Reference text: Pharmaceutical Calculation by Stoklosa; Latest edition.

No	Lecture title
1.	Some fundamentals of measurements and calculations.
2.	Interpretation of prescription or medication orders.
3.	The metric system.
4.	Calculation of doses.
5.	Reducing and enlarging formulas.
6.	Density, specific gravity and specific volume.
7.	Percentage and ratio strength calculation.

Lecturer:

Dr. Esra Tariq Bayrakdar

Pharmaceutics

Common topics

- Demonstrate an understanding of the format and components of a typical prescription.
- Demonstrate an understanding of the format and components of a typical medication order.
- Interpret correctly standard abbreviations and symbols used on prescriptions and medication orders.
- ➤ Differentiate between patient compliance and noncompliance and apply calculations to determine compliancy.

Definitions

A prescription is an order for medication issued by a physician, dentist, or other properly licensed medical practitioner.

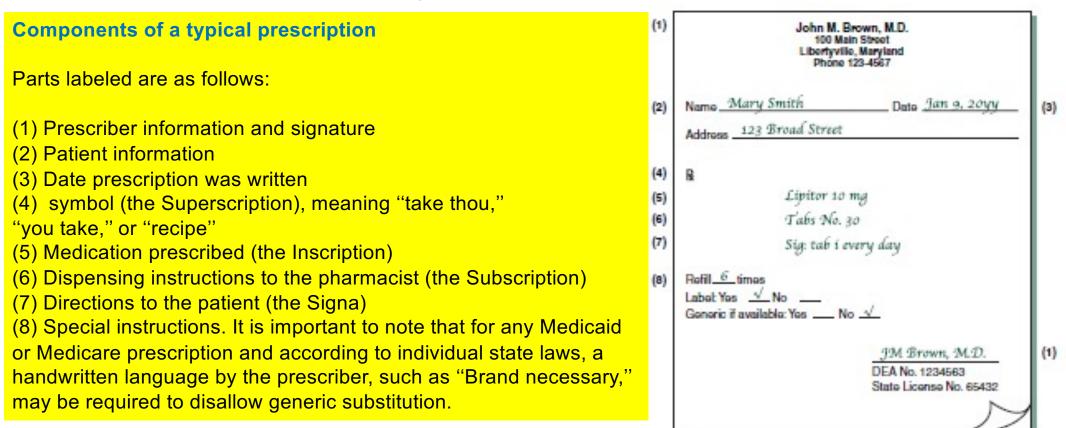
Compounding: the quantities of active and inactive components to use in the extemporaneous preparation of a pharmaceutical product, including the use of stock solutions and/or prefabricated dosage units in the process.

Pharmacy compounding involves the mixing, assembling, packaging, and labeling of a medication on receipt of a prescription order for a specific patient and FDA permit the advance preparation of very limited quantities of compounded products.

Chemical-physical factors including calculations to make solutions isotonic, iso-osmotic, equimolar, or buffered.

Pharmacoeconomics: including medication costs, cost-benefit analysis, cost-effectiveness analysis, alternative treatment plans, and medication pricing.

A prescription to be prepared by a pharmacist and administered to a particular patient



A prescription may include the chemical (generic) name of the substance or the trademark name (manufacturer's brand)

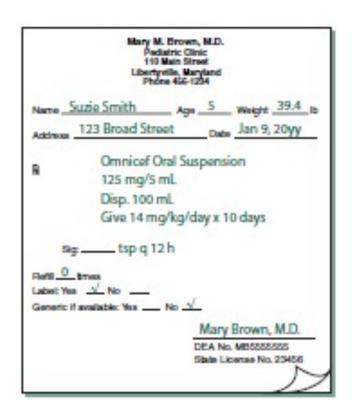
Medication Orders include instructions are written by the physician

CITY HOSPITAL			PATIENT NAME:	Thompson, Linda 2345 Oak Circle		
thens, GA 3	0600		ADDRESS:			
		CITY, STATE:		Athens, GA		
			AGE/SEX:	35 Female		
			PHYSICIAN:	J. Hardmer		
		HOSP.NO:		900612345		
			SERVICE:	Medicine		
		ROOM:		220 East		
DATE	TIME		ORDERS			
DATE	TIME		ORDERS			
02/01/yy	1200	1. Propranolol 40 mg po QID				
		Furosemide 20 mg po q AM Flurazopam 30 mg at HS pm sleep A. D-5-W + 20 mEq kcl/L at 84 mL/hr				
	K					
		Hardmer, MD				
		17				
9	2					

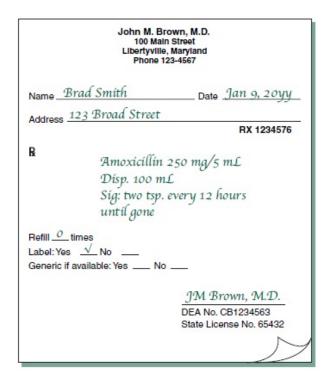
Typical hospital medication order sheet

Medication order for an infant, child, or an elderly person may also include the age, weight, and/or body surface area (BSA) of the patient

Example of a prescription for a pediatric



Example of a prescription written for a generic drug



	John M. Brown, M.D. 100 Main Street Libertyville, Maryland Phone 123-4567				
Nam	• Neil Smith	Date Jan 9, 20yy			
Addr	ress 123 Broad Street	33444			
R	Metoclopramide HCL	10 g			
	Methylparaben	50 mg			
	Propylparaben	20 mg			
	Sodium Chloride	800 mg			
	Purified Water, qs ad	100 mL			
	M. ft. nasal spray				
	Sig: Nasal spray for ch	emotherapy-			
	induced emesis. Use as				
	Discard after 60 days.				
Refill	1_0_times				
Labe	el:Yes ✓ No —				
Gene	eric if available: Yes No	-			
		JM Brown, M.D.			
		DEA No. CB1234563			
	5	State License No. 65432			

Example of a prescription requiring compounding

Drug-specific forms may be used, as for heparin dosing, electrolyte infusions, and morphine sulfate in patient-controlled anesthesia

City Hospital								
Patient Controlled Anesthesia (PCA) Orders								
	MORPHINI	E SULFATE INJECTION	, 1 mg/mL					
Patient Information	p1.00100							
r dioni mornidion	(Luboi)							
Physician:								
Date:	Date: Time:							
1. Mode (check)	□PCA	□Continuous	□PCA & Continuous					
			DOSING GUIDELINES					
2. PCA Dose	=	mL (mg)	1 mL (1 mg)					
3. Period between Ir	njections =	minutes	10 minutes					
4. Basal (Continuou	s) Rate =	mL (mg)/h	nr 1 mL (1 mg)/hr					
5. One-Hour Limit	=	mL (mg)	7 mL (7 mg)					
6. Initial Loading Do	se =	mL (mg)	2-5 mL (2-5 mg)					
7. Additional Instruc	tions:		'					
Physician's Signature								

Example of a hospital form for prescribing a specific drug treatment: Patient-Controlled Anesthesia

e-prescriptions

- In the inpatient or outpatient setting, a medication order, for a patient is entered into an automated data entry system as a personal computer (PC) or a handheld device loaded with *e-prescribing* software and sent to a pharmacy as an *e-prescription*.
- **When** received, a pharmacist immediately reduces the order to a hard copy and/or stores it as a computer file.

Advantages cited for e-prescriptions over traditional paper prescriptions

- ✓ Reduced errors due to prescription legibility;
- ✓ Concurrent software screens for drug interactions;
- ✓ Reduced incidence of altered or forged prescriptions;
- ✓ Efficiency for both prescriber and pharmacist; and,
- ✓ Convenience to the patient, whose prescription would likely be ready for pick-up upon arrival at the pharmacy

Prescription and Medication Order Accuracy

It is the responsibility of the pharmacist to ensure that each prescription and medication order received is correct in its form and content; is appropriate for the patient being treated; and is subsequently filled, labeled, dispensed, and administered accurately.

In essence, each medication should be:

- Therapeutically appropriate for the patient;
- Prescribed at the correct dose:
- Dispensed in the correct strength and dosage form;
- Correctly labeled with complete instructions for the patient or caregiver; and
- For the patient in a hospital or other health care facility, each medication must be administered to the correct patient, at the correct time, and by the correct rate and route of administration.

Roman Numerals on Prescriptions

Roman numerals commonly are used in prescription writing to designate quantities

Letters of fixed value used in the Roman system

SS	=	1/2	LorI	=	50
l, i, or j	=	1	Corc	=	100
Vorv	= 1	5	D or d	=	500
X or x	=	10	M or m	=	1000

Combining these letters are expressed as follows

(1) Two or more letters express a quantity that is the sum of their values

if they are successively equal or smaller in value:

(2) Two or more letters express a quantity that is the sum of the values remaining after the value of each smaller letter has been subtracted from that of a following greater:

SELECTED ABBREVIATIONS, ACRONYMS, AND SYMBOLS USED IN PRESCRIPTIONS AND MEDICATION ORDERSa,b

ABBREVIATION (LATIN ORIGIN ⁴)	MEANING	ABBREVIATION (LATIN ORIGIN ^c)	MEANING
Prescription Filling Di	rections	pt.	pint
aa. or (ana) ad (ad) disp. (dispensatur) div. (dividatur) d.t.d. (dentur tales	of each up to; to make dispense divide give of such doses	qt. ss or ss (semissem tbsp. tsp. Signa/Patient instruc	quart one half tablespoonful teaspoonful tions
doses) ft (flat) M. (mice) No. (numero) non rep. or NR (non repatatur)	make mix number do not repeat	a.c. (ante cibos) ad lib. (ad libitum) admin A.M. (ante meridiem)	before meals at pleasure, freely administer morning
q.s. (quantum sufficit) q.s. ad (quantum sufficiat ad) Sig. (Signa)	a sufficient quantity to make write (directions on label)	aq. (aqua) ATC b.i.d. (bis in die) c or c (cum) d (die) dil. (dilutus) et	water around the clock twice a day with day dilute and

Quantities and Measurement		h. or hr. (hora)	hour	
BSA cm ²	body surface area cubic centimeter or milliliter (mL)	h.s. (hora somni) i.c. (inter cibos) min. (minutum)	at bedtime between meals minute	
f or fl (fluidus) flʒ or fʒ flʒss orfʒss g gal gtt (gutta) lb (libra) kg L m² or M² mog mEq mg mg/kg mg/kg	fluid fluid dram (teaspoonful, 5 mL) half-fluidounce (tablespoonful, 15mL) gram gallon drop pound kilogram liter square meter microgram milligram milligrams (of drug) per kilogram (of body weight) milligrams (of drug) per square meter (of body	m&n N&V noct. (nocte) NPO (non per as) p.c. (post cibos) P.M. (post meridiem) p.o. (per os) p.r.n. (pro re nata) q (quaque) qAM q4h, q&h, etc. q.i.d. (quarter in die) rep. (repetatur) s (sine) s.o.s. (si opus sit) stat. (statim)	morning and night nausea and vomiting night nothing by mouth after meals afternoon; evening by mouth (orally) as needed every every morning every hours four times a day repeat without once a day if there is need; as needed immediately	
mL mL/h	surface area) milliliter milliliters (of drug administered) per hour	t.l.d. (ter in die) ut dict. (ut dictum) wk. Medications	three times a day as directed week	
mOsm or mOsmol oz.	(as through intravenous administration) milliosmoles ounce	APAP ASA AZT	acetaminophen aspirin zidovudine	

(continued)

(continued)

				LUDE	blak bland assesses	SUSD.	suspension
ABBREVIATION (LATIN ORIGIN ^c)	MEANING	ABBREVIATION (LATIN ORIGIN ^c)	MEANING	HBP	high blood pressure hormone replacement therapy	syr. (syrupus) tab. (tabletta)	syrup tablet
EES	erythromycin	D5NS	dextrose 5% in normal	mi sa min	hypertension	Routes of Administra	ation
HC HCTZ MTX NTG Clinical BM BP BS CHD CHF GERD GI GFR GU	ethylsuccinate hydrocortisone hydrochlorothlazide methotrexate nitroglycerin bowel movement blood preasure blood sugar coronary heart disease congestive heart failure gastrointestinal reflux disease gastrointestinal glomerular filtration rate genitourinary	DSW D10W elix. inj. NS 1/2NS oint or ungt. (unguentum) pulv. (pulvis) RL, R/L or LR sol. (solutio) supp.	saline (0.9% sodium chloride) dextrose 5% in water dextrose 10% in water elixir injection normal saline half-strength normal saline ointment powder Ringer's Lactate or Lactated Ringer's solution suppository	IOP MI OA Pt SOB TPN URI UTI Dosage Forms/Vehicle amp. cap. DSLR	Intraocular pressure myocardial ischemia/ infarction osteoarthritis patient shortness of breath total parenteral nutrition upper respiratory infection urinary tract infection	CIVI ID IM IT IV IVB IV Drip IVP IVPB NGT p.o. or PO (per os) rect. SL SubQ	continuous (24 hour) Intravenous infusion Intradermal Intramuscular Intrathecal Intravenous Intravenous bolus Intravenous infusion Intravenous push Intravenous piggy back nasogastric tube by mouth rectal or rectum sublingual subcutaneously
НА	headache	(suppositorium)				Top. V or PV	topically vaginally

^{*} The abbreviations set in boidface type are considered most likely to appear on prescriptions. It is suggested that these be learned first.

In practice, periods and/or capital letters may or may not be used with the abbreviations. Some abbreviations, acronyms, and symbols have medication-error risks associated with their use. Therefore, the institute for Safe Medication Practices (ISMP) and the Joint Commission on Accreditation of Healthcare Organizations (ICAHO) have issued a list of items prohibited from use and others considered for prohibition (see text). These designated items are not included in Table 4.2, with the exception of hs, subQ, AZT, and HCTZ, which are included for instructional purpose due to their remaining use in practice.

^{*} Muldoon HC. Pharmacoutical Latin. 4th Ed. New York: John Wiley & Sons, 1952.

The correct interpretation of these abbreviations and prescription notations plays an important part in pharmaceutical calculations and thus in the accurate filling and dispensing of medication

Examples of prescription directions to the pharmacist:

- (a) M. ft. ung.Mix and make an ointment.
- (b) Ft. sup. no xii Make 12 suppositories.
- (c) M. ft. cap. d.t.d. no. xxiv Mix and make capsules. Give 24 such doses.

Examples of prescription directions to the patient:

- (a) Caps. i. q.i.d. p.c. et h.s.

 Take one (1) capsule four (4) times a day after each meal and at bedtime.
- (b) gtt. ii rt.eye every a.m. Instill two (2) drops in the right eye every morning.
- (c) tab. ii stat tab. 1 q. 6 h. × 7 d.

 Take two (2) tablets immediately, then take one (1) tablet every 6 hours for 7 days.

CASE IN POINT 4.1: A pharmacist received the following prescription, which requires the correct interpretation of abbreviations prior to engaging in calculations, compounding, labeling, and dispensing.

R

Lisinopril

Hydrochlorothiazide aa. 10 mg

Calcium Phosphate 40 mg

Lactose q.s. ad 300 mg

M.ft. cap. i D.T.D. # 30

Sig: cap. i AM a.c.

- (a) How many milligrams each of lisinopril and hydrochlorothiazide are required to fill the prescription?
- (b) What is the weight of lactose required?
- (c) Translate the label directions to the patient.

Case in Point 4.1

(a) Since aa. means "of each," 10 mg lisinopril and 10 mg hydrochlorothiazide are needed for each capsule. And since D.T.D. means "give of such doses," 30 capsules are to be prepared. Thus,

10 mg lisinopril × 30 (capsules) = 300 mg lisinopril and 10 mg hydrochlorothiazide × 30 (capsules) = 300 mg hydrochlorothiazide are needed to fill the prescription.

- (b) Since q.s. ad means "a sufficient quantity to make," the total in each capsule is 300 mg. The amount of lactose per capsule would equal 300 mg less the quantity of the other ingredients (10 mg + 10 mg + 40 mg), or 240 mg. Thus,
 - 240 mg lactose/capsule \times 30 (capsules) = 7200 mg = 7.2 g lactose.
- (c) Take one (1) capsule in the morning before breakfast.

Medication Scheduling and Patient Compliance

Medication scheduling may be defined as the frequency (i.e., times per day) and duration (i.e., length of treatment) of a drug's prescribed or recommended use.

Some medications, because of their physical, chemical, or biological characteristics or their dosage formulations, may be taken just once daily for optimum benefit, whereas other drug products must be taken two, three, four, or more times daily for the desired effect.

Patient compliance with prescribed and nonprescribed medications is defined as patient understanding and adherence to the directions for use.

The compliant patient follows the label directions for taking the medication properly and adheres to any special instructions provided by the prescriber and/or pharmacist.

Some of the different types of problems relating to patient compliance with medication are exemplified by the following examples.

Examples:

B: Hydrochlorothiazide 50 mg
No. XC
Sig. i q AM for HBP

If the prescription was filled initially on April 15, on about what date should the patient return to have the prescription refilled?

Answer: 90 tablets, taken 1 per day, should last 90 days, or approximately 3 months, and the patient should return to the pharmacy on or shortly before July 15 of the same year.

Penicillin V Potassium Oral Solution Disp.____mL Sig. 5 mL q 6h ATC × 10 d 125 mg/5 mL

How many milliliters of medicine should be dispensed?

Answer: 5 mL times 4 (doses per day) equals 20 mL times 10 (days) equals 200 mL.

A pharmacist may calculate a patient's percent compliance rate as follows:

% Compliance rate =
$$\frac{\text{Number of days supply of medication}}{\text{Number of days since last Rx refill}} \times 100$$

Example:

What is the percent compliance rate if a patient received a 30-day supply of medicine and returned in 45 days for a refill?

% Compliance rate =
$$\frac{30 \text{ days}}{45 \text{ days}} \times 100 = 66.6\%$$
, answer.

In determining the patient's actual (rather than apparent) compliance rate, it is important to determine if the patient had available and used extra days' dosage from some previous filling of the prescription.

Patient noncompliance is the failure to comply with a practitioner's or labeled direction in the self-administration of any medication.

Noncompliance may involve underdosage or overdosage, inconsistent or sporadic dosing, incorrect duration of treatment, and drug abuse or misadventuring with medications.

Patient noncompliance may result from a number of factors, including

- unclear or misunderstood directions,
- undesired side effects of the drug that discourage use,
- lack of patient confidence in the drug and/or prescriber,
- discontinued use because the patient feels better or worse,
- >economic reasons based on the cost of the medication,
- >absence of patient counseling and understanding of the need for and means of compliance,
- confusion over taking multiple medications, and other factors.
- requently, patients forget whether they have taken their medications.

PRACTICE PROBLEMS

- Interpret each of the following Subscriptions (directions to the pharmacist) taken from prescriptions:
 - (a) Disp. supp. rect. no. xii
 - (b) M. ft. iso. sol. Disp. 120 mL.
 - (c) M. et div. in pulv. no. xl
 - (d) DTD vi. Non rep.
 - (e) M. et ft. ung. Disp. 10 g
 - (f) M. et ft. caps. DTD xlviii
 - (g) M. et ft. susp. 1 g/tbsp. Disp. 60 mL.
 - (h) Ft. cap. #1. DTD no.xxxvi N.R.
 - (i) M. et ft. pulv. DTD #C
 - (j) M. et ft. I.V. inj.
 - (k) Label: hydrocortisone, 20 mg tabs.
- Interpret each of the following Signas (directions to the patient) taken from prescriptions:
 - (a) Gtt. ii each eye q. 4 h. p.r.n. pain.
 - (b) Tbsp. i in $\frac{1}{3}$ gl. aq. q. 6 h.
 - (c) Appl. a.m. & p.m. for pain prn.
 - (d) Gtt. iv right ear m. & n.
 - (e) Tsp. i ex aq. q. 4 or 5 h. p.r.n. pain.
 - (f) Appl. ung. left eye ad lib.

- (g) Caps i č aq. h.s. N.R.
- (h) Gtt. v each ear 3× d. s.o.s.
- (i) Tab. i sublingually, rep. p.r.n.
- (j) Instill gtt. ii each eye of neonate.
- (k) Dil. c = vol. aq. and use as gargle q. 5 h.
- Cap. ii 1 h. prior to departure, then cap. i after 12 h.
- (m) Tab i p.r.n. SOB
- (n) Tab i qAM HBP
- (o) Tab ii q 6h ATC UTI
- (p) 3ii 4×d p.c. & h.s.
- (q) 3ss a.c. t.i.d.
- (r) Add crushed tablet to pet's food s.i.d.
- Interpret each of the following taken from medication orders:
 - (a) AMBIEN 10 mg p.o. qhs × 5 d
 - (b) 1000 mL D5W q. 8 h. IV c 20 mEq KCl to every third bottle.
 - (c) Admin. Prochlorperazine 10 mg IM q. 3h. prn N&V

- (d) Minocycline HCl susp. 1 tsp p.o. q.i.d. DC after 5 d.
- (e) Propranolol HCl 10 mg p.o. t.i.d. a.c. & h.s.
- (f) NPH U-100 insulin 40 Units subc every day A.M.
- (g) Cefamandole nafate 250 mg IM q. 12 h.
- (h) Potassium chloride 15 mEq p.o. b.i.d. p.c.
- (i) Vincristine sulfate 1 mg/m2 pt. BSA.
- (j) Flurazepam 30 mg at HS prn sleep.
- (k) D5W + 20 mEq KCl/L at 84 mL/ hour.
- (l) 2.5 g/kg/day amino acids TPN.
- (m) PROCRIT (epoetin alpha) stat. 150 units/kg subQ. 3×wk. × 3–4 wks.

- 4. (a) If a 10-mL vial of insulin contains 100 units of insulin per milliliter, and a patient is to administer 20 units daily, how many days will the product last the patient? (b) If the patient returned to the pharmacy in exactly 7 weeks for another vial of insulin, was the patient compliant as indicated by the percent compliance rate?
- 5. A prescription is to be taken as follows: 1 tablet q.i.d. the first day; 1 tablet t.i.d. the second day; 1 tablet b.i.d. × 5 d; and 1 tablet q.d. thereafter. How many tablets should be dispensed to equal a 30-day supply?
- 6. In preparing the prescription in Figure 4.3, the pharmacist calculated and labeled the dose as "1 teaspoonful every 12 hours." Is this correct or in error?

Refer to Figure 4.1 and identify any errors or omissions in the following prescription label:

Patient: Mary Smith Dr: JM Brown Date: Jan 9, 20yy

Take 1 capsule every day in the morning

Refills: 5

- Refer to Figure 4.2 and identify any errors or omissions in a transcribed order for the first three drugs in the medication order.
 - (1) Propranolol, 40 mg orally every day
 - (2) Flutamide, 20 mg orally every morning
 - (3) Flurazepam, 30 mg at bedtime as needed for sleep

 Refer to Figure 4.4 and identify any errors or omissions in the following prescription label:

Patient: Brad Smith Dr. JM Brown Date: Jan 9, 20yy

Take two (2) teaspoonfuls every twelve (12) hours until all of the medicine is gone

Amoxicillin 250 mL/5 mL

Refills: 0

Refer to Figure 4.5 and identify any errors or omissions in the following prescription label:

> Patient: Brad Smith Dr. JM Brown Date: Jan 9, 20yy

Nasal spray for chemotherapyinduced emesis. Use as directed. Discard after 60 days.

Metoclopramide HCl 10 g/100 mL Nasal Spray

Refills: 0