

# Antibacterial Agents

# Summary of what you are going to learn in this lecture

- Definition of antibiotics and antimicrobial agents
- Modes and sites of action of antibiotics
- Factors effective on activity of antimicrobial drugs
- Combined therapy
- Disadvantages of antimicrobial drugs

# Antibiotic Resistance and Its Importance in Veterinary Microbiology

- Explore how antibiotic resistance impacts animal and human health globally.
- Veterinary microbiology shapes solutions through a One Health approach.



# What are Antibiotics and Antimicrobial Agents?

## Antibiotics

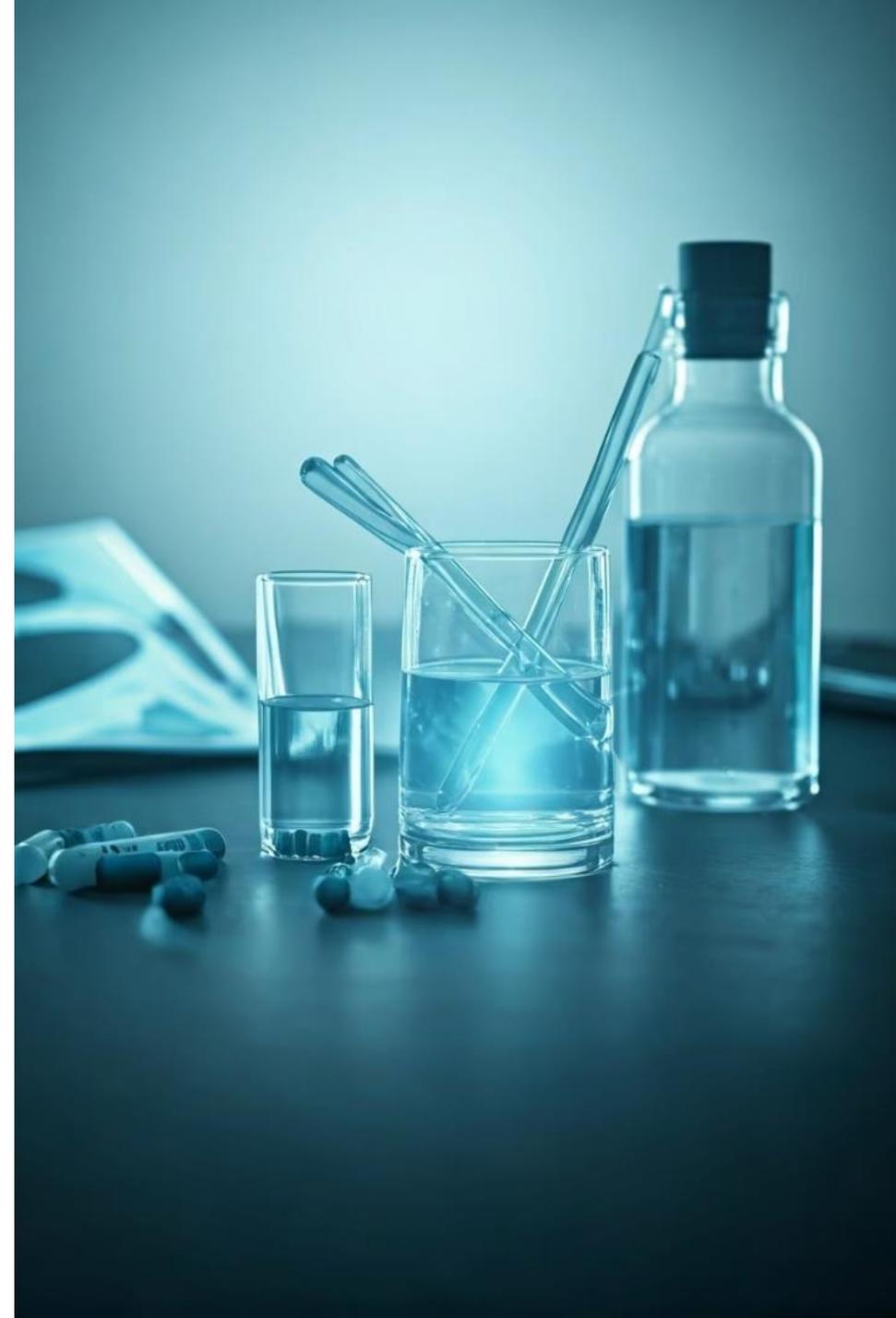
Substances that inhibit or kill bacteria, used to treat infections.

## Antimicrobial Agents

Broader group including antifungals, antiparasitics, antiparasitics, alongside antibiotics.

## Use in Medicine

Applied in both human and veterinary contexts for disease disease control.





# Importance of Antibiotics in Veterinary Medicine



## Animal Health & Welfare

Treats infectious diseases, diseases, ensuring animal animal productivity and well-being.



## Food Security

Supports production of of safe and nutritious animal-derived food.



## Human Health Impact

Livestock use can affect people via transmission of resistant resistant bacteria.

# Modes of Action of Antibiotics

## Cell Wall Synthesis

Beta-lactams block cell wall formation, causing bacterial death.

## Protein Synthesis

Tetracyclines and macrolides disrupt ribosome function.

## DNA/RNA Synthesis

Fluoroquinolones interfere with nucleic acid replication.

## Metabolic Pathways

Some antibiotics inhibit essential bacterial enzymatic processes.



# Target Sites Where Antibiotics Are Effective

1

## Cell Wall

Structural barrier targeted by certain antibiotics.

2

## Ribosomes

Sites of protein synthesis blocked to prevent bacterial growth.

3

## Nucleic Acids

Interference prevents DNA/RNA synthesis and replication.

4

## Metabolic Enzymes

Crucial biochemical pathways disrupted to kill bacteria.



# Tests Used to Reveal Antibiotic Resistance

## Culturing & Sensitivity

Disk diffusion and MIC tests detect resistance phenotypes.

## Molecular Diagnostics

Identify resistance genes with PCR and sequencing techniques.

## Surveillance

Ongoing monitoring in vet labs for emerging resistance trends.

# Mechanisms of Bacterial Resistance to Antimicrobials

## Antimicrobials

### Enzymatic Degradation

Bacteria produce enzymes that break down antibiotics.

### Target Alteration

Mutations change antibiotic binding sites, reducing efficacy.

### Drug Efflux

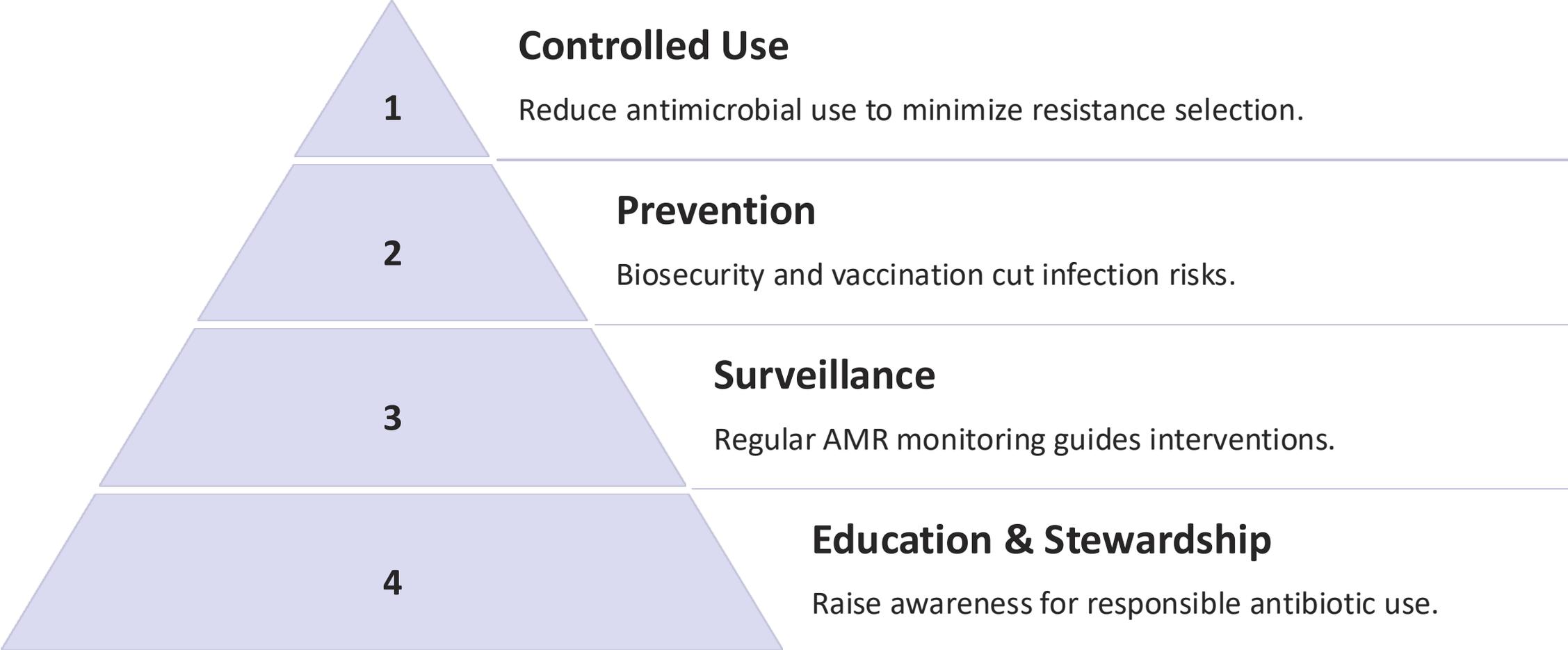
Pump systems expel antibiotics, lowering internal drug levels.

### Gene Acquisition

Resistance genes spread via horizontal gene transfer.



# Strategies for Controlling Antibiotic Resistance





# Conclusion: One Health Perspective on AMR

## Multisector Collaboration

AMR control needs veterinary, human, and environmental partners. partners.

## Coordinated Interventions

One Health strategies essential for global AMR containment.

## Veterinary Role

Veterinarians lead stewardship and and resistance prevention efforts. efforts.

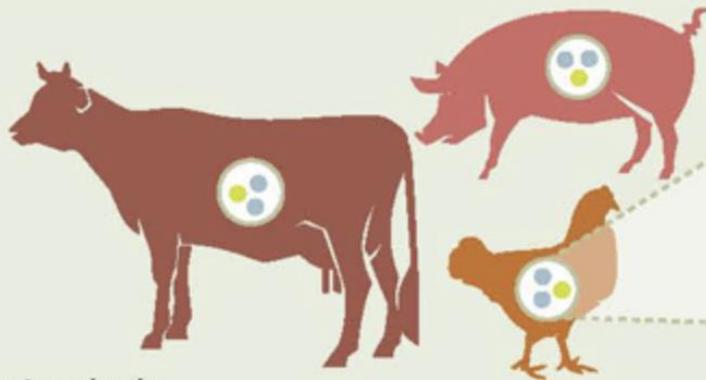


# ANTIBIOTIC RESISTANCE

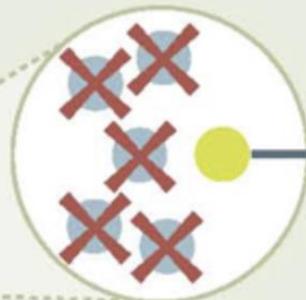
from the farm to the table

## RESISTANCE

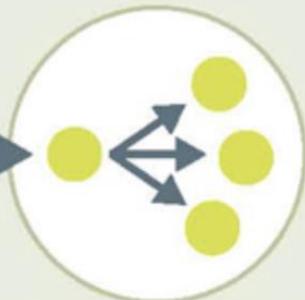
All animals carry **bacteria** in their intestines



Antibiotics are given to animals



Antibiotics kill most bacteria



But resistant bacteria survive and multiply

## SPREAD

Resistant bacteria can spread to...



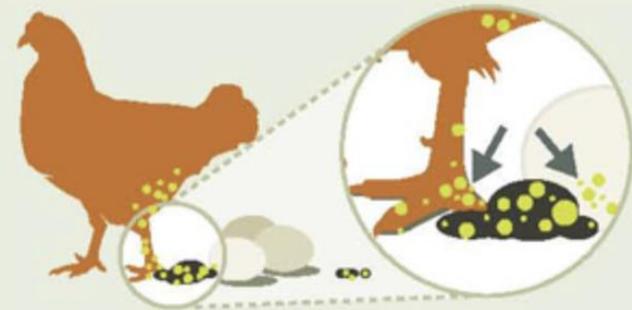
animal products



produce through contaminated water or soil



prepared food through contaminated surfaces



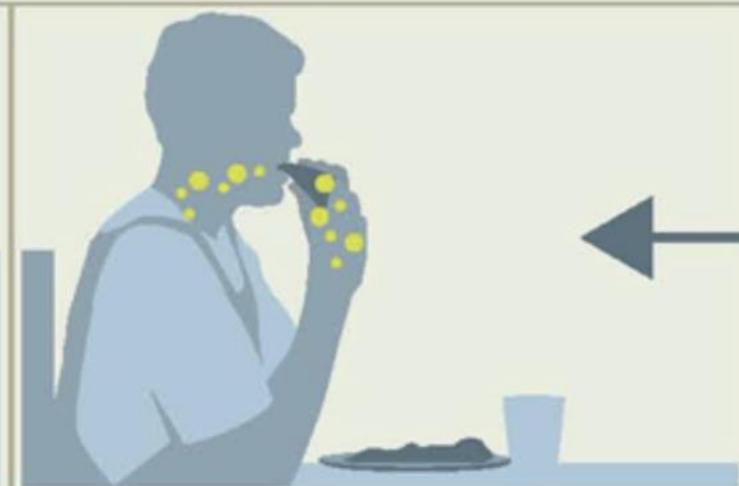
the environment when animals poop

# EXPOSURE

People can get sick with resistant infections from...



contaminated food



contaminated environment

# IMPACT

Some resistant infections cause...



mild illness



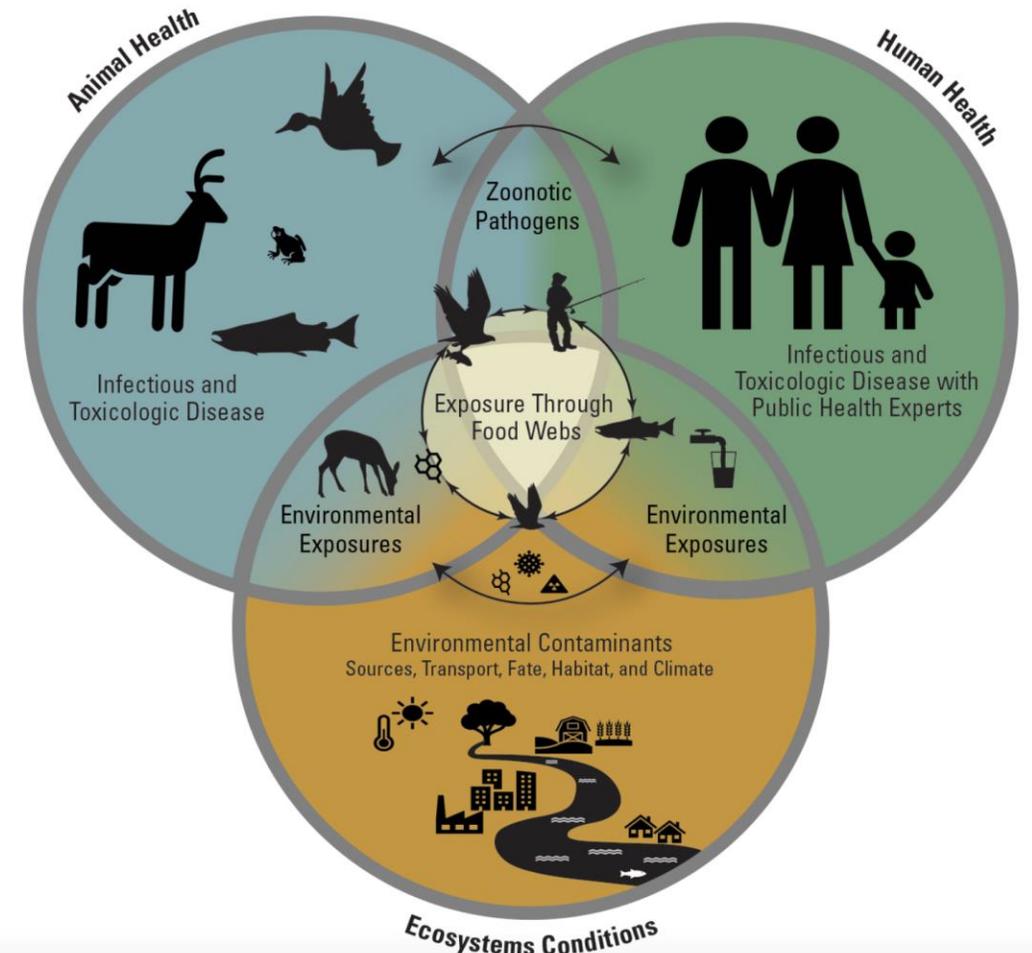
severe illness and  
may lead to death



Learn more about antibiotic resistance and food safety at [www.cdc.gov/foodsafety/antibiotic-resistance.html](http://www.cdc.gov/foodsafety/antibiotic-resistance.html)

# One Health Perspective: Why It Matters?

- Shared environment between humans, animals, and ecosystems
- Antibiotic use in animals can affect humans (and vice versa)
- Environmental dissemination of resistant genes



# Antibacterial Agents

# Antibiotics-Definition

- Low molecular weight microbial metabolites
- Either kill or inhibit the growth of susceptible bacteria
- Antibiotics & synthetic compounds showing antimicrobial activity
- Some effect narrow range of bacteria others show broad spectrum activity against bacteria
- Ex. Tetracyclines & chloramphenicol have broad spectrum activity

# The modes and sites of action of antibiotics

- Cell wall synthesis inhibition
  - Penicillins & cephalosporins
- Inhibition of protein synthesis
  - Aminoglycosides & macrolid antibiotics
- Inhibition of cell membrane function
- Inhibition of nucleic acid synthesis
  - quinolones, novobiocin, rifampin, nitroimidazoles and sulphonamides
  - Inhibition of DNA-dependent RNA polymerase
  - Distruption of DNA structure
  - Interference with DNA gyrase
  - Interference with DNA synthesis by blocking folic acid production

# Factors effecting activity of antimicrobial drugs

- Site and rate of absorption
- Site of excretion
- Tissue distribution
- Metabolism of an agent
- interactions between pathogen and drug
- interactions between host and pathogen

# Combined Therapy

Drugs those show synergistic activity can be used together

- **Trimethoprim & sulphonamides**: act at two different sites in the **folic acid pathway**
- **Penicillin & clavulanic acid** and/or amoxicillin & clavulanic acid
- Clavulanic acid **inhibits  $\beta$ -lactamase activity** which prevents inactivation of penicillin

# Disadvantages of antimicrobial drugs

- They can alter the host's immune response
- They may **change the normal flora**, particularly **on the skin** and **in the intestinal tract**,
- Disturbance of intestinal flora & **development of an extended carrier state**
- Prolonged therapy and/or therapy with inappropriate drugs may predispose the recipient to **fungal infections**