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Nursing Foundation

for BSc Nursing-II

As per the Revised Nursing Syllabus

Shiv Shankar Tyagi
Richa Gangwar

Foreword
C Vasantha Kalyani

JAYPEE

Contents

1. Health Assessment 1

- Concepts of Health Assessment *2*
- Methods of Data Gathering *6*
- The Nursing History or Health History *8*
- Nursing History Format *8*
- Family Health History *10*
- Inspection *18*
- Palpation *18*
- Percussion *20*
- Auscultation *21*
- General Assessment *23*
- Head *28*

2. The Nursing Process 33

- Critical Thinking *34*
- Nursing Process *44*
- Planning *63*
- Nursing Process: Evaluation *71*

3. Nutritional Needs 79

- Importance *80*
- Assessment *80*
- Anthropometric Measurements *83*
- Factors Influencing Nutritional Needs *87*
- Special Diet *90*
- Therapeutic Diet *91*
- Care of Patient with Dysphagia *94*
- Assessment Nasogastric Tube/Orogastric Tube-checking the Position *100*
- Jejunostomy Feeding *106*
- Total Parenteral Nutrition *111*
- Assessment of a Patient with TPN *114*
- Checklist: TPN Administration *115*
- TPN Complications, Rationale, and Interventions *116*

4. Hygiene 118

- Factors influencing Hygiene *119*
- Health *122*
- Care of Skin *123*
- Care of Feet *123*
- Care of Hair and Nails *124*
- Types of Hair Care for Patient *125*
- Pediculosis and its Treatment *126*
- Nail Care *127*

- ❑ Care of Pressure Points *128*
- ❑ Assessment of Pressure Ulcers *133*
- ❑ Perineal/Meatal Care *146*
- ❑ Oral Hygiene and Care of Teeth *148*
- ❑ Care of Dentures *150*
- ❑ Care of Eyes *152*
- ❑ Ear Care *157*

5. Elimination Needs 161
- ❑ Composition of Urine *162*
- ❑ Physical Characteristics of Urine *163*
- ❑ Physiology of Urine Elimination *164*
- ❑ Factors influencing Urinary Elimination *168*
- ❑ Alterations in Urinary Elimination *171*
- ❑ Facilitating Urine Elimination *174*
- ❑ Incontinence of Urine *181*
- ❑ Providing Urinal or Bedpan *182*
- ❑ Helping Patient to use Urinal *184*
- ❑ Care of Patients with Indwelling Urinary Catheter *184*
- ❑ Urinary Diversion *185*
- ❑ Cystostomy *187*
- ❑ Nephrostomy *187*
- ❑ Ureteral Stent *188*
- ❑ Urostomy *188*
- ❑ Continent Urinary Diversion *190*
- ❑ Caring for a Stoma *191*
- ❑ Bladder Irrigation *192*
- ❑ Bowel Elimination *194*
- ❑ Care of Patients with Ostomies *206*
- ❑ Bowel Wash/Colon Hydrotherapy *208*
- ❑ Digital Evacuation of Feces *212*

6. Diagnostic Testing 217
- ❑ Complete Blood Count (CBC) *218*
- ❑ Serum Electrolytes *225*
- ❑ Liver Function Test *230*
- ❑ Lipid Profile *239*
- ❑ Stool Routine Examination *248*
- ❑ Urine Testing *253*
- ❑ Urine Testing for Albumin and Ketones *256*
- ❑ Analysis of Urine *258*
- ❑ Urine Culture *260*
- ❑ Routine Urine Test *263*
- ❑ Timed Urine Specimen *266*
- ❑ Sputum Culture *269*
- ❑ Radio Diagnosis *276*
- ❑ Types of Services *279*

7. Oxygenation Needs 292
- ❑ Respiration *292*
- ❑ Physiology of Respiration *295*
- ❑ Focus on Older Adults *298*

- Physiology of Oxygenation *309*
- Assessment *309*
- General Respiratory Health and Policy *314*
- Improving Physical Mobility *315*
- Breathing Exercises *317*
- Mobilizing Secretions *318*
- Maintaining a Patent Airway *323*
- Oxygen Administration *324*
- Oxygenation Equipment *327*
- Suctioning *338*
- Chest Physiotherapy *339*
- Underwater Detector System *354*
- Care of Chest Drain *359*
- Pulse Oximeter *369*
- Types of Oximeters *370*
- Different Sites *371*
- Purposes and Uses *371*
- Restorative and Continuing Care *373*
- Coughing Technique *378*
- Breathing Exercises *379*
- Mindful Breathing *381*

8. Fluid, Electrolyte and Acid-Base Balance 383

- Electrolytes *384*
- Definition *384*
- Composition of Body Fluid *385*
- Regulation of Body Fluids *385*
- Cations *386*
- Anions *387*
- Factors Affecting Fluid and Electrolytes *387*
- Fluid Volume Deficit *388*
- Hypovolemia *391*
- Fluid Overload (Hypervolemia) *393*
- Edema *395*
- Electrolytes Imbalances *402*
- Hyperkalemia *405*
- Arterial Blood Gas *408*
- IV Therapy *411*
- Intravenous Administration Equipment *411*
- Infusing IV Fluids by Gravity or an Electronic Infusion Devices *413*
- Intravenous Solutions *417*
- Peripheral Puncture Sites *421*
- Calculation for IV Fluid Plan *421*
- Complication of IV Therapy *426*
- Monitoring Fluid Intake and Output *433*
- Measuring Fluid Intake *433*
- Measuring Fluid Output *435*
- Patient Instruction/Preparation *437*
- Cryoprecipitated Antihemophilic Factor *439*
- Fresh Frozen Plasma, Frozen Plasma, Thawed Plasma *440*
- Granulocyte, Pheresis or WBC Concentrates *440*
- Transfusion of Blood and Blood Products *442*

9. Administration of Medications 449
- ❑ Medication *451*
- ❑ Drug Nomenclature *455*
- ❑ Pharmacokinetics *463*
- ❑ Granules and Powders *466*
- ❑ Factors influencing Medication Action *475*
- ❑ Prescription and Order *484*
- ❑ Basics of Prescriptions and Medication Orders *484*
- ❑ System of Measurement *490*
- ❑ The Metric System *490*
- ❑ Apothecary System *491*
- ❑ The Household System *492*
- ❑ Drug Calculation *494*
- ❑ IV Flow Rate Calculation *495*
- ❑ Principles and Rights of Drug Administration *497*
- ❑ Medication Error *500*
- ❑ Preventive Measures *501*
- ❑ Routes of Drug Administration *503*
- ❑ Oral, Sublingual, Buccal Routes *511*
- ❑ Cannula *525*
- ❑ Syringes *536*
- ❑ Needle *541*
- ❑ Ampules *543*
- ❑ Vials *546*
- ❑ Safe Handling of Sharps *550*
- ❑ Risk Factors *551*
- ❑ Topical Drug Administration *553*
- ❑ Applying a Transdermal Patch *554*
- ❑ Applying Topical Creams, Lotions, and Ointments *559*
- ❑ Applying Topical Powder *562*
- ❑ Swabbing the Throat *565*
- ❑ Gargling *567*
- ❑ Suppository/Medicated Packing in Rectum/Vagina *568*
- ❑ Checklist: Medication Administered Rectally *570*
- ❑ Medication Administered Vaginally *575*
- ❑ Checklist: Medication Administered Vaginally *577*
- ❑ Instillations *581*
- ❑ Ear *583*
- ❑ Nasal Instillations *587*
- ❑ Bladder Instillation *592*
- ❑ Rectal Instillation *594*
- ❑ Irrigations *596*
- ❑ Nurse's Responsibility in Administering a Vaginal Irrigation *612*
- ❑ Intra-arterial *631*

10. Sensory Needs 632
- ❑ Components of Sensory Experience *635*
- ❑ Arousal Mechanism *636*
- ❑ Factors Affecting Sensory Function *639*
- ❑ Assessment of Sensory Alterations *644*
- ❑ Alteration in Sense of Motion *651*

- Aphasia *654*
- Artificial Airway *660*
- Communication with Visual Impairment *670*
- Care of Unconscious Patients *675*
- Pupillary Responses *681*
- Ocular Deviation and Dysconjugate Gaze *682*
- Management of Unconscious Patient *685*

11. Care of Terminally Ill, Death and Dying 686
- Management *689*
- Loss *690*
- Grief *691*
- Types of Grief *694*
- Theories of Loss and Grief *698*
- Factors Affecting Grief and Loss *700*
- Bereavement *703*
- Mourning *705*
- The Six 'R' Processes by Rando *706*
- Dying *709*
- The Bill of Rights for Dying People *714*
- Care of Dying Patient *716*
- Needs of Dying Patient *716*
- End of Life Care *720*
- Prepare for Death *722*
- Changes Following Death *722*
- Death Declaration and Certification *732*
- Autopsy *739*
- Embalming *749*
- Last Office *753*
- Counseling and Supporting Grieving Relatives *760*
- Placing in and Releasing Body from Mortuary *764*
- Physician Orders for Life-Sustaining Treatment *770*
- Code Status *775*
- Organ Donation *775*
- Contraindications *777*
- Medico-Legal Cases *778*
- Registration Procedure for a Medico-Legal Case *779*
- Reporting of the Medico-Legal Cases *779*
- Medico-Legal Case *780*
- General Guidelines *781*
- Record Keeping *782*
- Death in Medico-Legal Case *782*
- Medico-Legal Autopsy in MLC *782*
- Dying Declaration *782*
- Specific Cases *782*
- Euthanasia *784*

12. Self-Concept 787
- Components of Self-Concept *787*
- Factors Affecting Self-Concept *788*
- Nursing Management *788*

13. Sexuality 790
- ❑ Sexual Development *790*
- ❑ Sexual Health *793*
- ❑ Sexual Orientation *794*
- ❑ Prevention of Sexually Transmitted Diseases *795*
- ❑ Prevention of Unwanted Pregnancy *795*
- ❑ Prevention of Sexual Harassment *796*
- ❑ Prevention of Sexual Abuse *796*

14. Stress and Adaptation: Introductory Concepts 798
- ❑ Causes of Stress *802*
- ❑ Types of Stress *803*
- ❑ Sources of Stress *803*
- ❑ Other Sources *804*
- ❑ Stress Warning Signs and Symptoms *804*
- ❑ Stress Management *805*
- ❑ Adaptive Coping Strategies *805*
- ❑ Steps to Managing Stress *808*
- ❑ Role of Nurse in Stress Management *808*
- ❑ Diversional Therapy for Stress *809*

15. Concepts of Cultural Diversity and Spirituality 812
- ❑ Introduction to Cultural Diversity *812*
- ❑ Importance of Cultural Diversity In Education *813*
- ❑ Cultural Diversity *813*
- ❑ Cultural Concept *814*
- ❑ Larry Purnell's Model of Cultural Competence *817*
- ❑ Spirituality *819*

16. Introduction to Nursing Theories 822
- ❑ Nursing Philosophies *823*
- ❑ Conceptual Models and Grand Theories *824*
- ❑ Development of Nursing Theories *827*
- ❑ Importance of Nursing Theories *828*
- ❑ The Characteristics of Theories *828*
- ❑ Basic Processes in the Development of Nursing Theories *828*
- ❑ Common Concepts in Nursing Theories *829*
- ❑ Historical Perspectives and Key Concepts *829*
- ❑ Classification of Nursing Theories *830*
- ❑ Based on the Philosophical Underpinnings of the Theories *830*
- ❑ Models of Nursing *831*
- ❑ Growth and Stability Models of Change *831*
- ❑ Categories of Conceptual Models *832*
- ❑ Systems Theory as a Framework *832*
- ❑ Criticisms of Nursing Theories *834*
- ❑ Understanding the Work of Nurse Theorists *835*
- ❑ Purposes of Nursing Theories *836*
- ❑ Nursing Theorists *841*
- ❑ Concepts in the Nursing *841*
- ❑ Importance of Theoretical Frameworks *847*
- ❑ Application of Theory in Nursing Process *847*
- ❑ Theories and Nursing Research *849*
- ❑ Nightingale's Environmental Theory *853*

- Theory of Interpersonal Relations *857*
- Application of Interpersonal Theory in Nursing Practice *861*
- Virginia Henderson's Need Theory *866*
- Faye Glenn Abdellah's Theory *875*
- Imogene King: Theory of Goal Attainment *885*
- Betty Neumann's System Model *897*
- Application of Betty Neuman's Systems Model *905*
- Dorothea Orem's Theory *917*
- Application of Orem's Self-Care Deficit Theory in Nursing Practice *922*
- Jean Watson's Philosophy of Nursing *931*
- The Roy's Adaptation Model *939*
- Application of Roy's Adaptation Model in Nursing Practice *945*
- Johnson's Behavior System Model *954*
- Levine's Four Conservation Principles *960*

Index *971*

UNIT

9

Administration of Medications

Unit Outline

- Medication
- Medication orders and prescriptions
- Systems of measurement
- Medication dose calculation
- Principles, 10 rights of medication administration
- Errors in medication administration
- Routes of administration
- Storage and maintenance of drugs and nurses responsibility
- Parenteral administration of drugs
- Cannulas, infusion sets–parts, types, sizes
- Types of vials and ampules
- Topical administration
- Inhalation
- Other parenteral routes

LEARNING OBJECTIVES

At the end of this unit, the reader will be able to:

- Introduce medication administration.
- Outline pharmacy abbreviations and symbols.
- State drug nomenclature.
- Define pharmacokinetic and pharmacodynamics.
- Classify forms of medication.
- Enumerate factors influencing medication action.
- Recognize prescription and orders.
- Interpret metric system.
- Define apothecary system.
- Explain household system.
- Estimate drug calculation.
- Calculate IV flow rate.
- Enumerate principles and rights of drug administration.
- Outline factors influencing errors in drug administration.
- List out types of medication error and its preventive measures.
- Describe routes of drug administration.
- Illustrate equipment for drug administration.
- Differentiate ampules and vials.
- Practice safe handling of vials.
- Define needle stick injuries and preventive measures.
- Explain irrigations: Eye, ear, bladder, vaginal, rectal.
- Other parenteral routes.

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TERMINOLOGIES

- **Allergic reaction:** A reaction caused by an unusual hypersensitivity to a medication (allergic reactions can also occur with foods, animals and other environmental substances).
- **Counter indicative:** A condition or factor that increases the risks involved in using a particular drug or engaging in a particular activity (e.g., smoking).
- **Drug:** A word often used interchangeably with the word medication.
- **Generic name:** The name given by the federal government to a drug.
- **Medication**: Substance taken into (or applied to) the body for the purpose of prevention, treatment, relief of symptoms, or cure.
- **Medication administration:** The direct application of a prescribed medication—whether by injection, inhalation, ingestion, or other means—to the body of the individual by an individual legally authorized to do so.
- **Medication assistance:** Assistance with self-administration of medication rendered by a nonpractitioner to an individual receiving supported living residential services and supports.
- **Interactions:** The result, either desirable or undesirable, of drugs interacting with themselves, other drugs, foods, alcohol, or other substances (e.g., herbs or nutrients).
- **Medication error:** Any time the right medication is not taken as prescribed.
- **Delegation:** The procedure following a specific set of guidelines and standards that allow staff with a prescribed training and certification to perform medical tasks.
- **Ophthalmic:** Referring to the eyes.
- **Otic:** Referring to the ears.
- **Over-the-counter (OTC) medications:** All nonprescription medications including aspirin, antihistamines, vitamin supplements, and herbal remedies.
- **Pharmacist:** Licensed individual who prepares and dispenses drugs and is knowledgeable about their contents.
- **Physician/Doctor:** An individual licensed to practice medicine; for the purpose of prescribing medications only, the term is interpreted to mean any healthcare professional authorized by law to prescribe drugs: physician, dentist, optometrist, podiatrist, and nurse practitioner or physician's assistant (who write prescriptions is acting under the supervision of the individual's physician).
- **Prescription medications:** Medications that must be ordered by a physician or other licensed healthcare professional with authority to write prescriptions, such as a dentist or nurse practitioner.
- **PRN (pro re nata) medications:** Means that the medication is taken as needed to treat a specific symptom; PRN medications include both prescription and over-the-counter (OTC) medications. [Note: all PRN's must be documented on the Medication Administration Record (MAR)].
- **Psychoactive:** Possessing the ability to alter mood, anxiety level, behavior, cognitive processes, or mental tension; usually applied to pharmacological agents.
- **Psychoactive medications:** Refers to medications prescribed to treat a mental illness, improve functioning, or reduce challenging behaviors.; psychoactive medications include antipsychotics/neuroleptics, atypical antipsychotics, antidepressants, anticonvulsants, stimulants, sedatives/hypnotics, and antimania and antianxiety drugs; anticonvulsants and other classes of drugs are included in this category when they are prescribed for behavioral purposes. [Note: If a psychoactive medication is used solely to treat a physical condition

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(e.g., sleep aid, seizures) or dementia, and is not also used to treat a mental illness or for challenging behavior, it is not considered a psychoactive medication].

- **Side effects:** Unintended effects produced by medication other than those for which it was prescribed; sometimes side effects, such as a severe allergic reaction, can be deadly.
- **Topical:** Applied to a certain area of the skin.
- **Trade name/brand name:** The name given by the manufacturer to a medication.
- Drug is any substance or product that is used or intended to be used to modify or explore physiological systems or pathological status for the benefit of the recipient.

MEDICATION

A medication (also called medicament, medicine, pharmaceutical drug, medicinal drug or simply drug). A medication is a drug used to diagnose, cure, treat, or prevent disease.

Medication is a medicine or a chemical compound used to treat or cure illness. According to *Encyclopædia Britannica*, medication is "a substance used in treating a disease or relieving pain".

As defined by the National Cancer Institute, dosage forms of medication can include tablets, capsules, liquids, creams, and patches.

Any substance or combination of substances which may be used in or administered to human beings either with a view to restoring, correcting or modifying physiological functions by exerting a pharmacological, immunological or metabolic action or to making a medical diagnosis.

Medication Administration

Medication administration means the direct application of a medication or device by ingestion, inhalation, injection or any other means, whether self-administered by a resident, or administered by a guardian (for a minor), or an authorized healthcare provider.

The giving or application of a pharmacologic or other therapeutic agent.

Medication administration means the physical act of giving medication to a client by the prescribed route.

Pharmacy Abbreviations and Symbols

The following abbreviations and symbols are commonly used on medication labels. In order to read and understand medication labels, you should be familiar with these abbreviations and symbols:

- Rx = Prescription
- OTC = Over-the-counter
- PRN = when necessary, or as needed
- Qty = quantity
- q (Q) = every
- qd = daily
- bid (BID) = twice a day
- tid (TID) = three times a day
- qid (QID) = four times a day
- h = hour
- hs (HS) = hour of sleep (bedtime)
- tsp = teaspoon (or 5 mL)
- Tbsp = tablespoon (3 tsps or 15 mL)
- oz = ounce
- gr = grains
- mg = milligrams
- GM, gm = grams (1,000 mg)
- Cap = capsule
- Tab = tablet
- AM = morning
- PM = afternoon/evening
- D/C or d/c = discontinue

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	Latin term	*Common abbreviation*	*Translation*
A…			
	Ad	Ad	to, up to
		ad lib	at pleasure
	Adde	Add	add (thou)
	Agita	Agit	shake, stir
	alternis horis	alt. h	every other hour
	Ana	aa or aa	of each
	Ante	a	before
	ante cibum	ac	before food, before meals
	ante meridian	am	morning
		amp	ampule
	Aqua	aq	water
	aqua ad	aq ad	water up to
		ag dest; aqua dist	distilled water
	Auris	aur; a	ear
	auris dexter	ad	right ear
	aurix laevus	al	left ear
	auris sinister	as	left ear
	auris utro	au	each ear
	Auristillae	Aorist	ear-drops
		atc	around the clock
B…			
	Bis	b	twice
	bis in die	bid	twice a day
	Brachium	brach	the arm
		BSA	body surface area
C…			
	Capsula	Caps	a capsule
		cc	cubic centimeter
	Chartulae	Charts	powder papers; divided powders
	Cibus	cib; c	food
	Collunarium	Collun	a nose wash
	Collutorium	collut	a mouthwash
	Collyrium	collyr	an eyewash
	Compositus	comp	compound
	Congius	cong; C	gallon
	Cum	c or c	with
	cum cibus	cc	with food; with meals
D…			
	Denture	d	give (thou); let be given

Contd...

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Contd...

	Latin term	*Common abbreviation*	*Translation*
	dentur tales doses	dtd	give of such doses
	Dexter	d	right
	diebus alternis	dieb. alt	every other day
	Dilutes	dil	dilute, diluted
		disp	dispense
		div	divide
		DW	distilled water
E…			
		elix	elixir
	Emulsum	emuls	emulsion
	Et	Et	and
	ex modo prescripto	emp	in the manner prescribed; as directed
F…			
	fac, fiat, fiant	f; ft	let it be made; make
		f; fl	fluid
G…			
		g; G; gm	gram
	Granum	gr	grain
	Guttae	gtt	a drop
H…			
	Hora	H	at the hour of
	hora somni	hs	at bedtime
I…			
		im	intramuscular
	Injection	inj	injection
		iv; IV	intravenous
		ivp; IVP	intravenous push
		IVPB	intravenous piggyback
L…			
	Laevus	l	Left
	Linimentum	lin	Liniment
	Liquor	liq	a solution
		lot	Lotion
M…			
	Minimum	min; Mx	Minim
	Misce	m; M	Mix
		mcg	Microgram
		mEq	Milliequivalent

Contd...

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Contd...

	Latin term	*Common abbreviation*	*Translation*
		mg	Milligram
		mL	Millilitre
N…			
	Nocte	n	at night
	Naristillae	narist	nasal drops
	Nebule	neb	a spray
		NF	National Formulary
	non repetatur	non.rep.	do not repeat
		NS	normal saline
O…			
	Octarius	O	Pint
	Oculentum	occulent	eye ointment
	Oculus	o	Eye
	oculus dexter	od	right eye
	oculus laevus	ol	left eye
	oculus sinister	os	left eye
	oculus utro	ou	both eyes, each eye
	omni mane	om	every morning
P…			
	parti affectae applicandus	paa	to be applied to affected part
	per os	po	by mouth
	post cibum	pc	after meals
		pr	per rectum
	pro re nata	prn	as needed
	Pulvis	pulv	Powder
Q…			
	quater in die	qid	four times a day
	Quaque	q	each, every
	quaque die	qd	every day
	quaque hora	qh	every hour
	quantum sufficiat	qs	a sufficient quantity
	quantum sufficiat ad	qs ad	a sufficient quantity to make
R…			
S…			
	secundum artem	sa	according to the art
		SC; subc; subq	Subcutaneously
	Semis	Ss	one-half
	Signa	Sig	write, label

Contd...

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Contd...

	Latin term	*Common abbreviation*	*Translation*
	Sine	S	Without
	si opus sit	sos	if necessary
		sol	Solution
	Statim	stat	Immediately
	Suppositorum	supp	Suppository
	Syrupus	syr	Syrup
T…			
	Tabella	tab	Tablet
		tbsp	Tablespoonful
	ter in die	tid	three times a day
		tinc; tr	Tincture
	Trochiscus	Troche	Lozenge
	Tussis	tuss	a cough
U…			
	Ungentum	ung.	an ointment
	ut dictum	ut dict; ud	as directed

- Oral medications (capsules or tablets) are usually prescribed in mg (milligrams) or gm (grams).
- Liquid medications are usually prescribed in mL (milliliters), cc (centimeters), or oz (ounces).
- Liquid medications may also be prescribed in tsp (teaspoon), or Tbsp (tablespoon).

DRUG NOMENCLATURE

Introduction

Drug nomenclature is a systematic approach to naming the active component of a drug product for the purposes of identification, standardization, and unequivocal differential characterization.

The term drug nomenclature implies to the systematic and scientific naming of drugs. A drug generally has three different categories of names: chemical name, non-proprietary name and proprietary name.

This is the system that puts drugs into classification. Drugs are classifies into convenient groups for the sake of conformity, standardization, esoteric values of manufactures, research and replication and quality assurance.

A drug generally has three categories of names:

1. **Chemical name:** It describes the chemical structure of a drug, e.g., acetylsalicylic acid is the chemical name of aspirin. And N-acetyl-p-aminophenol is the chemical name of paracetamol. Chemical name is cumbersome and not suitable for use in prescription.
2. **Nonproprietary name:** It is the name accepted by a competent scientific body/authority, e.g., The United States Adopted Name (USAN) council. Commonly the term generic name is used in place of nonproprietary name. It is uniform throughout the world and denotes the active pharmaceutical ingredient. Ideally generic name should be used in prescriptions because it is generally uniform all over the world than the branded counterparts.

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3. **Proprietary name (brand name):** It is the name given by the drug manufacturers. Brand names are designed to be catchy, short, easy to remember and often suggestive (e.g., LOPRESOR suggesting drug for lowering BP) One drug may have multiple brand names. It may have different names within a country and in different countries. Brand names can also be used in prescriptions, e.g., DISPRIN is a brand name of ASPIRIN. CROCIN is a brand name of PARACETAMOL.

A chemical name is given when a new chemical entity (NCE) is developed and it describes the substance chemically, e.g., 7-chloro-1, 3-dihydro-1-methyl-5-phenyl-2H-1,4-benzodiazepin-2-one for diazepam. It is the name given to drug in accordance with rules of chemical nomenclature established by International Union of Pure and Applied Chemistry (IUPAC).

It is useful for chemists or technical personals as it provides the precise arrangement of atoms and atomic groups in the molecule. It is difficult and not used to identify the drug in a clinical (prescribing) or marketing situation. A code name, e.g., RO15-1788 (later named flumazenil) is the name given by the manufacturer for convenience and simplicity before an approved name. A nonproprietary name of a drug, after its regulatory approval, is the accepted name by a competent scientific body/authority, e.g., British Approved Name (BAN), Japanese Accepted Name (JAN) and United States Adopted Name (USAN), etc.

The nonproprietary names of newer drugs are kept uniform by an agreement to use the Recommended International Nonproprietary Name (rINN) in all member countries of World Health Organization (WHO).

A proprietary name or brand name is the name assigned by the manufacturer(s) and is the property or trade mark of the concerned pharmaceutical farm. Thus a single drug may be sold under different proprietary names by different manufacturers. For example, haloperidol is marketed under the brand names of Bezydol-P, Brain-Rest, Cizoren, Depidol, Gendol and Dolcin etc. The INN name or more popularly known as generic name identifies a pharmaceutical substance by a unique name that is globally recognized to varying extent and is public property. We will be restricting our discussion on the different aspects of INN nomenclature.

The INN nomenclature system: The system of INN was initiated by WHO through the World Health Assembly resolution and began operating in 1953. The first list of international nonproprietary names for pharmaceutical substances was published in the same year. Since then, thousands of pharmaceutical substances have been designated as INNs so far and continuously updated. WHO works in close collaboration with the major national nomenclature commissions, e.g., British Approved Name (BAN), Japanese Accepted Name (JAN), United States Adopted Name (USAN) etc. An International Nonproprietary Name (INN) identifies a pharmaceutical substance by a unique name that is globally recognized and is public property. INNs help to reduce confusion in drug nomenclature and allow us an understanding of the drug even when that individual drug is not known. They are the vital piece of information that is compulsory on medicine labels. INNs are nonproprietary in nature, which implies that the same INN can be used by all manufacturers of that pharmaceutical substance, irrespective of the brand name under which the drug is marketed by each manufacturer. These names are intended to be used in pharmacopoeias, labeling, advertising, drug regulation and scientific literature. The term approved name is used until the drug is included in an official pharmacopoeia. The approved name becomes official name after its appearance in the official pharmacopoeia. The procedure of INN selection

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Any person or company proposing and requesting for an INN needs to apply to WHO online at http://www.who.int/medicines/services/inn/en/index.html. Applications are also accepted by WHO made through the national nomenclature committee from the applicants where national nomenclature commissions exist. Members of the WHO expert panel on International Pharmacopoeia and Pharmaceutical Preparations or sometimes other panel examine with a formal procedure and select a nonproprieatary, agreed name based on the information provided. A four month window period is kept thereafter for any comments or formal objection to the proposed name by any person. If no objection is raised within that period, this agreed name is published as the recommended INN. WHO has strictly recommended in 1993 that pharmaceutical companies should not derive trade names from INNs as such practice may frustrate the rational selection of INNs and compromise the patient safety by confusing the drug nomenclature. In India, the trademark registration of words that are declared as INNs or those that are deceptively similar to INNs is prohibited under Section 13 (b) of the Trade Marks Act, 1999.

INN stems: The root of the nonproprietary naming system is the collection of short name fragments called stems. They define the pharmacologically related group to which the INN belongs. Each stem has a meaning connected to a particular drug class or mode of action. The stems and their definitions have been selected by WHO experts and are used when selecting new international nonproprietary names. The naming process itself "is an evolving type of science and therefore the nomenclature process is ongoing and constantly under revision". Definitions of older stems are modified as and when newer information becomes available. An INN generally includes the "common stem" expressing the pharmacologically-related group to which the substance belongs. Names conveying anatomical, physiological, pathological or therapeutic suggestions are avoided while devising an INN. International connotations are also considered while selecting an INN. A name that sounds perfectly fine in English might have bad or even obscene connotations elsewhere. Therefore, to make pronunciation possible in various languages, the letters "h" and "k" are avoided; "e" is used instead of "ae" and "oe", "i" instead of "y", "t" instead of "th" and "f" instead of "ph". Stems are generally used as suffixes but sometimes they are also used as prefixes.

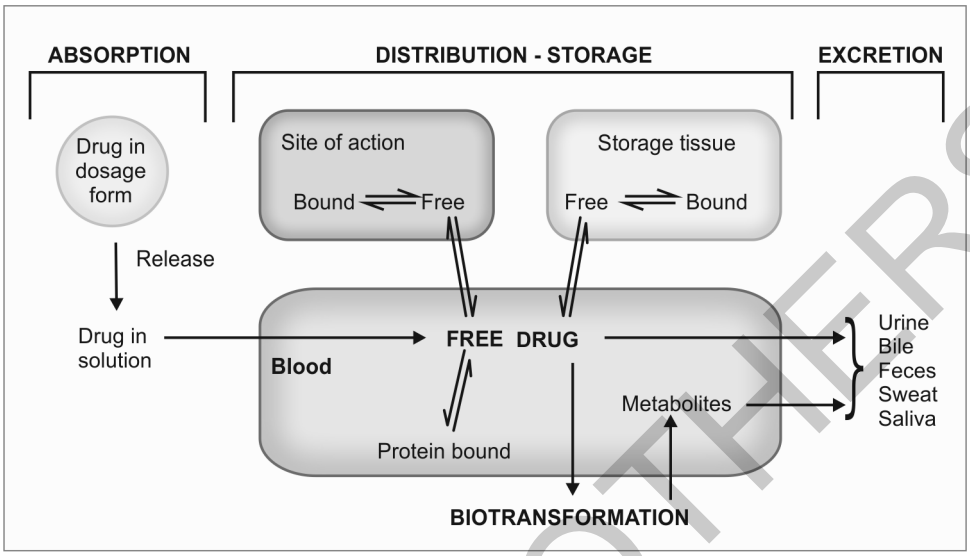
Classification System used by the INN Programme

The WHO stem classification system used by the INN Programme follows a core list to categorize the main activity of pharmaceutical substances while devising an INN. Each category included in the list has an appropriate code consisting of a capital letter and three digits, category, specific stem and appropriate information. When INNs for substances belonging to a given category include a specific stem, appropriate information is included in the list.

Pharmacokinetics

Pharmacokinetics is the quantitative study of drug movement in, through and out of the body. The overall scheme of pharmacokinetic processes is depicted in Figure on next page. The intensity of response is related to concentration of the drug at the site of action, which in turn is dependent on its pharmacokinetic properties. Pharmacokinetic considerations, therefore, determine the route(s) of administration, dose, latency of onset, time of peak action, duration of action and frequency of administration of a drug.

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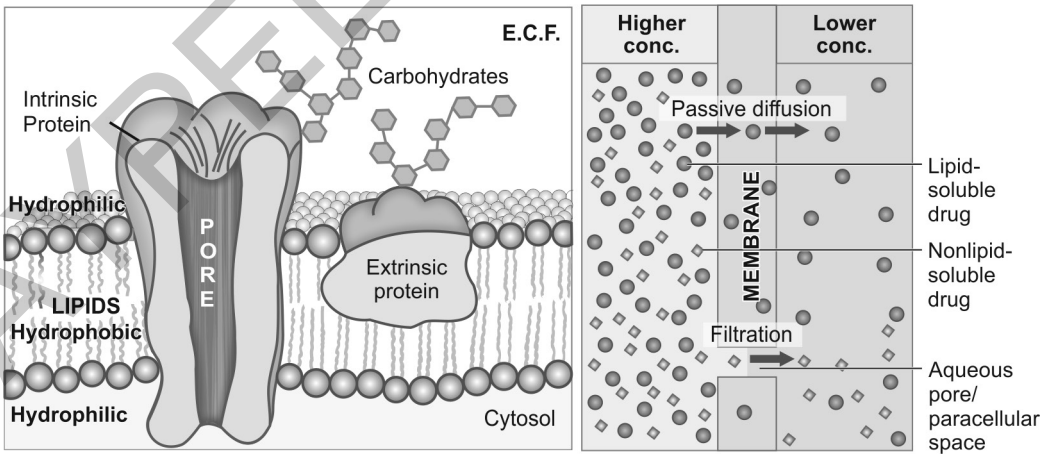


Schematic depiction of pharmacokinetic processes.

All pharmacokinetic processes involve transport of the drug across biological membranes.

Biological Membrane

This is a bilayer (about 100 Å thick) of phospholipid and cholesterol molecules, the polar groups (glyceryl phosphate attached to ethanolamine/choline or hydroxyl group of cholesterol) of these are oriented at the two surfaces and the nonpolar hydrocarbon chains are embedded in the matrix to form a continuous sheet. Extrinsic and intrinsic protein molecules are adsorbed on the lipid bilayer.



Glycoproteins or glycolipids are formed on the surface by attachment to polymeric sugars, aminosugars or sialic acids. The specific lipid and protein composition of different membranes

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differs according to the cell or the organelle type. The proteins are able to freely float through the membrane: associate and organize or vice versa. Some of the intrinsic ones, which extend through the full thickness of the membrane, surround fine aqueous pores. Paracellular spaces or channels also exist between certain epithelial/endothelial cells. Other adsorbed proteins have enzymatic, carrier, receptor or signal transduction properties. Lipid molecules also are capable of lateral movement. Thus, biological membranes are highly dynamic structures.

Drugs are transported across the membranes by:

- Passive diffusion and filtration
- Specialized transport

Passive Diffusion

The drug diffuses across the membrane in the direction of its concentration gradient, the membrane playing no active role in the process. This is the most important mechanism for majority of drugs; drugs are foreign substances (xenobiotics), and specialized mechanisms are developed by the body primarily for normal metabolites.

Lipid soluble drugs diffuse by dissolving in the lipoidal matrix of the membrane the rate of transport being proportional to the lipid: water partition coefficient of the drug. A more lipid soluble drug attains higher concentration in the membrane and diffuses quickly. Also, greater the difference in the concentration of the drug on the two sides of the membrane, faster is its diffusion.

Influence of pH: Most drugs are weak electrolytes, i.e., their ionization is pH dependent (contrast strong electrolytes that are nearly completely ionized at acidic as well as alkaline pH). The ionization of a weak acid HA is given by the equation:

$$pH = pKa + \log \frac{[A^-]}{[HA]} \quad ...(1)$$

pKa is the negative logarithm of acidic dissociation constant of the weak electrolyte. If the concentration of ionized drug [A^-] is equal to concentration of unionized drug [HA], then

$$\frac{[A^-]}{[HA]} = 1$$

Since log 1 is 0, under this condition

$$pH = pKa \quad ...(2)$$

Thus, *pKa* is numerically equal to the pH at which the drug is 50% ionized.

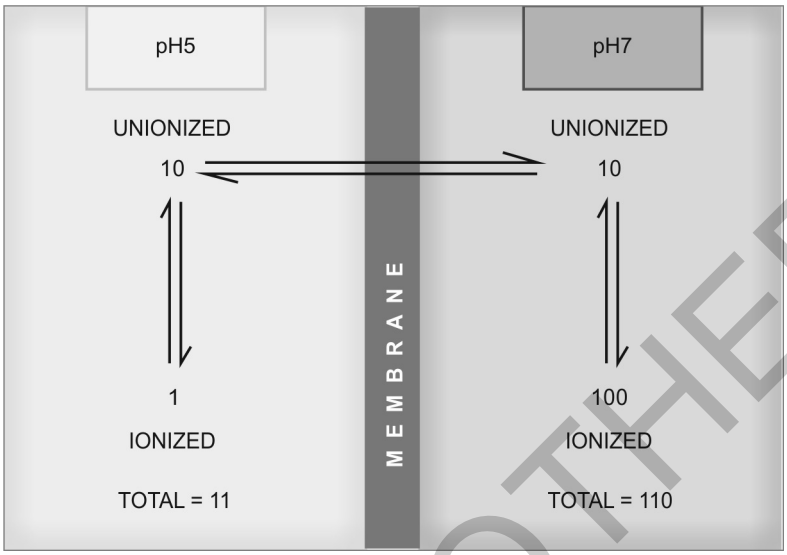
If pH is increased by 1 scale, then—log [A–]/[HA] = 1 or $[A^-]/[HA] = 10$

Similarly, if pH is reduced by 1 scale, then— $[A^-]/[HA] = 1/10$

Thus, weakly acidic drugs, which form salts with cations, e.g., *sod*. phenobarbitone, *sod.* sulfadiazine, *pot.* penicillinV, etc. ionize more at alkaline pH and 1 scale change in pH causes 10 fold change in ionization.

Weakly basic drugs, which form salts with anions, e.g., atropine *sulfate*, ephedrine *HCl*, chloroquine *phosphate,* etc. conversely ionize more at acidic pH. Ions being lipid insoluble, do not diffuse and a pH difference across a membrane can cause differential distribution of weakly acidic and weakly basic drugs on the two sides.

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Influence of pH difference on two sides of a biological membrane on the steady-state distribution of a weakly acidic drug with pKa = 6.

Implications of this consideration are: Acidic drugs, e.g., aspirin (*pKa* 3.5) are largely unionized at acid gastric pH and are absorbed from stomach, while bases, e.g., atropine (*pKa* 10) are largely ionized and are absorbed only when they reach the intestines.

The unionized form of acidic drugs which crosses the surface membrane of gastric mucosal cell, reverts to the ionized form within the cell (pH 7.0) and then only slowly passes to the extracellular fluid. This is called *ion trapping*, i.e., a weak electrolyte crossing a membrane to encounter a pH from which it is not able to escape easily. This may contribute to gastric mucosal cell damage caused by aspirin.

Basic drugs attain higher concentration intracellularly (pH 7.0 *vs* 7.4 of plasma).

Acidic drugs are ionized more in alkaline urine—do not back diffuse in the kidney tubules and are excreted faster. Accordingly, basic drugs are excreted faster if urine is acidified.

Lipid soluble nonelectrolytes (e.g., ethanol, diethylether) readily cross biological membranes and their transport is pH independent.

Filtration

Filtration is passage of drugs through aqueous pores in the membrane or through paracellular spaces. This can be accelerated if hydrodynamic flow of the solvent is occurring under hydrostatic or osmotic pressure gradient, e.g., across most capillaries including glomeruli. Lipid insoluble drugs cross biological membranes by filtration if their molecular size is smaller than the diameter of the pores. Majority of cells (intestinal mucosa, RBC, etc.) have very small pores (4 Å) and drugs with MW >100 or 200 are not able to penetrate. However, capillaries (except those in brain) have large paracellular spaces (40 Å) and most drugs (even albumin) can filter through these. As such, diffusion of drugs across capillaries is dependent on rate of blood flow through them rather than on lipid solubility of the drug or pH of the medium.

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Shiv Shankar Tyagi is a PhD (N) from Bareilly International University, Bareilly, Uttar Pradesh, India. He has completed his MSc (N) in Community Health Nursing from College of Nursing, Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun, Uttarakhand, India. He is External Examiner, Evaluator, and Paper setter for various universities. He has also addressed many conferences as a Resource Person. He has published many research articles in indexed journals. Currently, he is working as Director at RK Institute of Medical Sciences, Bareilly, Uttar Pradesh, India. He is Vice-President of Nursing Scholar Society (NSS, UP Chapter) and also holds the post of President of Rohilkhand Nursing Association. He has been appreciated with award from the Government of India for active participation in various initiatives regarding social issues. He is also merit holder of RIMSNR (Saifai), SGPGI, AMU, UPPSC (two times), and DGME.

Richa Gangwar MSc (N) is an eminent Scholar and Medalist of Teerthanker Mahaveer University (TMU), Moradabad, Uttar Pradesh, India. She has completed her MSc (N) in Obstetrics from TMU College of Nursing, Moradabad. She is a Nursing Faculty in Government College of Nursing (selected through DGME). She was previously working as Vice-Principal at RK Institute of Medical Sciences (College of Nursing), Bareilly, Uttar Pradesh. She has been appointed many times as an External Examiner by Uttar Pradesh State Medical Faculty (UPSMF), Lucknow, and Atal Bihari Vajpayee Medical University (ABVMU), Lucknow, Uttar Pradesh. She also evaluated answer sheets for Mahatma Jyotiba Phule Rohilkhand University (MJPRU), Bareilly. She is merit holder of UP CHO, RML, NHM and DGME (for both Assistant Professor and Nursing Tutor). She has attended many conferences as a delegate and also organizes workshops on first-aid management. She has published research articles in indexed journals.

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