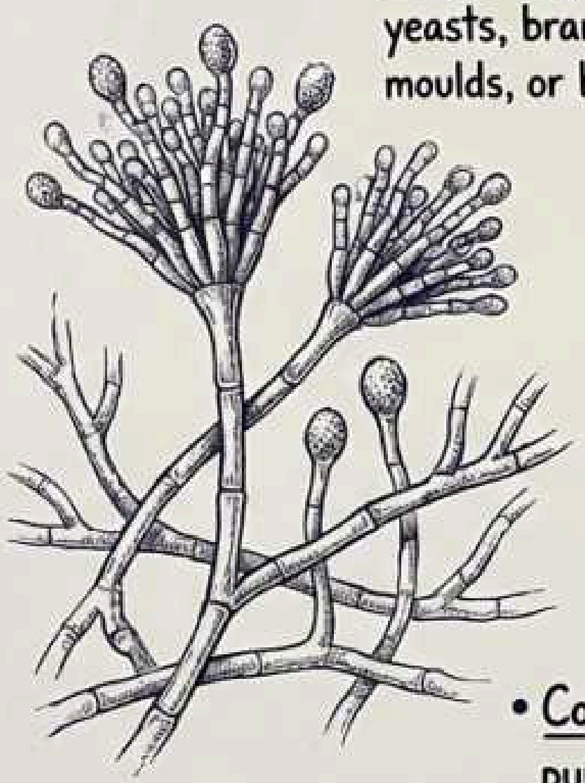
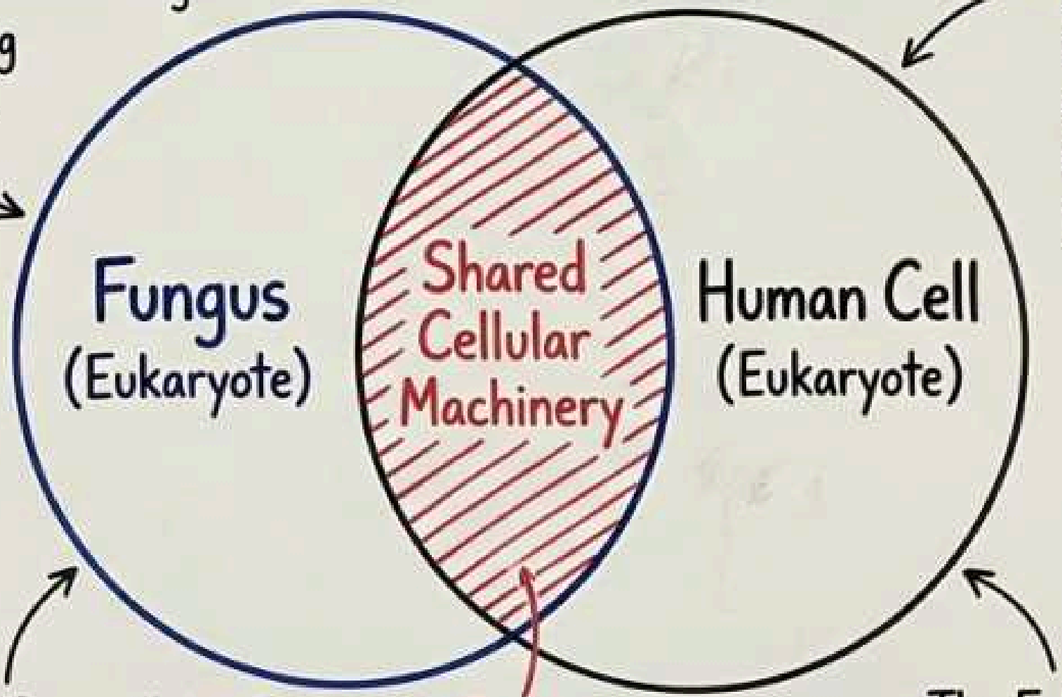
# MED 512 B — Other Microbes, Medicines and Vaccines

¶ 5.1

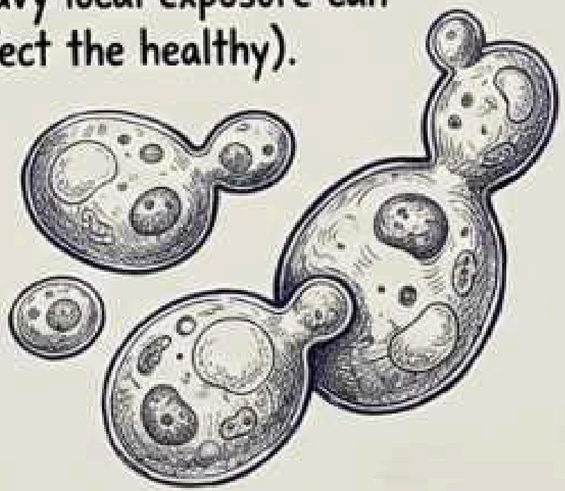
## Fungi: Distinct & Opportunistic Pathogens

- **Morphology**: Exists as single-celled yeasts, branching moulds, or both.






- **Behavior**: Primarily opportunistic. Attacks when immunity is suppressed or physical barriers break (though heavy local exposure can infect the healthy).

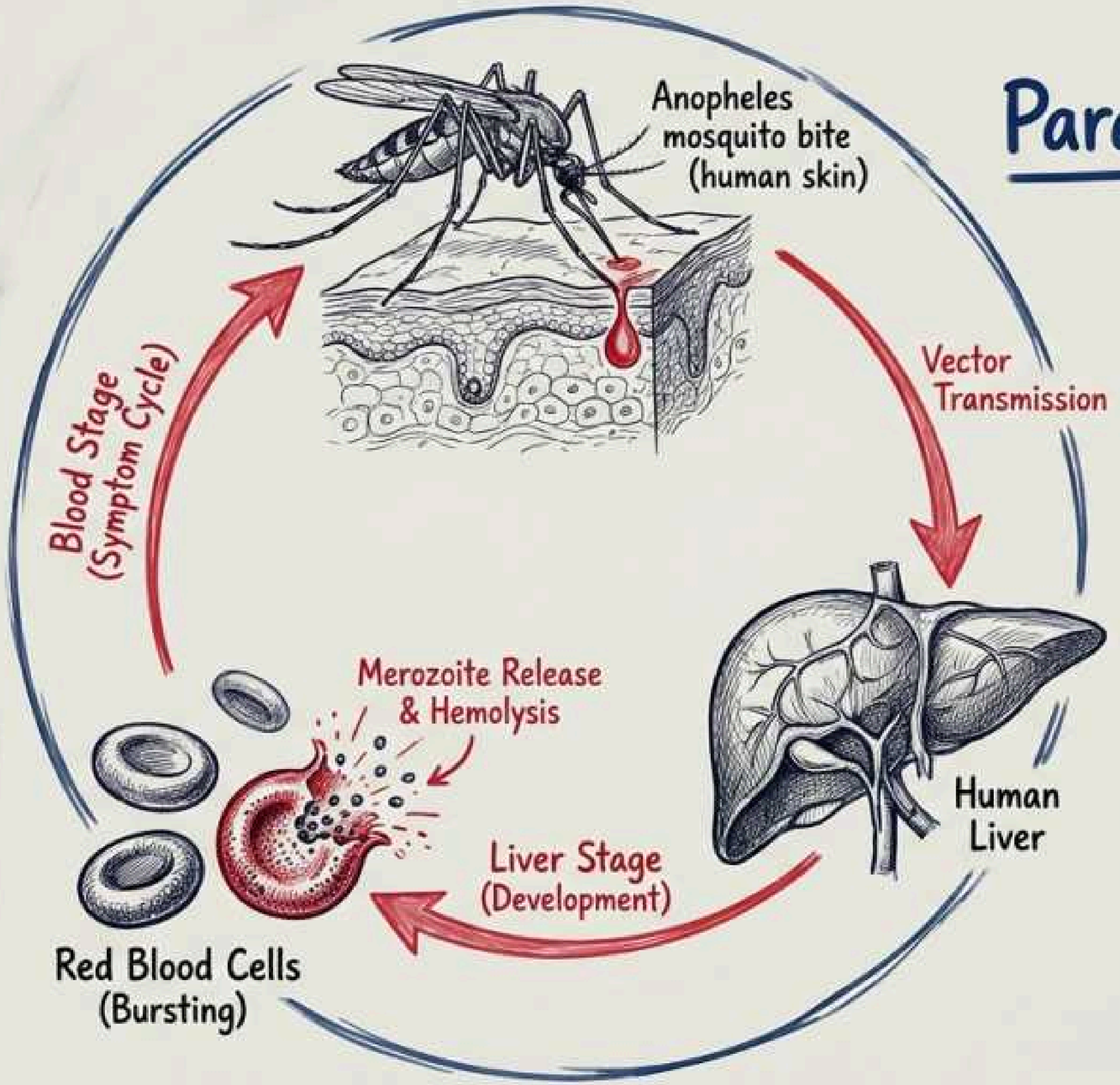


- **Course Scope Note**: Focus is purely on pathogenesis, not cultivation or industrial use.

Shared Cellular Machinery

- **The Eukaryotic Challenge**: Closer in cell structure to animals than bacteria → fewer unique targets for medicines.

# Parasites: Protozoa & Helminths




Protozoa (Single-celled Eukaryotes): e.g., Plasmodium (Malaria).

Path: Mosquito → Liver → Red Blood Cells.

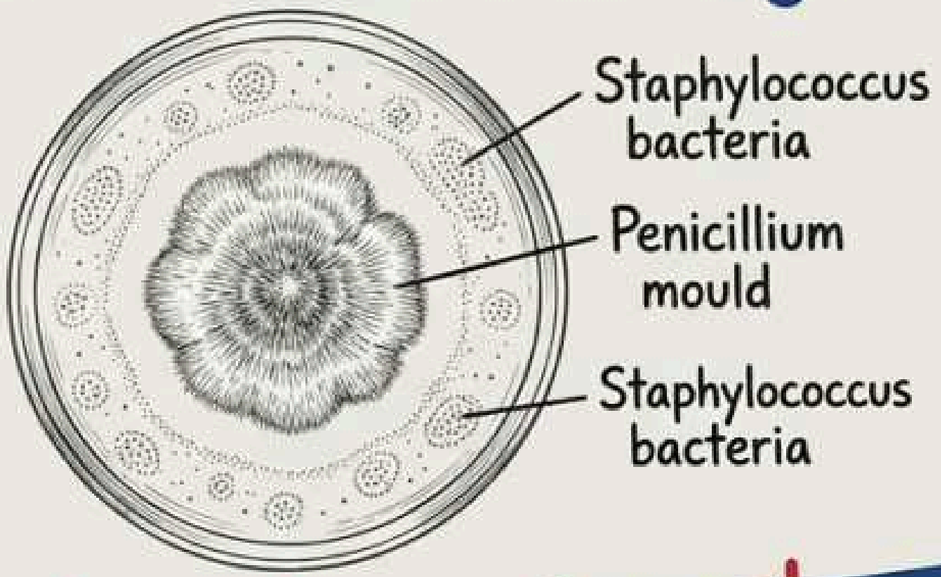
Impact: Waves of fever; severe forms risk coma and death if untreated.

Helminths (Multicellular Worms): Cause chronic illnesses impacting nutrition, specific organs, and immune character.

Core Concept: The evolutionary host "war" involves complex multi-cellular enemies. Vector-borne disease (carried by insects/animals) is central to this field.

# The Antimicrobial Age: The Penicillin Story

¶5.3




**1928 (Accident & Genius):** Alexander Fleming notices mould clearing bacteria.

**Early 1940s (Scale & Need):** Howard Florey, Ernst Chain, and colleagues isolate and mass-produce penicillin for clinical and wartime use.

**1945 (Recognition):** Fleming, Florey, and Chain share the Nobel Prize.

**The Legacy:** Changed the odds of a vast class of bacterial illnesses, but simultaneously created a new, lasting problem: resistance.

# Antibiotics & Selective Toxicity

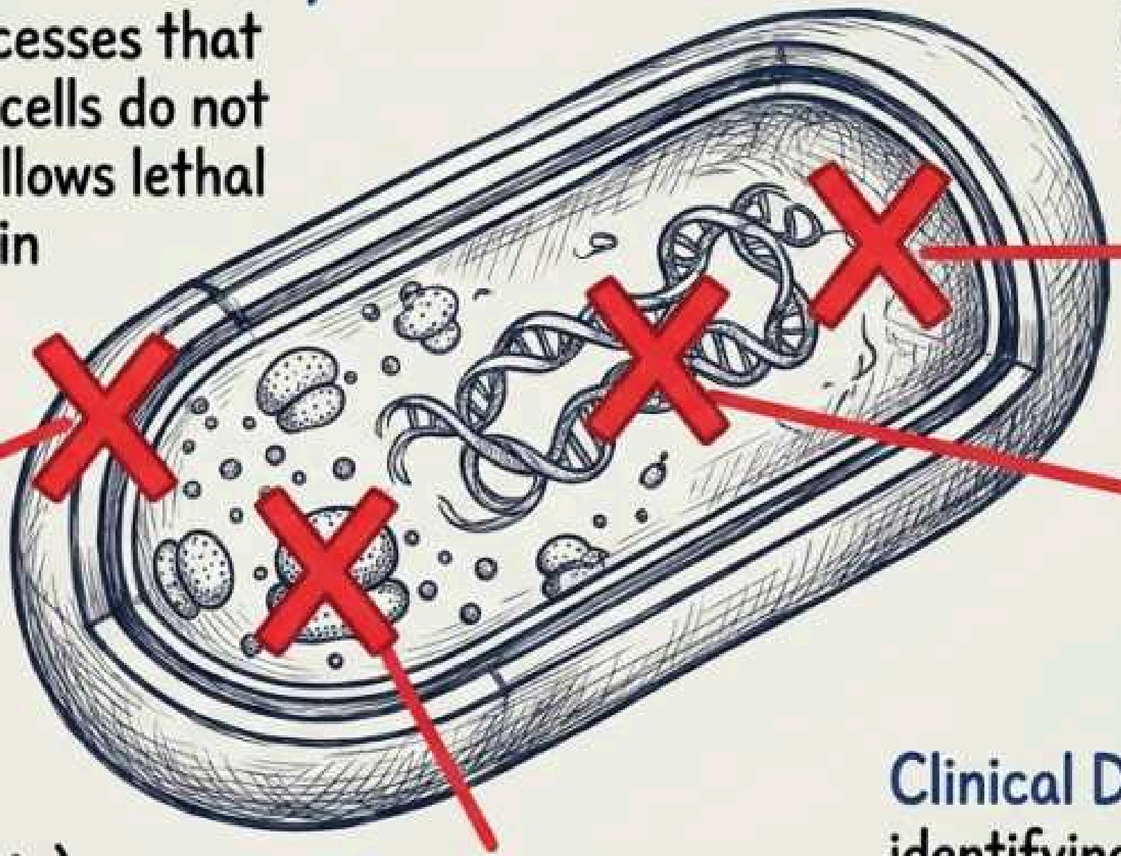
¶ 5.4

## The Core Principle: Selective Toxicity

Striking structures or processes that bacteria have and human cells do not (or use differently). This allows lethal bacterial doses that remain safe for humans.

## The Great Targets:

Cell wall, protein synthesis, DNA handling




## Spectrum:

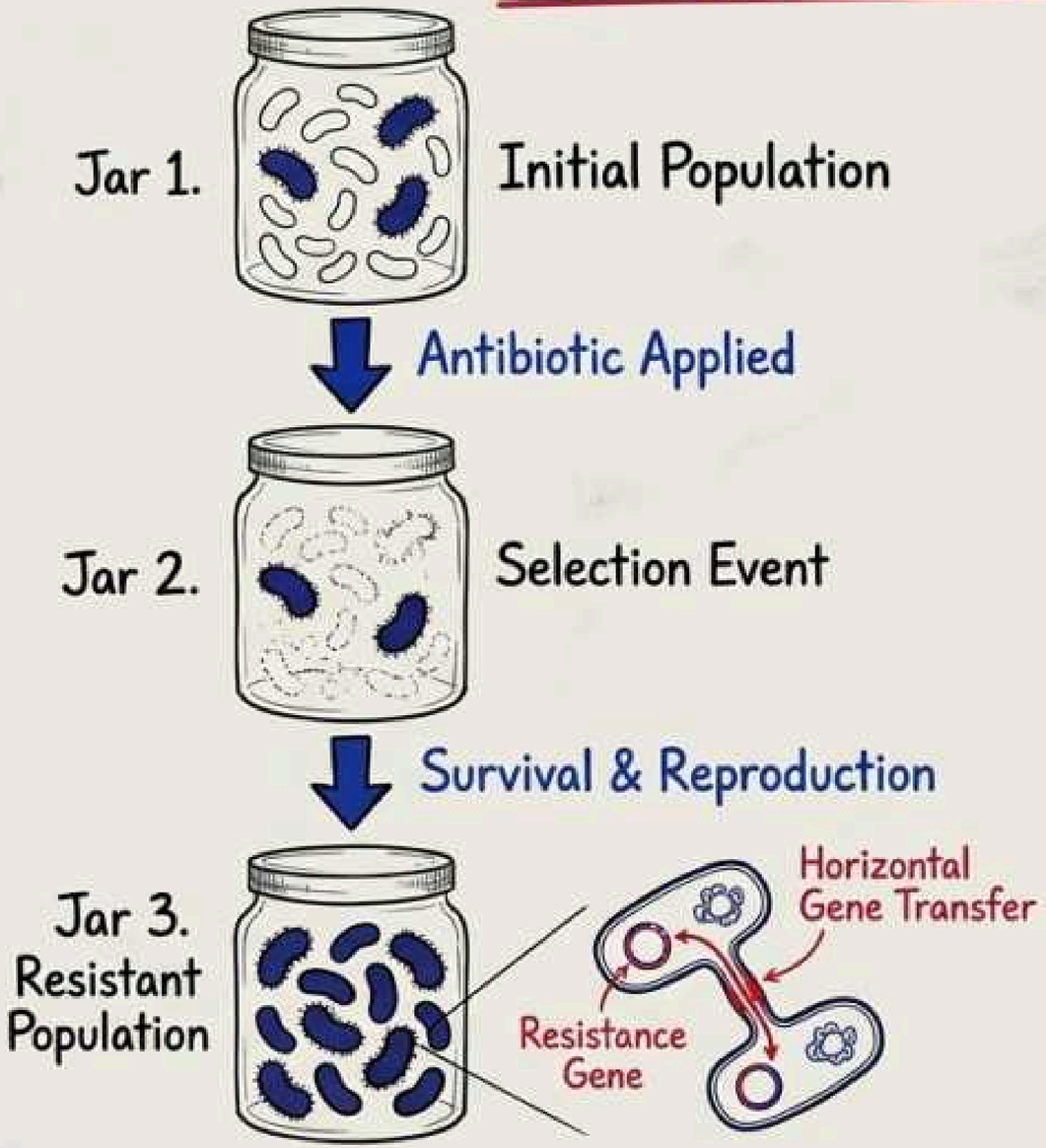
Narrow (specific bacteria) vs. Broad (wide range)

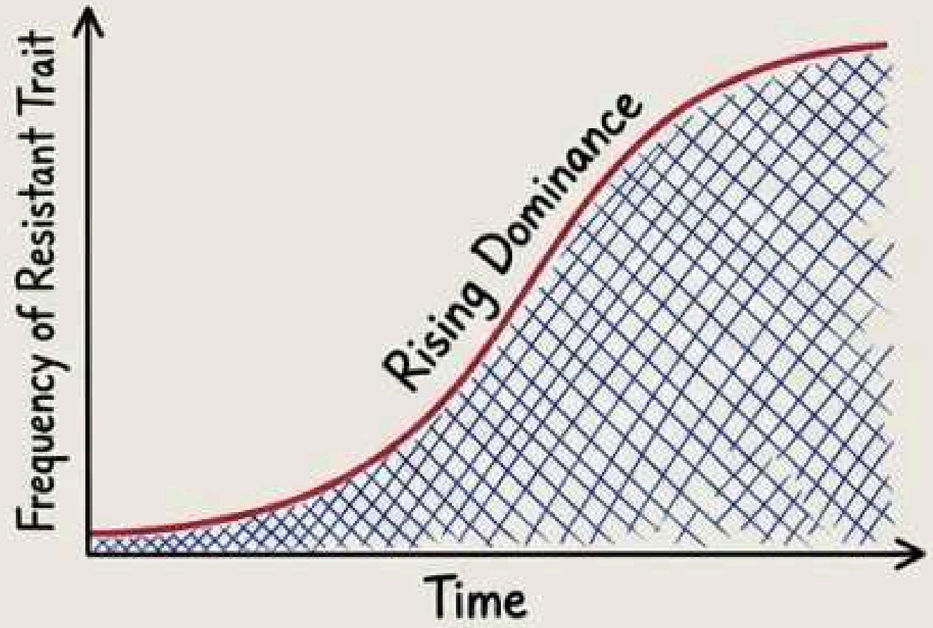
**Clinical Decision:** Choice relies on identifying the likely organism and knowing local resistance patterns.

(Course excludes specific doses/manufacturing details)

# Resistance: The Shadow of Selection

¶ 5.5



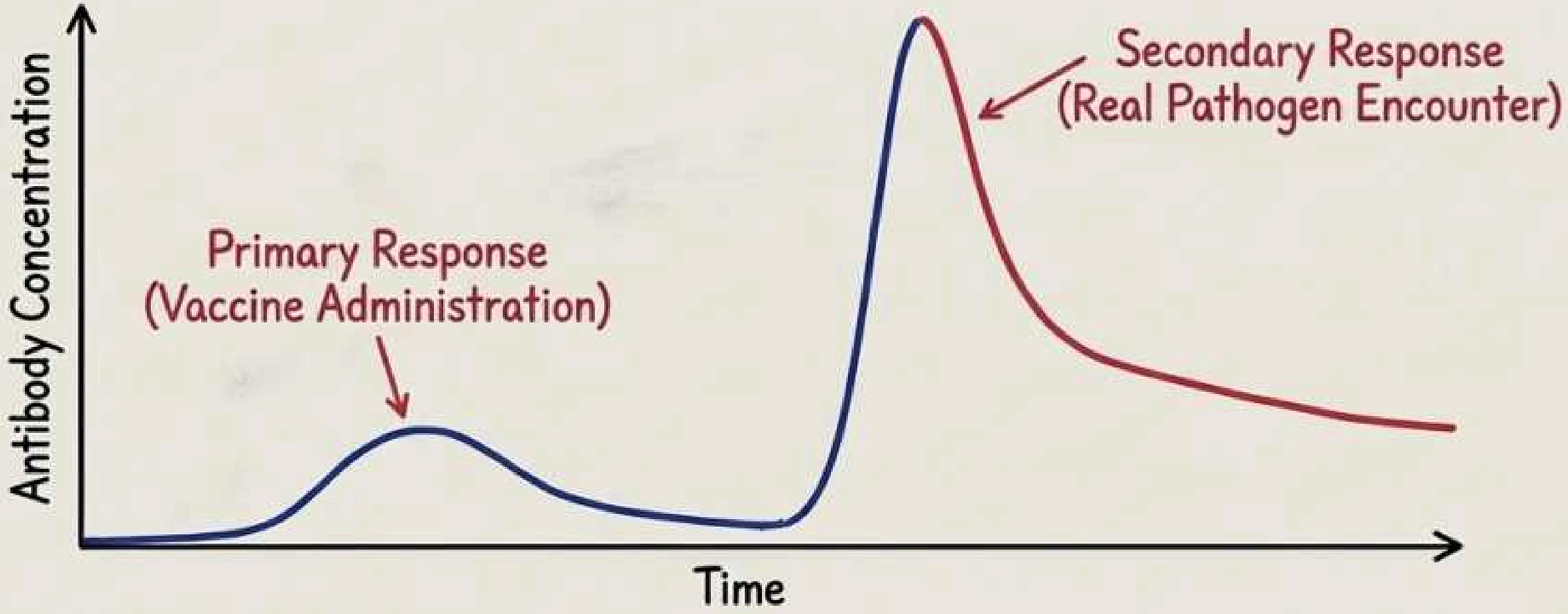




The Driver: Predictable result of selection pressure (variants survive, multiply, and share resistance genes).

Accelerators: Over-the-counter use, incomplete courses, treating viral illnesses, heavy/unnecessary use in certain settings.

The Answer (Not Despair): Careful prescribing, stringent infection prevention, new drug research, and vaccination (which reduces the need for drugs entirely).

# Vaccines: Teaching Immunological Memory ¶5.6




Mechanism: Presents a harmless/weakened threat (or genetic instruction) to prepare memory cells and antibodies before a dangerous encounter.

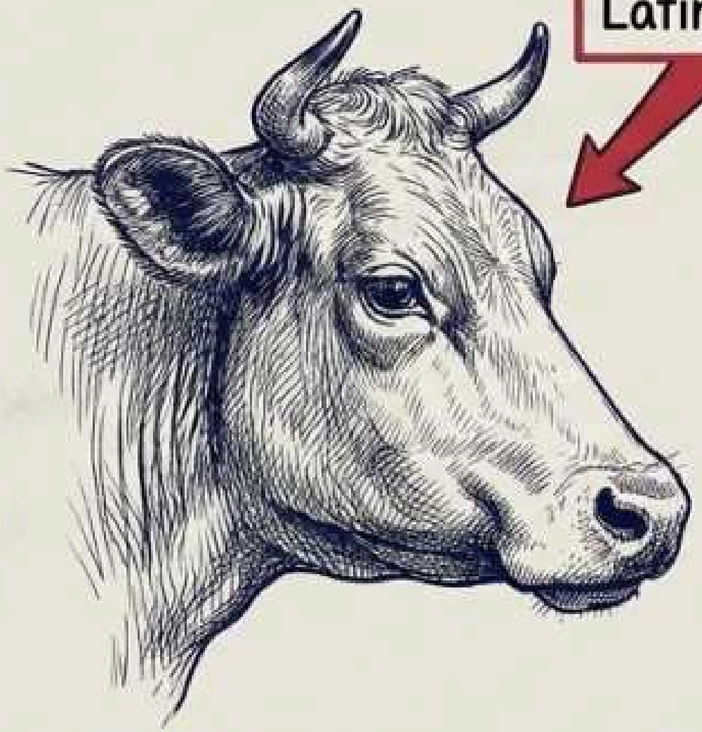
Result: Dramatic drop in illness, complications, and transmission.

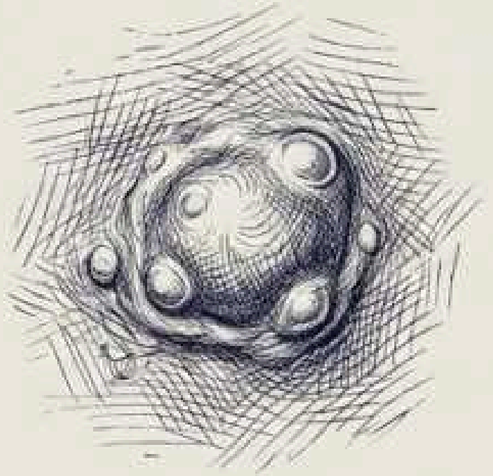
Consideration: Among medicine's most successful tools. Because they are given to healthy people (including children), massive benefits are weighed against meticulously watched safety standards.

# Historical Foundations: Jenner to Eradication

¶ 5.7

Latin *vacca* (cow) → Vaccine





1796 (Edward Jenner)
Proves cowpox material protects against smallpox (establishing the method and case).

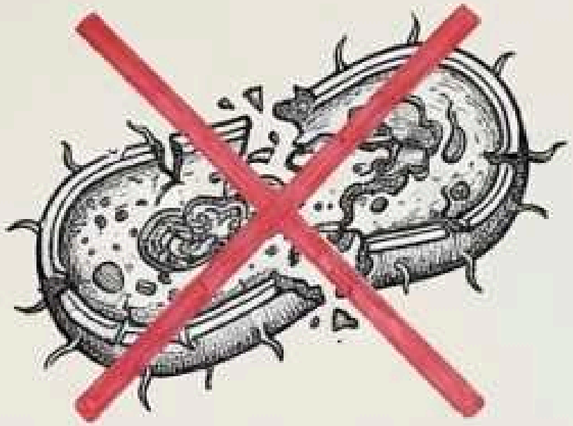
Late 19th Century (Louis Pasteur)
Extends the idea to other diseases; popularizes the term "vaccine" in Jenner's honor.

1980 (WHO Triumph)
Global eradication of smallpox declared.

Legacy: A unique achievement built on hard public-health labor, proving a well-used vaccine can fundamentally change the human condition.

# Four Broad Types of Vaccines

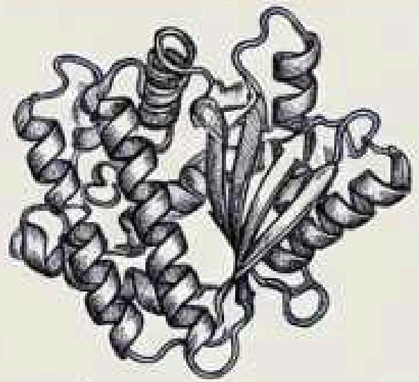
¶5.8



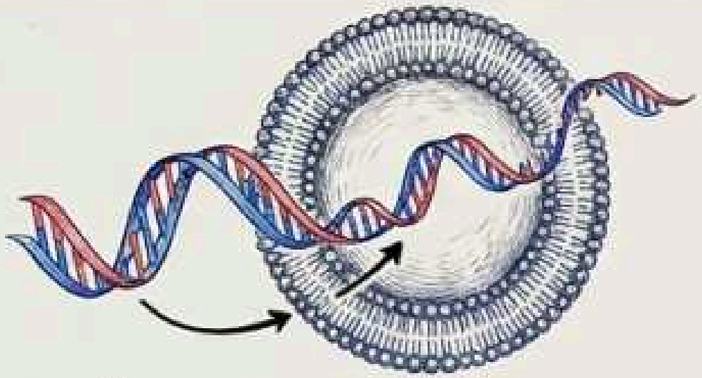
Inactivated: Killed organism.



Live Attenuated: Weakened organism. Raises strong immunity, but not suitable for patients without ordinary immunity.



Subunit / Toxoid: A piece of the organism (e.g., protein) or an inactivated harmless toxin. Cannot cause the infectious disease.

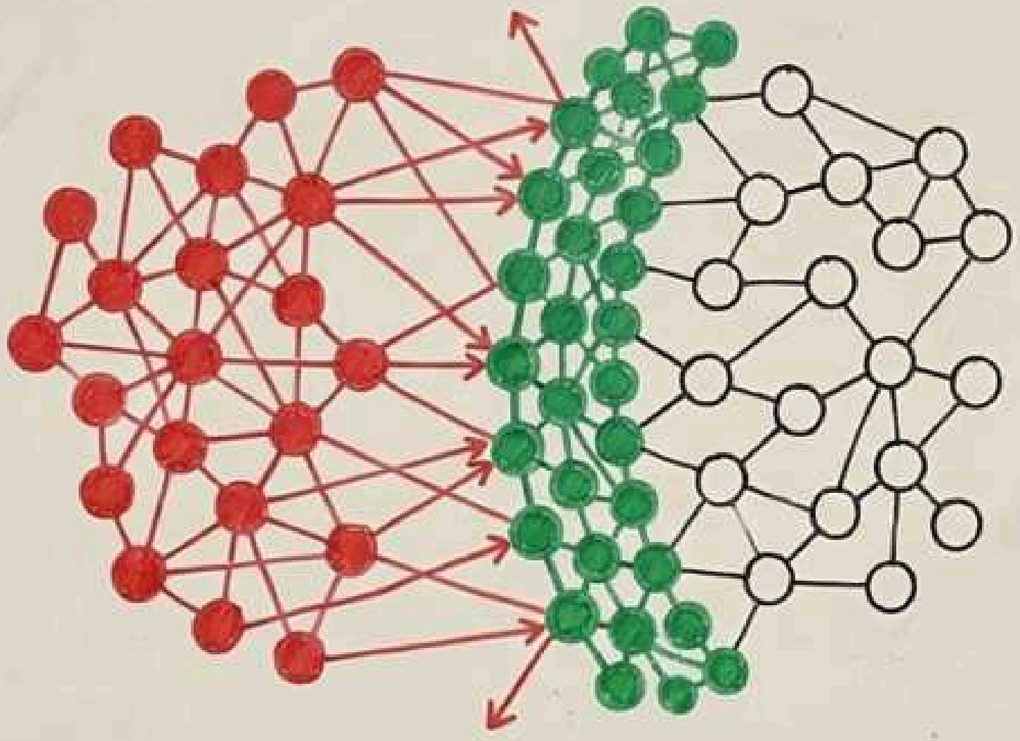


Genetic (Nucleic Acid): Genetic material instructs the recipient's cells to briefly make a viral protein to raise a response.

Note: Choice of type and schedule belongs to clinicians and public health authorities.

# Herd Immunity: A Population Effect

¶ 5.9



$$H_c = 1 - \frac{1}{R_0}$$

Concept: Breaks chains of transmission. Shelters those who cannot be vaccinated or who respond poorly.

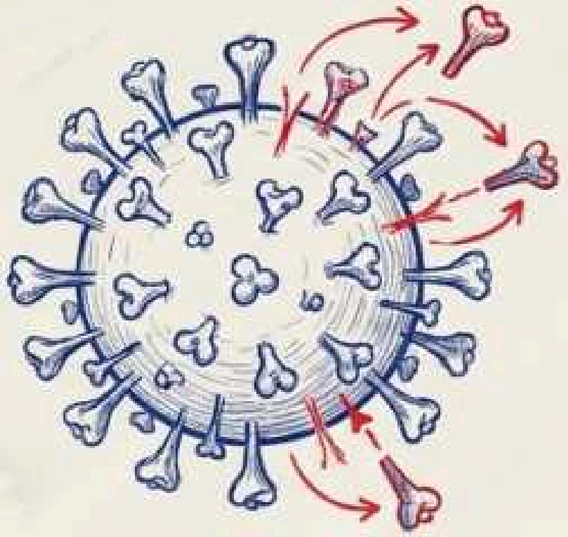
Variables: The "enough" threshold varies strictly by how readily a specific microbe spreads.

Reality: A useful idea but a fragile achievement. It is lost if immunity fades or new variants evade it. Vaccination is a public act, not just a private guarantee.

¶ 5.10

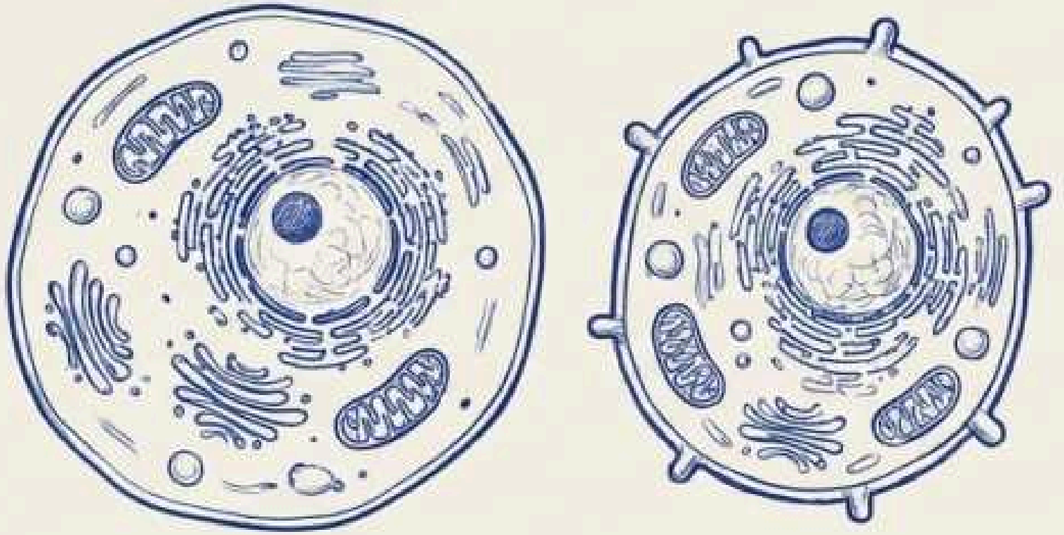
# The Limits of Medicines and Vaccines

## Vaccine Limits:



Design is immensely difficult when organisms hide well or rapidly mutate their surface proteins.

## Drug Limits:



Antifungal and antiparasitic drugs are fewer, more toxic, and easily evaded because their cells are structurally closer to human cells than bacteria are.

**Reality Check:** The contest is not over. Supportive care remains an essential pillar of medicine.

# Summary & Look Ahead

¶ 5.11

- **Pathogenesis Map Expanded:** Fungi and parasites widen the field beyond bacteria and viruses.
- **The Antimicrobial Age:** Driven by selective toxicity, but constantly shadowed by resistance.
- **Immunological Memory:** Jenner and Pasteur's legacy protects individuals and populations.

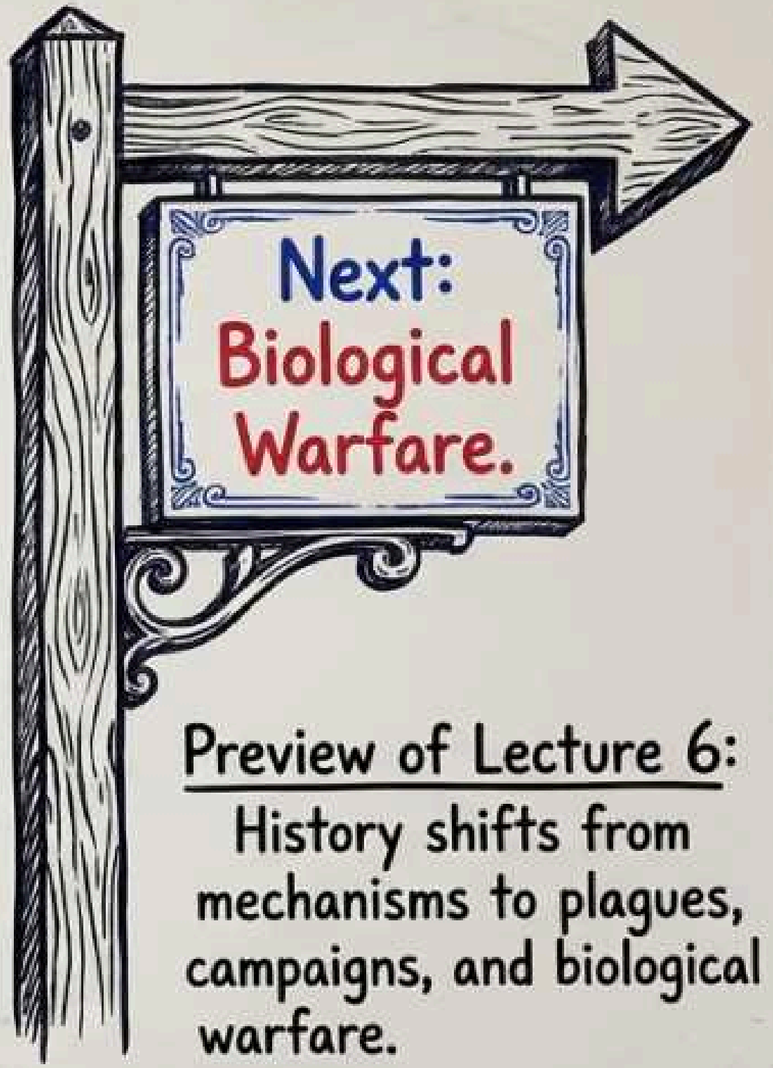
**Pathogens**
(Fungi/Parasites)

↓

**Interventions**
(Antibiotics/Vaccines)

↓

**Reactions**
(Resistance/Herd Immunity)




**Preview of Lecture 6:**

History shifts from mechanisms to plagues, campaigns, and biological warfare.

(Further reading: Grokipedia articles on vaccines, antibiotics, and antimicrobial resistance).