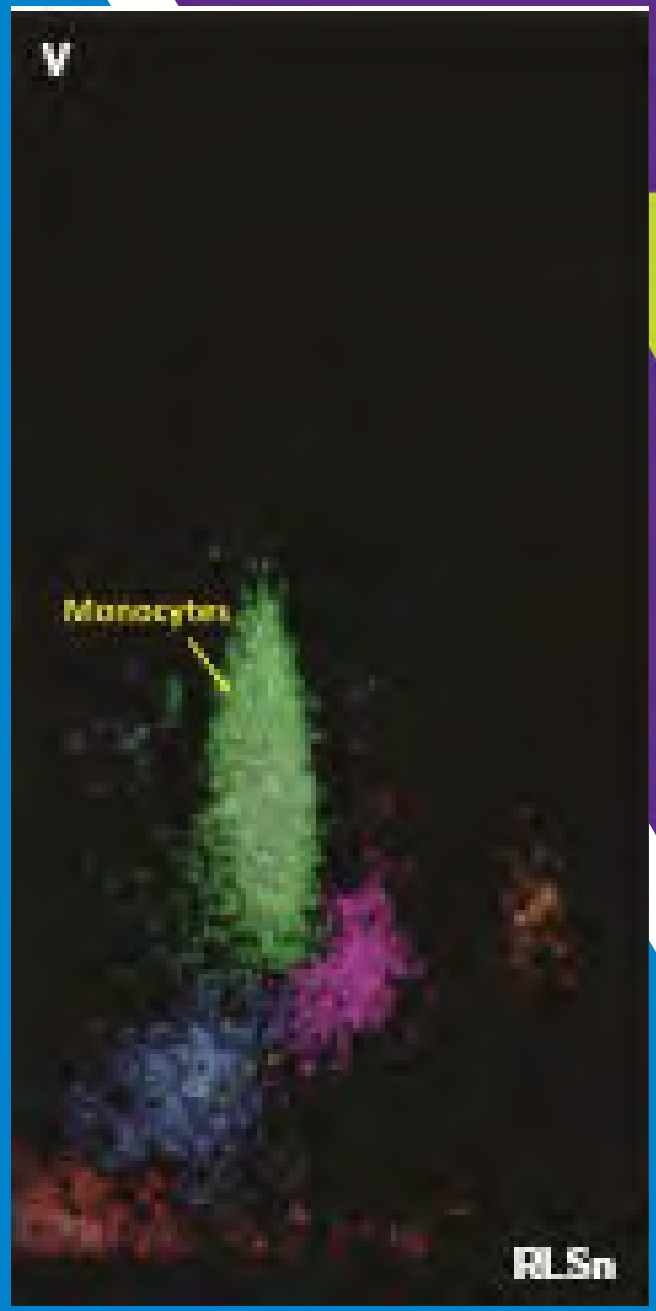


- MPV: Mean Platelet Volume
  - Average size of platelets
  - ↓Looks at bone marrow function. If someone loses blood and bone marrow is healthy it will send out large young platelets and the MPV will increase.
- PDW: Platelet Distribution Width.
  - Marker of platelet function & activation

Dean L. Blood Groups and Red Cell Antigens [Internet]. Bethesda (MD): National Center for Biotechnology Information (US); 2005. Chapter 1, Blood and the cells it contains. Available from: https://www.ncbi.nlm.nih.gov/books/NBK2263/

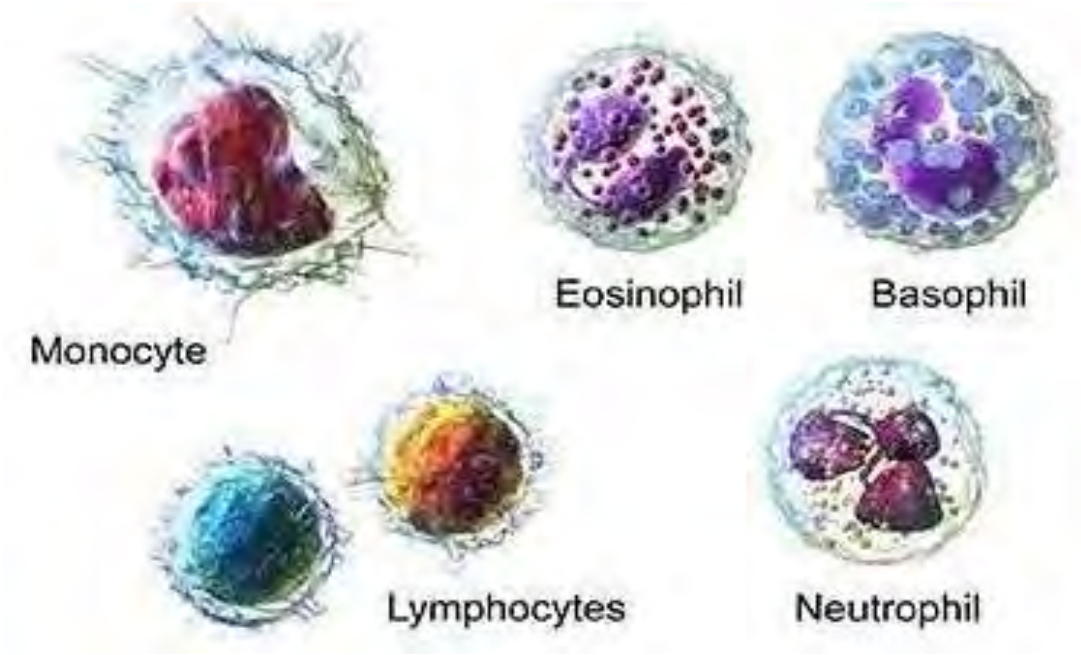
What’s the Diff?

Secrets of the WBC’s in Helping to Identify Infection



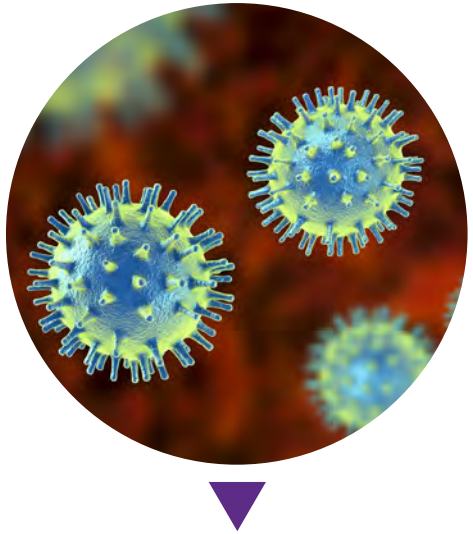
White Blood Count

- Measures the amount of white blood cells
- Normal WBC: 4.5 to 11.0 × 10^9/L
  - (varies with age and sex)
- Low WBC: Leukopenia
  - Viral infections, endocrine disorders, drugs and radiation
- High WBC: Leukocytosis
  - Bacterial infections
  - Acute inflammatory Conditions
  - Leukemia



What causes infections?

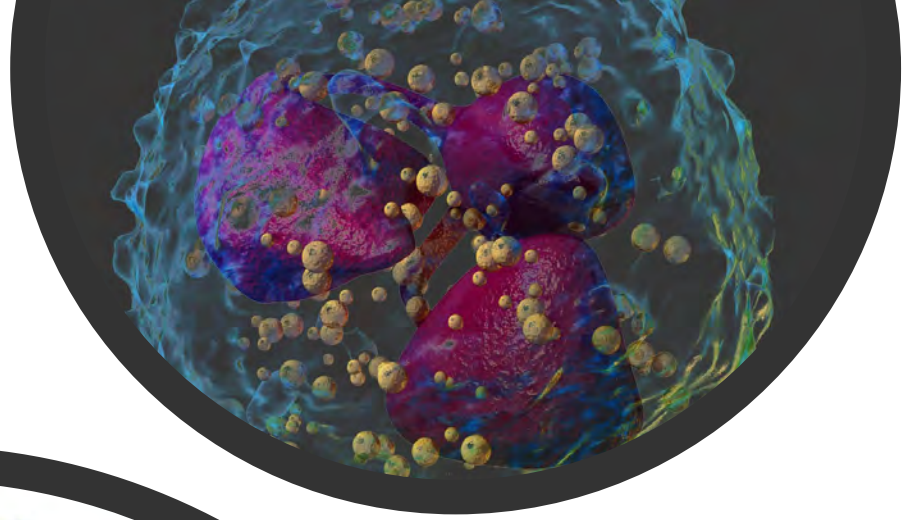
Bacteria

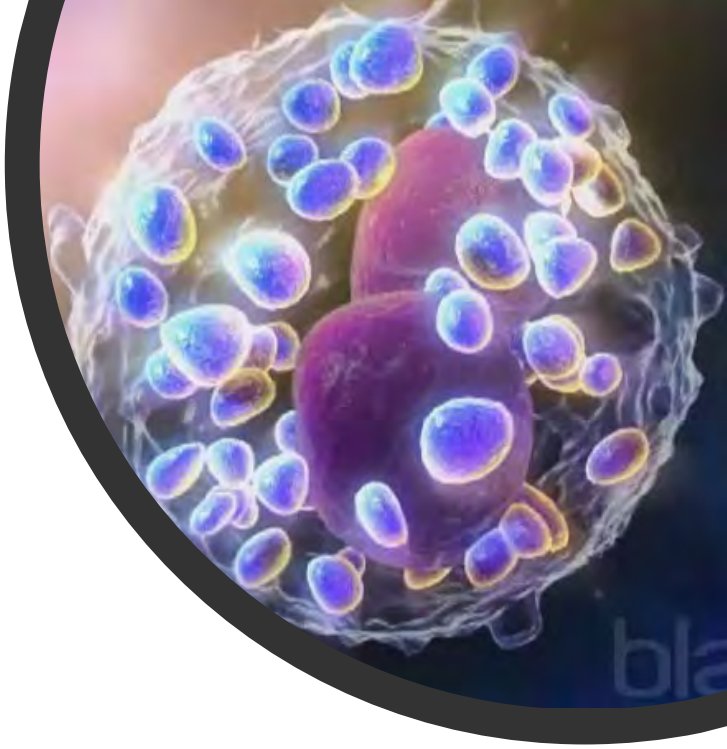


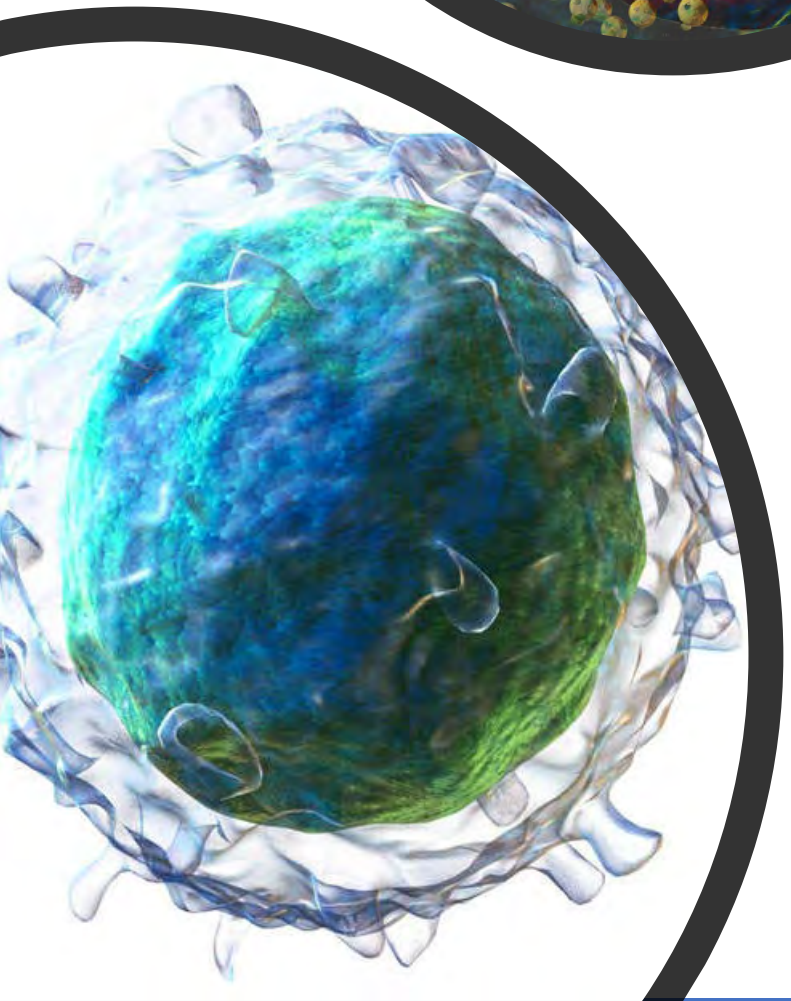
Virus

Fungus

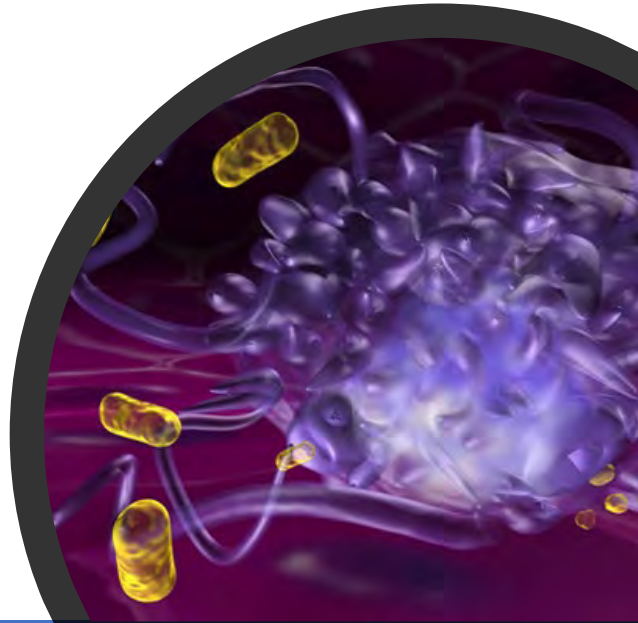
WBC’s are involved in fighting all of these infections

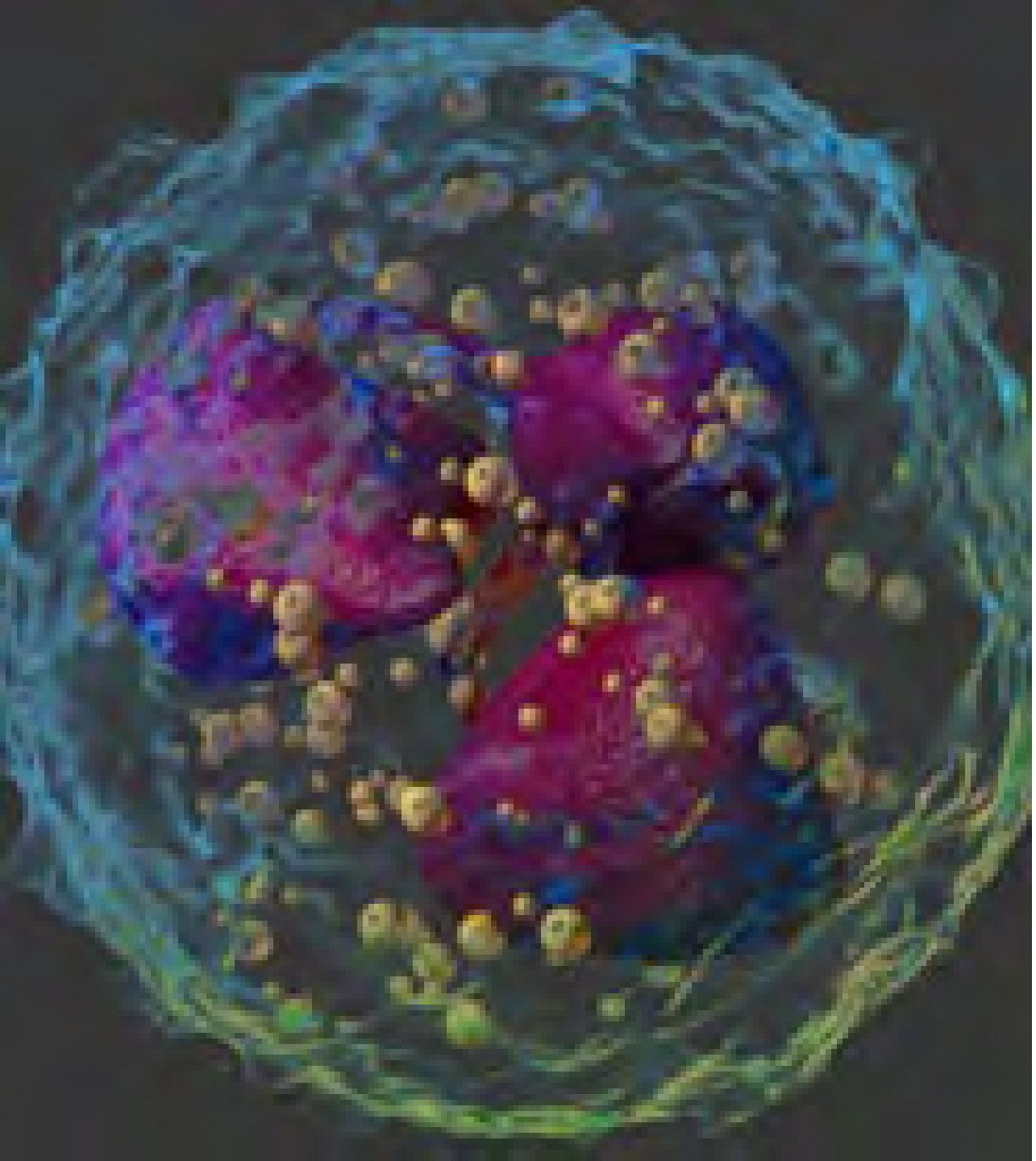






Types of white Blood Cells





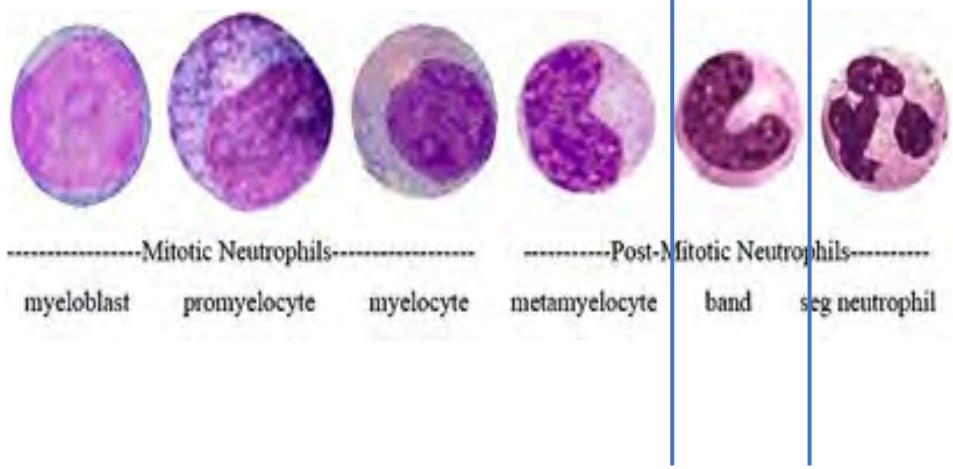
Neutrophils

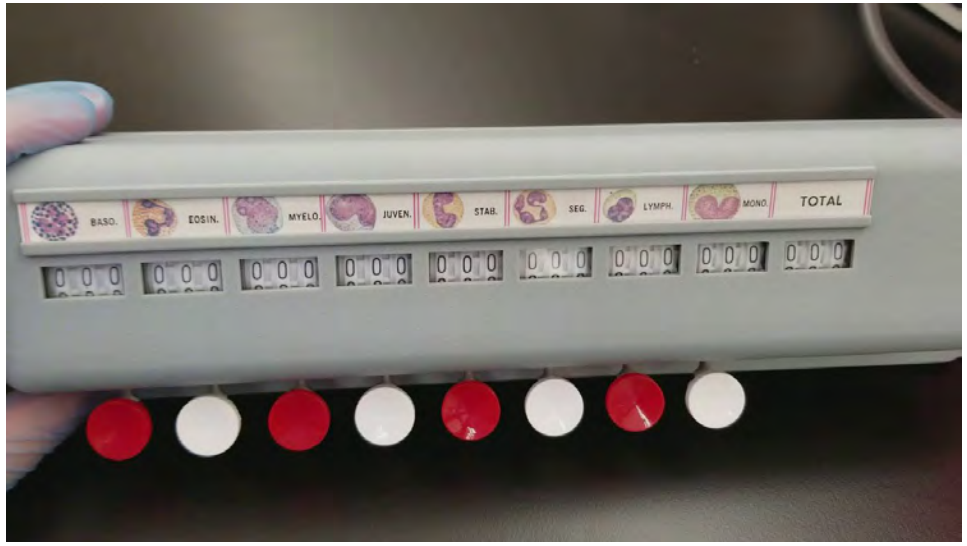
- First responder of immune cells to infection or tissue damage
- Most abundant WBC, make up 50-70% of total WBC’s
- Immature neutrophil is called a band
- Bands: 10% or less

What's A “Left Shift”

Left Shift

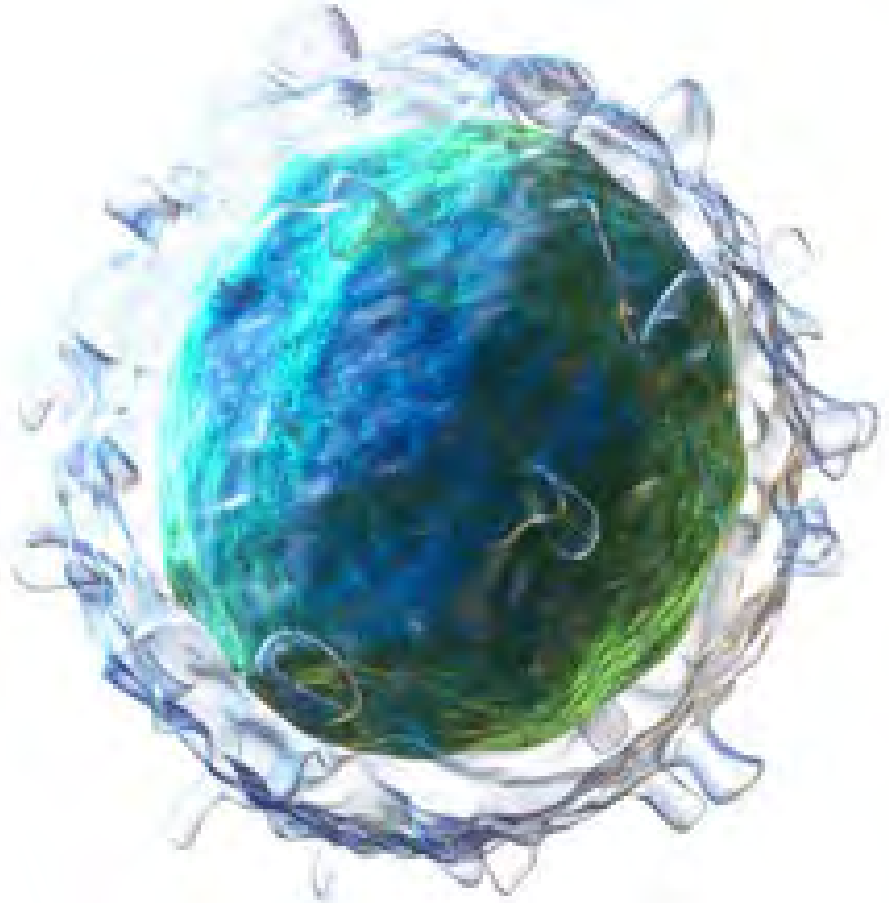
- Increase of neutrophil consumption which is equal to increase in production in the bone marrow





Lymphocytes

- Responsible for immune response, infection fighters
- Include T cells (regulates other immune cells and attacks virus infected cells and tumors) and B cells (makes antibodies)
- 20-45% of the total WBC’s
- If elevated-infection, cancer of the blood or lymphatic system or autoimmune disorder
- If low, higher risk for infection

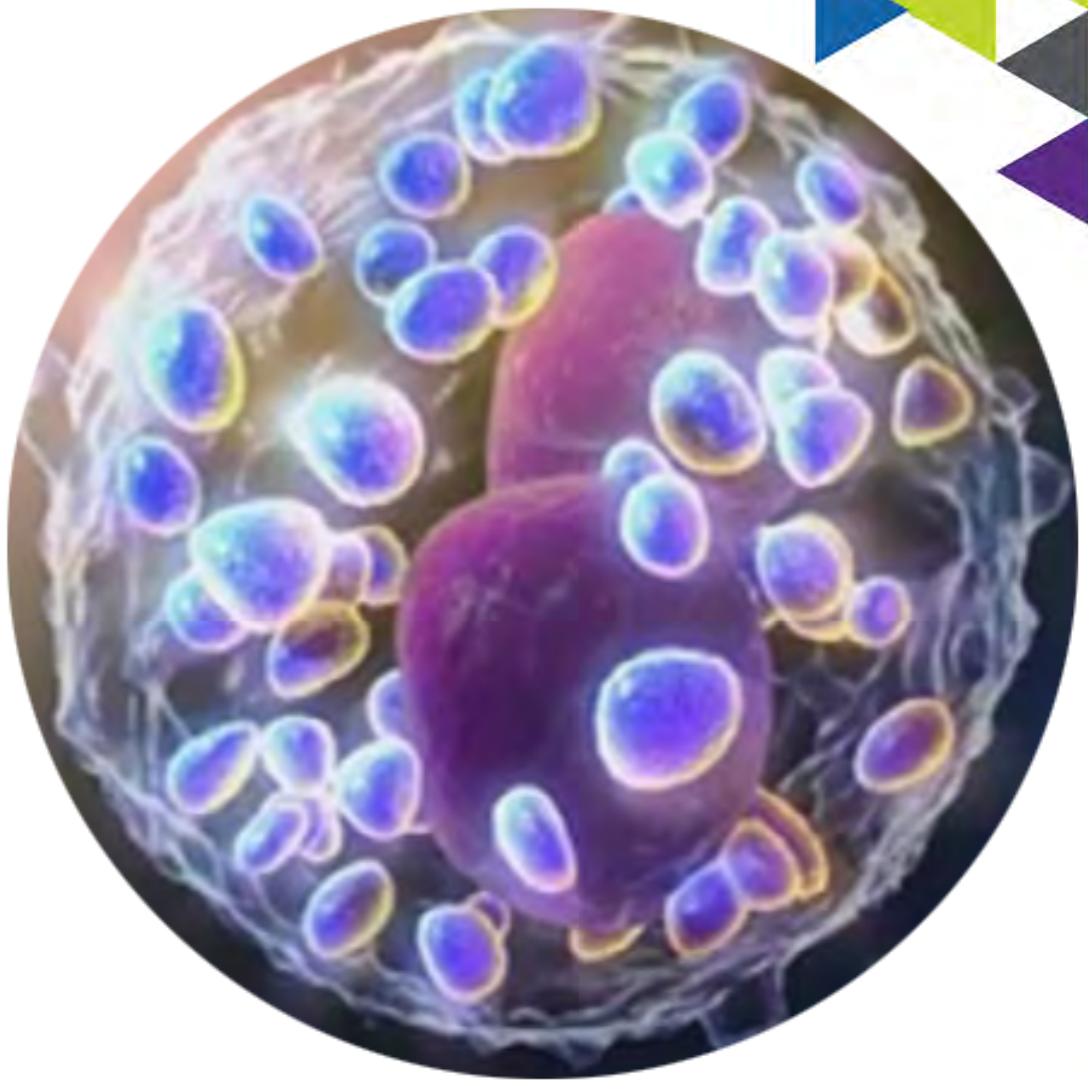


Eosinophils

- Released in allergic reactions, asthma, viral infections, and histamine response. Also see elevation with parasitic infections.
- Low with intoxication from alcohol or excessive cortisol production
- 1-3% of WBC’s

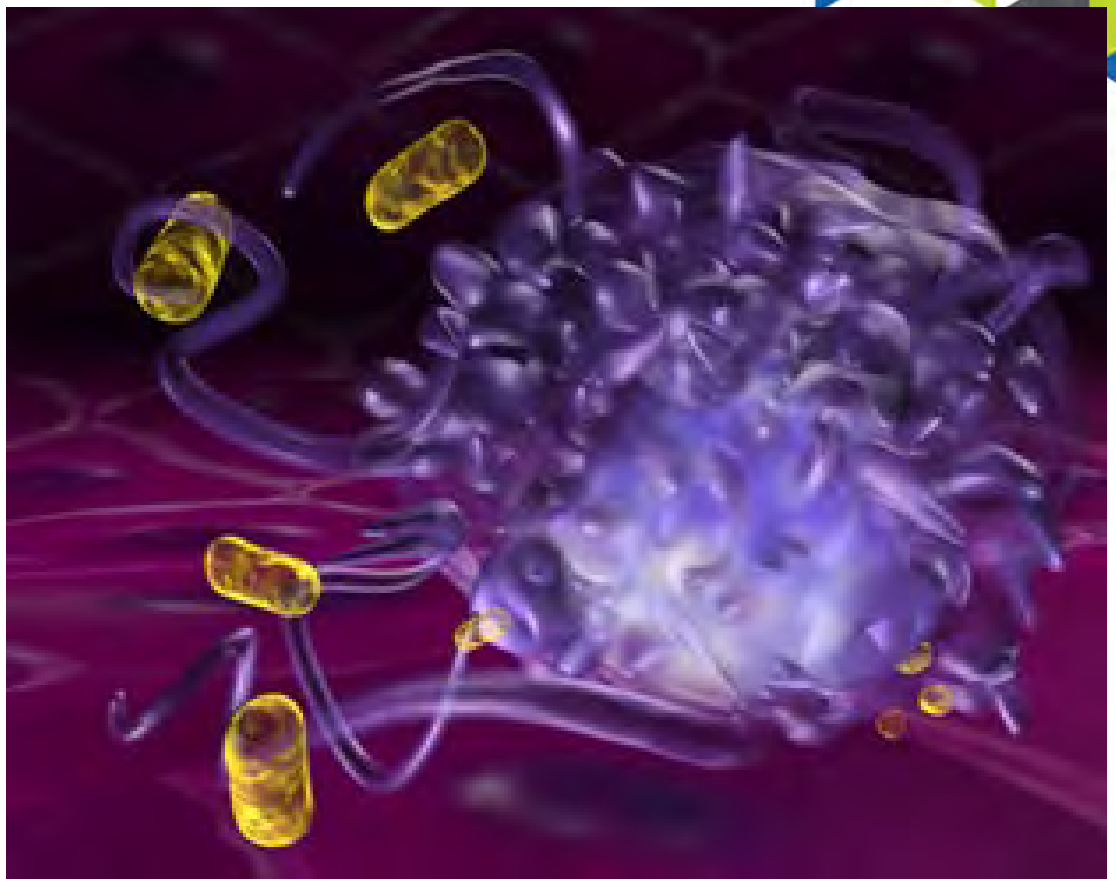
Basophils

- Defend the body from allergens, pathogens & parasites-contain histamine & heparin
- Low levels caused by allergic reaction, infections and overactive thyroid-placing basophils in overdrive
- High levels sign of blood disorders, autoimmune dx or infection leading to inflammation
- 1% of WBC's, smallest and least understood.



Monocytes

- Early part of the body's first line of defense against infection
- Monocytes:
  - phagocytize pathogens
  - display inflammatory characteristics
  - present antigens to lymphocytes
- When they move into tissue and ingest pathogens they are called MACROPHAGES
- Elevated levels link to infectious dx & immune disorders
- Low levels more susceptible to infection
- 3-11% of the total WBC's
- Largest size WBC



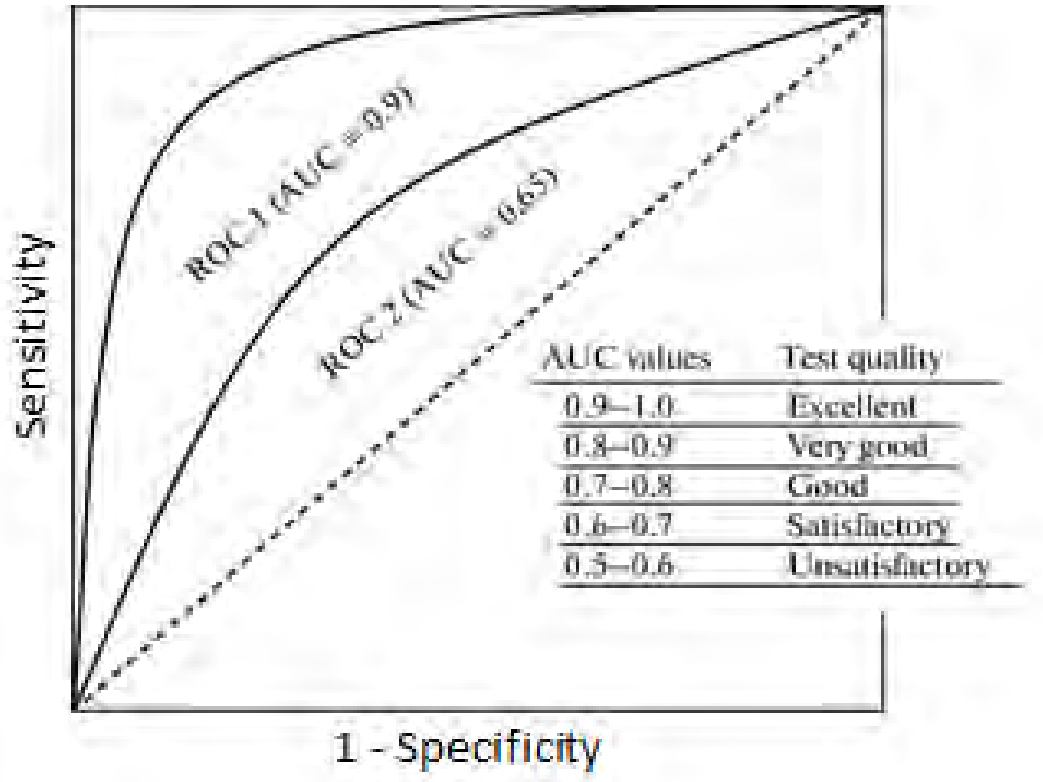
Polling Question

What biomarkers do you currently use for screening and potential diagnosis of sepsis in the ED

- Lactic acid
- PCT
- CRP
- MDW

Role of Current Biomarkers for Sepsis

Understand Overall Accuracy of Biomarkers

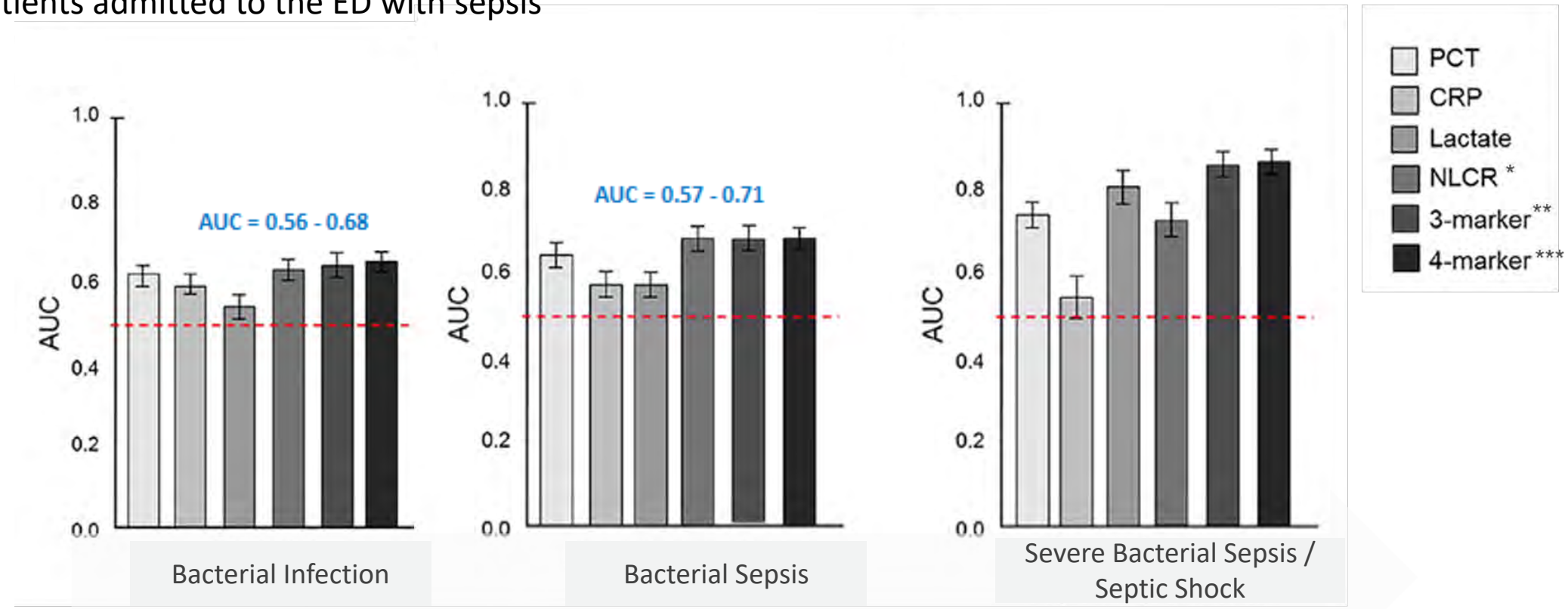


AUC values	Test quality
0.9–1.0	Excellent
0.8–0.9	Very good
0.7–0.8	Good
0.6–0.7	Satisfactory
0.5–0.6	Unsatisfactory

- Area under the curve: Value between .5 and 1.0
  - .5 indicates no discrimination, 1.0 is perfect discrimination
  - Reflects overall accuracy and separation performance of the biomarker
  - Can be used to compare different biomarkers

Limited Utility Of Conventional “Sepsis Biomarkers”

1500 patients admitted to the ED with sepsis



* Neutrophil-lymphocyte count ratio (NLCR)
** CRP+Lactate+NLCR
*** CRP+Lactate+NLCR+PCT

What Is The Right Tool For Early ID of Sepsis?

Lactate Is Useful, But You Need To Suspect Sepsis

Measuring Point of Care Lactate in Emergency Department Patients With **Suspected Sepsis**

Sepsis Severity	Sensitivity	Specificity
Lactate >2mmol/l Normal		
All Sepsis	34	82
Severe Sepsis & Septic Shock	64	94
Septic Shock	53	72
Lactate >4mmol/l Abnormal		
All Sepsis	7	98
Severe Sepsis & Septic Shock	13	99
Septic Shock	27	97

Academic Emergency Medicine, Volume: 21, Issue: 8, Pages: 853-857, First published: 24 August 2014

Triage Information - Guess How Many?

1. What % of SEPTIC patients **initially present** to ED with 2+ SIRS criteria? (Crouser et al, JICM)
    a. 87%
    b. 67%
    c. 27%

2. What % of SEPTIC patients **initially present** to ED with **hypotension** or **altered mental status?** (Crouser et al, JICM)
    a. 56% Hypotension and 52% Altered mental status
    b. 36% Hypotension and 32% Altered mental status
    c. 16% Hypotension and 12% Altered mental status

3. What % of SEPTIC SHOCK patients **initially present** to ED with **hypotension or altered mental status**? (Filbin et al)
    a. 82% Hypotension and 84% Altered mental status
    b. 32% Hypotension and 34% Altered mental status
    c. 22% Hypotension and 24% Altered mental status

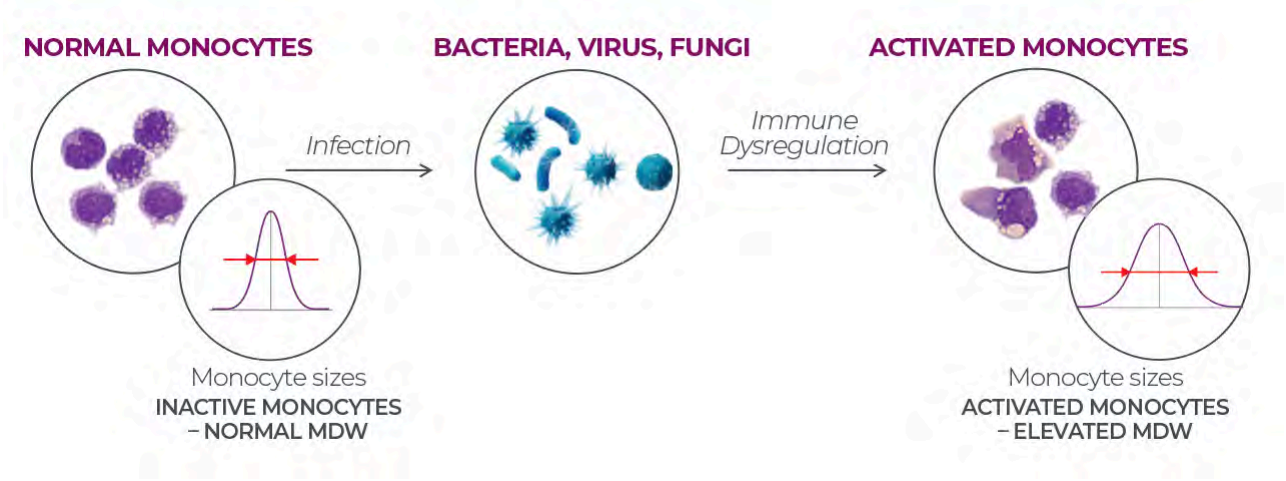
MDW- Monocyte Distribution Width

A Pragmatic Screening Tool for Sepsis

MDW Severity Of Infection Marker

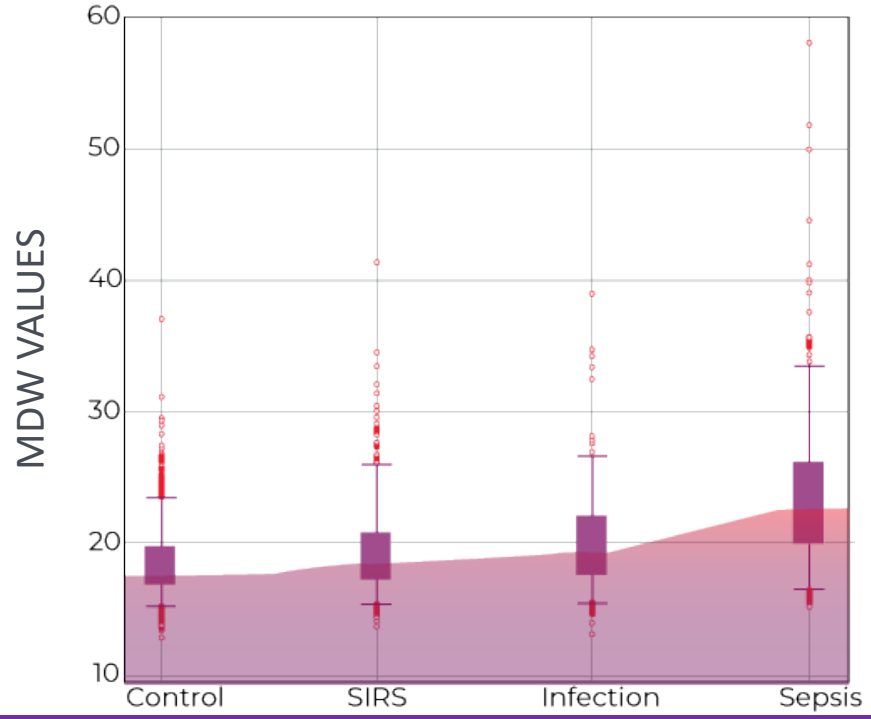
To assist clinically with patient assessment: higher mdw values equate to higher relative risk of severe infection

MDW measures increased morphological variability of monocytes in response to bacterial, viral or fungal infections



MONOCYTE ACTIVATION – SIGNAL FOR SEVERE INFECTION AND SEPSIS

Distribution of MDW Values for Various Sub-populations



Considered with other signs and symptoms, MDW cut-off value of **20.0** effectively **differentiates sepsis from non-septic presentations**, including non-infectious systemic inflammatory response

UniCel DxH 900 Coulter Cellular Analysis System Early Sepsis Indicator (ESId) Application Addendum PN C42014AA.

Fig. 1 UniCel DxH 900 Coulter Cellular Analysis System Early Sepsis Indicator (ESId) Application Addendum PN C42014AA. Figures 1.1, p. 1-6.

Numerous Studies Over Past 5 Years

2017 2019 2020 2021

[Original Research Critical Care] CHEST

Improved Early Detection of Sepsis in the ED With a Novel Monocyte Distribution Width Biomarker

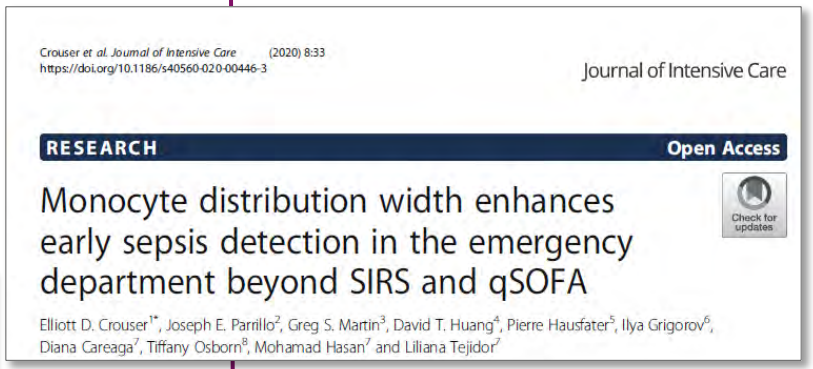
Elliott D. Crouser, MD; Joseph E. Parrillo, MD; Christopher Seymour, MD; Derek C. Angus, MD, MPH; Keri Bicking, PharmD; Liliana Tejidor, PhD; Robert Magari, PhD; Diana Careaga, BS; JoAnna Williams, MD; Douglas R. Closser, MD; Michael Sienczuk, MD; Luke Herren, BA; Emily Robart, BS; and Fernando Chaves, MD

Critical Care Medicine

Society of Critical Care Medicine

Monocyte Distribution Width: A Novel Indicator of Sepsis-2 and Sepsis-3 in High-Risk Emergency Department Patients*

Elliott D. Crouser, MD[1]; Joseph E. Parrillo, MD[2]; Christopher W. Seymour, MD[3]; Derek C. Angus, MD, MPH[3]; Keri Bicking, PharmD[2]; Vincent G. Esguerra, MD[1]; Octavia M. Peck-Palmer, PhD[4]; Robert T. Magari, PhD[2]; Mark W. Julian, MS[1]; Jennifer M. Kleven, MD[2]; Paarth J. Raj, DO[2]; Gabrielle Procopio, PharmD[2]; Diana Careaga, BS[2]; Liliana Tejidor, PhD[5]



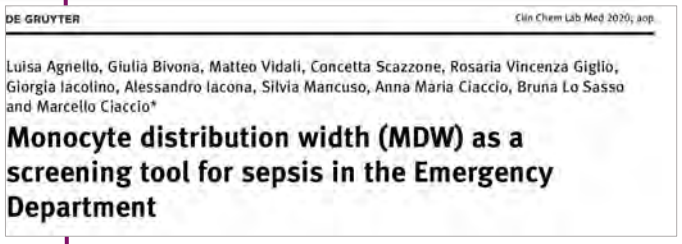
Crouser et al. Journal of Intensive Care (2020) 8:33
https://doi.org/10.1186/s40560-020-00446-3

Journal of Intensive Care

RESEARCH Open Access

Monocyte distribution width enhances early sepsis detection in the emergency department beyond SIRS and qSOFA

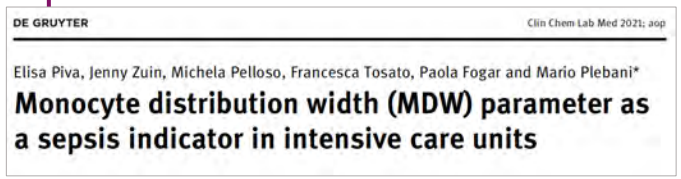
Elliott D. Crouser[1*], Joseph E. Parrillo[2], Greg S. Martin[3], David T. Huang[4], Pierre Hausfater[5], Ilya Grigorov[6], Diana Careaga[7], Tiffany Osborn[8], Mohamad Hasan[7] and Liliana Tejidor[7]



DE GRUYTER Clin Chem Lab Med 2020; aop

Luisa Agnello, Giulia Bivona, Matteo Vidali, Concetta Scazzone, Rosaria Vincenza Giglio, Giorgia Iacolino, Alessandro Iacona, Silvia Mancuso, Anna Maria Ciaccio, Bruna Lo Sasso and Marcello Ciaccio*

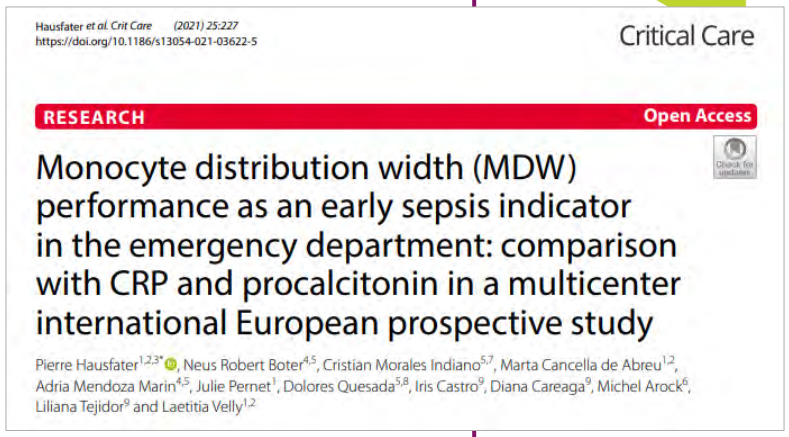
Monocyte distribution width (MDW) as a screening tool for sepsis in the Emergency Department



DE GRUYTER Clin Chem Lab Med 2021; aop

Elisa Piva, Jenny Zuin, Michela Pelloso, Francesca Tosato, Paola Fogar and Mario Plebani*

Monocyte distribution width (MDW) parameter as a sepsis indicator in intensive care units



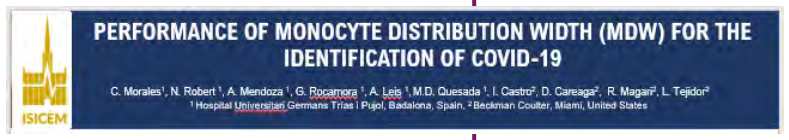
Hausfater et al. Crit Care (2021) 25:227
https://doi.org/10.1186/s13054-021-03622-5

Critical Care

RESEARCH Open Access

Monocyte distribution width (MDW) performance as an early sepsis indicator in the emergency department: comparison with CRP and procalcitonin in a multicenter international European prospective study

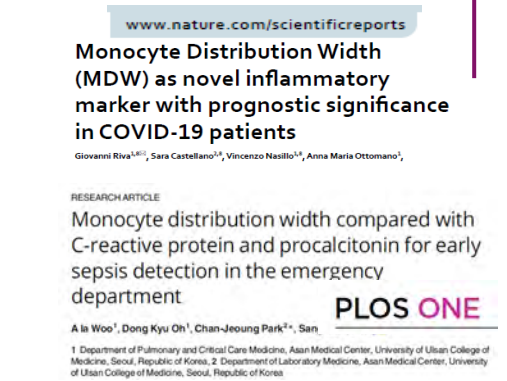
Pierre Hausfater[1,2,3*], Neus Robert Boter[4,5], Cristian Morales Indiano[5,7], Marta Cancella de Abreu[1,2], Adria Mendoza Marin[4,5], Julie Pernet[1], Dolores Quesada[5,8], Iris Castro[9], Diana Careaga[9], Michel Arock[6], Liliana Tejidor[9] and Laetitia Velly[1,2]



ISICEM

PERFORMANCE OF MONOCYTE DISTRIBUTION WIDTH (MDW) FOR THE IDENTIFICATION OF COVID-19

C. Morales[1], N. Robert [1], A. Mendoza [1], G. Rocamora [1], A. Leis [1], M.D. Quesada [1], I. Castro[2], D. Careaga[2], R. Magari[2], L. Tejidor[2]
[1] Hospital Universitari Germans Trias i Pujol, Badalona, Spain, [2] Beckman Coulter, Miami, United States



www.nature.com/scientificreports

Monocyte Distribution Width (MDW) as novel inflammatory marker with prognostic significance in COVID-19 patients

Giovanni Riva[1,2✉], Sara Castellano[3,4], Vincenzo Nasillo[3,4], Anna Maria Ottomano[1],

RESEARCH ARTICLE

Monocyte distribution width compared with C-reactive protein and procalcitonin for early sepsis detection in the emergency department

PLOS ONE

A la Woo[1], Dong Kyu Oh[1], Chan-Jeoung Park[2]*, San

1 Department of Pulmonary and Critical Care Medicine, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Republic of Korea, 2 Department of Laboratory Medicine, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Republic of Korea

JOHNS HOPKINS MEDICINE

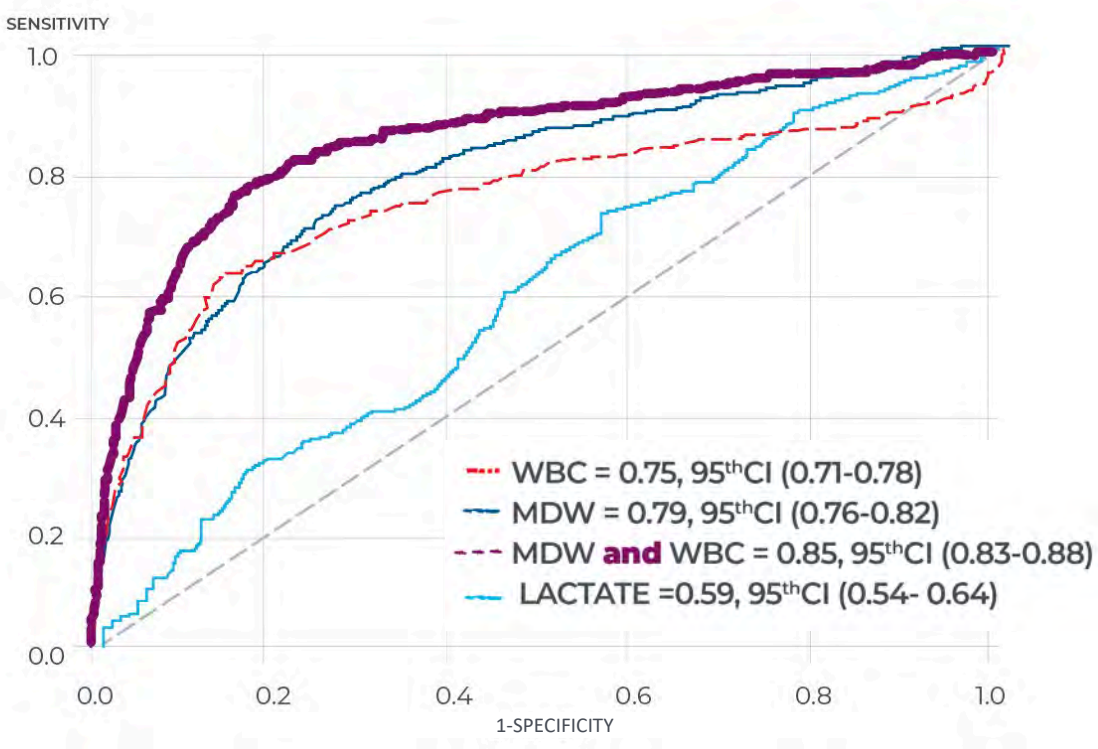
MassGeneral for Children

MDW: Regulatory-cleared Marker for Detection of Severe Infection and Sepsis in ED

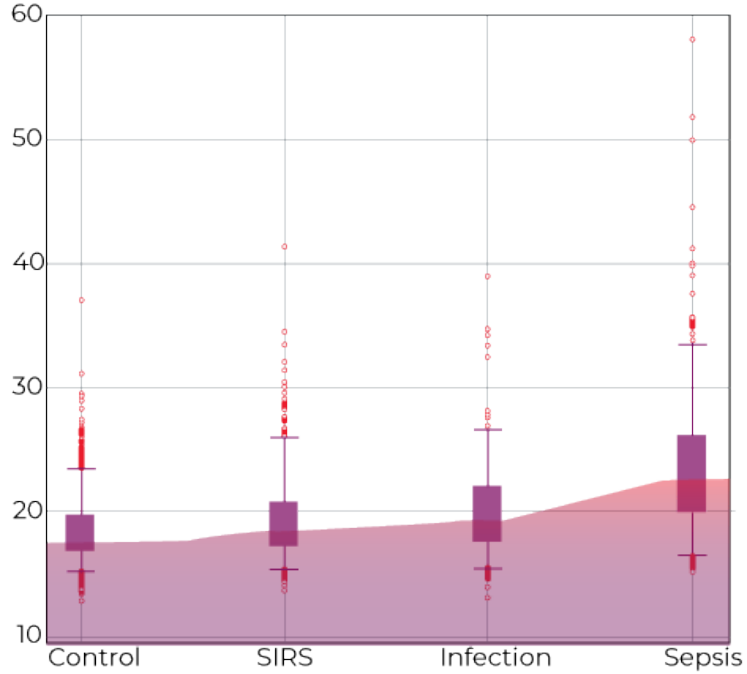
N=2158 | 3 Large EDs in US:

Hackensack University Medical Center; Ohio State University Wexner; Medical Center University of Pittsburgh

Receiver-Operator Curves for Sepsis-2 Detection



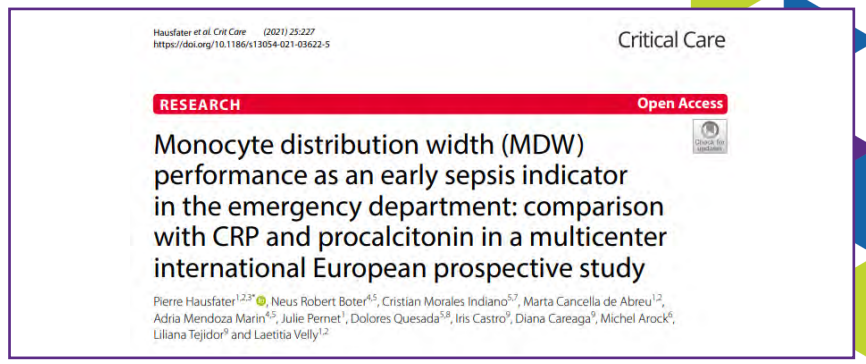
Distribution of MDW Values for Various Sub-populations



Crouser et al, Critical Care, 2019

MDW Results Replicated in EU

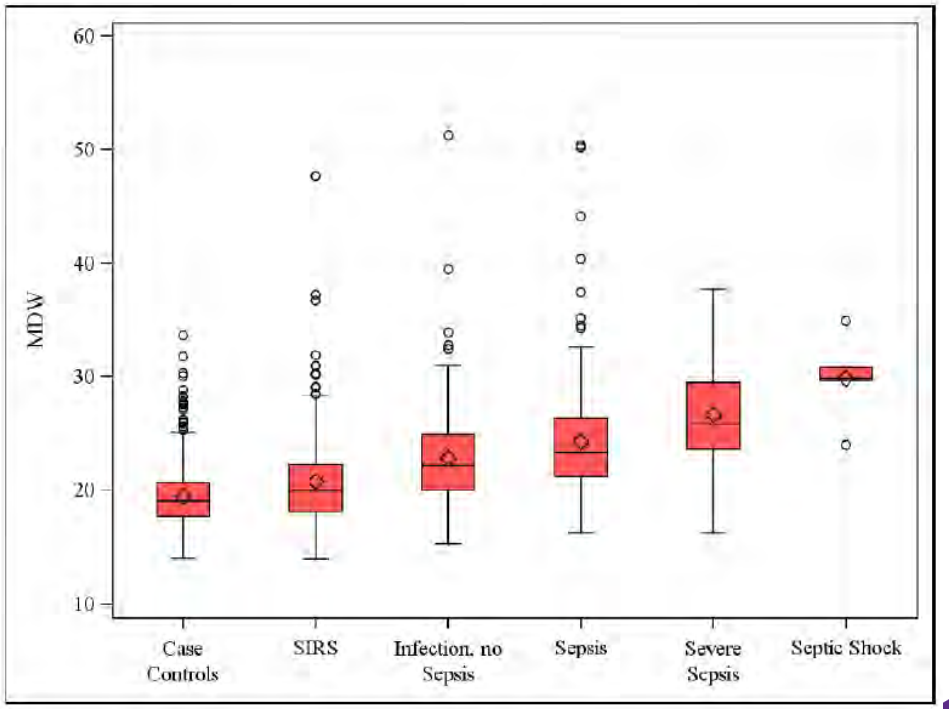
N=1517 | 2 Large EDs in France and Spain



Performances of MDW, WBC, PCT, CRP alone or in combination, for baseline measurement in the ED vs. Sepsis-2 & Sepsis-3

Parameters	SEPSIS-2		SEPSIS-3	
	AUC	CI 95%	AUC	CI 95%
MDW	**0.81**	**[0.78-0.84]**	**0.82**	**[0.79-0.85]**
WBC	0.76	[0.72-0.79]	0.65	[0.60-0.70]
MDW+WBC	**0.86**	**[0.84-0.88]**	**0.83**	**[0.79-0.86]**
PCT	0.78	[0.75-0.81]	0.84	[0.81-0.87]
CRP	0.85	[0.83-0.87]	0.85	[0.82-0.87]
MDW+WBC+PCT	0.86	[0.84-0.89]	0.83	[0.80-0.86]
MDW+WBC+CRP	0.87	[0.85-0.89]	0.85	[0.82-0.87]

Distribution of MDW Values for Various Sub-populations

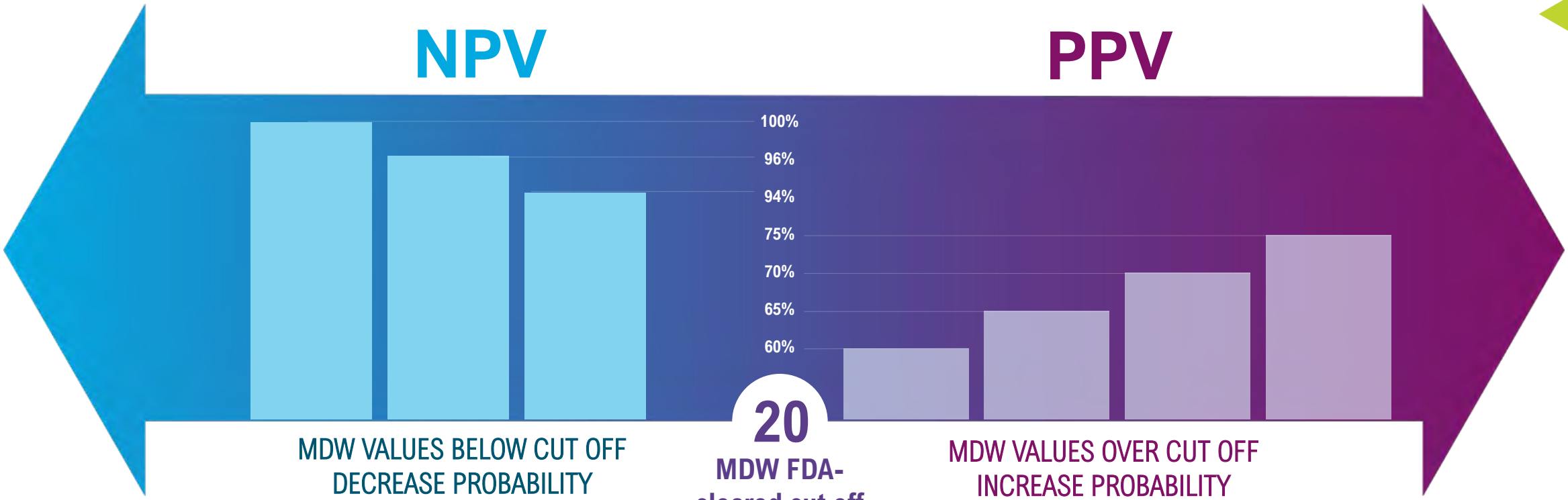


Hausfater et al, Critical Care, 2021

Mitigate Diagnostic Uncertainty

MDW IS AVAILABLE EARLY IN-PATIENT ASSESSMENT TO HELP DETERMINE PATIENT ACUITY AND RISK OF SEPSIS

Enhances WBC interpretation – helps to identify patients at risk



MDW VALUES BELOW CUT OFF DECREASE PROBABILITY
of severe infection and/or risk of sepsis

MDW VALUES OVER CUT OFF INCREASE PROBABILITY
Combination of abnormal MDW+WBC further improves Positive Predictive Value

MDW FDA-cleared cut off value of 20 K_2EDTA - NPV 92%, PPV 36%

Data drawn from Prospective Pivotal Trial N=2156 | UniCel DxH 900 Coulter Cellular Analysis System Early Sepsis Indicator (ESId) Application Addendum PN C42014AA.

Can MDW Help to Tag More Patients with Sepsis Time Zero?

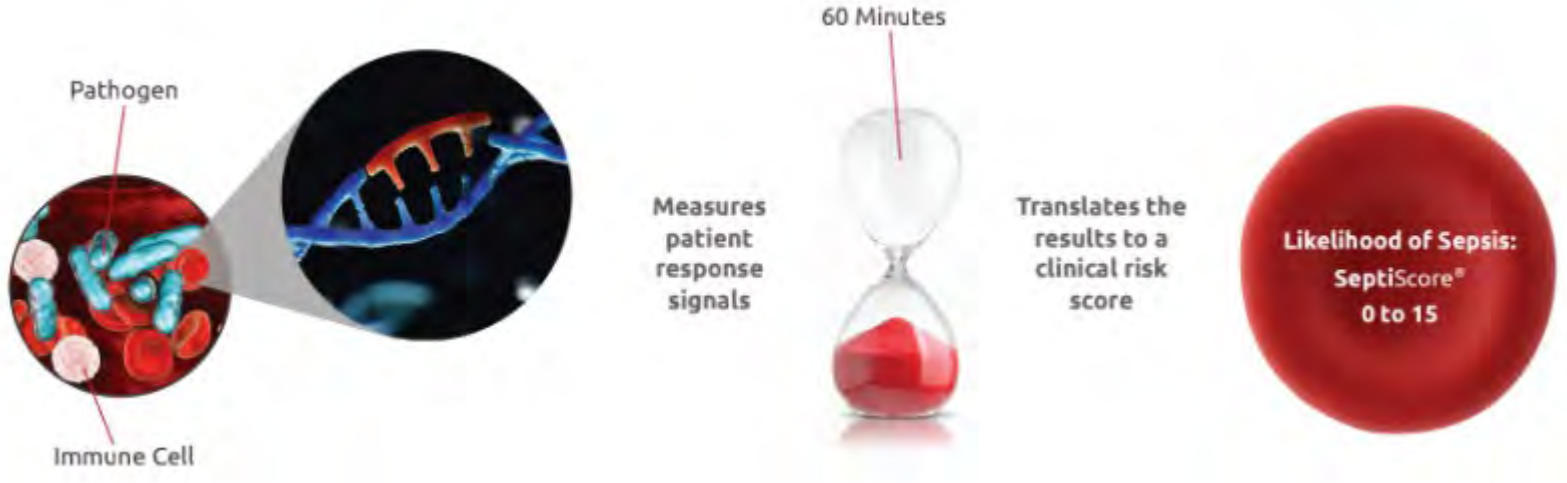
example

SEPSIS SCREENING/STANDING ORDERS

		Value	Time	Nurse
Does the patient have any of the following documented or suspected infections? **Please circle any that apply**	**Pneumonia (Cough, Shortness of Breath)** **UTI (Urinary Pain/ Frequency), Indwelling device(foley or central line)** **Wound Infection (Cellulitus, Decubitus Ulcer, Purulent Drainage)** **Abdominal Pain/Distention/Firmness** **Stiff neck** **Recent Surgery** **Currently on Antibiotics, Antibiotics or reports of infection within last 30 days.**		_____	_____
Screen within 30 minutes of presentation to the ED **Date/Time** _____	**Does the patient meet 2 or more of the following SIRS?** o Temperature >100.4 or <96.8 o Heart rate > 90 bpm o Respiratory rate >20 bpm o WBC >12,000 or <4,000 or >10% bands o MDW >20	_____ _____ _____ _____	_____	_____
	TIME ZERO FOR SEPSIS _____			
Do not delay antibiotic administration if unable to obtain timely blood cultures *****MAY GIVE ANTIBIOTICS IM ONLY IF YOU CAN NOT OBTAIN IV—PLEASE DOCUMENT IV ATTEMPTS*****	➢ *Lab draw for CBCD, CMP, UA, lactate level STAT* ➢ *Blood cultures (x2) STAT* ➢ *CXR* ➢ *Administer a broad- spectrum antibiotic STAT* ➢ ***REPEAT** Lactate Level in 4 hours if > 2mg/dl **(Put order in as soon as you know the results)*** ***(Give Antibiotic prior to transport and within 3 hour after arrival to ED)*** o **Zosyn 3.375 gms IV/IM** o **Vancomycin _____ IV** o **Levaquin 750mg IV** o **Rocephin 2 gm IV/IM** o **Unasyn _____ IV/IM**		_____ _____ _____ _____ _____	_____ _____ _____ _____ _____
Does the patient have one or more of the following organ dysfunctions? SEVERE SEPSIS = Sepsis + one of the following.	• **Cardiovascular:** Systolic BP ≤90 • **CNS:** Significant mental status change • **Respiratory:** SaO2 90% or increasing O2 needs • **Renal:** Urinary output ≤ 0.5ml/kg/hr or Creatinine >2(must be NEW ONSET) • **Hematologic:** Platelets <100,000/mm3 or > 400.000/mm3 or INR >1.5 • **Hepatic:** Liver Function Test >2 times upper limit of normal or bilirubin >2mg/dl • **Metabolic:** pH < 7.3 or lactate >2 mmol/l	_____ _____ _____ _____ _____ _____ _____	_____ _____ _____ _____ _____ _____ _____	_____

MDW Customer Protocol Example

SeptiCyte® Host Response Technology



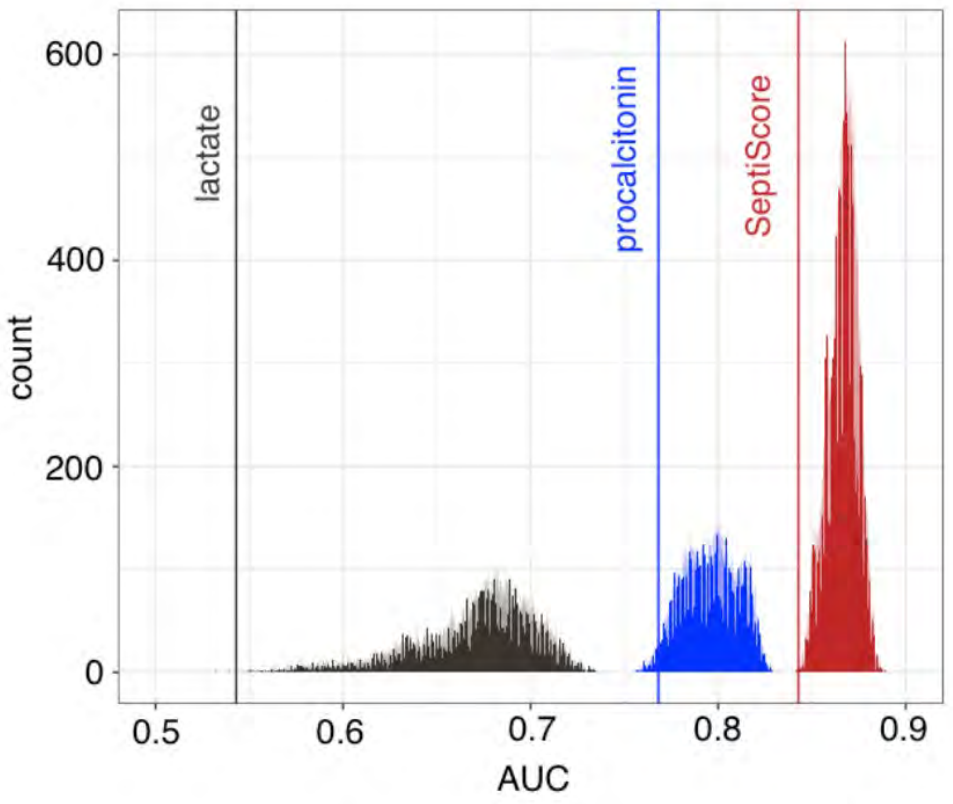
Measures Host Response Signals

- Measures mRNA in White Blood Cells (WBCs)
- Quantifies expression in two WBC genes
- Specific to infection in systemic inflammation
- Independent of type of pathogen causing sepsis (bacterial gram +tive, gram –tve, viral fungal/yeast)
- Not reliant on finding pathogen in blood sample

Clinical Interpretation of Result

- Reports the likelihood of sepsis
- Independent of severity
- Actionable results in ~100% of suspected sepsis patients

SeptiCyte RAPID outperforms PCT and lactate, alone and in combination with other clinical variables



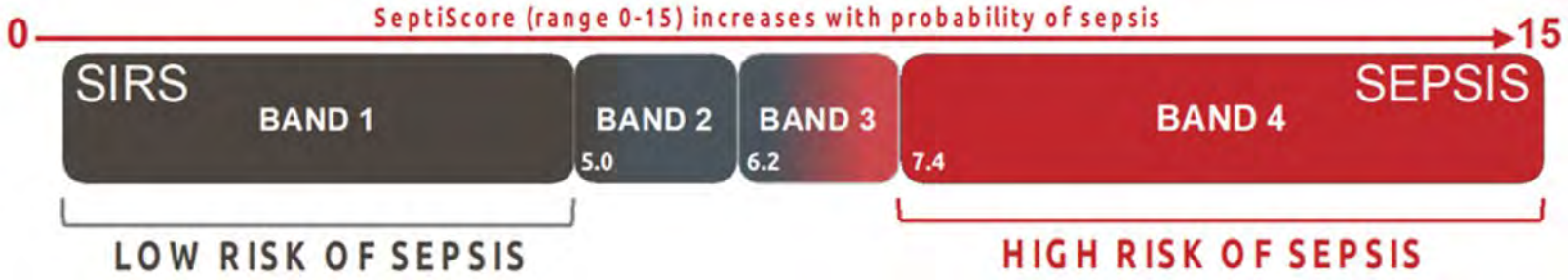
Comparison of lactate, PCT and SeptiScore, without or with additional clinical variables, for discrimination of sepsis vs. SIRS. AUC distributions are shown for all 32,767 possible logistic combinations of the following variables: age, race, sex, MAP max, T min, T max, HR min, HR max, WBC min, WBC max, glucose max, lactate, PCT, SeptiScore, # of SIRS criteria

Performance was assessed against consensus RPD.

Key:
vertical line, lactate alone; grey distribution, lactate combined with other clinical variables except SeptiScore or PCT
vertical line, PCT alone; blue distribution, PCT combined with other clinical variables except SeptiScore;
vertical line, SeptiScore alone; red distribution, SeptiScore combined with other clinical variables

*Pre-print manuscript “Validation of SeptiCyte RAPID For Sepsis vs SIRS” https://doi.org/10.1101/2022.07.20.22277648

3. Early Rule In/Rule Out Sepsis (510k clinical validation data)



High Specificity, 90% for band 4 - Rule In
PPV = 0.81

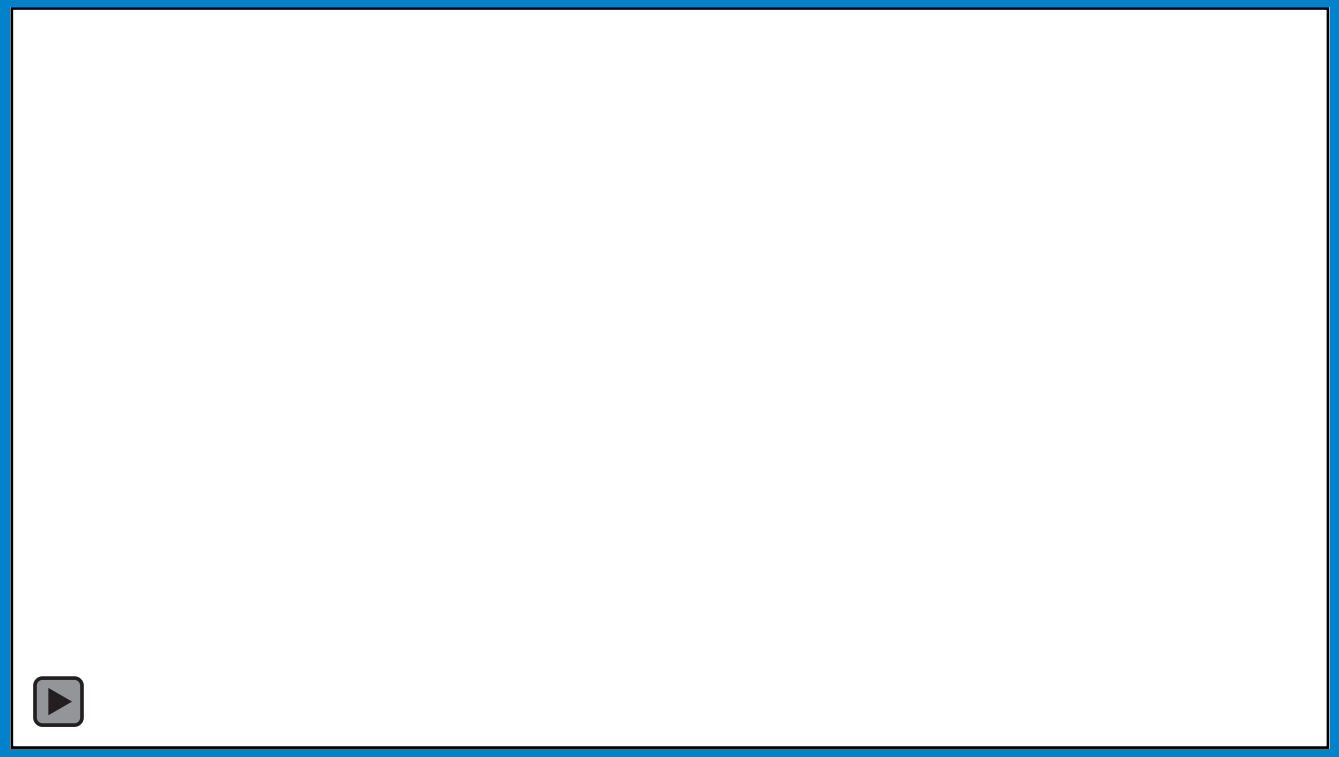
Using Likelihood Ratio, (LR), actionable results are obtained in bands 1,2 (LR = < 1.0) and band 4 (LR = > 6.0) which accounts for 80% of all patients tested

Grady
Intermountain Healthcare
Johns Hopkins Medicine
Northwell Health
Amsterdam UMC Universitair Medische Centra
Utrecht University
RUSH
Loyola Medicine

For results falling into band 2 or 3 the SeptiScore value can drive the probability up or down in conjunction with the other clinical variables and lab tests

USC University of Southern California Keck School of Medicine of USC

Case Studies—Using the CBC with Diff to Help Rule in or Rule Out Sepsis



This case study is presented for educational purposes only, it may not reflect a typical patient triage process and only applicable to the specific study population.

Statements made in this video are the opinions of the presenter based on their implementation of MDW at this facility and do not represent performance claims made by Beckman Coulter.

For MDW specific performance claims, please refer to UniCel DxH 900 Coulter Cellular Analysis System Early Sepsis Indicator (ESId) Application Addendum PN C42014AC.
MDW values greater than 20.0 together with other laboratory findings and clinical information, aids in identifying patients with sepsis or at increased risk of developing sepsis within the first 12 hours of hospital admission.
MDW results greater than 20.0 should be interpreted in association with other clinical information and diagnostic testing as a proportion of patients without sepsis may have an elevated MDW value at baseline. MDW values less than or equal to 20.0 cannot rule out sepsis or the development of sepsis within 12 hours of hospital admission. The Early Sepsis Indicator should not be used as the sole basis to determine the absence of sepsis.

11:15 AM

PATIENT ARRIVES TO ED

63 year old brought in by EMS for generalized weakness and fatigue for 1 week

- ✓ Decrease appetite for 2 weeks
- ✓ Intermittent nausea
- ✓ Vomited twice yesterday
- ✓ Mild, intermittent abdominal pain
- ✓ Denies change in BM or urination
- ✓ No f/c
- ✓ No cough or sob
- ✓ No cp

PMH:

Prostate cancer

Urinary retention s/p suprapubic catheter

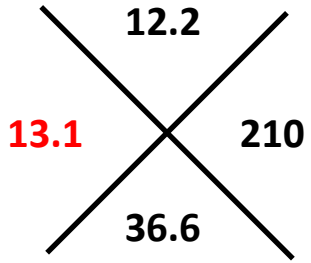
07:08 T: 37.4 BP: 122/81 P: 127 RR: 21 SpO2: 97% (RA)

Positive Physical Exam Findings: Mildly dry mucous membranes

Mild TTP of the periumbilical region Tachycardic, irregular rhythm

07:35 EKG: A fib w/ RVR, rate 130

08:10 CBC w/Diff



MDW: 16.7

08:35 BMP

LACTATE: 2.8

1.03 (1 mo ago)

08:38 Troponin & BNP: Negative

09:35 UA: WBC 5-10 RBC 10-20 Epithelial cells moderate Leukocyte esterase 2+ Few bacteria UTI??

08:55 CXR: No acute findings

10:43 CT abdomen/pelvis: No acute findings

Urine culture after 5 days: No Growth

CBC w/Diff

12.2

13.1 210

36.6

+ LACTATE: 2.8

Cr: 2.67

√ SIRS

UA: WBC 5-10
RBC 10-20
Epithelial cells moderate
Leukocyte esterase 2+
Bacteria few

+ MDW:= 16.7

Sepsis & Bacteremia Not Suspected

Initial Vital Signs

P: 127

07:08

IVF

RATE CONTROL

LACTATE: 2.8 → LACTATE: 1.5

Cr: 2.67 → Cr: 2.07 → Cr: 1.5

Dehydration & Afib

Urine culture after 5 days: No Growth

CBC w/Diff

12.2

13.1 210

36.6

+ LACTATE: 2.8

Cr: 2.67

√ SIRS

UA: WBC 5-10
RBC 10-20
Epithelial cells moderate
Leukocyte esterase 2+
Bacteria few

Broad Spec Abx

UTI?? = Urosepsis???

Stop antibiotics

In the presence of leukocytosis, when MDW is not elevated, significant underlying infection is less likely

Trauma

63 y/o presents post fall with left hip pain

P: 115 **RR:** 24

WBC: 21.2

MDW: 15.3

Hemorrhage

35 y/o presents post dark brown emesis

P: 124 **BP:** 88/57 **Lactate:** 5.5

WBC: 22.0

MDW: 16.1

DKA

27 y/o w/ h/o IDDM and noncompliance presents w/ fatigue, vomiting and abdominal pain

P: 133 **RR:** 28 **Lactate:** 4.7

WBC: 19.4

MDW: 17.3

9:30 AM

PATIENT ARRIVES TO ED

A 63-year-old male with a history of coronary artery disease, diabetes, and lung cancer presents to the ED complaining of generalized body aches, fatigue and weakness, which started about one week prior.

- ✓ Denies localized weakness or numbness, chest pain, shortness of breath, abdominal pain, headache, or urinary symptoms. His last chemotherapy was the month prior
- ✓ Feeling more tired than usual
- ✓ H/o anemia and thromocytopenia

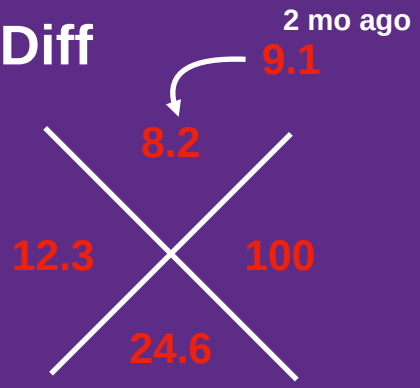
Chief Complaint:

- ✓ Fatigue, generalized weakness

09:35 T: 37.1 BP: 122/73 P: 88 RR: 21 SpO2: 97% (RA)

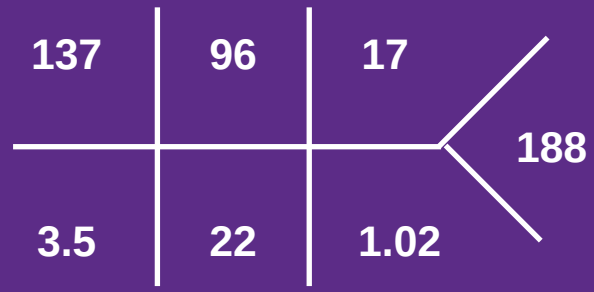
Positive Physical Exam Findings: Mildly dry mucous membranes
Hemoccult positive stool

10:40 CBC w/Diff



MDW: 27.3

11:05 CMP



Tot Bili: 0.9

10:45 Lactate, blood cultures and Abx ordered

10:50 Head to toe exam: Mild erythema and induration around Portacath

11:15 Antibiotic given

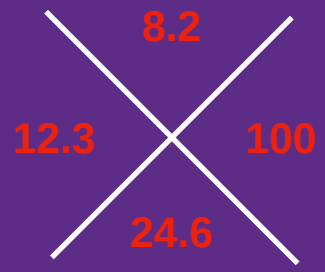
11:27 Lactate: 3.2

11:33 CXR: No acute findings

12:55 UA: WBC 0-2 RBC 0 Bacteria None

Blood Cultures: Gram-positive cocci in clusters

10:40 CBC w/Diff



CONSIDER SEPSIS

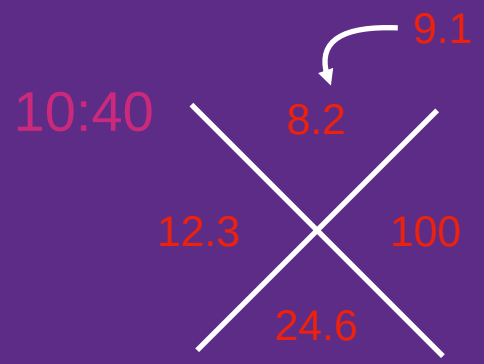
MDW: 27.3 → 11:15 Abx given

Additional orders placed: Lactate, Blood Clx, Abx

Head to toe exam reveals possible port infection

√ SIRS (RR + WBC) √ Infection SEPSIS

11:27 Lactate: 3.2 Time Zero



\+ Hemoccult positive stool = **Transfusion?**

09:35 Initial Vital Signs

No Metrics Met

11:27 Time Zero

Blood Cultures: Gram-positive cocci in clusters

All Metrics Met

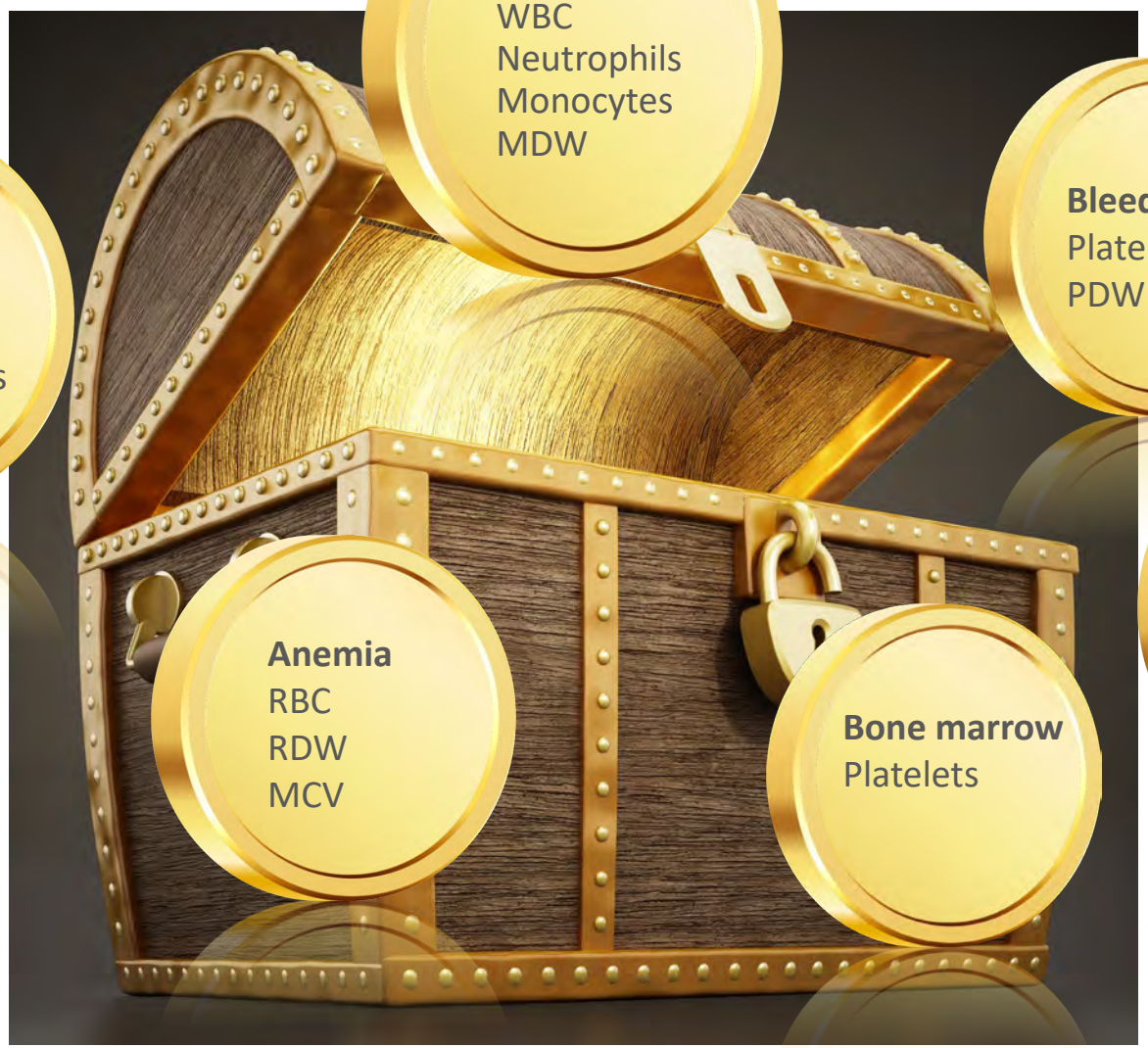
CONSIDER SEPSIS

MDW: 27.3

11:15 Abx given

Lactate and Blood Cultures Collected
Repeat Lactate

CBC with Diff



Sepsis
WBC
Neutrophils
Monocytes
MDW

Immune Function
Lymphocytes

Bleeding Risk
Platelets
PDW

Anemia
RBC
RDW
MCV

Bone marrow
Platelets

Allergen & Histamine
Basophils
Eosinophils

Kathleen Vollman
ADVANCING NURSING THROUGH KNOWLEDGE & INNOVATION

Kathleen M. Vollman MSN, RN, CCNS, FCCM, FCNS, FAAN
Clinical Nurse Specialist / Educator / Consultant
ADVANCING NURSING
kvollman@comcast.net
Northville, Michigan
www.vollman.com