Drugs Used To Treat Infection:
Antimicrobials

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What’s the plan?
- Antiinfectives
  - Action/Indication
  - Administration
  - Safety: Labs
  - Side Effects
  - Adverse Effects
  - Patient Teaching
- Drug Monitoring
- Food Considerations
- Nursing Process
- Drug Reactions
- Documentation
- Teaching
- Alternative Medicine
- Cultural Considerations
- NCLEX review game

Penicillins (PCN)
1. Pencillins
2. Broad-spectrum
3. Penicillinase-resistant
4. Extended-spectrum
5. Beta-lactamase Inhibitors
1. Combination abx
Table 29-3
Basic Penicillins

- “Beta-lactam antibiotics”
- Interferes with & inhibits bacterial cell wall synthesis
- Narrow-spectrum
- Bacteriostatic & bactericidal
  - Dose dependent

Basic Penicillins

- Indications of use
  - Staphlococcal infections
  - Severe wound & respiratory infections
- Examples
  - Penicillin G procaine
  - Bicillin
Broad-spectrum PCNs

- “Aminopenicillins”
- Bactericidal
- Against gram + & gram –

- Indications of use: LRI, otitis media, sinusitis & UTI

- Examples: Amoxicillin & Ampicillin

Amoxicillin

- Most prescribed PCN derivative
- Effect of Amoxicillin when taken with Aspirin & Probenecid
- Effect of Amoxicillin when taken with Tetracycline & Erythromycin

Labs
- Increased serum AST, ALT & BUN/Cr

Food
- Decreased effect with acidic fruits & juices

Side effects
- N/V/D, rash, edema

Adverse reactions
- Blood dyscrasias, hemolytic anemia, bone marrow depression, respiratory distress
**Penicillinase-resistant PCNs**

- Effective against penicillinase-producing Staphylococcus aureus
- Against most gram +
  - *Less effective than PCN G*
- Examples
  - Diloxacinil (PO) & Oxacillin (IM/IV)

**Extended Spectrum Penicillins**

- Effective against Pseudomonas aeruginosa
- Proteus spp., Serratia spp., Klebsiella pneumoniae
- Broad Spectrum

- Indications of use
  - Treats bone, skin, respiratory tract infections & UTI
- Examples: Piperacillin & Ticarcillin

**Beta-lactamase Inhibitors**

**Clavulanic acid, Sulbactam, & Tazobactam**

- Indications for use
  - Penicillinase-producing Staph. aureus
- Combined with broad-spectrum abx
  - Extending the antimicrobial effect
- Adding Clavulanic Acid intensifies the effect of Amoxicillin (Augmentin)
**Beta-lactamase Inhibitors**

- **PO:** amoxicillin-clavulanic acid (Augmentin)
  - Sinusitis, pneumonia & bronchitis

- **IM/IV:** Piperacillin-tazobactam (Zosyn)
  - UTI, bone & joint infections, stomach infections, skin infections & pneumonia
  - Reduce dose in renal insufficiency

**Drug Interactions**

- Amoxicillin & ampicillin → the effectiveness of oral contraceptives
- K+ supplements → serum K+ levels when taken with Potassium PCN G or V
- PCN & Aminoglycosides mix in IVF → the actions of both are inactivated

**Safety: PCN**

- 10% allergy rate: Monitor closely!
- Serum BUN/Cr, LFTs & Urine output
  - Decrease dose with renal dysfunction
- **Side Effects**
  - Rash, itching, fever, chills, N/V/D
- **Adverse Reactions**
  - Hypersensitivity, superinfection, laryngeal edema, wheezing, hypotension
Penicillins: Nursing Interventions

- C&S before med administration
- Monitor for bleeding
- Observe closely for allergic reaction
  - 1st and 2nd dose (epinephrine)
  - Medical Alert bracelet
- Increase fluid intake
- Assess for superinfection
  - Stomatits & vaginitis

Cephalosporins

- Four generations
- Beta-lactam structure
  - Semi-synthetic
- Inhibits bacterial cell-wall synthesis
  - Bactericidal
  - Cross-resistance with PCN
- Indications of use
  - Respiratory, urinary, skin, bone, joint & genital infections

Cephalosporin Generations

First-generation
- Gram + bacteria: E. coli, Klebsiella
- Cephalexin & cefazolin

Second-generation
- Gram + & gram –: Neisseria gonorrhoeae, Haemophilus influenzae, Neisseria meningitidis
- Cefaclor & cefoxitin
Cephalosporins

Third-generation
- Gram + & gram –: Psuedomonas aeruginosa
- Cefoperazone & ceftriaxone

Fourth-generation
- Gram + & gram –: Streptococci, staphylococci
- Cefepime
- 3 checks! Similar names.

Cephalosporins

Pharmacokinetics
- Few PO; most IM, IV

Side effects
- N/V/D, GI distress & HA

Adverse reactions
- With high doses: Increased bleeding
- Nephrotoxicity (in CRF/ARF)

Cephalosporins

Drug Interactions
- Alcohol: may cause flushing, dizziness, HA, N/V & muscular cramps
- Oral Contraceptives: decreases effect
- Uricosurics: decrease Cephalosporin excretion (i.e. Probenecid)
  - Accumulation & toxicity
Cephalosporins

- **Nursing Interventions**
  - Assess for allergic reaction
  - Assess renal & liver function
  - Monitor for superinfection
  - Monitor bleeding studies, VS & UO

- **Safety**
  - Keep out of reach of children

Client Teaching

- **Report s/s of superinfection**
  - Instruct to ingest buttermilk or yogurt for prevention with long-term use

- Complete course of medication

- Childproof caps and out of reach of children

- Infuse all meds \( \geq 30 \) min

- Report all side effects

PCN Substitutes

- **Macrolides, Lincosamides, Glycopeptides, & Ketolides**
  - Broad-spectrum
  - Abx effectiveness similar to PCN
  - Used in PCN allergic patients
Macrolides

- Broad spectrum: Some gram -/most gram +
  - Binds to ribosomal units & inhibits protein synthesis
  - Low to moderate doses: Bacteriostatic
  - High doses: Bacteriocidal

- Indications of Use
  - STIs, GI, respiratory, & skin infections
  - Commonly used in clients with PCN allergies

- erythromycin (E-Mycin)
- Extended Macrolides
  - Longer half-life
  - azithromycin (Zithromax)
  - clarithromycin (Biaxin)

- Increases effect of Digoxin, Tegretol, Theophylline, Cyclosporin & Warfarin
- NOT administered IM (OUCH!)
- Azithromycin
  - Decreases effect of PCNs & Clindamycin
  - Avoid antacids within 2 hours
- Erythromycin
  - Don’t take with Clindamycin or Lincomycin
Macrolides

- Safety: LFTs & UO
- Side Effects:
  - N/V/D & abdominal cramps
- Adverse Reactions:
  - Jaundice/icteric, anaphylaxis, superinfection, & hearing loss
  - **Hepatotoxicity**: Erythromycin & Azithromycin + other hepatotoxics

Nursing Interventions

- Obtain C&S
- Monitor VS & UO
- Monitor liver functioning:
  - Jaundice
  - LFT & bilirubin
- Instruct patient to report loose stools:
  - Pseudomembranous colitis (C. dif)

Lincosamides

- Inhibit bacterial protein synthesis
- Bacteriostatic & bacteriocidal

- Clindamycin (Cleocin)
  - Most gram +

- Side effects/Adverse reactions:
  - N/V, stomatitis, colitis & anaphylactic shock
**Glycopeptides**

- **Glycopeptide bacteriocidal antibiotic**
  - Vancomycin (Vancocin)
  - Telavancin (Vibativ) **Once daily**
    - Select gram + bacteria & skin infections
    - Effective against MRSA

- **Indications of Use**
  - Cardiac surgical prophylaxis if PCN allergy

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**Vancomycin**

- **Side Effects & Adverse Reactions**
  - Thrombophlebitis, N/V, dizziness, fever
  - Ototoxicity & Nephrotoxicity

- **Monitor**
  - Peak & trough levels
  - Bun/Cr

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**Redman Syndrome (Red Neck Syndrome)**

- Red blotching of the face, neck & chest
- Toxic effect/Not an allergic reaction

- **Treatment**
  - Mild to moderate:
    - Benadryl & Ranitidine, and ½ IV rate or 10mg/min
  - Severe:
    - IVF PRN w/ hypotension
    - Administer Benadryl & Ranitidine
    - May restart once symptoms resolve (rate over 4 hours)
Red Man Syndrome

Epidermis separates from the dermis
Hypersensitivity affecting skin & mucous membranes

Stevens-Johnson Syndrome

Epidermis separates from the dermis
Hypersensitivity affecting skin & mucous membranes

Vancomycin

Risk of nephro & ototoxicity are potentiated with:
- Furosemide, aminoglycosides, amphotericin B...
- Ototoxicity can be masked with Dramamine
- May inhibit methotrexate excretion = toxicity
Ketolides

- Inhibits protein synthesis → bacterial cell death

- Telithromycin (Ketek)
  - >18 yo: Mild to mod. CA-pneumonia

- Side effects/Adverse reactions
  - HA, dizziness, N/V/D & liver failure

Ketolide Drug Interactions

- Telithromycin levels ↑ with:
  - Antilipidemics, itraconazole, ketoconazole & benzodiazeplines

- Telithromycin levels ↓ with:
  - Rifampin, phenytoin, carbamazepine & phenobarbital

- Increases multiple other drug levels

Tetracyclines

- Broad-spectrum
  - Gram - & + & other organisms
  - ↑ Bacterial resistance d/t overuse
  - Tx of H. Pylori → Peptic Ulcers w/ Metronidazole & bismuth

- Indications of use
  - Acne, rosacea, & skin infections
  - Respiratory infections & STIs
Tetracyclines

- **Short-Acting**
  - tetracycline (Sumycin)
- **Intermediate-Acting**
  - demeclocycline (Declomycin)
- **Long-Acting**
  - doxycycline hyclate (Vibramycin)

Tetracyclines

- **PO**: Rapid & complete absorption in newer preparations
- **IV**: Used to treat severe infections

Tetracycline Administration

- Antacids, high calcium & iron drugs
  - Can prevent absorption of Tetracyclines
- Dairy products decrease Tetracycline effect
- **Doxycycline**
  - Decreases effect of oral contraceptives
  - Increases absorption of Digoxin → toxicity
  - Absorption enhanced with food
Tetracyclines

- Side Effects
  - N/V/D & photosensitivity
  - Teratogenic in 1st trimester (icon)

- Adverse Reactions
  - Superinfections, hepatotoxicity, CNS toxicity…

- Labs: BUN/Cr & LFTs

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Tetracycline Teeth

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Glycyclcyclines

- Broad spectrum; gram + & -
- tigecycline (Tygacil)

- Indications of Use
  - Complicated skin infections, intrabdominal infections
  - E. coli, S. aureus, Klebsiella pneumoniae
Tigecycline

- Side effects & adverse reactions
  - N/V/D, photosensitivity, HTN/hypotension, anemia, leukocytosis & thrombocytopenia
  - Hyperglycemia, hypokalemia, ↑ BUN & LFTs

- Concurrent therapy effects:
  - Oral contraceptives less effective
  - Warfarin levels may increase

Aminoglycosides

- Inhibits bacterial protein synthesis
  - Gram -
    - Some gram + cocci are resistant → PCNs or Cephalosporins are used

- Indications of Use
  - PID, MRSA, & Pseudomonas
  - Serious infections

- amikacin (Amikin)
- gentamicin (Garamycin)
- neomycin (Mycifradin)
- tobramycin (Nebcin)
- No GI absorption: Primarily given IV & IM
Aminoglycosides

**Side Effects**
- N/V, rash & photosensitivity

**Adverse Reactions**
- Ototoxicity, nephrotoxicity & liver damage, thrombocytopenia & agranulocytosis

Aminoglycoside Safety

**Peak & Trough**
- ↑ BUN, Serum AST, ALT, LDH, Cr & bilirubin
- ↓ Serum K⁺ & Magnesium

1. **Nephrotoxicity**
   - Renal functioning, dose & age

2. **Ototoxicity risk**
   - Concurrent ethacrynic acid treatment

Nursing Interventions

- Check for hearing loss & balance
- Monitor U/O
  - Report < 600 mL/24 hrs
- Peak and Trough
  - Gentamicin
- Monitor for superinfection
- Increase fluid intake
Fluoroquinolones

- Broad Spectrum bacteriocidal
  - Interferes with enzyme DNA gyrase
  - Gram - & gram +
- Primary indications of use
  - UTI & Respiratory infections

Fluoroquinolones

- Ciprofloxacin HCl (Cipro)
- Levofloxacin (Levaquin)
- Ofloxacin (Floxin)
- Moxifloxacin (Avelox)

Fluoroquinolones Safety

- Food slows the absorption rate
- Levofloxacin drug absorption with:
  - Antacids & Iron (within 4 hrs)
- Levofloxacin's effect of:
  - Oral hypoglycemics, Theophylline, & Caffeine
  - CNS reactions (tachycardia, anxiety...) can occur
Fluoroquinolones

- Safety: BUN/Cr & UO
  - Elevated = kidney dysfunction
  - Fluid > 2,000 ml/day

- Side Effects
  - Dizziness, photosensitivity, N/V/D

- Adverse Reactions
  - Seizures, cardiac dysrhythmias & superinfection
  - Steven-Johnson syndrome

Lipopeptides

- Bacteriocidal
- Daptomycin (Cubicin)

- Indications
  - Complicated gram + skin infections, S. aureus septicemia and MRSA infective endocarditis

- Side effects
  - HTN, hypotension & anemia

- Adverse reactions
  - Hyper/hypokalemia, hyper/hypoglycemia, bleeding & pleural effusion
  - Toxicity with tobramycin
  - Increased bleeding with Warfarin
**Sulfonamides**

- **Bacteriostatic**
  - Inhibit bacterial synthesis of folic acid
  - Gram –
  - Prevents bacterial growth in the kidneys & bladder

- **Indications of Use**
  - UTI, ear infections, meningococcal meningitis, newborn eye prophlaxis & STIs

**Sulfonamides**

- **Short-Acting**
  - sulfadiazine (Microsulfon)

- **Intermediate-Acting**
  - trimethoprim-sulfamethoxazole (Bactrim, Septra)

- **Topical**
  - silver sulfadiazine (Silvadene)

- Can be used in clients with PCN allergy

**Side Effects/Adverse Reactions**

- Skin rash/itching, photosensitivity, cross-sensitivity, & N/V/D

- Prolonged use
  - Hemolytic or aplastic anemia, thrombocytopenia, neutropenia, & agranulocytosis
Nursing Interventions

- **Teaching**
  - Crystalluria → Increase fluid intake
  - Sunglasses, report bruising or bleeding
- **Assess renal functioning**
  - BUN/Cr and UO
  - Bactrim and Septra: contraindicated in renal clients
- **Increases hypoglycemic effect with hypoglycemics**
- **Increases anticoagulant effect with Warfarin**

Urinary Tract Disorder Drugs

- **Upper UTI**
  - Pylonephritis
- **Lower UTI**
  - Cystitis, urethritis or prostatitis
- **UA and C&S prior to tx**
- **Acute Cystitis**
  - Demographics
  - Signs & Symptoms

Definitions

- **Urinary Antiseptics/antinfectives:**
  - Prevents bacterial growth in the kidneys & bladder
    - Sulfonamides/Fluoroquinolones
- **Urinary Analgesics:**
  - Relieve urinary tract pain & burning
- **Urinary Stimulants:**
  - Increase urinary muscle tone
Urinary Antiseptics/Antiinfectives

- nitrofurantoin (Macrodantin)
  - Bacteriostatic & Bacteriocidal (dose dep.)
  - Gram - & +

- Indications of Use
  - Acute & Chronic UTI

Urinary Antiseptics/Antiinfectives & Antibiotics

- nitrofurantoin (Macrodantin)
- Adverse Reactions
  - Dyspnea, chest pain, fever/chills
- Nursing Considerations
  - ↓ absorption with antacids
  - Accumulates in serum with urinary dysfunction

Urinary Antiseptics/Antiinfectives & Antibiotics

- methenamine (Hiprex)
  - Bacteriocidal when pH < 5.5
- Indications of Use
  - Chronic UTI
- Nursing Considerations
  - Cystalluria occurs with sulfonamides
  - Encourage acidic juices & ascorbic acid (vit c)
  - Decrease alkaline food intake
Urinary Analgesics

- Pyridium (Phenazopyridine)
- Urinary Analgesic: Azo dye
  - Relieves pain, burning, frequency & urgency

Indications of Use
- Lower UTI
- Concurrent antibiotic tx

Pyridium (Phenazopyridine)

- Clinitest: Alters the result
- Side effects/Adverse reactions
  - GI disturbances, hemolytic anemia, blood dyscrasias, nephrotoxicity & hepatotoxicity
- Teaching
  - Reddish-orange urine from dye
  - May stain contact lenses
  - Report N/V/D

Urinary Stimulants

- Parasympathomimetics

- Urecholine
  - Bladder tone
  - Produces contraction that stimulates micturition

- Which type of client would benefit from this drug class?
Urinary Antispasmotics/Antimuscarinics

- Relieve urinary tract spasms from infection
- dimethyl sulfoxide, oxybutynin & flavoxate

Contraindications
- GI obstruction
- Glaucoma

Side Effects:
- Dry mouth, HR, dizziness, GI distention & constipation

Teaching
- Report retention, severe dizziness, blurred vision, palpitations & confusion
- Avoid prolonged heat exposure

Adverse Effects of Antibacterials

- Allergy or hypersensitivity reaction
  - Mild: Rash, pruritis & hives → antihistamine
  - Severe: Laryngeal edema, bronchospasms, cardiac arrest → epi, bronchodilator & antihistamine
  - Usually occurs in the first 20 minutes
- Superinfection
- Organ toxicity
  - Liver & Kidneys
Superinfection

- Secondary infection: when normal flora are killed
- Sites: Mouth, skin, resp. tract, vagina, intestines
- Fungal or Bacterial
- Broad-spectrum > 1 wk

- Adverse reaction
  - Notify the MD stat!

Resistance

- Lessened antibiotic effect d/t misuse
  - Used on viruses or wrong bacteria/fungus
  - Mutant bacteria survive antibiotic use
  - Taken incorrectly

- Combating resistance
  - New classes of drugs
    - Abx resistant disabler
  - Bacterial vaccines (pneumococcal)
  - Patient teaching

It was on a short-cut through the hospital kitchens that Albert was first approached by a member of the Antibiotic Resistance.
Peak & Trough Review

- **Peak**
  - Drawn at drug’s peak of action
  - Indicates rate of drug absorption
- **Trough**
  - Drawn minutes before drug administration
  - Indicates rate of drug elimination
- **Gentamicin**
  - Peak 5-10
  - Toxic Peak > 12
  - Trough < 2
  - Toxic Trough > 2
  - ~Peak is 30 minutes after IV administration

Culture & Sensitivity (C&S)

- Detects the infective microorganism in the blood & what drug can kill it
- **Culture**: Organism causing the infection
- **Sensitivity**: Antimicrobial the organism is sensitive to
- Draw **before** antimicrobial administration

Liver & Kidney Tests

- **CLcr**
  - Most accurate lab test in determining renal function
  - Determines dose adjusting
- **BUN**
  - Determines renal functioning or dehydration (high levels)
- **Creatinine**
  - Specific indicator of renal functioning
- **LFTs**
  - ALT
  - AST
  - Alk Phos
Dose Adjusting

- **Organ Toxicity**
  - Liver, Kidney & Ears
  - CLcr, BUN/Cr & LFT's
  - Jaundice, UO, auditory checks

- **Critically-ill patients**
  - Immunocompromised

Nursing Process: Assessment

- **Allergies**
- **Diet**

- **Lab Results**
  - LFTs, Peak & Trough, C&S

- **Record/Report**
  - UO, VS

- **History**
- **Physical Assessment**

Physical Assessment Findings

- Describe wound, surgical site...
- Monitor for allergic reaction, notify MD & document findings **promptly**
  - Rash, wheezing, fever...
- Kidney/Liver damage
  - Jaundice/Icteric
  - Urine output decreased
- Superinfection
Nursing Diagnosis

1. Risk for impaired tissue integrity r/t rash.
2. Risk for infection r/t invasion of bacteria through surgical incision.
3. Noncompliance with drug regimen r/t lack of knowledge relevant to regimen behavior (AEB taking two days of 11 day therapy).

Planning/Goals

**Short Term**
- Client will demonstrate meticulous hand washing technique by 1300.
- Client will demonstrate knowledge of risk factors associated with infection by 1100.

Interventions

- Send labs, swabs…
  - Before antibiotic administration
- Assess for Allergic Reaction
  - Medical Alert bracelet
- Monitor temperature
  - 1 hr after antipyretic
  - Administer 2nd antipyretic prn
Patient Teaching

- Teaching Plan
  - Indication of use
  - Schedule/duration
  - Food considerations
  - Interaction with herbs & other medications
- Validation of Understanding
- STI Prevention

Hand Washing
- Take full course of antibiotic as directed
  - Finish full Rx
  - Prevent resistance
- Report side effects/adverse reactions
  - Superinfection

Evaluation

- Infection ceased
- Adverse reactions
  - Superinfection
- WBC count WNL
- Afebrile
- VSS: i.e. HR, RR

Cultural Considerations

- Alternative Practices
  - Curandero/healer
- Language Barrier
  - Translator
- Drug Schedule
  - Alternative methodology
Complimentary, Alternative & Traditional Medications

- **Client Preference**
  - Homeopathic vs. Rx
  - Interactions with Rx
  - Previous experience

- **Teaching**
  - Stress importance of medical regime

- **Family Involvement**
  - Teach client with family at bedside

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**Questions?**

"It's a prescription for one of those new super-antibiotics. You won't just get better, you'll get even."