

### Fever - classes of medication

Acetaminophen	<p><b>Mechanism of action:</b> acts at hypothalamus to cause peripheral vasodilation, which enables sweating and allows body to rid excess heat</p> <p>No anti-inflammatory action</p> <p><b>Primary use:</b> fever, mild to moderate pain, osteoarthritis</p>
NSAID's	<p>Same mechanism of action as acetaminophen (for fever)</p> <p>Because of acetaminophen's safety record (few drug interactions and side effects), it is first-line for fever</p> <p>NSAID could be more appropriate if inflammation is also present (ibuprofen &gt; ASA)</p> <p>ASA is contraindicated in children ☹️ Reye's Syndrome (ASA + virus + fever in child)</p>

### Adverse effects

NSAID	<p>nausea, dyspepsia, ulcer with long-term use, potential anti-platelet action, hypertension, increased risk of cardiac event with long-term use</p> <p>Take with food</p> <p>Caution in kidney disease, cardiovascular disease, GI conditions</p>
Corticosteroids	

### Adverse effects (cont)

Acetaminophen	<p>very rare liver toxicity (max dose of 4g/24hours), avoid alcohol, interacts with warfarin (but doesn't ↑ bleeding on its own)</p>
1st-Generation Antihistamines	<p>Significant sedation</p>
2nd-Generation Antihistamines	
Intranasal Corticosteroids	<p>nasal irritation, dryness and bleeding (epistaxis), bad taste, loss of smell</p>
Decongestants <i>Phenylephrine, pseudoephedrine</i>	<p>oral – hypertension, anxiety, insomnia;</p> <p>intranasal – nasal irritation, rebound congestion, rarely systemic effects</p>
Penicillin	<p>anaphylaxis, diarrhea, nausea, vomiting, pain at injection site, superinfections, some (minor) drug interactions</p>
Cephalosporins <i>Cefotaxime</i> (3rd Gen.)	<p>hypersensitivity, rash, itching, anaphylaxis, diarrhea, vomiting, nausea, pain at injection site, some (minor) drug interactions</p> <p>Must be given IV or IM (not orally)</p>

### Adverse effects (cont)

Tetracyclines	<p>diarrhea, yeast infections, nausea, vomiting, epi-gastric burning, yellow-brown teeth discoloration in young children (we don't prescribe for kids), photosensitivity</p> <p>Can potentially interfere with oral contraceptives (recommend backup method)</p> <p>Higher chance of superinfections because it is broad-spectrum</p>
Macrolides <i>Erythromycin</i>	<p>: significant nausea, vomiting, diarrhea (take with food), some important drug interactions</p> <p>Warfarin, cyclosporine, anticonvulsants (all via CYP450 inhibition/induction)</p> <p>Fidaxomicin – new; for treatment of <i>c. difficile</i>; not absorbed, stays in GI tract</p> <p>nausea, constipation, vomiting</p>
Aminoglycosides <i>Gentamicin</i>	<p>ototoxicity, nephrotoxicity</p>



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Published 13th April, 2021.  
Last updated 13th April, 2021.  
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### Adverse effects (cont)

Fluoroquinolones <i>Ciprofloxacin</i>	nausea, diarrhea (can take with food), photosensitivity Separate from minerals like calcium, iron, magnesium, aluminum (including supplements and antacids) by 2h Serious adverse effects associated with fluoroquinolones: Tendinitis or tendon rupture (1.3-5.6 in 10,000) Cardiac arrhythmias (15-57 in 100,000) CNS effects ☑ seizures, tremors, altered mental state Peripheral neuropathy
Sulfonamides <i>Sulfamethoxazole-Trimethoprim (SMZ-TMP, Septra®, Bactrim®, -DS)</i>	nausea, vomiting, skin rashes, photosensitivity, anemia, crystalluria Drink lots of water to prevent crystalluria Monitor for: painful urination, abdominal pain, blood in urine, fever
Carbapenems <i>ertapenem, imipenem, meropenem</i>	skin reactions, inflammation at injection site, diarrhea, nausea, vomiting
Clindamycin	High risk of superinfection (GI)

### Adverse effects (cont)

Nitrofurantoin	Changes urine to orange colour Must take with food
Metronidazole	Disulfiram reaction – flushing, tachycardia, shortness of breath, severe nausea & vomiting, throbbing headache, visual disturbance, confusion, dizziness Occurs ~ 5-10 minutes after intake, lasts 30 mins ☑ several hours
Vancomycin	Ototoxicity and nephrotoxicity
Linezolid	lactic acidosis, myelosuppression (↓WBC and platelets), peripheral and optic neuropathy, serotonin syndrome, diarrhea, Major drug interaction with any serotonergic drug, may need to discontinue until course of treatment finished, also inhibits MAO
Rifampin (RMP)	Rashes, blood dyscrasias, GI disturbances, liver damage, nephrotoxicity Secretions coloured a reddish-orange (sweat, urine, sputum, tears)

### Adverse effects (cont)

Amphotericin B	fever & chills during infusion, vomiting, headache, phlebitis, nephrotoxicity, hypokalemia, ototoxicity
Azole Antifungals <i>fluconazole, itraconazole, ketoconazole, miconazole, voriconazole</i>	Rare hepatotoxicity – avoid alcohol, watch for jaundice, monitor liver enzymes
Nystatin	Oral thrush – swish and swallow oral suspension four times daily (works topically) (needs Rx)



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Published 13th April, 2021.

Last updated 13th April, 2021.

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### Adverse effects (cont)

Classic Immuno-suppressant

Increased risk of infections, Increased risk of cancers such as lymphomas, cysts, and polyps

Frequency increases with intensity and duration of treatment, Kidney impairment, hepatic impairment, Hypertension, hyperlipidemia, CNS: tremor, headache, skin prickling sensation, GI: nausea, vomiting, abdominal pain, diarrhea, gingival hyperplasia, MSK: Muscle cramps, myalgia

Endocrine: Menstrual disturbances, gynecomastia, Hypertichosis (abnormal amount of hair growth over body), Fatigue

### Adverse effects (cont)

Chemotherapy

**short term**

Nausea/vomiting, Diarrhea or constipation, Mucositis/stomatitis, Myelosuppression, Hair growth alterations, Weight gain / weight loss, Taste alterations, Fatigue, Hepatic and renal changes, Cardiac function changes, Rash / skin changes / nail changes, High blood pressure

**Long term**

Infertility, Secondary malignancies, Heart failure, Osteoporosis, Pulmonary fibrosis, Cataracts, Peripheral neuropathy, Hearing loss, Fatigue, Endocrine abnormalities

### Inflammation mediators

Histamines

Bradykinin

Leukotrienes

Cytokines

Interleukins

Prostaglandin

### Inflammation classes of medication

**Non-steroidal anti-inflammatory NSAID**

Inhibit cyclo-oxygenase (COX), which reduces prostaglandin synthesis therefore inhibiting inflammation

Also have analgesic and antipyretic properties

For mild to moderate inflammation

### Inflammation classes of medication (cont)

COX-1

– In all tissues, stomach lining (mucosa), involved in platelet aggregation

COX-2

more specific for inflammation

*Ibuprofen*

mild to moderate inflammation, fever, mild to moderate pain, dysmenorrhea, musculoskeletal pain, arthritis

**Corticosteroids**

Mimic endogenous cortisol, attempting to bring body back to homeostasis after a fight-or-flight response

Anti-inflammatory and immuno-suppressive

For severe inflammation

Serious systemic adverse effects limit use to emergencies and severe inflammation (multiple sclerosis, rheumatoid arthritis, auto-immune diseases)

Local administration, short-term use preferred whenever possible



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Published 13th April, 2021.

Last updated 13th April, 2021.

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### Antibiotics - Classes of medication

<b>Penicillins</b> <i>-cillin</i>	Disrupt bacterial cell walls, Bactericidal Penicillin-binding protein: a protein only in bacterial cell walls that penicillin binds to which weakens the cell wall, allows fluid to enter and destroys the cell Penicillins contain a beta-lactam ring in its structure necessary for activity Many bacteria produce beta-lactamase (penicillinase) that is a natural defense to penicillin – it breaks the beta-lactam ring, leaving it ineffective therefore penicillin resistance
<i>Amoxicillin + Clavulanic Acid (Amoxiclav)</i>	Clavulanic acid inhibits $\beta$ -lactamases (penicillinases) of some microorganisms to allow amoxicillin to be active against it Synergistic relationship

### Antibiotics - Classes of medication (cont)

<i>Penicillin G Potassium (Pen G)</i>	Drug of choice against streptococci, pneumococci, staphylococci, gonorrhea and syphilis (given IV or IM)
<b>Cephalosporins</b> <i>-ce(f)ph</i>	Related to penicillins (1st gen. also have beta-lactam ring) Also inhibit cell wall synthesis, Bactericidal Classified according to “generation” (1 - 4) <b>General Rules</b> 1st generation not effective against bacteria producing beta-lactamase More potent as go up in generation Fewer similarities with penicillins as go up in generation Higher generations reserved for known resistant infections
<i>Cefotaxime (3rd Gen.)</i>	Has broad-spectrum activity against gram-negative organisms; for serious infections of lower respiratory tract, CNS, genitourinary system, bones, blood, and joints

### Antibiotics - Classes of medication (cont)

<b>Tetracyclines</b> <i>doxycycline, minocycline, tetracycline</i> <i>-cycline</i>	Inhibit bacterial protein synthesis, Bacteriostatic Broad-spectrum (both gram-positive and negative) Usually given orally (PO) Should not be given at the same time as iron, calcium, magnesium (ions bind to drug so it can't absorb) – separate by 2h
<i>Tetracycline</i>	Used for Rocky Mountain spotted fever, h.pylori infections, acne vulgaris, chlamydia
<b>Macrolides</b> <i>azithromycin, clarithromycin, erythromycin, fidaxomicin</i> <i>-thromycin</i>	Inhibit bacterial protein synthesis, Some are bactericidal, some bacteriostatic No structural similarities to penicillin – zero chance of cross-reactivity
<i>Erythromycin</i>	Used for upper and lower respiratory tract infections, whooping cough, diphtheria, or for other infections in patients who cannot take penicillins



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Published 13th April, 2021.  
Last updated 13th April, 2021.  
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### Antibiotics - Classes of medication (cont)

**Aminoglycosides** Inhibit bacterial protein synthesis and cause abnormal protein synthesis, *amikacin*, *gentamicin*, *streptomycin*, *tobramycin* Dose-dependent bactericidal Very effective, usually reserved for serious infections (like tuberculosis) or when other antibiotics have failed Require therapeutic drug monitoring – levels must be in specific range to be effective, but not toxic Injection or topical

*Gentamicin* Used for serious (life-threatening) infections or when other antibiotics have failed (also topically as eye drops and creams/ointments – this would not require therapeutic drug monitoring)

### Antibiotics - Classes of medication (cont)

**Fluoroquinolones** Affect bacterial DNA synthesis, Bactericidal Most often used orally (also ear, eye) Absorption is affected by minerals (calcium, iron, magnesium) and need to be separated (~2h) Generally not used in children – affects cartilage development

*Ciprofloxacin* Used commonly for respiratory, urinary, ophthalmic, gastrointestinal, and gynecological infections – high usage in community/out-patient

**Sulfonamides** Suppress bacterial growth by inhibiting essential folic acid needed within the cell, Bacteriostatic Broad spectrum, older class ☑ more resistance seen Orally and topically (acne) “Sulfa” is also a common “allergy”

### Antibiotics - Classes of medication (cont)

**Sulfamethoxazole-Trimethoprim** Both drugs inhibit essential folic acid synthesis; work synergistically (a pharmacodynamic interaction) (*SMZ-TMP*, *Septera*®, *Bactrim*®, *-DS*) Used to treat urinary tract infections

**Carbapenems** Relatively new-ish Contain beta-lactam ring and inhibit cell wall synthesis (like penicillins) The beta-lactam ring is very resistant to destruction by penicillinase Broad spectrum – and very effective; as a newer class, they are being reserved for resistant infections (like MRSA, etc.)

### Miscellaneous VIPs

*Clindamycin* protein synthesis inhibitor; bacteriostatic Used topically (acne), oral or IV for serious systemic infections High risk of superinfection (GI)



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Published 13th April, 2021.  
Last updated 13th April, 2021.  
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### Antibiotics - Classes of medication (cont)

*Nitrofurantoin* inhibits protein, RNA, DNA, and cell wall synthesis; bactericidal  
Excreted unchanged through the kidney (no metabolism), therefore used only for urinary tract infections  
Changes urine to orange colour  
Must take with food

*Metronidazole* destroys bacterial DNA; bactericidal  
For anaerobic bacteria  
NO ALCOHOL USE (even small amounts present in cough syrup or mouthwash)

### Antibiotics - Classes of medication (cont)

*Vancomycin* inhibits cell wall synthesis; bactericidal (through different mechanism than aminoglycosides)  
Reserved for severe infections that are resistant to anything else ☒ usually only used in hospital (methicillin-resistant staph. aureus - MRSA)  
Injection or oral  
If IV given too quickly ☒ Red Man Syndrome (flushing, red face, hypotension) ☒  
slow down infusion  
Therapeutic drug monitoring required (like aminoglycosides)

*Linezolid* inhibits bacterial protein synthesis  
Use to treat vancomycin-resistant enterococcus (VRE), pneumonia or skin infections caused by MRSA i.e. Severe infections resistant to other antibiotics

### Allergies- Classes of Medication

#### Antihistamines

### Allergies- Classes of Medication (cont)

1st-Generation Antihistamines Block H1 receptors  
Shorter acting, cause more drowsiness, and work faster than 2nd Generation  
Used mostly to treat allergic response  
*Diphenhydramine* and *chlorpheniramine* most common  
Have anticholinergic effects  
Significant sedation – some use as a sleep aid

2nd-Generation Antihistamines  
*Cetirizine (Reactine®)*, *loratidine (Claritin®)*, *desloratidine (Aerius®)*, *fexofenadine (Allegra®)*

Intranasal Corticosteroids To reduce inflammation in nasal mucous membranes, and local immunosuppression  
Used daily to prevent symptoms  
Can take up to 2 weeks for full effect  
Local administration prevents systemic side effects



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### Allergies- Classes of Medication (cont)

**Decongestants** Sympathomimetics – stimulants – cause vasoconstriction and reduction of mucous production

*Phenylephrine, pseudoephedrine* For immediate relief of nasal congestion – oral or intranasal

Short term-use only – rebound congestion if longer than 3-5 days (intranasal)

### Drugs for Anaphylaxis

**Epinephrine** Stimulates both  $\alpha$  and  $\beta$  adrenergic receptors

Via  $\alpha$ -receptors: counters the high vascular permeability that occurs during anaphylaxis that leads to loss of intravascular fluid and hypotension

Via  $\beta$ -receptors: causes bronchial smooth muscle relaxation and relieves bronchospasm, dyspnea, and wheezing

Also alleviates pruritus, urticaria, and angioedema

### Anti-fungals - Classes of medication

**Amphotericin B** Binds to fungal cell membranes, making them leaky, Given IV

**Azole Antifungals** Alter fungal cell membranes by depleting ergosterol

*fluconazole, itraconazole, ketoconazole, miconazole, voriconazole*

Used orally, topically, injection; fluconazole available OTC

Safer than amphotericin B

Most often for vaginal candidiasis, athlete's foot, or thrush

metronidazole is NOT an azole antifungal

### Miscellaneous

*Ciclopirox* topical med used for fungal nail or scalp infections (nail polish or shampoo)

*Terbinafine* oral med for fungal nail infections

*Nystatin* cream available without prescription for many topical fungal infections (ringworm, diaper rash)

### Anti-Virals -Classes of medication

**HIV** Because of antiretroviral drugs, HIV patients are able to live symptom-free for much longer with very low counts of the retrovirus

Antiretroviral drugs block the HIV replication cycle

### Anti-Virals -Classes of medication (cont)

**HAART** – Goal is to reduce plasma HIV to its lowest possible level - highly active antiretroviral therapy

HIV still remains in the lymph nodes

Blood and lymph are separate rivers that cross occasionally

Use different classes of antiretrovirals at same time to reduce resistance

Each class 'attacks' different step of replication cycle

### Herpes Infections

HSV1: oral cold sores

HSV2: genital ulcerations

Zoster: shingles (due to previous varicella-zoster infection)

*Acyclovir, famciclovir, valacyclovir*

Mostly controlled by oral therapy of antivirals – taken at first sign of outbreak, continued for short term

These antivirals prevent viral DNA synthesis

Very well tolerated – take with food

### Over the Counter medications for Herpes

*Lipactin®* - can reduce pain, may speed healing

heparin + zinc Mechanism does not match pathophysiology



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### Anti-Virals -Classes of medication (cont)

*Abreva®* - prevents viral entry into cells, stops spread if caught early (can reduce duration of cold sore by ~1 day)

**Influenza** BEST PROTECTION = VACCINATION  
*Amantadine, and neuraminidase inhibitors (oseltamivir and zanamivir)* Antiviral drugs may decrease severity of symptoms of influenza and may shorten symptom time by a couple days IF taken within first 48 hours  
 Generally used only in patients at high risk of complications from influenza

### Immunosuppression - Classes of Medication

**Calcineurin Inhibitors** "Classic" immuno-suppressants used for transplants (or topically for psoriasis)  
*Cyclosporine, tacrolimus, pimecrolimus (topical)* Disrupt T-cell function by binding to calcineurin  
 They are not specific – suppress the ENTIRE immune system ☑ patient is very susceptible to any other infection  
 Extensive monitoring for detailed WBC counts and signs of infection (see slide on monitoring)

### Immunosuppression - Classes of Medication (cont)

**Corticosteroids** Anti-inflammatory and immunosuppressant activity  
 Often used to control exacerbations of condition such as asthma, rheumatoid arthritis, MS, etc.  
 Pulse therapy (very high doses, gradual taper) to minimize side effects  
 Many, many side effects

**Biologics** medications produced using biological processes in living organisms such as yeast and bacteria  
 Have active pharmaceutical ingredients that cannot reasonably be synthesized by chemical means (too complicated)  
 Are complex, large molecules derived from living sources and produced through a number of intricate steps  
 Biologics can be immunosuppressant or immunostimulant (very specifically) or replace a substance that is missing (insulin)

### Immunosuppression - Classes of Medication (cont)

Vaccines, Blood products, Hormones & growth factors, Enzymes Gene therapy, Cancer treatments

### Chemotherapy

*Cytotoxic drugs* traditional; interfere with or damage DNA, causing apoptosis (programmed cell death)

*Hormonal therapy* not cytotoxic; effects mediated through hormonal receptors (deprivation) – for hormone-responsive cancer (breast, prostate, etc.)

*Immuno-therapy* monoclonal antibodies, vaccines; non-specifically boost immune system to help eradicate cancer (interferon alfa)

*Targeted agents* monoclonal antibodies, tyrosine-kinase inhibitors (TKIs); the future of treatment – to target cancer cells only

### Tuberculosis medications

**Rifampin (RMP)** Most potent anti-TB drug available  
 Good bactericidal activity, prevents acquired drug resistance and is very important in preventing relapse  
 Current doses are based on studies performed in the 1960s, when the lowest effective dose was used because of the high cost of the drug; concerns now that dose is too low -> current trials -> dosing recommendations may change



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