

PRINCIPLES OF SYSTEMIC THERAPY & PRESCRIPTION WRITING

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WRITING A PRESCRIPTION

Definition

- Prescription = Verbal, written, or electronic order for a drug issued by a properly licensed and authorized health care practitioner.

Writing an Rx

- Prescriptions are often written on preprinted pads (scripts) which should contain the following information about the practitioner:
 - ▣ Prescriber's Name
 - ▣ Office Address
 - ▣ Telephone Number
 - ▣ Fax number (Optional)
- Must be legible to decrease risk of error.

DR. MICHAEL GOODMAN & ASSOCIATES
123 Main Street
Anytown, USA 00000
000-555-1034 • FAX 000-555-4567

Patient Name: _____ Date: _____

Rx

Dr. Michael Goodman (000-555-1034) Dr. Mary Smith (000-555-1034) Dr. John Doe (000-555-1034)

Controlled Substances

All Schedule Medications that are monitored are required to be written on tamper resistant notepads. The Rx must also include an identifying number for the patient (e.g., health card number).

NORTHEASTERN STATE UNIVERSITY
OKLAHOMA COLLEGE OF OPTOMETRY
1001 North Grand Avenue, Tahlequah, Oklahoma 74464-7017
918.458.2109

Name: _____ Date: _____

Address: _____

Rx

Dispense as Written: _____ Product Selection Permitted: _____

Printed Name: _____ LIC #: _____

☐ No Refills ☐ Refills 1 2 3 4

Preventing Opioid Abuse: PDMP

- A prescription drug monitoring program (PDMP) is an electronic database that tracks controlled substance prescriptions.
- PDMPs can help identify patients who may be misusing prescription opioids or other prescription drugs and who may be at risk for overdose.

<https://www.cdc.gov/drugoverdose/data/overdose.html>

Preventing Opioid Abuse: PDMP

- PDMPs improve patient safety by allowing clinicians to:
 - ▣ Identify patients who are obtaining opioids from multiple providers.
 - ▣ Calculate the total amount of opioids prescribed per day (in MME/day-morphine milligram equivalent).
 - ▣ Identify patients who are being prescribed other substances that may increase risk of opioids—such as benzodiazepines.

<https://www.cdc.gov/drugoverdose/data/overdose.html>

What if you find something suspicious in the PDMP?

- Patients should not be dismissed from care based on PDMP information. Use the opportunity to provide potentially life-saving information and interventions.
 - ▣ Confirm that the information in the PDMP is correct.
 - ▣ Assess for possible misuse or abuse.
 - ▣ Discuss any areas of concern with your patient and emphasize your interest in their safety.

<https://www.cdc.gov/drugoverdose/data/overdose.html>

Required Elements

- Patient's Name and *Current Address*
- **Date Rx was written**
- Rx symbol (Superscription)
- **Medication Prescribed (Inscription)**
- **Dispensing directions to pharmacist (Subscription)**
- **Directions for Patient Use (Signa or Signatura)**
- **Refill**, special labeling, or any additional instructions
- **Prescribers signature, address, phone # (Typically Preprinted)**
- Additional Information to Include: Patient's age, height, weight, or additional laboratory data and indications for why the drug is prescribed.

Requirements

- **Patient Info:**
 - ▣ Must have name and address so patient can immediately be reached.
 - ▣ Age is highly recommended – helps distinguish between patients with the same name and allows pharmacists to verify medication quantity recommended for that age group.
- **Date:** Flag to the pharmacist if medications are not being filled promptly. Can facilitate communication with provider.
- **Rx Symbol (Superscription)** is an ancient symbol of healing.
 - ▣ Means “take thou” or “you take” in Latin.

Inscription = Medication Prescribed

- Name of the drug to be dispensed
 - ▣ Brand name or generic
 - ▣ Do not use medication abbreviations
 - Ex) No HCTZ for hydrochlorothiazide

Inscription = Medication Prescribed

- Concentration or dosage units
 - ▣ Examples: 0.5%, 150 milligrams, etc
 - ▣ Remember that a zero always holds its place before a decimal, but never after to avoid confusion.

Inscription = Medication Prescribed

- Formulation
 - ▣ Examples: Solution, Suspension, Capsule, etc
 - ▣ Important to specify ophthalmic when using topical medications

Subscription = Dispensing Directions

- Very brief if the medication is pre-manufactured.
 - ▣ Ex) Dispense one five mL bottle, Dispense thirty tablets
- Must be much more detailed if pharmacy is to compound the medication themselves.
- Recommend using the metric system for measurements.
- Write out your numbers, especially for controlled substances.

Signature = Patient Directions

- Provide directions for how to use the medication. Including the amount to take each time, when to take it, what route to use, how and where to administer the medication, and when to stop.
 - ▣ Often written using abbreviations or Latin.
 - Recommendation is moving away from Latin to writing out fully in English.
 - Avoid using periods, commas, or any extra notations.
- Ex) Sig: Instill one drop in your right eye every four hours while awake X ten days

Latin Abbreviations Commonly Used

Abbreviation	Latin	English Translation
bid	bis in die	Twice a day
tid	ter in die	Three times a day
qid	quarter in die	Four times a day
Hs	hora somni	At Bedtime
qh	quaque hora	Every hour
sol	solutio	solution
tab	tabella	tablet
ung	unguentum	Ointment
gt(t)	gutta(e)	Drop(s)

JCAHO Do Not Use

- ▣ QD (daily) or QOD (every other day)
 - Mistaken for each other
 - Write "daily" vs. "every other day"
- ▣ Trailing zero (X.0 mg) or Lack of leading zero (.X mg)
 - Write 0.X mg

Sig Continued...

- Be specific especially if you plan to taper a medication.
 - ▣ Include number of drops, which eye, frequency of instillation, and duration (number of days) for each component.
 - ▣ Ex) Instill one drop in right eye every four hours X four days, one drop in right eye every six hours X three days, one drop in right eye every eight hours X two days, and one drop every twelve hours X one day
- It is best to be specific on times – writing twice per day can mean at 8 and 10 AM.
- Always avoid as needed directions.

Refills

- Be sure to designate number of refills
 - ▢ Some prescription forms require writing in the information rather than circling the number
- Acute Treatment = No Refills
- Chronic Treatment = Multiple
 - ▢ Provide the number of refills required to get the patient to their next appointment.
 - ▢ Allows you to monitor compliance issues as well.
 - One mL = Approximately 20 drops
 - Average 5mL bottle = 100 drops
 - Patient using medication 2X/day in each eye uses ~120 drops per month.

Additional Elements to the Rx

- Consider Indication
 - ▢ Especially important when medications are approved for multiple areas.
 - ▢ This is very helpful for patients especially when on multiple medications.
- Extra Labeling that provides directions to the patient on use.
 - ▢ Ex) Shake well before use, Keep in the refrigerator, Take 30 minutes before bed, Avoid alcohol, etc.
 - ▢ These have become automatic computer print outs for pharmacies at this point but is still valuable to include.

Points to Remember

- If you do not have an established relationship with a pharmacy as a provider, you must include your license # on the Rx in addition to the elements discussed.

Age and Medications

- When considering drug use in children, the following age groups should be used: Preterm (born before 37 weeks), neonate (birth to 1 month), infant (1 month to 12 months), child (1 to 12 years) and adolescent (12 to 18 years).
- Unless the age is specified, the term 'child' in the British National Formulary (BNF) includes persons aged 12 years and younger.

Pediatric Patients



- Not just smaller adults when it comes to drug use.
 - ▢ Must be more aware of details on the individual patient and the drug that will be used.
- Calculation of dosage commonly performed for oral medications based on age, weight, or body surface area.
 - ▢ Young's Rule
 - Pediatric Dose = Adult Dose X [Age in years / (Age + 12)]
 - ▢ Clark's Rule
 - Pediatric Dose = Adult Dose X [Weight in kg / 70]
 - Pediatric Dose = Adult Dose X [Weight in lbs / 150]
 - ▢ Body surface area calculator: <http://patient.info/doctor/body-surface-area-calculator-mosteller>

Northeastern State University College of Optometry
Jenna Lighthizer, OD

1001 North Grand Avenue Phone: 918.444.4019
Tahlequah, OK 74464 Fax: 918.458.2104

Patient Name _____ Date _____
Patient Address _____ Patient Age _____

Rx: erythromycin 0.5% ophthalmic ointment
Disp: one 3.5 gram tube
Sig: Apply one ¼ inch strip every night before bed X ten days

Refills: None

Doctor Signature _____

Northeastern State University College of Optometry
Jenna Lighthizer, OD

1001 North Grand Avenue Phone: 918.444.4019
Tahlequah, OK 74464 Fax: 918.458.2104

Date _____

Patient Name _____
Patient Address _____ Patient Age _____

Rx: Keflex 500 mg tablets
Disp: 28 tablets
Sig: Take one tablet by mouth four times per day X one week

Refills: None

Doctor Signature _____

Northeastern State University College of Optometry
Jenna Lighthizer, OD

1001 North Grand Avenue Phone: 918.444.4019
Tahlequah, OK 74464 Fax: 918.458.2104

Date _____

Patient Name _____
Patient Address _____ Patient Age _____

Rx: Vigamox ophthalmic solution
Disp: one three (3) mL bottle
Sig: Instill i gt OU q4h X 7 days for bacterial infection

Refills: None

Doctor Signature _____

Northeastern State University College of Optometry
Jenna Lighthizer, OD

1001 North Grand Avenue Phone: 918.444.4019
Tahlequah, OK 74464 Fax: 918.458.2104

Date _ 01/14/11 _____

Patient Name _ Mary Smith _____
Patient Address _ 112 South 5th Street, Tahlequah OK 74464 _____
Patient Age _ 64 _____

Rx: Augmentin 500 mg tablets
Disp: twenty one tablets
Sig: Take one tablet three times per day X seven days for preseptal cellulitis

Refills: None

Principles of Systemic Therapy

Pharmacodynamics and Pharmacokinetics

Pharmacodynamics

- The study of drugs and their actions on living cells, tissues, and organisms.
 - ▣ This is how the medication causes a response, which pathways are involved, and what cells/systems are affected – what the drug does to the body.
 - Most medications create a response by acting on a receptor as either an antagonist or agonist.
 - ▣ Largely determines the specificity of action, as well as the therapeutic and adverse reactions that are possible.

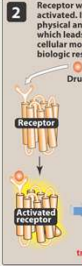
Receptors

1 Unoccupied receptor does not influence intracellular processes.



Receptor

2 Receptor with bound ligand is activated. It has altered physical and chemical properties, which leads to interaction with cellular molecules to cause a biologic response.



Drug

Activated receptor

Signal transduction

Biologic response

- Most drugs exert their effects, both beneficial and harmful, by interacting with receptors.
- For a drug to have a response it must first bind to something (receptor site) through signal transduction
- Most receptors for a given reaction are 95% of the time inactive until a drug (which is usually an agonist) binds to the receptor resulting in a response.

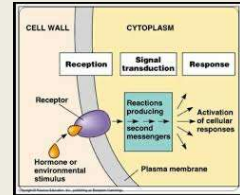
In Whalen, K., In Finkel, R., & In Panavell, T. A. (2015). *Pharmacology*.

Receptors: What they Do?

- Receptors largely determine the quantitative relations between dose or concentration of drug and pharmacologic effects.
 - receptor's affinity for binding a drug determines the concentration of drug required to form a significant number of drug-receptor complexes, and the total number of receptors may limit the maximal effect a drug may produce.
- Receptors are responsible for selectivity of drug action.
- Receptors mediate the actions of pharmacologic agonists and antagonists
 - Agonists: activate the receptor to signal as a direct result of binding to it
 - Antagonists: bind to receptors but do not activate generation of a signal; consequently, they interfere with the ability of an agonist to activate the receptor.

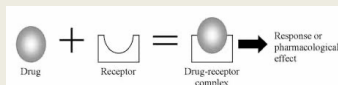
Signal Transduction

- The drug-receptor complex initiates alterations in biochemical and/or molecular activity of a cell by a process called signal transduction
- "ligand" refers to a small molecule that binds to a site on a receptor protein.
- "Second messenger" molecules (also called effector molecules) translates ligand binding into a cellular response.



Drug-Receptor Complex

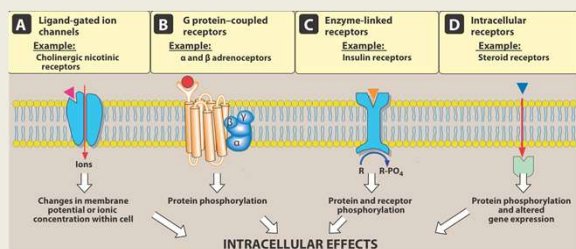
- Cells have different types of receptors
- Each is specific for a particular ligand and produces a unique response.
 - Drug + Receptor → D-R complex → Biologic effect.
 - Complexes between enzyme and substrate or antigen and antibody.



Receptor States

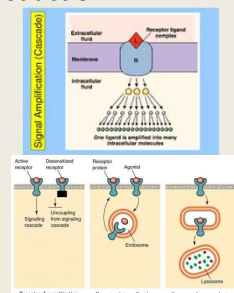
- Receptors exist in two states, inactive (R) and active R* states.
- In the absence of an agonist, R* typically represents a small fraction.
 - Agonists rapidly shift the equilibrium from R to R*.
 - Other drugs render the receptor less functional or nonfunctional.

Major Receptor Families

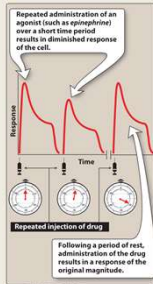


Features of Signal Transduction

- the ability to amplify small signals (hormones, neurotransmitters, peptides)
 - 1) a single ligand-receptor complex can interact with many G proteins
 - 2) the activated G proteins persist for a longer duration than the original ligand-receptor complex.
- mechanisms to protect the cell from excessive stimulation



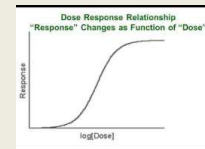
Desensitization and Down-regulation of Receptors



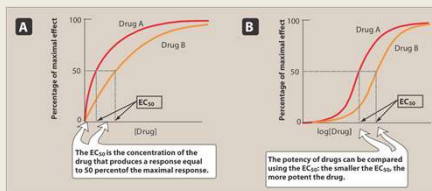
- Tachyphylaxis: When repeated administration of a drug results in a diminished effect.
 - Desensitization
 - Down regulation
- “refractory” or “unresponsive”: recovery phase (voltage-gated channels)

DOSE–RESPONSE RELATIONSHIPS

- The magnitude of the drug effect depends on the drug concentration at the receptor site.
 - the dose of drug administered
 - drug’s pharmacokinetic profile

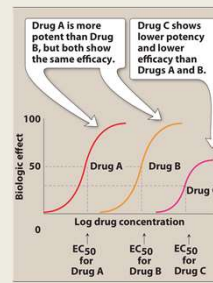


Graded D-R Relations



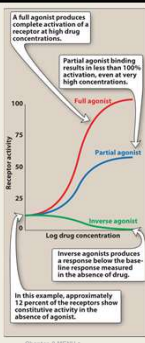
- EC50: The concentration of drug producing an effect that is 50 percent of the maximum.

Efficacy & Potency



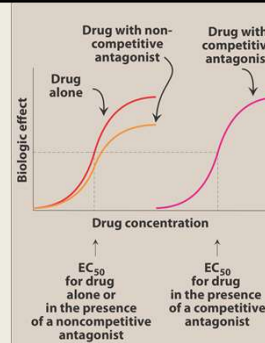
- Efficacy: ability of a drug to elicit a response when it interacts with a receptor.
- Potency: a measure of the amount of drug necessary to produce an effect of a given magnitude.
- Generally, want more effectiveness rather than potency because we want something that will help fix a problem rather than how potent the drug actually is.

Agonists



- Full agonists, a maximal biologic response (Phenylephrine)
 - a strong affinity for its receptor and good efficacy
- Partial agonist, cannot reach Emax
 - Partial agonists gives 60-80% of the full response
 - may act as an antagonist of a full agonist

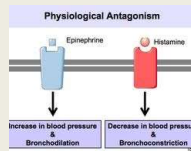
Antagonists



- decrease or oppose the actions of another drug or endogenous ligand.
- has no effect if an agonist is not present.
- Competitive: same site
 - Shift DR curve to right
- Irreversible: decrease Emax
 - Cannot overcome by more agonist
 - Irreversible binding (covalent)
 - Allosteric site

Functional and chemical antagonism

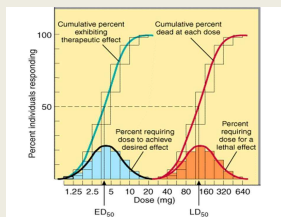
- An antagonist may bind to a completely different receptor site initiating effects that are functionally opposite
- Functional/physiological antagonism by epinephrine to histamine-induced bronchoconstriction.



Pharmacodynamics

- **Effective Dose:** The Amount of drug required to produce a therapeutic effect.
 - **ED50:** The dosage necessary to be effective in 50%
- **Toxic Dose:** The amount of drug shown to produce symptoms of overdose.
 - **Lethal Dose (LD50):** Dose shown to kill 50% of animals during experimentation.
- **Therapeutic Index = Toxic Dose/Effective Dose**
 - Often given as LD50/ED 50
 - Ratio of the dose that produces toxicity to the dose that produces an effective response.
 - Higher the number means safer the drug.

QUANTAL DOSE-RESPONSE RELATIONSHIPS

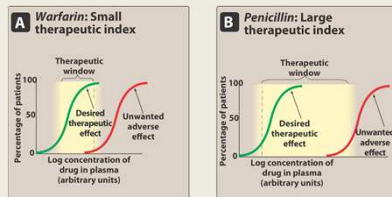


- the influence of the magnitude of the dose on the proportion of a population that responds.
- What concentration of atenolol would decrease 5mmHg DBP for 70% of population?

Therapeutic Index

- ratio of the dose that produces toxicity to the dose that produces a clinically desired or effective response in a population
- TD50/ED50
- A measure of a drug's safety

Examples for TI

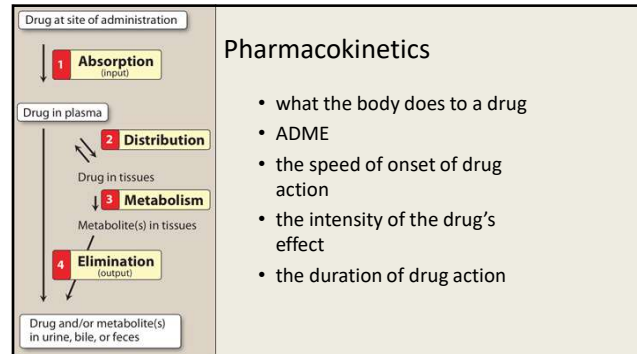


Pharmacodynamics

- **Potency:** The amount of drug required to produce an effect.
- **Efficacy:** The ability of a drug to produce a therapeutic effect once bound.
- **Affinity:** How well a drug binds to a reception site.

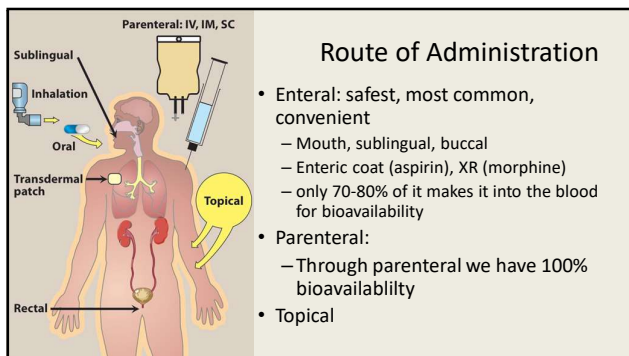
Pharmacokinetics

- The study of the time course of absorption, distribution, metabolism, and elimination of an administered drug.
 - ▣ This is what the body does to the drug.
 - ▣ Determines recommended dose, onset and duration of action, as well as the frequency of application necessary to maintain continued effects.
- Pharmacokinetics of topical medications are very different from orals due to the application directly into the eye.



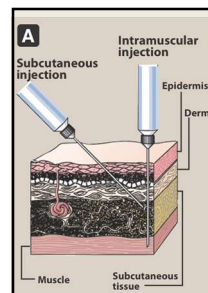
Pharmacokinetics

- what the body does to a drug
- ADME
- the speed of onset of drug action
- the intensity of the drug's effect
- the duration of drug action



Route of Administration

- **Enteral**: safest, most common, convenient
 - Mouth, sublingual, buccal
 - Enteric coat (aspirin), XR (morphine)
 - only 70-80% of it makes it into the blood for bioavailability
- **Parenteral**:
 - Through parenteral we have 100% bioavailability
- **Topical**



Parenteral

- Good for drugs that are poorly absorbed (heparin) or unstable (insulin) in the GI tract.
- Unconsciousness
- Good dose control, but irreversible, pain, fear, local tissue damage, and infections.
- intravascular (intravenous or intra-arterial), intramuscular (depot), and subcutaneous (pump)

Other Routes

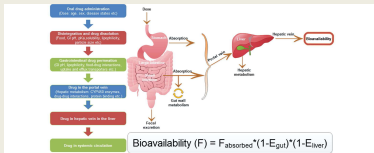
- Oral inhalation (albuterol, fluticasone)
- Nasal inhalation (oxymetazoline, calcitonin)
- Intrathecal/intraventricular: directly into CSF (amphotericin B)

Topical

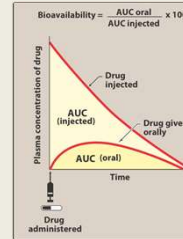
- Clotrimazole cream, hydrocortizone, local effect
- Transdermal: nitroglycerin, scopolamine, nicotine, variable absorption
- Rectal: unconscious, emesis, erratic absorption
- Ophthalmic drops

Factors influencing absorption

- Total surface area available for absorption: intestine 1000x that of the stomach
- Contact time at the absorption surface: diarrhea, anticholinergics (dicyclomine), food
- P-glycoprotein is a multidrug trans-membrane transporter protein
 - Liver: transporting drugs into bile for elimination
 - Kidneys: pumping drugs into urine for excretion
 - Brain capillaries: pumping drugs back into blood, limiting drug access to the brain



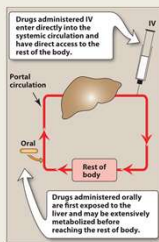
Bioavailability



- the fraction of administered drug that reaches the systemic circulation
- 100 mg p.o., and 70 mg absorbed, bioavailability is 70%

Figure 1.10 (non-estimated)
Chapter 1.10 (2012)

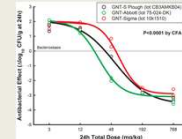
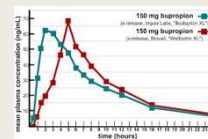
Factor affecting bioavailability



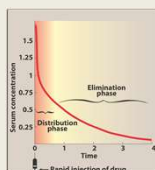
- First-pass metabolism: enters portal circulation before entering the systemic circulation
- GI or liver limits the efficacy of many drugs when taken orally.
 - Nitroglycerin (90%); Penicillin G, unstable; Insulin, protease

Equivalence

- Bioequivalence: comparable bioavailability and similar times to achieve peak blood concentrations.
- Therapeutic equivalence: pharmaceutically equivalent with similar clinical and safety profiles

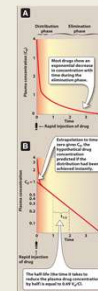


DRUG DISTRIBUTION

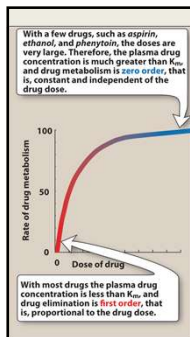


- Process by which a drug reversibly leaves the bloodstream and enters into the interstitium:
 - Cardiac output and regional blood flow, capillary permeability, tissue volume, protein binding, and relative hydrophobicity of the drug.
- High flow: brain, eye, liver, and kidney
- Low flow: skeletal muscles, adipose tissue, skin, and viscera.

DRUG CLEARANCE THROUGH METABOLISM



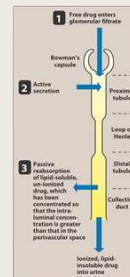
- 1) hepatic metabolism
- 2) elimination in bile
- 3) elimination in urine



Kinetics of metabolism

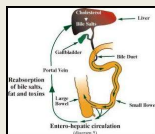
- First-order kinetics: rate of drug metabolism and elimination is directly proportional to the concentration of free drug
 - constant rate of metabolism going on, concentration dependent. Increase concentration of drug enzyme increases rate of metabolism
- Zero-order kinetics: aspirin, ethanol and phenytoin, the doses are very large
 - Enzyme is saturated and the rate of metabolism remains constant over time

DRUG CLEARANCE BY THE KIDNEY



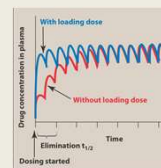
- Most important route
 - Sweating and breathing remove drugs but very small amounts
- Older patients who have kidney issues need to adjust drug amounts because they may have reduced clearance which can lead to toxicity
- Overdose can be treated through emesis (vomiting)

CLEARANCE BY OTHER ROUTES



- Intestines & bile (unabsorbed), the lungs (halothane), and milk in nursing mothers,
- Sweat, saliva, tears, hair, skin
- Some drugs may also be reabsorbed through the enterohepatic circulation, thus prolonging their half-lives.

Loading Dose



- a "loading dose" achieve the desired plasma level rapidly
- the therapeutic benefit of the drug is required immediately
 - lidocaine for arrhythmias

Drug Absorption and Distribution

- Absorption:** The movement of a medication from the site of entry.
 - Oral medications often undergo First-Pass Metabolism by the liver, etc. This does not occur with topical medications.
- Distribution:** How the medication is moved throughout the body.
 - This directly relates to the medication concentration gradient, the blood flow, the size of the medication, and the binding potential.

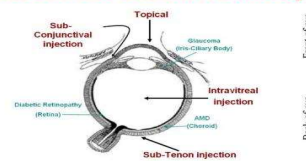
Drug Elimination

- Medications are either eliminated directly or converted into metabolites and excreted.
 - The major routes of excretion are the liver and kidneys.
- Most medications are eliminated by first order kinetics.
 - A constant fraction of the medication is lost per unit of time. This includes many topical medications.
- Half – Life: Time during which the concentration of drug is reduced to ½ its original concentration.
 - Example: 20 mg drug with 1 hr half-life
 - 1 Hr = 10 mg = 50% gone
 - 2 Hr = 5 mg = 75% gone
 - 3 Hr = 2.5 mg = 87.5% gone
 - 4 Hr = 1.25 mg = 93.75% gone
 - 5 Hr = 0.625 mg = 96.875% gone

Bioavailability

- Bioavailability: This is the amount of drug present at the desired site of action.
 - Depends upon absorption, distribution, metabolism, and excretion, as well as the route of administration, the drug's chemical properties, and the patient's physiology.
- Drug companies spend millions of dollars to develop the optimum drug so bioavailability is at the peak levels.

Routes of Ocular Delivery



OPHTHALMIC DRUG DELIVERY

Drug Delivery to the Ocular Tissues

- To be effective therapeutics must reach the ocular tissues in relatively high concentrations.
- Topical instillation/application is the most common method used to administer medications for the optometrist followed by the enteral (by the digestive system) route.

Topical Administration

- Topical is the most common route of administration for ophthalmic drugs.
- Advantages:
 - Simple and non-invasive
 - Easy self-administration by patients

Topical Administration

- Disadvantages:
 - Topical medications must be of high concentration in order for the effect on ocular tissues to be reached.
 - High turnover rate of tears and diffusion into circulating blood are both quick to eliminate the medication from the eye.
 - High rate of drug loss means most medications will not reach the posterior segment at all.
 - Some people are horrible at inserting eye drops.

Various Modes of Topical Delivery

- Solutions
- Suspensions
- Emulsions
- Sprays
- Gels
- Ointments
- Lid Scrubs
- Devices such as Contacts, Corneal Shields, Pledgets, Inserts, and Filter Strips

Solutions, Suspensions, and Emulsions

- Majority of ocular medications are solutions.
- Suspensions must be shaken to provide an accurate drug dosage.
 - Best to roll the drug between the hands, instead of shaking to avoid air bubbles before instilling.
 - Some suspensions do not adequately re-suspend even with shaking and these should be avoided.
- Emulsions are oil-water mixtures that behave clinically like solutions and suspensions, but do not require shaking.

Advantages and Disadvantages

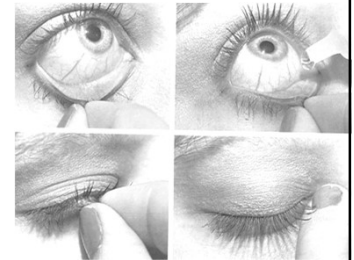
- Advantages
 - Easily instilled
 - Interfere less with vision than thicker ointments/gels
 - Fewer potential complications
- Disadvantages
 - Short ocular contact time
 - Imprecise and inconsistent delivery of active drug
 - Frequent contamination
 - Possibility of injury by tip of dropper

Tear Turnover

- Normal tear volume is 8-10 mcl with a maximum capacity of 30 mcl if the eyelids are not squeezed.
- Single drop of medication is approximately 50mcl (0.05mL) – therefore the excess is quickly drained out through the nasolacrimal duct or blinked onto the eyelid.
 - Absorption by the blood vessels of the nasal mucosa in the lacrimal drainage system and swallowing excess medication are the major factors leading to systemic side effects.

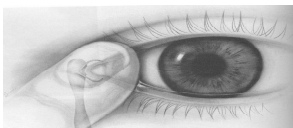
Maximizing Ocular Absorption

- Proper Instillation Techniques:
 - Pull on inferior lid to form a “pouch”
 - Instill drop making sure the dropper tip is avoiding contact with the lashes
 - Have patient close eyes and look down (turn cornea inferiorly)
 - Keep eyes closed for 2-3 minutes and punctal occlude.



Punctal Occlusion

- Keeping the eyelids closed slows drainage and decreases systemic absorption.
 - Improved ocular penetration is shown when punctal occlusion is also performed.



Emphasize gentle pressure in nasal area – NOT ON THE ACTUAL EYEBALL.

Tips for Drop Instillation

- Observe your patients instilling eye drops
 - Especially important in elderly patients with tremors, arthritis, etc.
 - Putting medications in the refrigerator (if allowed) will help patients to know if the drop reaches the eye.
- Telling a child to open their mouth will sometimes increase palpebral width and placing their hand on their forehead will increase upward gaze.
 - Consider instilling over closed gently closed eyes in children.

Sprays

- Alternative method of administering solutions.
 - ▢ Often less irritating than drops.
- Mainly used for dilation drops and cycloplegics in children
- Must be prepared at compounding pharmacy.

Gels

- Less thick than ointments with prolonged contact times better than solutions.
- Frequently seen in artificial tear formulations.
- In situ-activated gel-forming systems are now very common.
 - ▢ Medication is delivered as eyedrop and converts to gel by body temp.

Ointments

- Medications added to a mixture of petrolatum, liquid mineral oil, and occasionally lanolin to increase their viscosity. This combination allows for the gradual “melt” of ointments at body temperature.

Ointments

- Advantages
 - ▢ Ointments provide for much longer contact time
 - 2X as long if eye blinking, 4X as long if patched
 - Larger molecules prolong time in the eye before drainage through the lacrimal sac is possible.
 - ▢ Useful in children – cannot cry out meds as easily.
 - ▢ Beneficial for treatment under pressure patches before the days of contact lenses.

Ointments

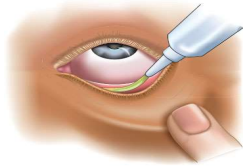
- Disadvantages
 - ▢ Blurred vision for average time of 2-3 minutes
 - ▢ Contact dermatitis of the eyelids can occur due to prolonged contact.
 - ▢ Can affect absorption of subsequently instilled medications – ALWAYS instill ointment last.

Guidelines for Using Ointments

- Ointments may delay healing of corneal wounds.
- Never use if you are questioning wound integrity after surgery.
- Never used in jagged corneal lacerations.
- Caution in deep corneal wounds and corneal ulcers.

Instilling Ointments

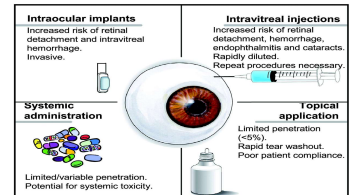
- Looking up apply to inferior conjunctival sac
 - ▢ Use tube directly
 - ▢ Use clean finger
- Recommend ¼ - ½ inch strip
- Tell patient to very gently squeeze the tube.



Route of Administration

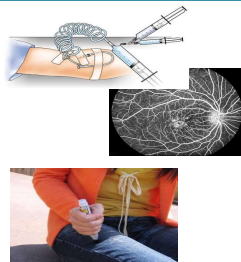
- Additional Options used in Ocular Treatments:

- ▢ Periocular
 - Subconjunctival, Sub-Tenon's, Retrobulbar, Peribulbar
- ▢ Intracameral
- ▢ Intravitreal
- ▢ Enteral
 - Oral and Sublingual
- ▢ Parenteral
 - Intravenous
 - Intramuscular
 - Subcutaneous



Parenteral

- Providing drugs by piercing the skin or mucous membrane.
 - ▢ Intravenous
 - Injection straight into venous circulation.
 - ▢ Intramuscular
 - Injection directly into muscle tissue.



Subcutaneous Injections

- Involves injection just under the skin.
 - ▢ Most common use is insulin for diabetics.
- Increasing frequency of use in optometric settings as scope of practice increases in minor surgical procedures.
 - ▢ Injection of anesthetic lidocaine often performed prior to lesion removal around the eyelids.

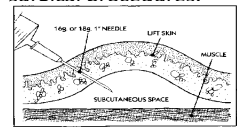


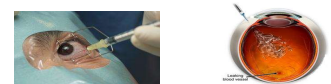
Figure 2. Subcutaneous injection.

Enteral Administration

- Enteral means it is absorbed by the digestive tract.
- In optometry this consists mainly of oral medications.
 - ▢ Sublingual is under the tongue such as nitroglycerin or the new fast dissolvable medications.
- Common Oral Medications Used in Optometry
 - Corticosteroids
 - Analgesics and NSAIDs
 - Antibiotics and Antivirals
 - Antihistamines
 - Oral Hypotensives

Intravitreal Injections

- Injection directly into the vitreous.
- Systemic medications are limited from entering the eye due to the blood-ocular barrier – intravitreal injections are best option for treatment of the posterior segment.

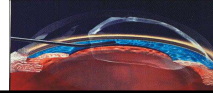


Intravitreal Injections

- Frequent uses:
 - Antibiotics, antivirals, and antifungal agents for the treatment of endophthalmitis.
 - Anti-VEGF (vascular endothelial growth factor) to help prevent new blood vessel growth in macular degeneration
 - Steroids for reducing diffuse cases of macular edema or treatment of posterior uveitis.

Intracameral Administration

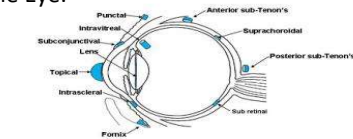
- Delivering a drug directly into the anterior chamber.
- Most common application is the injection of viscoelastic to protect the cornea during cataract surgery or glaucoma filtering surgery.



Periocular Administration

- Injections around the Eye:

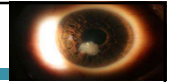
- Subconjunctival
- Sub-Tenon's
- Retrobulbar
- Peribulbar



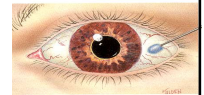
Schematic diagram of various routes of ocular drug administration.

Subconjunctival

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site/images/CornealUlcer.jpg

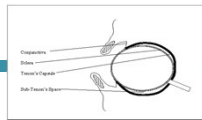


- Best used for drugs that penetrate the corneal and conjunctival epithelium poorly.
 - Ex) Antibiotics for large corneal ulcers
- Advantages:
 - High local concentrations with small amounts of medications (helps avoid systemic side effects)
 - Beneficial for patients that are not reliable



Sub-Tenon's Injection

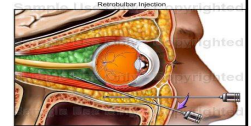
- Anterior and Posterior Subtenon's



- Anterior offers no benefit over subconjunctival with greater risks such as globe perforation or infection.
 - Less medication is delivered to the eye (more lost through scleral absorption)
- Posterior
 - Most often used for injection of steroids for chronic posterior uveitis.
 - Beginning to be used more frequently for providing anesthetic during cataract surgery.

Retrobulbar and Peribulbar

- Retrobulbar
 - Involves injection directly into the muscle cone of the eye.
 - First developed to provide anesthetic during surgery, but now occasionally being used for antibiotics, steroids, and alcohol.
- Peribulbar
 - Consists of multiple injections around the globe, but not into muscle cone for anesthesia.
 - Slower in achieving akinesia.
 - Less risk of globe penetration, ONH injury, or hemorrhage.



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