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Modern Medical Laboratory Technology

Methods and Interpretation

Highlights

- Thoroughly updated with recent advancements
- As per latest guidelines and syllabus for MLT
- Special emphasis on quality control for various laboratory methods
- Concise yet comprehensive coverage of laboratory technologies



7th Edition

Ramnik Sood

JAYPEE

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CHAPTER 3

SI Units

INTRODUCTION

The SI units (International System of Units or Système International d'Unités) have replaced the old system of reporting and measurements. This is in accordance with a World Health Organization resolution which recommends the adoption of the International System of Units by the medical community throughout the world. Consequently, reports and measurements from any corner of the world can be safely understood anywhere else.

The SI system is based on meter-kilogram-second system and replaces both the foot-pound-second system and the centimeter-gram-second system. There are seven SI base units, i.e., meter, kilogram, second, mole, ampere, Kelvin, and Candela. The symbols for these units and what they measure are listed in **Table 3.1**.

LITER

The SI unit of volume is cubic meter (m^3). This is a very large unit, hence, the liter (L) although not an SI unit, has been recommended for use in the laboratory.

The liter is equal to a cubic decimeter ($1\ dm^3$). Volume measurements are made in liters or multiples and submultiples of the liter, e.g., dL (10^{-1}l), mL (10^{-3}l), µL (10^{-6}l).

One liter is, therefore, equivalent to 10 dL, 1,000 mL or 1,000,000 µL. One dL is equivalent to 100 mL, and 1 mL to 1000 µL.

SI unit	*Old unit*
dl	100 mL
ml or cm^3	cc
µl	lambda
nl	—
pl	µ µL

GRAM

The kilogram (kg) is the SI unit for mass and the gram (g) is the working unit.

Formerly, the gram (gm) was written as gramme, or gm.

Mass measurements are made in grams or in multiples and submultiples of the gram, e.g., mg (10^{-3}gm), µg (10^{-6}g), ng (10^{-9}g), pg (10^{-12}g). One g is, therefore, equivalent to 1000 mg, 1000,000 µg, or 1000 000 000 ng. One mg is equivalent to 1000 µg.

Table 3.1: The symbols of units and what they measure.

SI base units			*SI base units*			
	Symbol	*Quantity measured*	*Prefix*	*Symbol*	*Function*	*Divide by*
Meter	m	Length	deci	d	10^{-1}	10
Kilogram	kg	Mass	centi	c	10^{-2}	100
Second	s	Time	milli	m	10^{-3}	1000
Mole	mol	Amount of substance	micro	µ	10^{-6}	1000 000
Ampere	A	Electric current	nano	n	10^{-9}	1000 000 000
Kelvin	K	Temperature	pico	p	10^{-12}	1000 000 000 000
Candela	cd	Luminous intensity	femto	f	10^{-15}	1000 000 000 000 000
SI derived units						
Square meter	m^2					Multiply by
Cubic meter	m^3		deca	da	10^1	10
Meter per second	m/s		hecto	h	10^2	100
Named SI derived units			kilo	k	10^3	1000
Hertz	Hz	Frequency	mega	M	10^6	1000 000
Joule	J	Energy, quantity of heat	giga	G	10^9	1000 000 000
Newton	N	Force	tera	T	10^{12}	1000 000 000 000
Pascal	Pa	Pressure	peta	P	10^{15}	1000 000 000 000 000
Watt	W	Power				
Volt	V	Electric potential difference				
degree Celsius	°C	Celsius temperature				

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SI unit	*Old unit*
nm µm	m µ µ (micron)

MOLE (MOL)

The mole (mol) is the SI unit for amount of substance and measurements of the amounts of substances are made in moles, or in mmol (10^{-3} mol), µmol (10^{-6} mol), or nmol (10^{-9} mol).

One mol is, therefore, equivalent to 1000 mmol, 1000 000 µmol, or 1000 000 000 nmol. One mmol/L is equivalent to 1000 µmol/L.

Earlier, the results of tests expressed in mmol/L or µmol/L were expressed in mg/100 mL or µg/100 mL. The formula used to convert mg/100 mL to mmol/L is as follows:

$$\text{mmol/L} = \frac{\text{mg/100 mL} \times 10}{\text{molecular weight of substance}}$$

where the molecular weight of a substance cannot be accurately determined (e.g., albumin), results are expressed in gm/L.

SI unit	*Old unit*
Mol Mmol Mmol Nmol	M m Eq µM nM

INTERNATIONAL UNIT (U)

This unit is used to express enzyme activity. An International Unit of enzyme activity is that amount of enzyme which under defined assay conditions will catalyze the conversion of 1 mmol of substrate per minute. Results are expressed in International Units per liter (U/L).

CONVERSION FACTORS BETWEEN CONVENTIONAL AND SYSTEM INTERNATIONAL UNITS (SIU)

This list is included to assist the reader to convert values between conventional units and the newer SI units that have been mandated by many journals. Only common analytes are included.

Hematology

			Conversion factors	
Analyte	*Conventional units*	*SI units*	*Conventional to SI units*	*SI to conventional units*
WBC count (leukocytes) (B) (CSF) (SF)	µl or/cu mm or/mm^3 /cu mm or → cu µL #/µ1	cells 10^9L 10^6/L 10^6/L #/L	0.001 1 10^6 10^6	1000 1 10^{-6} 10^{-6}
Platelet count	10^3/cu mm	10^9/L	1	1
Reticulocytes	/cu mm	10^9/L	0.001	1000
RBC count (erythrocytes) (B)	10^6/µL or /cu mm	10^{12}/L	1	1
(CSF)	or/mm^3/cu mm	10^6/L	1	1
Hematocrit [packed cell volume (PCV)]	%	Volume fraction	0.01	100
Mean corpuscular volume (MCV) (volume index)	μ^3 (cubic microns)	fl	1	1
Mean corpuscular hemoglobin (MCH) (color index)	pg (or µg) pg	pg fmol	1 0.06206	1 16.11
Mean corpuscular hemoglobin	gm/dL	gm/L	10	0.1
concentration (MCHC) (saturation index)	gm/dL	mmol/L	0.6206	1.611
Hemoglobin	gm/dL	gm/L	10	0.1
(whole blood)	gm/dL	mmol/L	0.155	6.45
(plasma)	mg/dL	µmol/L	0.155	6.45
Fetal hemoglobin	%	mol/mol (may omit symbol)	0.01	100
Haptoglobin	mg/dL	mg/L	10	0.1
Fibrinogen	mg/dL	gm/L	0.01	100

Chemistry

			Conversion factors	
Analyte	*Conventional units*	*SI units*	*Conventional to SI units*	*SI to conventional units*
Adrenocorticotropic hormone (ACTH)	pg/mL pg/mL	ng/L pmol/L	1 0.2202	1 4.541

Contd...

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Contd...

			Conversion factors	
Analyte	***Conventional units***	***SI units***	***Conventional to SI units***	***SI to conventional units***
Aldosterone				
(S)	ng/dL	nmol/L	0.0277	36.1
(U)	mEq/24 hr	mmol/d	1	1
(U)	µg/24 hr	nmol/d	2.77	0.36
Angiotensin	ng/dL	ng/L	10	0.1
	pg/mL	ng/L	1	1
Angiotensin-converting enzyme (ACE)	nmol/min/mL	U/L	1	1
Antidiuretic hormone (ADH) (vasopressin)	pg/mL	ng/L	1	1
Albumin				
(S)	gm/dL	gm/L	10	0.1
(CSF, AF)	mg/dL	mg/L	10	0.1
Alpha antitrypsin	mg/dL	gm/L	0.01	100
Alpha-fetoprotein (AFP)	ng/mL	µg/L	1	1
(S)	ng/dL	ng/L	10	0.1
	mg/dL	gm/L	0.01	100
	mg/dL	mg/L	10	0.1
	µg/dL	µg/L	10	0.1
Ammonia	µg/dL	µmol/L	0.714	1.4
(P)	µg/dL	µmol/L	0.5872	1.703
Anion gap	mEq/L	mmol/L	1	1
Base excess	mEq/L	mmol/L	1	1
Bicarbonate	mEq/L	mmol/L	1	1
Bilirubin	mg/dL	µmol/L	17.1	0.0584
Calcitonin	pg/mL	ng/L	1	1
Catecholamines (U)	µg/24 hr	nmol/d	5.91	0.169
Norepinephrine	µg/mg creatinine	µmol/mol creatinine	669	0.00149
	pg/mL	pmol/L	5.91	0.169
	ng/mL	nmol/L	5.91	0.169
Epinephrine	µg/24 hr	nmol/d	5.46	0.183
	µg/mg creatinine	µmol/mol creatinine	617	0.00162
	pg/mL	pmol/L	5.46	0.183
	ng/mL	nmol/L	5.46	0.183
Normetanephrine	ng/mL	nmol/L	5.46	0.183
Dopamine	µg 24 hr	nmol/d	6.53	0.153
	µg/mg creatinine	µmol/mol creatinine	783	0.00136
	pg/mL	pmol/L	6.53	0.153
	ng/mL	nmol/L	6.53	0.153
Chorionic gonadotrophin (HCG), beta, subunit	mU/mL	IU/L	1	1
	U/24 hr	IU/d	1	1
Calcium				
(S)	mg/dL	mmol/L	0.25	4.0
	mEq/L	mmol/L	0.5	2.0
(U)	mg/24 hr	mmol/d	0.025	40
Carbon dioxide total (content; CO_2 + bicarbonate)	mEq/L	mmol/L	1	1
CO_2 partial pressure, tension (PCO_2)	mmHg	kPa	0.133	7.52
Standard bicarbonate (hydrogen carbonate)	mEq/L	mmol/L	1	1
Chloride	mEq/L or mg/dL	mmol/L	1	1
CEA	ng/mL	µg/L	1	1
	µg/mL	mg/L	1	1
Ceruloplasmin	mg/dL	mg/L	10	0.1

Contd...

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Contd...

			Conversion factors	
Analyte	***Conventional units***	***SI units***	***Conventional to SI units***	***SI to conventional units***
Cholesterol	mg/dL	mmol/L	0.0259	38.61
HDL-cholesterol	mg/dL	mmol/L	0.0259	38.61
LDL-cholesterol	mg/dL	mmol/L	0.0259	38.61
Copper (S) (U)	 µg/dL µg/24 hr	 µmol/L µmol/d	 0.157 0.0157	 6.37 63.69
Coproporphyrins (I and III) (U) (F)	µg/dL µg/24 hr µg/gm	nmol/L nmol/d nmol/gm	15 1.5 1.5	0.067 0.67 0.67
Porphobilinogen (PBG) (U)	 mg/24 hr	 µmol/d	 4.42	 0.226
Cortisol (S)	 µg/dL ng/mL	 µmol/L nmol/L	 0.028 2.76	 35.7 0.362
17-OHKS (cortisol) (U)	mg/24 hr µg/24 hr	µmol/d nmol/d	2.759 2.759	0.3625 0.3625
Creatine (S)	mg/dL	µmol/L	76.3	0.0131
Creatinine (S, AF) (U) (U) (U) (C)	 mg/dL gm/24 hr mg/24 hr mg/kg/24 hr mL/min/1.73 m^2	 µmol/L mmol/d mmol/d µmol/kg/d mL/sec/m^2	 88.4 8.84 0.00884 8.84 0.00963	 0.0113 0.1131 113.1 0.113 104
cAMP (cyclic adenosine monophosphate) (S) (B) (U)	 µg/L ng/mL mg/24 hr	 nmol/L nmol/L µmol/d	 3.04 3.04 3.04	 0.329 0.329 0.329
Dehydroepiandrosterone sulfate (DHEA-S) (S) (AF)	 µg/mL ng/mL	 µmol/L nmol/L	 2.6 2.6	 0.38 0.38
17-Ketosteroids (as DHEA) (U)	 mg/24 hr	 µmol/d	 3.467	 0.2904
17-Ketogenic steroids (as DHEA) (U)	 mg/24 hr	 µmol/d	 3.467	 0.2904
17-Hydroxycorticosteroids (17-OHCS) (U)	 mg/d of creatinine	 mg/mol of creatinine	 113.1	 0.00884
11-Deoxy corticosterone (DOC) (S)	 pg/mL	 pmol/L	 3.03	 0.33
Glucose	mg/dL	mmol/L	0.0555	18.02
Ferritin	ng/mL	µg/L	1	1
Gastrin	pg/mL	ng/L	1	1
Growth hormone	ng/mL	µg/L	1	1
Homovanillic acid (HVA) (U)	 mg/24 hr µg/24 hr µg/mg of creatinine	 µmol/d µmol/d mmol/mol of creatinine	 5.49 0.00549 0.621	 0.182 182 1.61
5-Hydroxyindoleacetic acid (5-HIAA) (U)	 mg/24 hr	 µmol/d	 5.2	 0.19
Hormone receptors (T) Progesterone receptor assay (PRA) Estrogen receptor assay (ERA)	 fmol/mg of protein fmol/mg of protein	 nmol/kg of protein nmol/kg of protein	 1 1	 1 1

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			Conversion factors	
Analyte	***Conventional units***	***SI units***	***Conventional to SI units***	***SI to conventional units***
Iron	µg/dL	µmol/L	0.179	5.587
Iron-binding capacity	µg/dL	µmol/L	0.179	5.587
Iron saturation	%	fraction saturation	0.01	100
Lactate	mg/dL	mmol/L	0.111	9.01
Lead (S) (S) (U)	 µg/dL mg/dL µg/24 hr	 µmol/L µmol/L µmol/d	 0.0483 48.26 0.00483	 20.72
Lipids (total)	mg/dL	gm/L	0.01	100
Magnesium	mEq/L mg/dL	mmol/L mmol/L	0.5 0.411	2 2.433
Osmolality	mOsml/kg	same		
O_2 partial pressure (PaO_2)	mm Hg	kPa	0.133	7.5
Parathyroid hormone	pg/mL µlEq/mL	ng/L mlEq/L	1 1	1 1
Phosphate (inorganic phosphorus) (S) (U) pH	 mg/dL gm/24 hr nEq/L	 mmol/L mmol/d nmol/L	 0.323 32.3 1	 3.10 0.031 1
Porphobilinogen	µg/d	µmol/d	4.42	0.226
Potassium (S) (U) (U)	 mEq/L mEq/24 hr mg/24 hr	 mmol/L mmol/L nmol/d	 1 1 0.02558	 1 1 39.1
Protein, total (S) (U) CSF	 gm/dL mg/24 hr mg/dL	 gm/L gm/d mg/L	 10 0.001 10	 0.1 1000 0.1
Renin [plasma-renin activity (PRA)] Sodium (S) (U) (U)	ng/mL/hr mEq/L mEq/24 hr mg/24 hr	µg/L/hr mmol/L mmol/L mmol/d	1 1 1 0.0435	1 1 1 22.99
Serotonin (S)	 ng/mL	 µmol/L	 0.00568	 176
Testosterone (total) (S)	 ng/dL	 nmol/L	 0.0347	 28.8
Thyroid-binding globulin (TBG)	mg/dL µg/dL	mg/L µg/L	10 10	0.1 0.1
Thyroglobulin	ng/mL	µg/L	1	1
TSH (thyroid-stimulating hormone)	µU/mL	mIU/L	1	1
Thyrotropin-releasing hormone (TRH)	pg/mL	ng/L	1	1
Triiodothyronine, total (T-3)	ng/dL	nmol/L	0.0154	65.1
Reverse T-3 (rT-3)	ng/dL	nmol/L	0.0154	65.1
Thyroxine, total (T-4)	µg/dL	nmol/L	12.9	0.0775
Transferrin (TIBC)	mg/dL	gm/L	0.01	100
Triglycerides	mg/dL	mmol/L	0.0113	88.5
Urea nitrogen (S) (U)	 mg/dL gm/24 hr	 mmol/L mol/d	 0.357 0.0357	 2.8 28

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			Conversion factors	
Analyte	***Conventional units***	***SI units***	***Conventional to SI units***	***SI to conventional units***
Uric acid (S) (U)	 mg/dL mg/24 hr	 mmol/L mmol/d	 0.05948 0.0059	 16.9 59.48
Vanillylmandelic acid (VMA) (U)	 mg/24 hr µg/mg of creatinine	 µmol/d mmol/mol of creatinine	 5.05 0.571	 0.198 1.75
Viscosity (S)	Centipoise	Same		
Vitamin B_{12} (cyanocobalamin)	pg/mL	pmol/L	0.738	1.355
Unsaturated B_{12} binding capacity (S)	 pg/mL	 pmol/L	 0.738	 1.355
Vitamin C (ascorbic acid)	mg/dL	µmol/L	56.78	0.176
Vitamin A	µg/dL	µmol/L	0.0349	28.65
Vitamin D (calcitriol; 1,25-dihydroxy)	pg/mL	pmol/L	2.4	0.417
Xylose (U)	mg/dL gm/5 hr	mmol/L mmol/5 hr	0.0666 6.66	15.01 0.15

(µ: microns; µmol: micromoles; mmol: millimoles; nmol: nanomoles; fmol: femtomoles; mg: milligrams; gm: grams; pg: picograms; ng: nanograms; L: liter; mL: milliliter; mEq: milliequivalent; mL/sec: milliliter/second; mL/min: milliliter/minute; U: units; mU: milliunits; IU: international units; d: day; 24 hr: 24 hours; S: serum; U: urine; B: blood; C: clearance; F: feces; AF: amniotic fluid; SF: synovial fluid; T: tissue). All references are to serum unless otherwise indicated.

Enzyme

Conventional unit	***IU/L Equivalent***	
Acid phosphatase (prostatic) • Bodansky • Shinowara–Jones–Reinhart • King–Armstrong • Bessey–Lowry–Brock	 5.37 5.37 1.77 16.67	
Alkaline phosphatase • Bodansky • Shinowara–Jones–Reinhart • King–Armstrong • Bessey–Lowry–Brock • Babson	 5.37 5.37 7.1 16.67 1.0	 0.14
Aldolase • Sibley–Lehninger	 0.74	
Amylase • Somogyi (saccharogenic) • Somogyi	 1.85 20.6	 0.541
Creatine kinase (CK)	1.0	
Hydroxybutyric dehydrogenase (d-HBD) • Rosalki–Wilkinson	 0.482	
Isocitrate dehydrogenase (ICD) • Wolfson–Williams–Ashman • Taylor–Friedman	 0.0167 0.0167	
Lactate dehydrogenase (LDH) • Wroblewski	 0.482	
Lipase • Cherry–Crandal	 278	
Malic dehydrogenase (MD) • Wacker–Ulmer–Valee	 0.482	
Transaminases • Reitman–Frankel • Karmen	 0.482 0.482	

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Therapeutic and Toxic Drugs

			Conversion factors	
Analyte	*Conventional units*	*SI units*	*Conventional to SI units*	*SI to conventional units*
Acetaminophen	µg/mL	µmol/L	6.62	0.151
Amikacin	µg/mL	µmol/L	1.71	0.585
Amitriptyline	ng/mL	nmol/L	3.61	0.277
Amobarbital	µg/mL	µmol/L	4.42	0.226
Amphetamine	ng/mL µg/mL	nmol/L µmol/L	7.4 7.4	0.135 0.135
Bromide	µg/mL	mmol/L	0.0125	79.9
Caffeine	µg/mL	µmol/L	5.15	0.194
Carbamazepine (Tegretol)	µg/mL	µmol/L	4.23	0.236
Carbenicillin	µg/mL	µmol/L	2.64	0.378
Chloral hydrate	µg/mL	µmol/L	6.69	0.149
Chloramphenicol	µg/mL	µmol/L	3.09	0.323
Chlordiazepoxide (Librium)	ng/mL	µmol/L	0.00334	0.303
Chlorpromazine (Thorazine)	ng/mL	nmol/L	3.14	0.319
Chlorpropamide (Diabinese)	µg/mL	µmol/L	3.61	0.227
Cimetidine (Tagamet)	µg/mL	µmol/L	3.96	0.252
Clonazepam (Clonopin)	ng/mL	nmol/L	3.17	0.316
Clonidine (Catapres)	ng/mL	nmol/L	4.35	0.230
Cocaine	ng/mL	nmol/L	3.3	0.303
Codeine	ng/mL	nmol/L	3.34	0.299
Demerol (Meperidine)	ng/mL	nmol/L	4.04	0.247
Desipramine (Norpramin)	ng/mL	nmol/L	3.75	0.267
Diazepam (Valium)	ng/mL	µmol/L	0.0035	3.512
Digitoxin	ng/mL	nmol/L	1.31	0.765
Digoxin	ng/mL	nmol/L	1.28	0.781
Dilaudid	ng/mL	nmol/L	4.85	0.206
Disulfiram	µg/mL	µmol/L	12.12	0.0761
Doxepin (Sinequan)	ng/mL	nmol/L	3.58	0.279
Ethanol	mg/dL	mmol/L	0.217	4.61
Ethchlorvynol (Placidyl)	µg/mL	µmol/L	6.92	0.145
Ethosuximide (Zarontin)	µg/mL	µmol/L	7.08	0.141
Gentamicin	µg/mL	µmol/L	2.09	0.478
Glutethimide (Doriden)	µg/mL	µmol/L	4.60	0.217
Haloperidol (Haldol)	ng/mL	nmol/L	2.66	0.376
Ibuprofen	µg/mL	µmol/L	4.85	0.206
Imipramine (Tofranil)	ng/mL	nmol/L	3.57	0.28
Isoniazid	µg/mL	µmol/L	7.29	0.137
Kanamycin (Kantrex)	µg/mL	µmol/L	2.06	0.485
Lidocaine (Xylocaine)	µg/mL	µmol/L	4.27	0.234
Lithium	mEq/L	mmol/L	1	1
Lorazepam	ng/mL	nmol/L	3.11	0.321
LSD (lysergic acid diethylamide)	µg/mL	µmol/L	3.09	0.323
Meprobamate	mg/L	µmol/L	4.58	0.218

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			Conversion factors	
Analyte	***Conventional units***	***SI units***	***Conventional to SI units***	***SI to conventional units***
Methadone	ng/mL	µmol/L	0.00323	309
Methaqualone (Quaalude)	µg/mL	µmol/L	4.0	0.250
Methotrexate	ng/mL	nmol/L	2.2	0.454
Methsuximide	µg/mL	µmol/L	5.29	0.189
Methyldopa (Aldomet)	µg/mL	µmol/L	4.73	0.211
Morphine	ng/mL ng/mL	nmol/L µmol/L	3.5 0.0035	0.285 3.504
Nortriptyline	ng/mL	nmol/L	3.8	0.263
Oxazepam	µg/mL	µmol/L	3.49	0.287
Paraldehyde	µg/mL	µmol/L	7.57	0.132
Pentobarbital (Nembutal)	µg/mL	µmol/L	4.42	0.179
Percodan	ng/mL	nmol/L	3.17	0.315
Phenacetin	µg/mL	µmol/L	5.58	0.179
Phenobarbital (Luminal)	µg/mL	µmol/L	4.31	0.232
Phenylbutazone (Butazolidin)	µg/mL	µmol/L	3.08	0.324
Phenytoin (Dilantin)	µg/mL	µmol/L	3.96	0.253
Primidone	µg/mL	µmol/L	4.58	0.218
Procainamide (Pronestyl), procaine (Novacain)	µg/mL	µmol/L	4.23	0.236
Propoxyphene (Darvon)	µg/mL	µmol/L	3.07	0.326
Propranolol	ng/mL	nmol/L	3.86	0.259
Quinidine	µg/mL	µmol/L	3.08	0.324
Quinine	µg/mL	µmol/L	3.08	0.324
Salicylic acid	µg/mL	µmol/L	7.24	0.138
Secobarbital (Seconal)	µg/mL	µmol/L	4.2	0.238
Theophylline (Aminophylline)	µg/mL	µmol/L	5.55	0.180
Tobramycin	µg/mL	µmol/L	2.14	0.467
Valproic acid	µg/mL	µmol/L	6.93	0.144
Vancomycin	µg/mL	mg/L	1	1
Warfarin (Coumadin)	µg/mL	µmol/L	3.24	0.308

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Modern Medical Laboratory Technology

Methods and Interpretation

The art and science of in-vitro diagnosis (diagnosis outside the body) has changed considerably. Newer techniques and technologies are being introduced at frequent intervals. Gone are the days when technologists used to prepare their own testing kits in their laboratories. Now, every conceivable reagent and kit is available commercially. In fact, most sophisticated tests can nowadays be conducted at the patient's bedside too. It is called point-of-care testing.

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So, delve into the past of laboratory testing and the latest technologies—all from one source—within the covers of this precious book!

Ramnik Sood PGEn & OH MD (Pathology Gold Medalist) is an eminent, internationally acclaimed medical author and has scores of books to his credit especially on Medical Laboratory Technology and Allied Sciences. He has also authored over 150 techno-commercial Journals for In-Vitro Diagnostic Industry and Medical Group Chains. This book is the seventh edition under this title and has been popular for over 3 decades. It has been much appreciated for its comprehensiveness and ease of understanding, both by students (undergraduates/postgraduates) and practitioners alike. It would not take long to net search Ramnik Sood to fathom his contribution as an author to Medicos worldwide.

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