# Introduction to Antibiotics

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# Objectives of the Lecture

At the end of lecture, the students should be able to understand the following:

- Classification of antibiotics.

- Misuses of antibiotics.

- Choice of antibiotics.

- Bacterial resistance and ways to prevent it.

- General principles of chemotherapy.

- Indications for antibiotics prophylaxis

# History of Antibiotic?
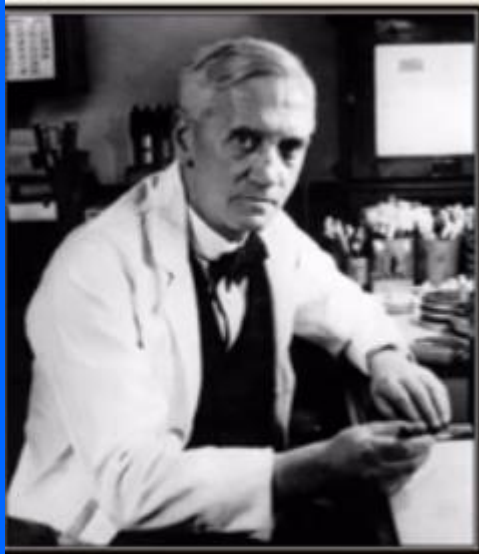
**Alexander Fleming**
(1881-1955)

**Howard Florey**
(1898-1968)

**Ernst Boris Chain**
(1906-1979)

Nobel prize in
1945

# Definition of Antibiotics

Chemical substances produced by various microorganisms ( bacteria, fungi, actinomycetes) that have the capacity to inhibit or destroy other microorganisms.

Now a day they are chemically synthesized.

They either kill bacteria(bactericidal) or keep more bacteria from growing(bacteriostatic).

Antibiotics will not cure infections caused by viruses.

# CLASSIFICATION OF ANTIBIOTICS ACCORDING TO MECHANISM OF ACTION

- **INHIBITION OF CELL WALL SYNTHESIS e.g. Penicillins, Cephalosporin**

- **INHIBITION OF PROTEIN SYNTHESIS e.g. Macrolides, Tetracyclines**

- **INHIBITION OF DNA SYNTHESIS e.g. Quinolones.**

- **INHIBITION OF RNA SYNTHESIS e.g. Rifampicin.**

- **INHIBITION OF FOLATE METABOLISM e.g. Sulphonamides, Trimethoprim**

# According to spectrum

- **Narrow spectrum , e.g.:**

  **penicillin G , aminoglycosides**

- **Broad spectrum , e.g.:**

  **ampicillin , amoxicillin**

# Choice of Antibiotic

A) Clinical diagnosis (e.g.,syphylis)

B) Microbiological information

C) Pharmacological consideration

# B)Bacteriological informations

## Advantages

- ❖ The exact antibiotic to be used
- ❖ The most effective and reject the one with little or no activity
- ❖ The least toxic
- ❖ The cheapest

# Disadvantages

- The bacteria isolated may not be the prime cause of the disease.

- do not take in consideration site of infection

- some bacteria cannot be cultivated or take time to grow( e.g. M. Leprae, M. Tuberculosis )

- Bacteriological services are not available at all hospitals

# Choice of Antibiotics(cont.)

C)**Pharmacological consideration**

**1. Site of infection**

**2. Host factors**

   **a) Immune system e.g. Alcoholism, diabetes, HIV, malnutrition, advanced age- (higher than usual doses or longer courses are required).**

   **b) Genetic factors**

   **e.g. Patients with G-6-PD deficiency treated with sulfonamides (Hemolysis )**

c) **Pregnancy and Lactation**
   Aminoglycosides (hearing loss in the child)
   Tetracyclines    (bone deformity in the child)

d) **Extreme Age**
   Neonates and elderly

e) **Renal function**

   e.g. Aminoglycosides (renal failure)

f) **Liver function**
   e.g. Erythromycin(hepatic failure)

3. **Drug Allergy**

# MISUSES OF ANTIBIOTICS

❖ Treatment of diseases caused by viruses.

❖ Improper dosage.

❖ Therapy of fever of unknown origin.

❖ Presence of pus or necrotic tissues , or blood at the surgical site

❖ Excessive use of prophylactic antibiotics in travelers.

❖ Lack of adequate bacteriological information.

❖ Over use as growth promoters in animals and agriculture.

❖ Pts do not take them according to their doctor's instructions.

❖ Some pts save unused antibiotics for another illness, or pass to others.

# Reasons for MISUSES of ANTIBIOTICS

**A consequence of many factors:**
1- Availability of a very wide selection
2- Limitation of physician's time
3- Physician shortage and expenses
4- Availability without Rx in pharmacies
3- Public demand ( pressure to prescribe )

# Bacterial Resistance

➢ **One result of the widespread use of antibiotics has been the emergence of resistant pathogens that have been sensitive in the past.**

## Definition

**Conc of antibiotic required to inhibit or kill the bacteria is greater than the conc that can safely be achieved in the plasma.**

# Mechanisms of Acquired Antibiotic Resistance

**1. Inactivation by enzyme produced by bacteria**

 **Bacterial β-lactamase inactivates penicillins & cephalosporins by cleaving the β-lactam ring of the drug.**

**2. Bacteria develops an altered receptor for the drug**

**3. Bacteria develops an altered metabolic pathway**

**4. Reduced bacterial permeability to antibiotic**

**5. Actively transporting the drug out of the cell**

# Prevention of Resistance

*Use antibiotics only when absolutely required

*Use antibiotics in adequate dosage for sufficient period of time

    Not too brief therapy

    Not too prolonged therapy( exceptions, e.g. TB )

*Combination of antibiotics may be required to delay resistance ( e.g. TB )

# General Principles of Antibiotics Therapy

❖ Administer drug in *full dose*, at *proper interval* and by the b*est route*

❖ When apparent cure achieved , continue antibiotic for  about 3 days further to avoid  relapse

❖ Skipping doses may decrease effectiveness of antibiotic & increase the incidence  of bacterial resistance.

❖  In some infections bacteriological proof of cure is  desirable ( e.g. TB, UTI )

❖  Measurement of plasma conc. of antibiotics is seldom needed, except for systemic aminoglycosides(e.g., streptomycin, gentamicin, etc.).

# General Principles of Chemotherapy(cont)

❖ **Two or more antimicrobials should not be used without good reason, e.g.:**

Mixed bacterial (polymicrobial) infections

Desperately ill patient of unknown etiology

To prevent emergence of resistance (e.g. TB )

To achieve synergism

eg.piperacillin+gentamicin(p. aeruginosae)

**Disadvantages of multiple antibiotics**

Increased risk of sensitivity or toxicity

Increased risk of colonization with a resistant bacteria

Possibility of antagonism

Higher cost

# Indications for antibiotics prophylaxis

**Surgical prophylaxis, e.g.:**
   bowel surgery, joint replacement,etc. to prevent postoperative
      infections.

**Immunosuppressed  Patients, e.g.:**
 Very old, Very young , Diabetics, Anaemics, AIDS ,Cancer pts.

**Dental extractions, e.g.:**
  Pts with total joint replacements
  Pts with cardiac abnormalities