

## Antibiotics

### History

*1928- Penicillin discovered*

*1935- Sulfa Drugs introduced*

*1945 Cephalosporin discovered*

- The miracle of antibacterial drugs have saved many lives in the treatment of infections.
- However, now the greater threat is the existence of superbugs resistant to existing antibiotics.
- These have developed from the overuse of antibiotics.

### Animal Production

- **Consumer Reports has been sounding the alarm for years.** In tests of chicken, pork and turkey, they found antibiotic resistant strains.
- The American meat and chicken industry relies heavily on the overuse of antibiotics to speed growth and help animals survive filthy, crowded conditions.
- MRSA infections more common near areas of cattle production.

### Overprescribing

- Doctors and hospitals overprescribe too. According to the CDC, **up to 50% of all the antibiotics prescribed for people are not needed or are not optimally effective as prescribed.**
- Every time we take antibiotics we don't need, we risk producing resistant strains with no benefit to our own health. Prescribers know better, or they should.

### Describing and Classifying Bacteria

- Bacteria are classified by
  - Staining: violet Gram stain
    - Gram positive
    - Gram negative
  - Shape
    - Rod-shaped
    - Spherical
    - Spiral
  - Ability to use oxygen:
    - Aerobic
    - Anaerobic

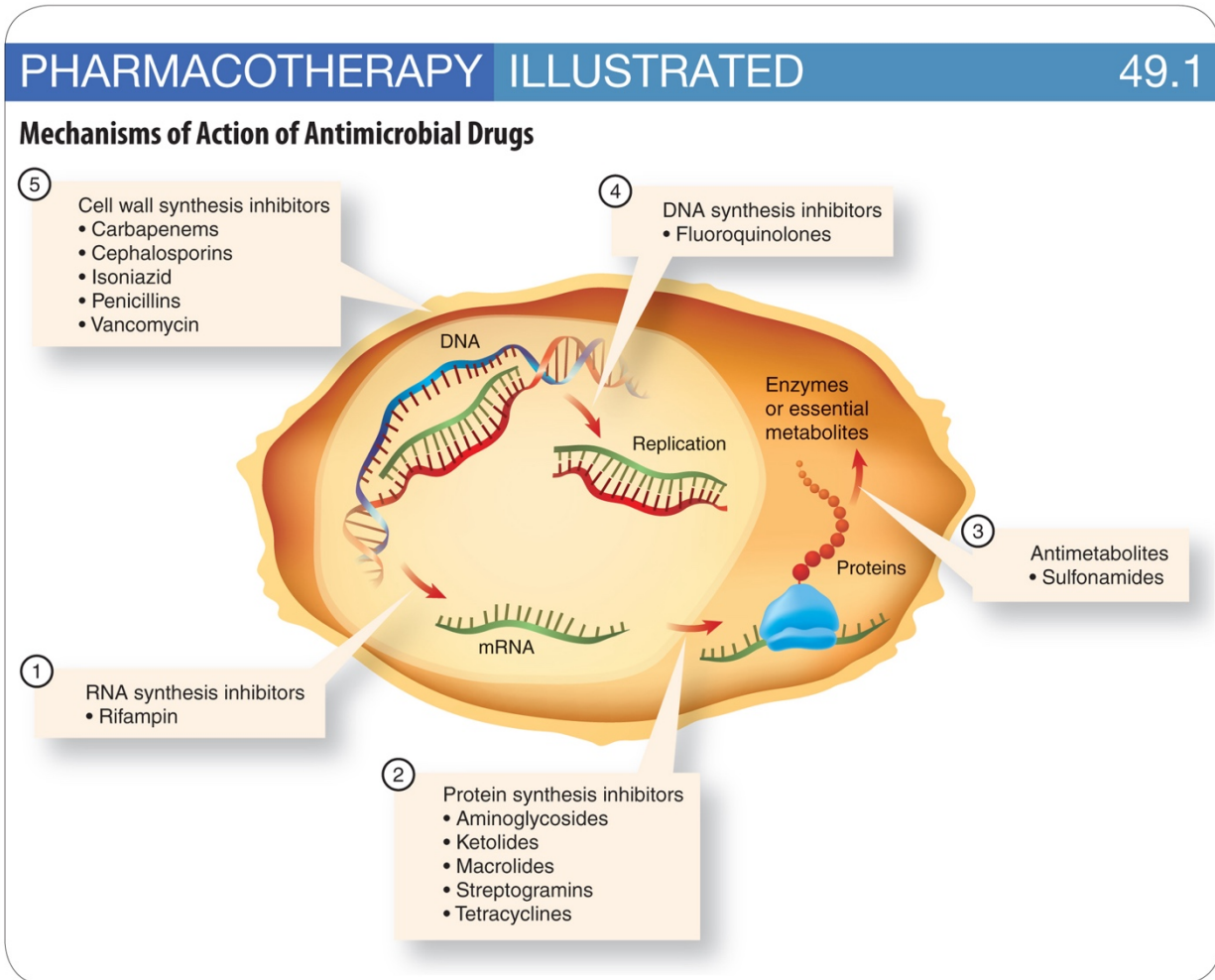
### Classification of Anti-Infectives

- Any medication effective against pathogens
- Anti-infectives are classified according to:
  - Susceptible organism
    - Antibacterial, antiviral, antifungal, antihelminthic (treat parasites)
  - Chemical structure

- Mechanism of action

### Mechanisms of Action of Anti-Infectives

- Anti-infectives target a pathogen's metabolism or life cycle
  - Inhibition of cell wall synthesis (e.g., penicillins)
  - Inhibition of protein synthesis (e.g., macrolides)
  - Disruption of plasma membrane (Azoles-antifungals )
  - Inhibition of nucleic acid synthesis (Fluoroquinolones- such as Cipro, Levaquin)
  - Inhibition of metabolic pathway (Sulfonamides- Bactrim)



### Acquired Resistance

- ability of organism to become insensitive to effects of anti-infective
  - Major clinical problem, worsened by improper use of anti-infectives

### Promotion of Resistance

- Bacteria become resistant by
  - Replicating rapidly
  - Mutating spontaneously and randomly
  - Acquiring resistance and promoting resistance to other bacteria via conjugation
- Guidelines to help prevent resistant strains

- Prevent infections
- Diagnose and treat infection properly, don't use a stronger antibiotic if a lower one works
- Use antimicrobials wisely
- Prevent transmission of infections

#### Use of Correct Antibiotic Key to Effective Treatment

- Culture and sensitivity (C&S) testing isolates the organism, identifies ideal antibiotic. Throat cultures for strep, urine cultures.
- Antibiotics should not be prescribed for viral infections such as common cold.
- General rule of thumb for sinus infections they must have symptoms for 2 weeks. Many resolves on their own.

#### Spectrum of Activity of Anti-infectives

- Narrow spectrum anti-infectives affect only a few bacterial types. Less likely to kill off host flora; the "good bacteria"
  - i.e.-Early Penicillins
- Broad spectrum anti-infectives affect many bacteria types.
  - i.e.-Carbapenems (Doribux, Invanz)
- Since narrow spectrum antibiotics are selective, they can be more active against a single organism than the broad spectrum antibiotics.

#### Bacteriostatic/ Bactericidal

- Antibiotics that interfere with ability of a bacteria to reproduce/replicate without killing them are called BACTERIOSTATIC drugs
  - Macrolides, Tetracycline, Chloramphenicol, sulfonamides or Trimethoprim separately.
- Antibiotics that can cause bacterial death are called BACTERICIDAL
  - Ampicillin, Cephalosporins (Keflex or Rocephin), Vancomycin, Fluoroquinolones (Cipro, Levaquin), Aminoglycosides and Sulfonamethoxazole with Trimethoprim (Bactrim).

#### Factors Affecting Anti-Infective Selection

- Patient factors affect choice of anti-infective
  - Host defenses: immune system status
  - Local tissue conditions: at infection site
  - Allergic reactions: hypersensitivity
  - Pregnancy: some drugs secreted in breast milk or cross placenta
  - Bacterial resistance- newer classes of antibiotics need to be used with resistant strains. i.e. if resistant to Vancomycin may need to use Streptogramins.

#### Adverse Reactions to Anti-infective Therapy

- Nephrotoxicity- decreased kidney function
- Gastrointestinal toxicity- diarrhea
- Neurotoxicity -cross blood brain barrier
- Hypersensitivity- rash, hives, itching. May progress to anaphylaxis.

- Super-infections
  - antibiotic kills host's normal flora

#### Super-infections

- Symptoms include diarrhea, bladder pain, painful urination, abnormal vaginal discharge
- Broad-spectrum antibiotics are more likely to cause super-infections
- Common organisms found in cases of super-infection:
  - Clostridium Difficile (colon)
  - Clostridium Albicans (vagina)

#### Antifungal Medications

- Antifungals- "Azoles"-topical, oral or by IV.
  - Treats ringworm, thrush, athlete's foot and more serious infections such as Aspergillosis or fungal meningitis. Can be given topically for any "tinea" infections (ringworm, thrush)
  - Clotrimazole- Lotrimin cream used for fungal skin infections.
  - Miconazole- Cream used to treat vaginal yeast infections.
  - Meloxicam- A non-steroidal anti-inflammatory drug.
  - Fluconazole- Amphotericin given orally or by IV to treat systemic fungal infections.

#### Complimentary Health Approaches

- Probiotics
  - Live bacteria
    - Lactobacillus
    - Many others
  - Common uses
    - diarrhea – most common use
    - Bloating, constipation
    - H Pylori
    - Crohn's Disease
    - Helpful information for your practice
      - <https://www.cdc.gov/antibiotic-use/community/materials-references/print-materials/index.html>

#### Urinary Tract Infections and Antibiotic use:

- Bacteria can live in the bladder. You should only take antibiotics if you have symptoms and a positive urine test
- Most common e.coli but can live in bladder without symptoms
  - If they do not have symptoms only treat if pregnant or if pt is having urinary surgery

#### Antibiotic Resistance

- Resistant genes are transferred to the next generation by
  - Vertical Gene transfer
    - replication

- Horizontal gene transfer
  - Transaction
  - Conjugation
  - Transformation
- Mechanism
  - Drug Inactivation or Modification
    - Bacterial resistant genes
      - Makes antibiotic counter acting substances
        - B-lactase
          - Inactivate penicillin G
  - Alterations of target or binding site of antibiotics
    - In MRSA – PBP site gets altered
      - Penicillin unable to bind
  - Active efflux
    - Efflux of antibiotics from bacterial cells
    - Genetic elements encoding efflux pumps are naturally selected
    - Over expression of efflux pumps
    - Antibiotics effluxes out