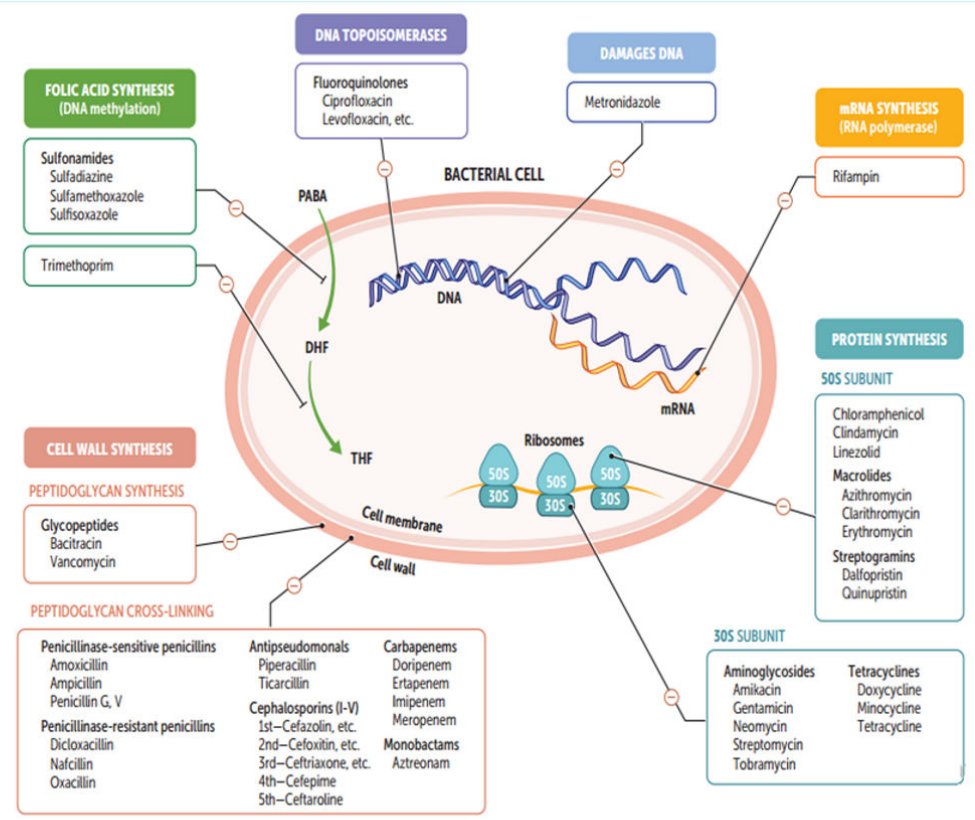
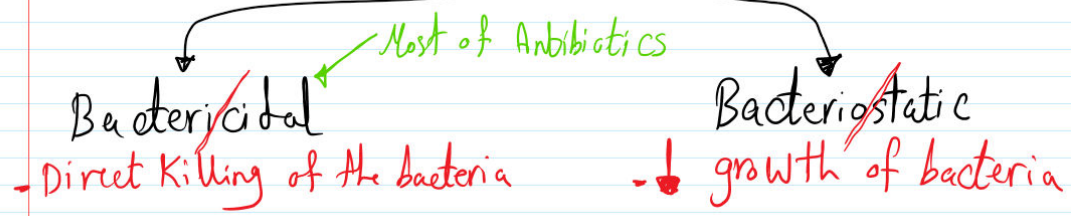


Antibiotics



Beta lactam Antibiotics



Cell wall Inhibitors

⊗ If you use for resistant organism when the organism is really sensitive, There is a much higher treatment failure Rate.

penicillins: structural Analog to D-Ala D-Ala.
 * Binds PBP (Transpeptidase) ^{Irreversible binding} → No peptidoglycan synth.

[ALways Narrow your spectrum]

* Anti Microbial Activity:

very Narrow spectrum

- Ex: Methicillin, Nafcillin, oxacillin
Cloxacillin, Dicloxacillin
- Beta-lactamase **Resistant**
(Bulky R group)
- spectrum: S. Aureus.
- Exception: MRSA
(Altered PBP)
- Methicillin → Interstitial Nephritis
- Not used Anymore
- MSSA → MRSA

Narrow spectrum

- Ex: penicillin G (IV, IM), penicillin V (PO)
- Beta lactamase **sensitive**
- spectrum:
Mostly Gram +
 - S. Pyogenes
 - Actinomyces
- some Gram -ve
 - N. Meningitis
 - T. Pallidum
- (SNAP)
 - sulfa
 - penicillin

Broad spectrum

- Ex: Aminopenicillin
 - Ampicillin
 - Amoxicillin
- Beta Lactamase **sensitive**
- combination with Beta lactamase Inhibitors **CAST**
 - clavulanic Acid
 - sulbactam
 - tazobactam
- spectrum:
Gram + Cocci (not staph)
E. coli, H. Influenza
L. Monocytes (Ampicillin)
B. Borgeferi (Amoxicillin)
H. pylori (Amoxicillin)

Extended spectrum

- Ex: piperacillin & Ticarcillin
- Antipseudomonal drugs
- Beta lactamase **sensitive**
- ↑ Activity Against Gram -ve Rods
- Including **P. Aeruginosa**

* S.E: Hypersensitivity 5-7%

- Common** skin Rash
- use cephalosporins

- Anaphylactic Reaction
- No Beta lactam XX

Cross Allergenicity between penicillin & cephalosporins 1-5%

XX Methicillin → Interstitial Nephritis

Jarish-Herxheimer Reaction 24hrs after TIT of syphilis or Lyme disease.
[spirochetes]

2 cephalosporins:

penicillin Allergy

Gram +ve
Macrolides
[Erythromycin]

Gram -ve
Aminoglycosides
[Azetronam]

Cephalosporins:

- Work AS penicillin in cell wall inhibition.
- Anti Microbial Activity:

↑ Gram -ve Coverage

1st Generation

- Ex: Cephazolin, cephalexin

- spectrum:

- Gram +ve Cocci (Not MRSA)

PECK

proteus E. coli Klebsilla

None Enter CNS

2nd Generation

- Ex: cefuroxime, cefotetan, cefoxitin, cefaclor

- spectrum:

- Gram +ve Cocci

HEN PECK

H. Influenza Enterobacter

Nisseria

None enter CNS

Except cefuroxime

& cefoxitin

• cefotetan has fair Activity

Against Anaerobs, but less

Effective than Metronidazole

3rd Generation

- Ex: ceftriaxone, cefotaxime, ceftazidime, cefixime

- spectrum:

- Gram +ve
- Gram -ve Cocci

Serious Gram -ve

Infections Resistant

to other β -lactams.

ceftriaxone

Meningitis Gonorrhea Lyme Dx

• ceftazidime: pseudomonas

- Not reliable in their staph coverage

• Most Enter CNS

4th Generation

Ex: Cefepime

- spectrum:

- Gram -ve with

Antipseudomonal Activity

• Gram +ve Bacteria

- Resistant to most

β -lactamases

(cover staph)

• Enter CNS

5th Generation

Ex: ceftriaxone

- spectrum:

- Broad Gram + & -ve Coverage

• MRSA ceftriaxone + vancomycin

• No Antipseudomonal Activity

0% Cross Allergenicity

* organisms Not covered by cephalosporins are

LAME

Listeria (Ampicillin)

Atypicals (Macrolides or Tetracyclins)

MRSA (vancomycin)

Enterococci (Ampicillin + Gentamycins)

* penicillins & cephalosporins

Renally Excreted

(Adjust the Dose in Renal Impairment)

Exception ceftriaxone (Eliminated by liver)

★ Avoid ceftriaxone in Neonates

Disp
↓

spontaneous bacterial peritonitis

We give cefotaxime Instead.

★ S.E: Hypersensitivity 2%.

3 penemes
→ IM Penemes
→ Mero penemes
Entapenem ~~XX~~ pseudomonas

★ Works as penicillins & cephalosporins

★ spectrum: Broad (poly Microbial Infection)

- Gram +ve Cocci (S. Aureus)
- Gram -ve Rods
- Anaerobes
Enterobacteriaceae
pseudomonas
* spectrum Against Gram -ve Bacteria
similar to Aminoglycoside & ceftriaxone

★ Empiric use in life-threatening infections in hospitals.

★ Imipenim ^{Dehydropeptidase} _{Enzyme in the kidney} → Nephrotoxic Metabolite.

So, we give Imipenim + Cilastatin (Dehydropeptidase Inhibitor)

Meropenem without cilastatin

★ S.E: Imipenem CNS S.E (seizure) in overdose or Renal Impairment. ↓ clearance.

4) Azetronam:

★ Work as penicillin & Cephalosporin.

★ spectrum:

Gram Negative only

No Activity Against Gram +ve or Anaerobes.

Resistant to beta-lactamases.

★ Used for penicillin Allergic pts & Those with Renal Impairment [can't tolerate Aminoglycosides].
[No cross-Allergenicity with penicillin or cephalosporins]

★ S.E: usually Non-toxic [GIT upset].

5) vancomycin:

★ Binds to D-Ala D-Ala

★ spectrum:

- Gram +ve only.

- Multidrug Resistance:

• MRSA → VRSA

• Enterococci → VRE

- C. Difficile (Drug of choice Metronidazole)

- No CNS Entry.

★ S.E: Well tolerated in general, but NOT trouble free.

nephrotoxicity

ototoxicity

Thrombophlebitis

Red Man syndrome

Rapid Iv Injection → histamin Release → Diffuse flushing

-preventable

5) vancomycin:

★ Binds to D-Ala D-Ala

★ spectrum:

- Gram +ve only.

- Multidrug Resistance:

• MRSA → VRSA

• Enterococci → VRE

- C. Difficile (Drug of choice Metronidazole)

- No CNS Entry.

★ S.E: Well tolerated in general, but **NOT** trouble free.

nephrotoxicity

ototoxicity

Thrombophlebitis

Red Man syndrome

Rapid Iv Injection → histamin Release → Diffuse flushing

- preventable

slow Iv Infusion
pretreatment with Anti-histamine

★ Dapto Mycin: Transmembrane channels XX

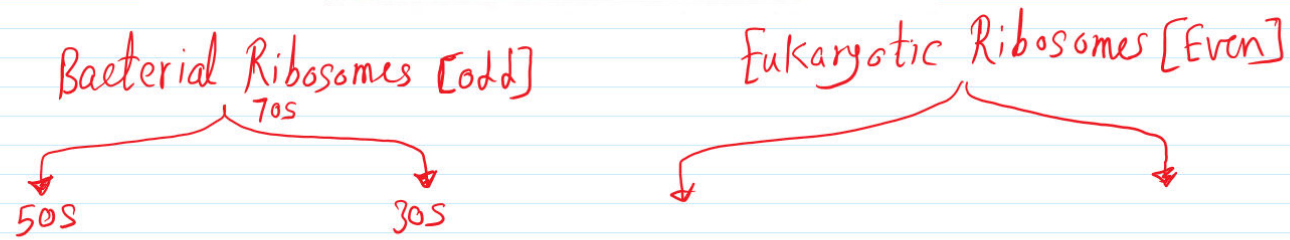
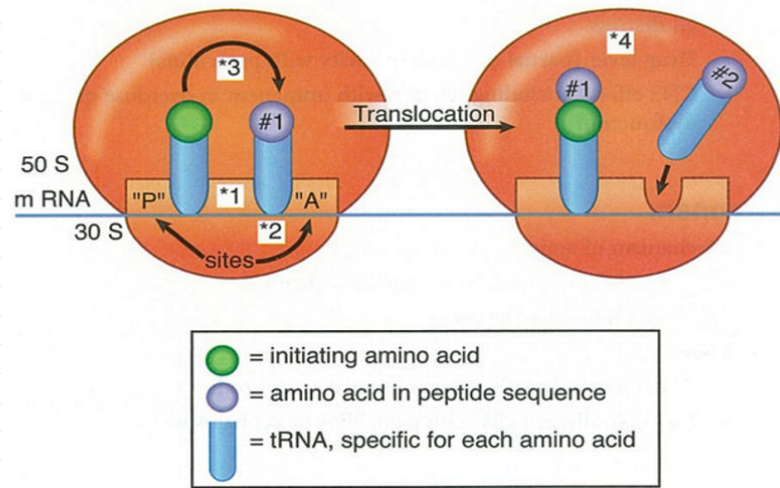
can't Do that
to Gram -ve

- Gram +ve including MRSA

- pulmonary surfactant bind it → Inactivation

Not effective in
treating pneumonia

- S.E: Myopathy ↑ CPK XX Antilipids (statins)



* Buy AT 30, CELL at 50

30S Inhibitors { Aminoglycosides
Tetracycline

50S Inhibitors { Chloramphenicol, Clindamycin
Erythromycin [Macrolides]
Linezolid

Dalbapristin/Quinipristin

Aminoglycosides;

- Ex: Gentamycin, Neomycin, Amikacin, Tobramycin, Streptomycin.

★ Accumulate intracellularly via O_2 Dependent Mechanism.

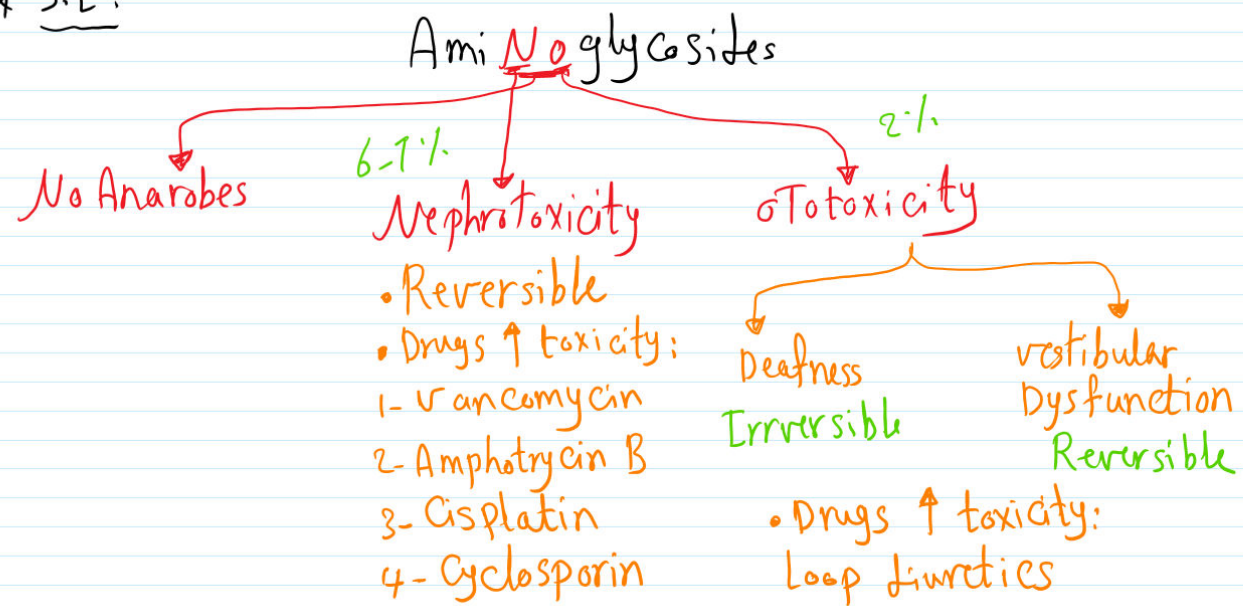
XX Anaerobes

★ Good spectrum Against Gram negative Rods. They are considered Exclusively Gram -ve Agent.

★ often used in combination → synergy.

- If you Want to cover Gram +ve & Gram -ve with Amino → synergy

★ S.E:



★ Teratogenic pregnancy XX

2) Tetracyclines:

- Ex: Tetracyclin, Doxycyclin, Mino cyclin, Demeclocyclin.

★ Broad spectrum Antibiotics

★ Tetracyclin

- Milk (Ca) XX
- Antacid (Ca, Mg) XX
- Iron chelating Agents XX

Divalent cations → ↓ Absorption

Block ADH Receptors
↓
SIADH

★ S.E:

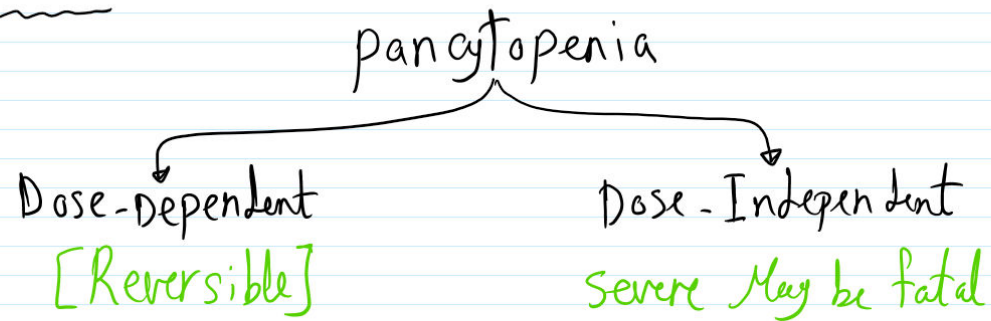
- Doxycyclin
↓
phototoxicity
- Tetracyclin
↓
Teratogenic
 - Bone growth Retardation
 - Discoloration of Deciduous teeth

3) chloramphenicol:

★ limited use High toxicity

★ Cyt P₄₅₀ Inhibitors ↑ theophylline, warfarin

★ S.E:



Gray baby syndrome Metabolism in liver
premature Infant [hepatic glucuronidation]

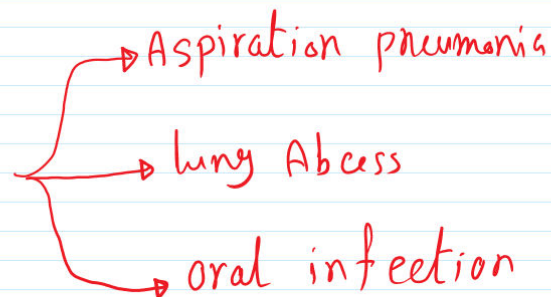
XX

[Liver UDP glucouronyl transferase]

4) clindamycin:

★ spectrum:

Narrow
Anaerobic Inf.



clindamycin

Diaphragm

Metronidazole

★ S.E: pseudomembranous colitis

5) Macrolides:

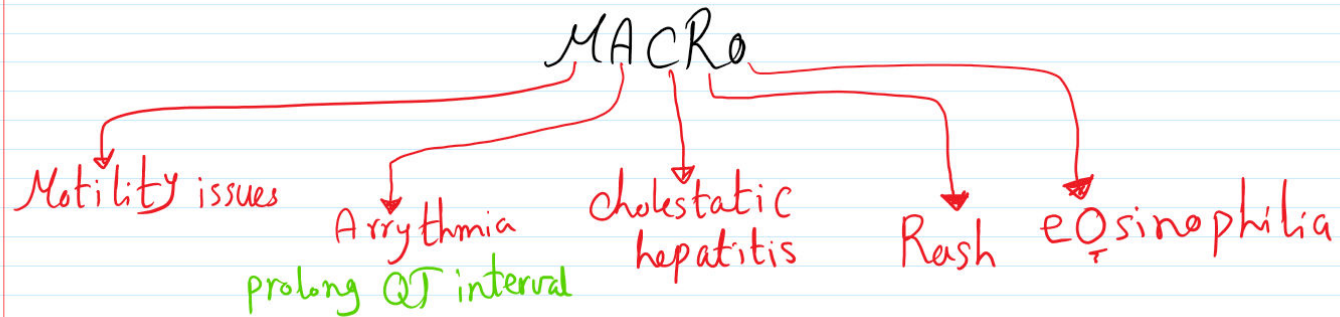
- Ex: Erythromycin, Azithromycin, clarithromycin

★ Erythro, clarithromycin cytochrome P₄₅₀ Inhibitors
↑ theophylline, warfarin

★ S.E:

stimulate Motilin receptors → GIT distress

III of Diabetic Gastroparesis



6) linezolid:

★ spectrum:

→ VRSA
→ VRE

Quinupristin & Dalbapristin
[streptogramin]

→ Drug-Resistant pneumococci

★ S.E.:

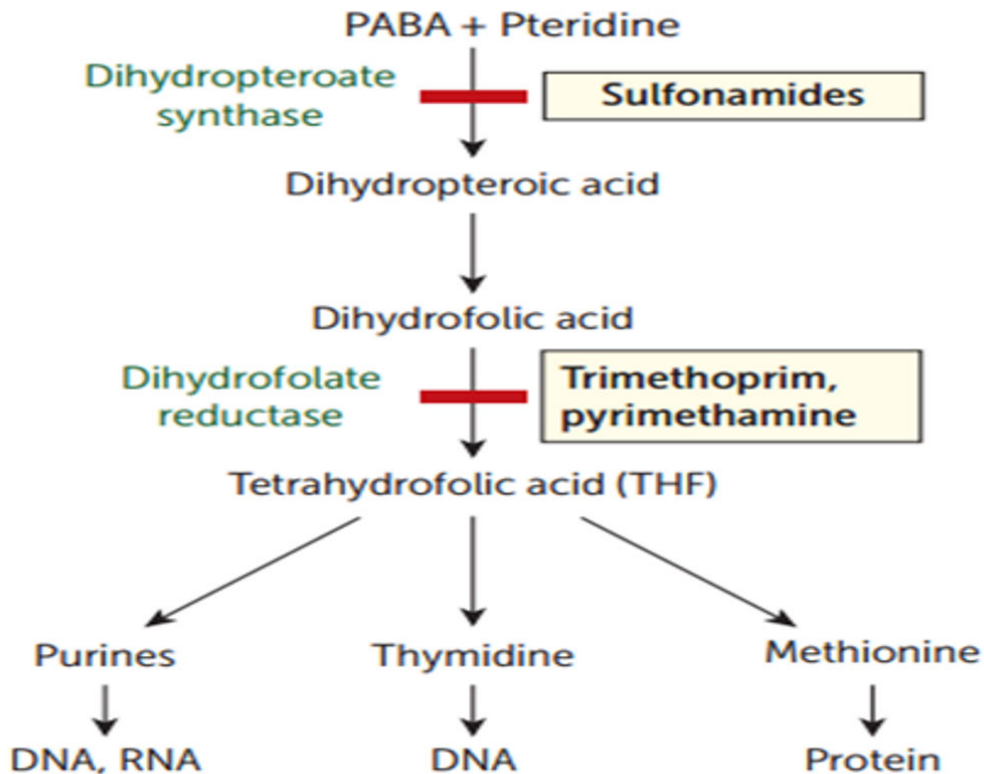
→ Bone Marrow suppression (Thrombocytopenia)

→ peripheral Neuropathy

→ serotonin syndrome Interaction with MAOI

MRSA: vancomycin, linezolid, ^{XX pneumonia} Daptomycin, tigecycline, ceftaroline.

VRE: Linezolid, streptogramin → Quinupristin
→ Dalbapristin



Folic Acid synthesis Inhibitors:



A) sulfonamides:

★ PABA $\xrightarrow[\text{synthase}]{\text{Dihydropterate XX}}$ folic Acid synth.

★ spectrum:

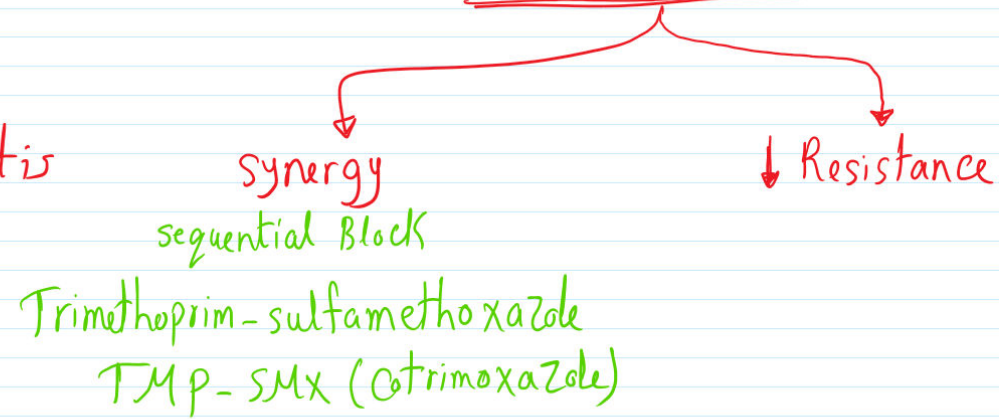
- Alone Multiple Resistance, we prefer combination with DHF reductase Inhibitors

- DOC in Nocardia

- sulfasalazine [prodrug] \rightarrow ulcerative colitis

\rightarrow Rheumatoid Arthritis

- sulfadiazine Burns



★ S.E:

- Hypersensitivity (Stevens-Johnson syndrome) - photosensitivity.

- Avoid in G6PD def \rightarrow Hemolysis

- Nephrotoxic Tubulointerstitial Nephritis

- Kernicterus in Neonates Avoid in pregnancy ★ We Give Nitrofurantoin

4) Ethambutol:

★ S.E: optic Neuritis [Red-Green color blindness]

↓ visual Acuity

Eyethambutol

★ Most of Antimycobacterial Agents can cause hepatotoxicity

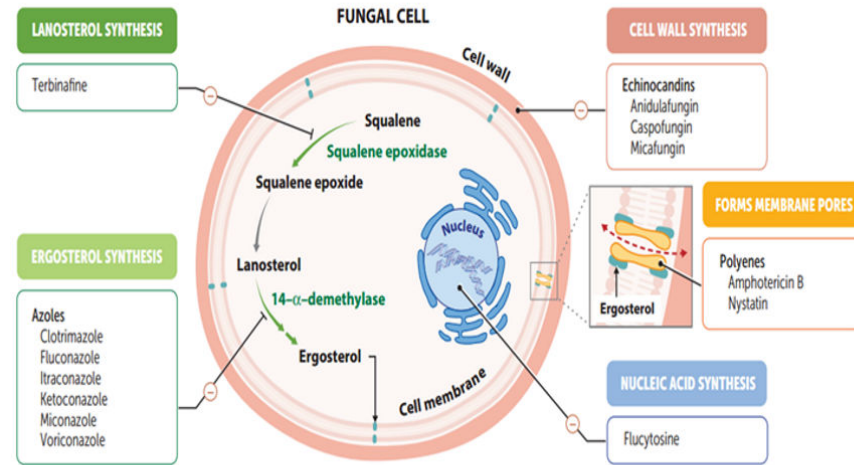
⊗ Mycobacterium Avium Intracellular (MAC):

$CD_4 < 50$ start prophylactic Azithromycin

+ Antiretroviral Therapy $\uparrow CD_4 > 200$

Resistant to many of Antitubercular drugs

Antifungal therapy



1) polyenes:

- Ex: Amphotericin B, Nystatin.

* C.U: serious systemic Mycoses

* poor penetration to CNS Intrathecal

* S.E: \uparrow BUN \uparrow creat.

- Dose Dependent Nephrotoxicity \downarrow GFR
Monitor Renal function
~~XX~~ other Nephrotoxic drugs

- hypo Kalemia & hypomagnesemia

Monitor Electrolytes
Replace if needed

* Nystatin: Too toxic for systemic use

Local \leftarrow \rightarrow Candida Thrush
 \rightarrow Diaper Rash

- hypokalemia & hypomagnesemia

Monitor Electrolytes
Replace if needed

★ Nystatin: Too toxic for systemic use

Local

- Candida Thrush
- Diaper Rash
- vaginal candidiasis

2) Azoles:

- Ex: fluconazole, clotrimazole, ketoconazole, itraconazole, Miconazole, voriconazole.

★ C.U: Local & less serious systemic mycoses

★ only fluconazole penetrates into the CSF

↓
cryptococcal Meningitis in
HIV pts

★ Azoles are cytochrome P450 Inhibitors.

★ S.E: ↓ synthesis of steroid

Especially
Ketoconazole

↓
↓ Testosterone

↓
↓ Lipids, Gynecomastia ♂
Menstrual Irregularities ♀

★ liver dysfunction.

③ pyrimidines (flucytosine):

★ systemic fungal Inf. in combination with Amphotericin B.

★ penetrates CNS *Cryptococcal Meningitis*

★ S.E: Bone Marrow suppression.

④ Terbinafine:

★ C.U:

Dermatophytosis *Especially onychomycosis*
sup. to griseofulvin

⑤ Echinocandin:
 → Caspofungin
 → Micafungin

★ C.U: Invasive Aspergillosis & candida.

⑥ Griseofulvin:

★ Deposition in Keratin containing tissue **Ex: Nails.**

★ C.U: Superficial Infections **oral Not topical**
Active only Against Dermatophytes

★ S.B:

Work through Microtubules

XX
Disruption of Mitosis

Teratogenic, carcinogenic
cyt P450 Inducer

⑦ Anti-Malarial Drugs:

Chloroquine sensitive Malaria

P. falciparum & *P. Malarie*

Chloroquine

P. vivax & *ovale* → Chloroquine
+ primaquine

Chloroquine Resistant Malaria

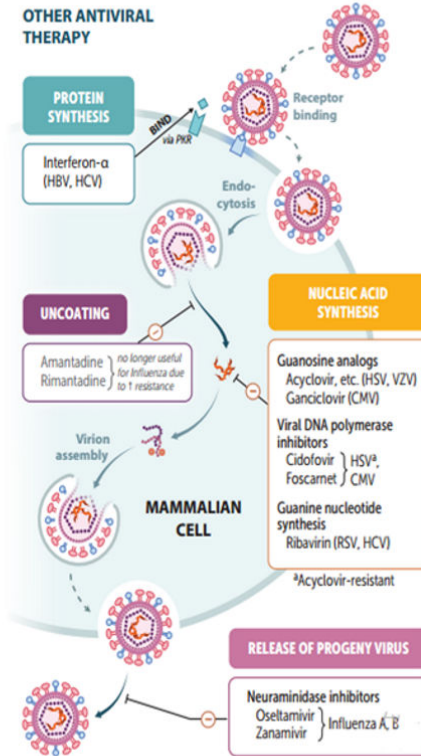
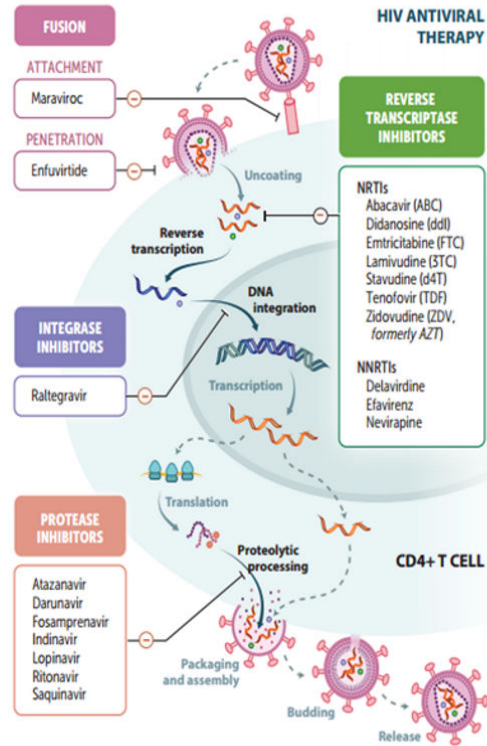
prophylaxis

Mefloquine

quinine

* S.E: XX
 G6PD def → Hemolysis
 Quinine cinchonism

sulfa
 Dapsone
 Anti-Malarial drugs



① Acydovir, fam cydovir, vala cydovir

★ C.U:

- HSV & VZV

- EBV weak

- CMV XX

Advice pt to hydrate

★ S.E: OBstructive crystalline Nephropathy

& Acute Renal failure

↑ conc
↓ solubility
↓
crystaluria
Renal tubular
damage

② Ganciclovir:

2) Gancyclovir:

★ Work as Acyclovir.

★ C.U:

- HSV & VZV

CMV prophylaxis & TTT

★ S.E:

Crystalluria

Hematoxicity

Leukopenia

Thrombocytopenia

3) Foscarnet:

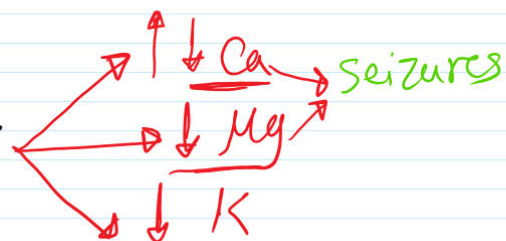
★ CMV Retinitis When Gancyclovir fails.

★ Acyclovir Resistant HSV.

★ S.E:

- Nephrotoxicity

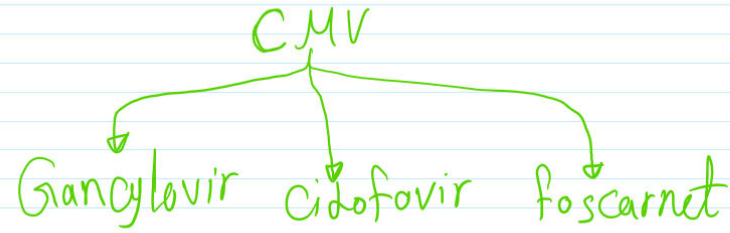
- Electrolyte Abnormalities



4) Cidofovir:

★ C.U: same as foscarnet.

★ S.E: Nephrotoxic



5) Amantadine:

★ Mainly prophylactic to Influenza.

May ↓ duration of flu symptoms 1-2 days.

6) zanamivir & oseltamivir:

★ Neuraminidase Inhibitors

★ TTT & prevention.

HIV Therapy

1) NRTIs:

- Ex: Zidovudine, Lamivudine, Tenofovir, Didanosine.

★ Zidovudine

- General prophylaxis
- pregnancy ↓ Risk of fetal transmission

★ S.E:

- Bone Marrow suppression

Reversible with [G-CSF] & Erythropoietin

- peripheral Neuropathy

- lactic Acidosis

- pancreatitis (Didanoside)

2) NNRTIs:

- Ex: Nevirapine, Efavirenz

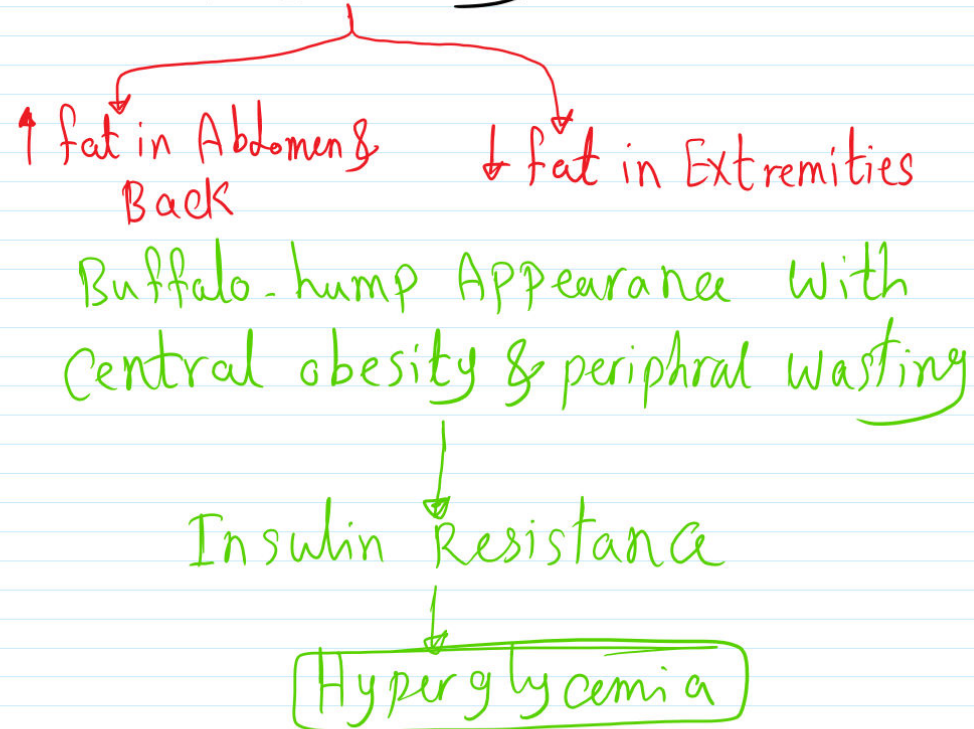
★ S.E: Rash & Hepatotoxicity

- vivid Dreams & CNS symptoms (Efavirenz)

③ protease Inhibitors: **navir**

-Ex: **Indinavir**, **Ritonavir**, other **navirs**

★ S.E: **Lipodystrophy**



★ P450 Inhibitor → **Rifabutin**

★ **Indinavir** **Nephrotoxic**

4) Integrase Inhibitor:

-Ex: Raltegravir

★ ↑CK

5) Fusion Inhibitor:

-Ex: Enfuvirtide

★ Skin Reaction at Injection site.

⊗ prophylaxis in HIV pts:

Cell count	Prophylaxis	Infection
CD4 < 200 cells/mm ³	TMP-SMX	Pneumocystis pneumonia
CD4 < 100 cells/mm ³	TMP-SMX	Pneumocystis pneumonia and toxoplasmosis
CD4 < 50 cells/mm ³	Azithromycin or clarithromycin	Mycobacterium avium complex

⊗ Hepatitis C Therapy:

1) Ribavirin:

★ C.u: Chronic HCV

★ S.E:

- Hemolytic Anemia
- severe teratogen

2) simeprevir:

★ C.u:

Chronic HCV

In combination with

Ribavirin

peginterferon α

+ Ribavirin \mp peginterferon α

3) sofosbuvir:

★ C.u: chronic HCV

★ S.E: Headache, fatigue.

2) simeprevir:

★ C.U:

chronic HCV

In combination with

Ribavirin

peginterferon α

+ Ribavirin \mp peginterferon α

3) sofosbuvir:

★ C.U: chronic HCV

★ S.E: Headache, fatigue.

4) Interferons:

★ S.E: Neutropenia & Myopathy *flu like symptoms.*

Antibiotics to avoid in Pregnancy

Antibiotic	Adverse effect
Sulfonamides	Kernicterus
Aminoglycosides	Ototoxicity
Fluoroquinolones	Cartilage damage
Clarithromycin	Embryotoxic
Tetracyclines	Discolored teeth, inhibition of bone growth
Ribavirin (antiviral)	Teratogenic
Griseofulvin (antifungal)	Teratogenic
Chloramphenicol	Gray baby syndrome

❖ Mnemonic:

- **SA**Fe **C**hildren **T**ake **R**eally **G**ood **C**are.

★ S.E:

- Hypersensitivity (Stevens-Johnson syndrome) - photosensitivity.

- Avoid in G6PD def → Hemolysis

- Nephrotoxic Tubulointerstitial Nephritis

- Kernicterus in Neonates Avoid in pregnancy ★ We Give Nitrofurantoin

B) Trimethoprim:

★ DHF Reductase XX

★ Combination With sulfa sequential block

★ S.E: → Megaloblastic Anemia folic Acid def.

→ Leukopenia

→ Granulocytopenia

Give folic Acid supplement

2) Direct Inhibitors of Nucleic Acid synthesis

Quinolones Floxacin

old (cipro)

- Doesn't cover *S. pneumoniae*.

★ S.E:

Contraindicated

children

- Inhibition of chondrogenesis
- Tendonitis, Tendon Rupture

New (Levofloxacin, Gemifloxacin, Moxifloxacin)

- very Good coverage for streptococcal Infection especially *S. pneumoniae*

old Age
CNS Effect

Insomnia

seizure

Dizziness

pneumonia (Levo)

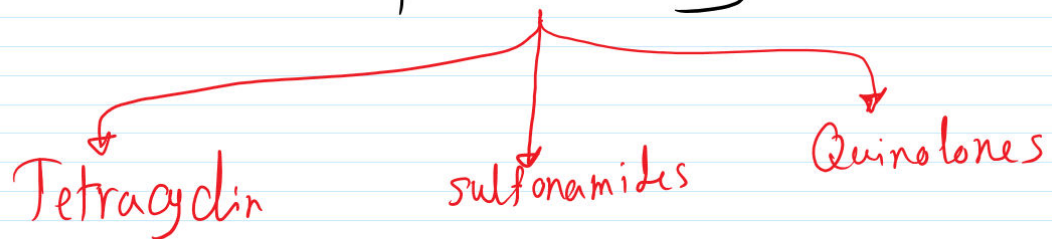
Even penicillin Resistant
S. pneumoniae (Except cipro)

Atypicals

⊗ Best therapy for community-acquired pneumonia.

→ Anaerobes

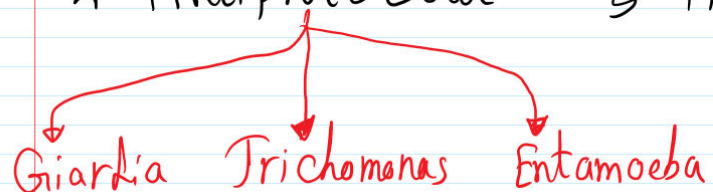
★ Antibiotics that cause photosensitivity



⊗ unclassified Antibiotics [Metronidazole]:

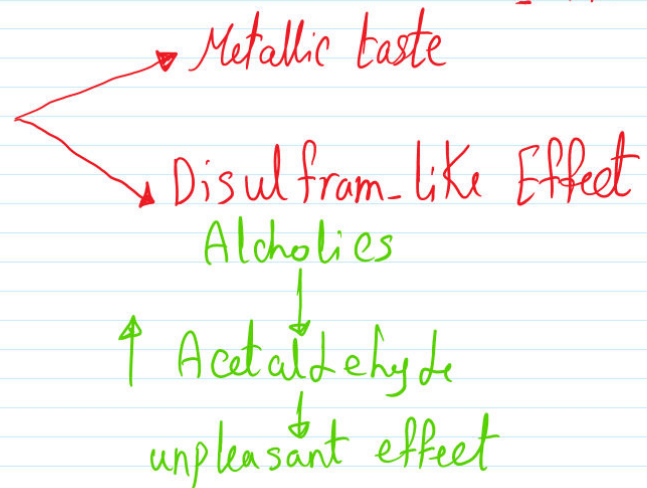
★ form free Radicals → Damage DNA

★ Antiprotozoal & Antibacterial



- Anaerobs below the Diaphragm
- Doc in pseudomembranous colitis
- Gardnerella vaginalis
- H. pylori

★ S.E:



⊗ other Antibiotics with good Coverage

Against Anaerobs:

- Carbapenems.
- Beta Lactam / Beta lactamase combination
- 2nd Generation cephalosporin (cefotaxime) → less effective
- Moxifloxacin

} Good as Metronidazole

Distinguishing characteristics of *Pseudomonas aeruginosa* infections

Types of infections

- Pneumonia (especially in cystic fibrosis and ventilated patients)
- Life-threatening infections in neutropenic and burn patients
- Otitis externa (particularly malignant)
- Hot tub folliculitis
- Ecthyma gangrenosum

Microbiology

- Motile aerobic Gram-negative rod
- Nonlactose-fermenting, oxidase-positive
- Produces pyocyanin (blue-green) pigment
- Emits a grapelike, fruity odor
- Produces endotoxin (fever, shock) and exotoxin A (inactivates EF-2)

Effective antibiotics

- Aminoglycosides (gentamicin, tobramycin, amikacin)
- Antipseudomonal penicillins (ticarcillin, piperacillin)
- 3rd and 4th generation cephalosporins (ceftazidime, cefepime)
- Quinolones (ciprofloxacin)
- Monobactams (aztreonam)
- Carbapenems (imipenem, meropenem)

STDs

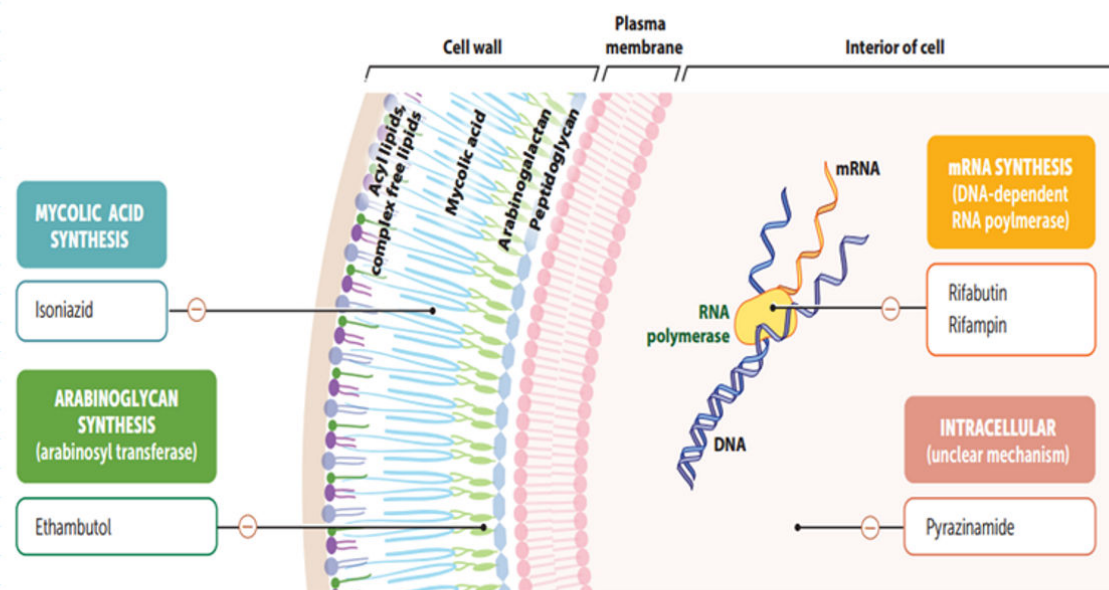
sypilis
Benzathine
penicillin

Gonorrhea
ceftriaxone

chlamydia
Azithromycin
OR
Doxycycline

Trichomonas
Metronidazole

Gardnerella
Metronidazole



* In U.S: ↑ HIV → ↑ M. tuberculosis

* Combination drug therapy { synergy
↓ Resistance

R I P E → Ethambutol
↓
Rifampin Isoniazid pyrazinamide

Rifamycins:

- Ex: Rifampin, Rifabutin.

* C.U:

- Multidrug Therapy (T.B)

- Delay Resistance to Dapsone when used for leprosy.

- prophylactic N. Meningitides
prophylaxis if you are
a close contact to

* Cyt P₄₅₀ Inducer

favoured over Rifampin in HIV pts

rifAMPin Amplifies Cyt P₄₅₀, but Rifabutin Doesn't

* Toxicity:

o Range Discoloration of secretions

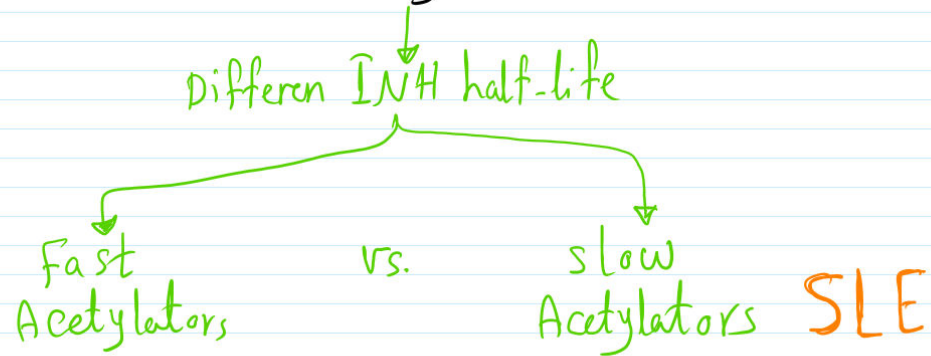
- urine
- Breast Milk
- Tears
- contact lens

* Rapid Resistance if used alone.

2) Isoniazid:

★ The only Agent used as solo prophylaxis against TB.

★ Metabolism in liver via Acetylation



★ S.E.:

- Neurotoxicity (periphral Neuritis) Give pyridoxin (vitamin B₆)
- hepatotoxicity

-sideroblastic Anemia pyridoxine def
↓
Insufficient heme formation

3) pyrazinamide:

prodrug → pyrazinoic Acid

★ The best for M. Tuberculosis engulfed by Macrophages.

Require Acidic Environment