CLS 291 Clinical Hematology 1

جامعة الملك سعود
King Saud University

Lecture9

Complete Blood Count (CBC)

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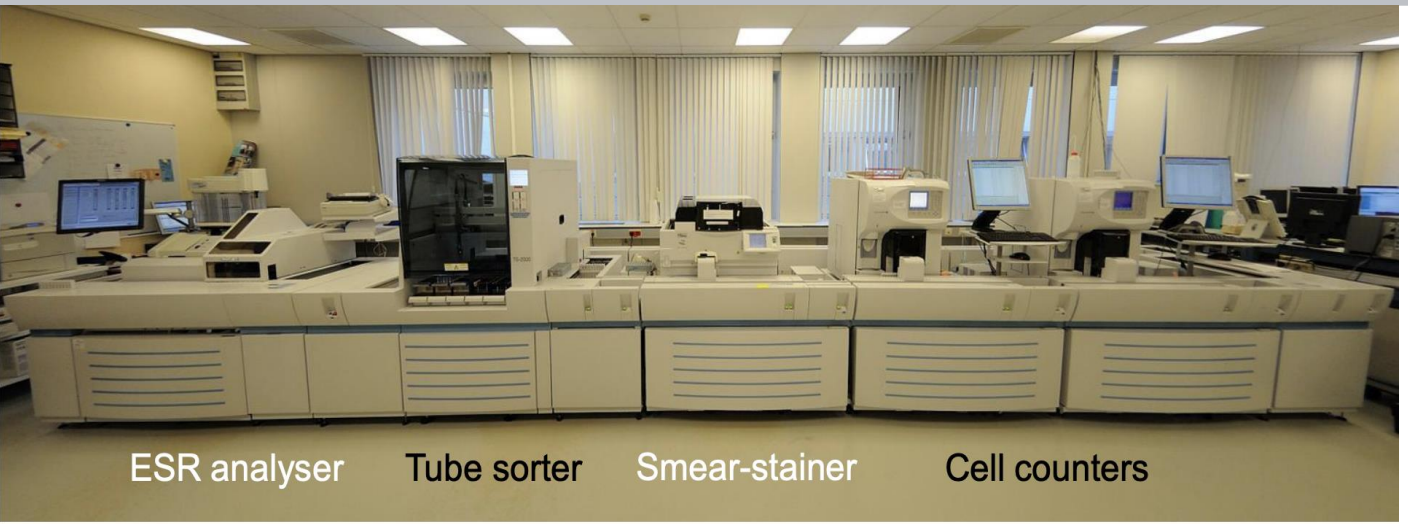
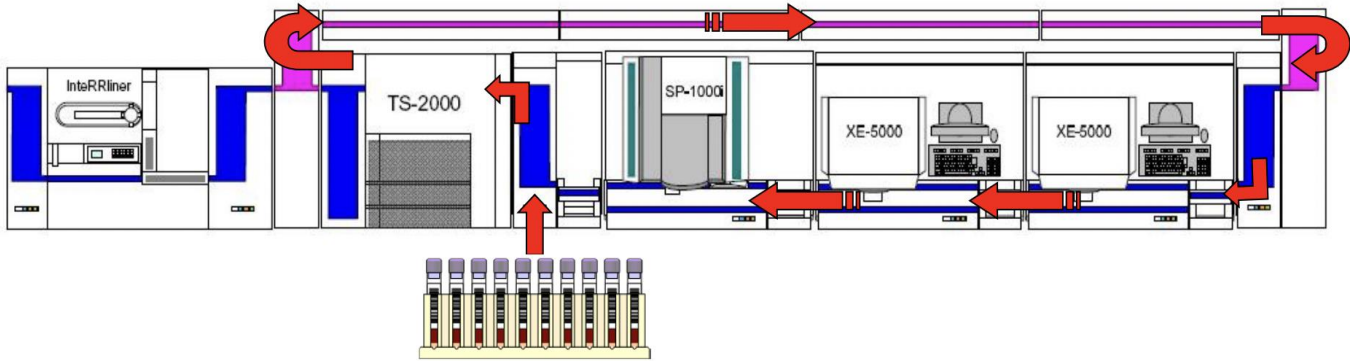
Automated Blood Counter Instruments

- Complete blood counts (CBC) is one of the most frequently requested tests in clinical hematology labs (routine test).

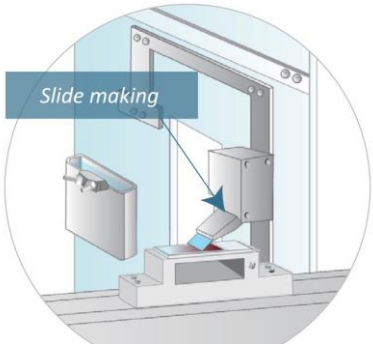
Automated Blood Counter

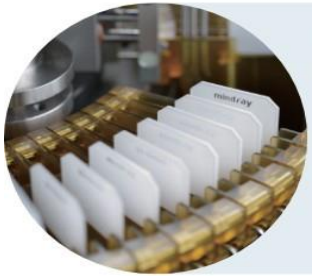




Automated Blood Counter

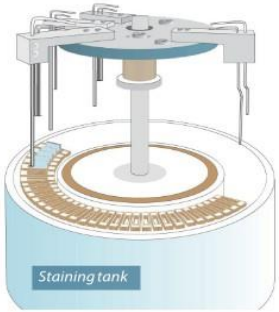
Microscope Smear-stainer Analysers

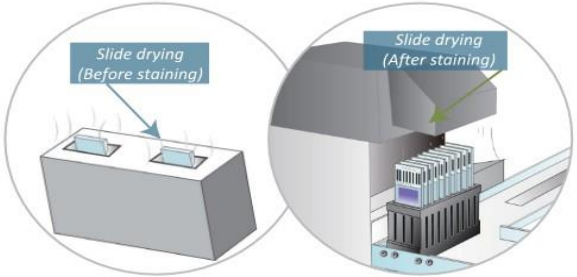




Staining Cassette

Each staining cassette holds single slide for staining, this eliminates the problem of stain evaporation and these cassettes could be cleaned automatically without any manual interventions.





Cell Analyzer

Types of Cell Analyzers:

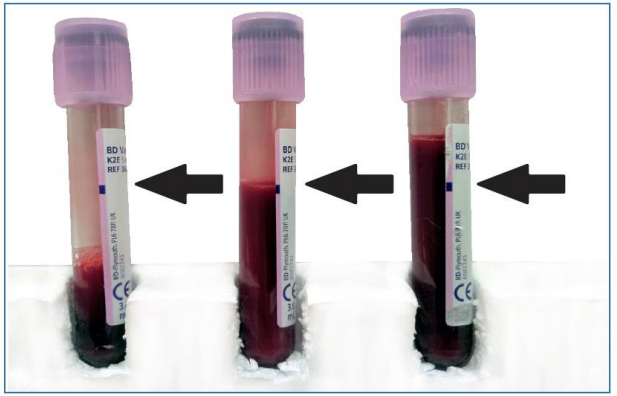
a. **Semi-automated**
   - Some steps are carried out manually (e.g., dilution of blood).
   - Measures only a few parameters.

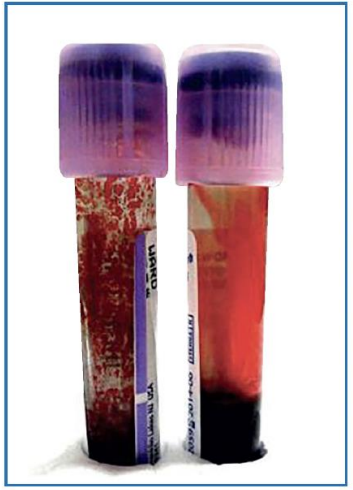
b. **Fully automated**
   - It does not require manual steps to be performed before running the sample.
   - Measure multiple parameters.

- Results obtained from hematological cell analyzers instruments are collectively known as **complete blood counts (CBCs)**.
- Some cell counters can process 120-150 samples per hour.

Cell Analyzer

- **Type of sample:** Whole EDTA blood sample.
- **Criteria for sample rejection:** Clotted sample, Insufficient sample, Improper tube, hemolysis, lipemia, old sample, no patient information.
- **Number of variables:** patient demographic data.





Parameters of Automated Blood Counter

- **8-20 parameters, including:**

1. Total WBC count.
2. WBC DIFF count.
3. Red blood cell (RBC) count.
4. Platelet (PLT) count.
5. Hb estimation.
6. Mean cell volume (MCV).
7. Mean cell Hb (MCH).
8. Mean cell Hb concentration (MCHC).
9. Hematocrit (Hct).
10. Red cell distribution width (RDW).
11. PLT volume (MPV).

CBC results

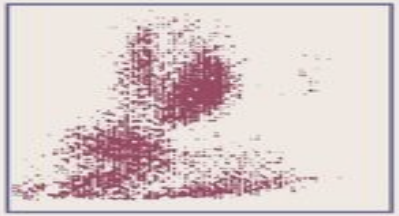
Coulter LH 750

Date:	5/26/2005	Sample ID:	4004	
Time:	11:28:26	Sample Type:	CD A NO Read	
Cass / Pos:	000904	Operator ID:	LABADMIN	
Listname:	37H5QDD4	Instrument:	LH1N	

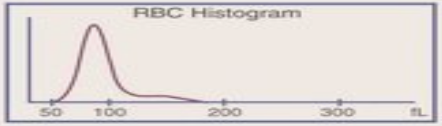
			Flags	
WBC		8.8		$10^3/uL$
NE	%	65.7		%
LY	%	25.7		%
MO	%	7.9		%
EO	%	0.5	L	%
BA	%	0.2	L	%
NRBC	%	0.0		%
NE	#	5.8		$10^3/\mu L$
LY	#	2.3		$10^3/\mu L$
MO	#	0.7		$10^3/\mu L$
EO	#	0.0	L	$10^3/\mu L$
BA	#	0.0		$10^3/\mu L$
NRBC	#	0.0		$10^3/\mu L$
RBC		4.24	L	$10^6/\mu L$
HGB		12.4	L	g/dL
HCT		37.3	L	%
MCV		88.0		fL
MCH		29.2		pg
MCHC		33.1		g/dL
RDW		14.7	H	%
PLT		344		$10^3/\mu L$
MPV		7.2		fL

Suspect Definitive

A



B



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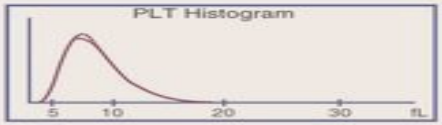


Measurement in Automatic CBC Devices

Principles of the Measurement in Automatic Blood Count Devices:

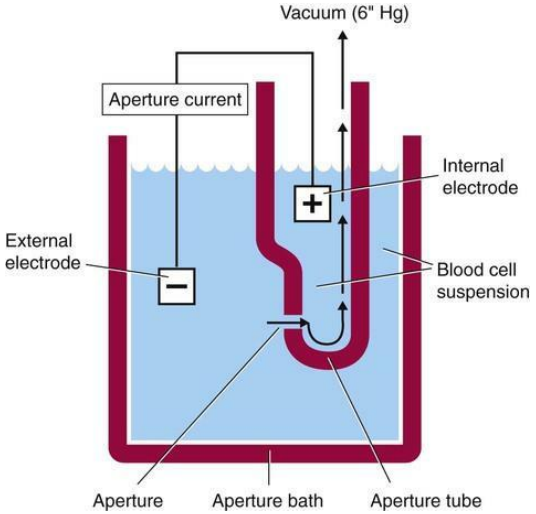
I. Impedance counting (coulter principle)
II. Flow-cytometry
III. Light scattering
IV. Photometry

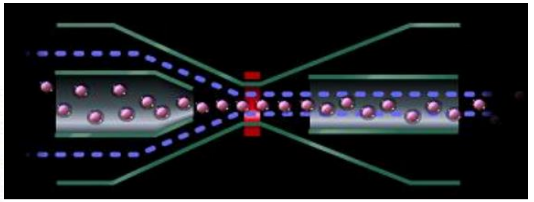
- More than one principle is implemented in one analyzer instrument.

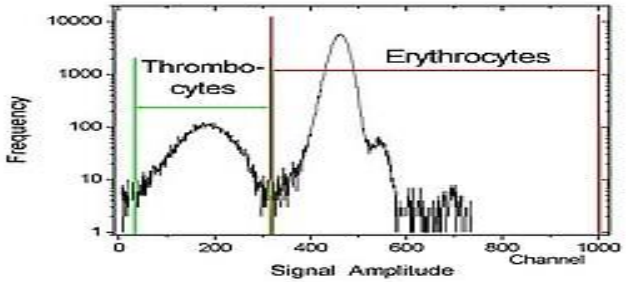
I. Impedance Method in Blood Count

Principle:

- Whole blood is passed between two electrodes through a narrow aperture.
- Allowing only that passage of one cell at a time.
- The impedance (electrical current) changes as a cell passes through.
- Changes in electrical current are sensed by the electrode.
- The change in electrical current is proportional to cell volume, resulting in a cell count and measure of volume.
- **Sources of error:** sample clumping of two cells passing at the same time or the presence of bubbles or organisms



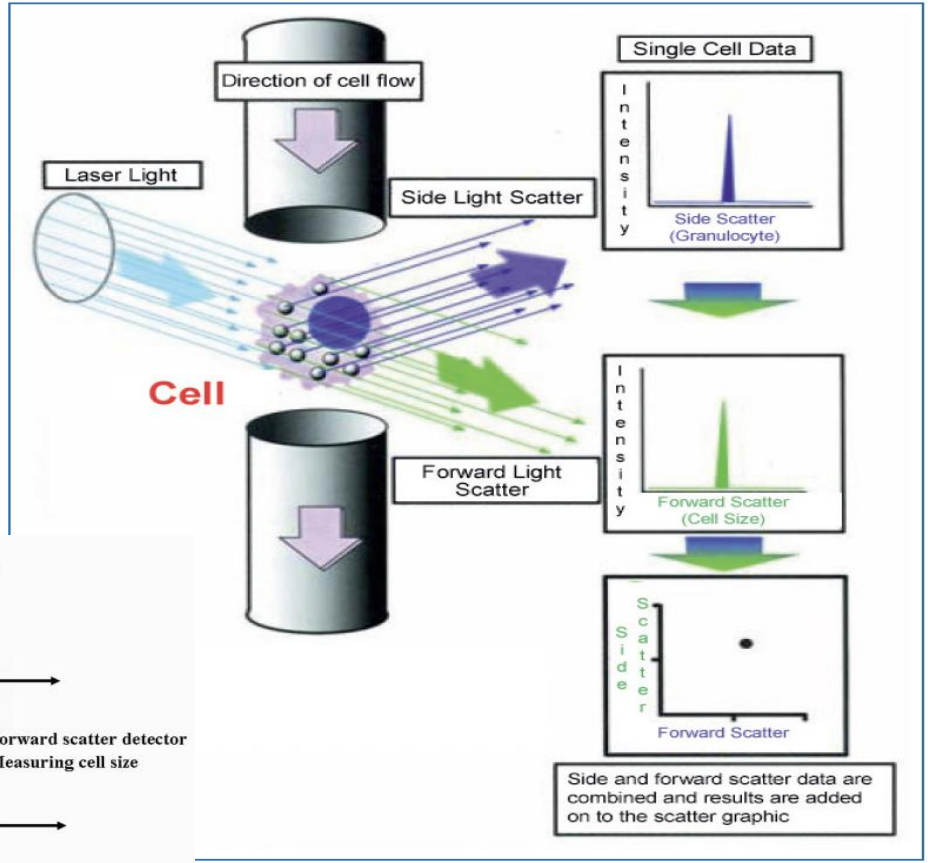


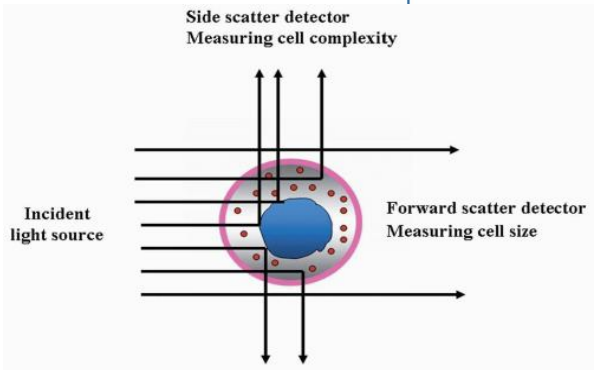


II. Flow Cytometry

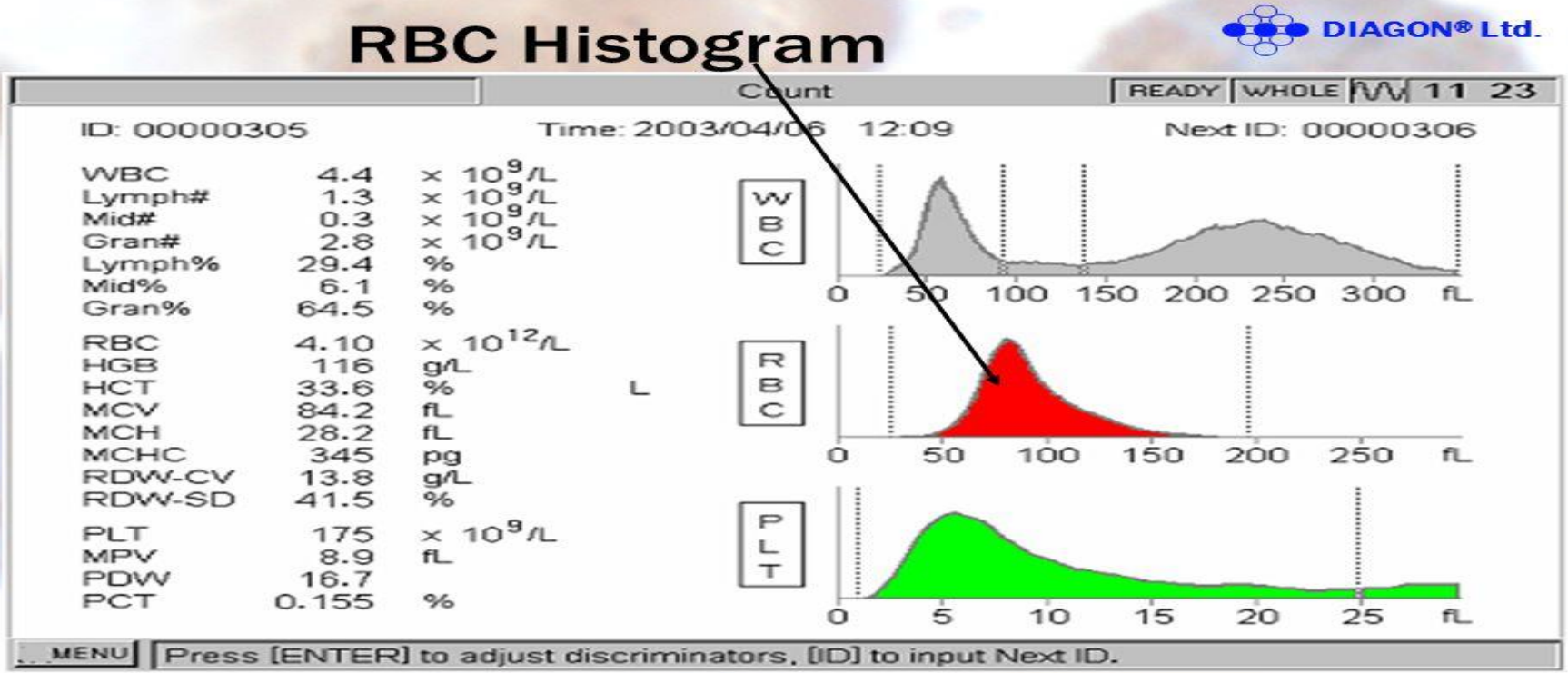
Principle:

- Cell flows through the channel are exposed to the **laser** light, which causes light scatter.
- Detectors collect the signal of scattered light, and based on the size, shape, cell granularity, and antigenic components of the cells, the WBC type is identified.





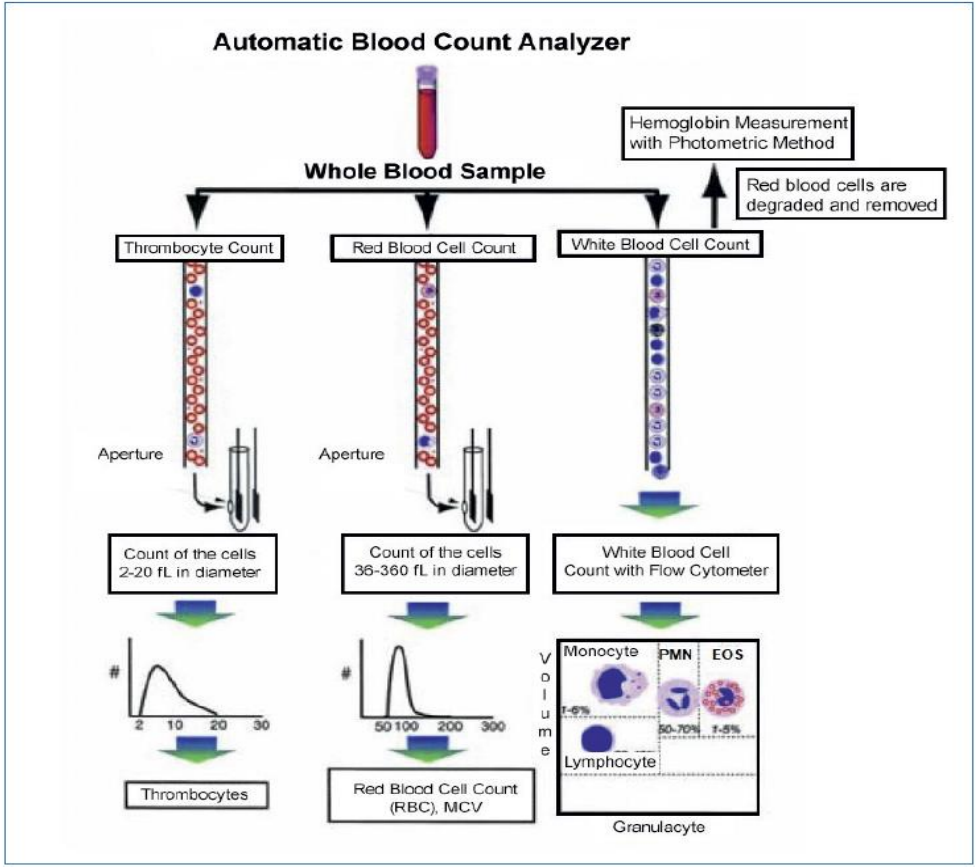
RBC Histogram



Normal Distribution Histogram in Normal samples

Automated Blood Counter Design

- More than one principle is implemented in one analyzer instrument.



Parameters

Parameter	Methadology
Red cell count	Impedance or light scattering
Plts count	Impedance technique or by immunofluorescent (Florence-Ab), or optical fluorescent (Florence-dye)
Total WBC count	Impedance
WBC Differential count	Flow-cytometry
MCV	RBC size is measured directly by light scattered or, more frequently by impedance counting.
Red cell distribution width (RDW)	The distribution of RBC population cell sizes is measured directly for each cell by light scattered or impedance counting.
Hct	Hct Method is different than PCV. It is a calculated value. Derived by the formula (MCV x RBC count / 10).
Hb concentration	HiCN method using the photometric technique.

Parameters

Parameter	Methadology
NRBC	NRBC is counted by using a dye that binds to DNA that is detected by flow cytometer.
Reticulocytes	Reticulocytes are counted by using a Fluorochromes dye that binds to rRNA that is detected by a flow cytometer. Most immature (stage I) reticulocytes will give a high fluorescence signal in comparison to most mature (stage IV).
MCH	Calculated by dividing Hb conc. by RBCs number.
MCHC	Calculated by dividing Hb conc. by Hct value.