Fever - classes of medication

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

Adverse effects

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

Adverse effects (cont)

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

Adverse effects (cont)

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

By **kjaniskevich**

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Published 13th April, 2021.
Last updated 13th April, 2021.

Adverse effects (cont)	
Fluoroquinolones *Ciprofloxacin*	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 *Sulfamethoxazole-Trimethoprim (SMZ-TMP, Septra®, Bactrim®, -DS)*	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 *ertapenem, imipenem, meropenem*	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 *fluconazole, itraconazole, ketoconazole, miconazole, voriconazole*	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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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, Hypertrichosis (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-inflammatories ***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

Antibiotics - Classes of medication

Penicillins *-cillin*	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-l-actam ring in its structure necessary for activity Many bacteria produce beta-l-actamase (penicillinase) that is a natural defense to penicillin – it breaks the beta-lactam ring, leaving it ineffective therefore penicillin resistance
Amoxicillin + Clavulanic Acid (Amoxiclav)	Clavulanic acid inhibits β–lactamases (penicillinases) of some microorganisms to allow amoxicillin to be active against it Synergistic relationship

Antibiotics - Classes of medication (cont)

Penicillin G Potassium (Pen G)	Drug of choice against streptococci, pneumococci, staphylococci, gonorrhea and syphilis (given IV or IM)
Cephalosporins *-ce(f)ph*	Related to penicillins (1st gen. also have beta-lactam ring) Also inhibit cell wall synthesis, Bactericidal Classified according to "generation" (1 - 4) **General Rules** 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
Cefotaxime (3rd Gen.)	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)

Tetracyclines *doxycycline, minocycline, tetracycline -cycline*	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
Tetracycline	Used for Rocky Mountain spotted fever, h.pylori infections, acne vulgaris, chlamydia
Macrolides *azithromycin, clarithromycin, erythromycin, fidaxomicin -thromycin*	Inhibit bacterial protein synthesis, Some are bactericidal, some bacteriostatic No structural similarities to penicillin – zero chance of cross-reactivity
Erythromycin	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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Antibiotics - Classes of medication (cont)

Aminoglycosides *amikacin, gentimicin, streptomycin, tobramycin -mycin OR -micin*	Inhibit bacterial protein synthesis and cause abnormal protein synthesis, 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 *besifloxacin, ciprofloxacin, gatifloxocin, levofloxacin, moxifloxacin, norfloxacin, ofloxacin -floxacin*	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 *sulfacetamide, sulfamethoxazole, sulfapyridine Sulfa-*	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 (SMZ-TMP, Septra®, Bactrim®, -DS)	Both drugs inhibit essential folic acid synthesis; work synergistically (a pharmacodynamic interaction) Used to treat urinary tract infections
Carbapenems *ertapenem, imipenem, meropenem -penem*	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.

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®)*	*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

Allergies- Classes of Medication (cont)

Decongestants *Phenylephrine, pseudoephedrine*	Sympathomimetics – stimulants – cause vasoconstriction and reduction of mucous production 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 α and β adrenergic receptors {{nl} Via α–receptors: counters the high vascular permeability that occurs during anaphylaxis that leads to loss of intravascular fluid and hypotension Via β–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 *fluconazole, itraconazole, ketoconazole, miconazole, voriconazole*	Alter fungal cell membranes by depleting ergosterol 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 – highly active antiretroviral therapy	Goal is to reduce plasma HIV to its lowest possible level - 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® - heparin + zinc	can reduce pain, may speed healing Mechanism does not match pathophysiology

Anti-Virals -Classes of medication (cont)

Abreva® - docosanol	prevents viral entry into cells, stops spread if caught early (can reduce duration of cold sore by ~1 day)
Influenza *Amantadine, and neuraminidase inhibitors (oseltamivir and zanamivir)*	BEST PROTECTION = VACCINATION 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 *Cyclosporine, tacrolimus, pimecrolimus (topical)*	"Classic" immuno-suppressants used for transplants (or topically for psoriasis) 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.)
Immunotherapy	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