

5.1 Disease transmission and immune response

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS pathogen • antigen

Objective

Disease transmission and immune response. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

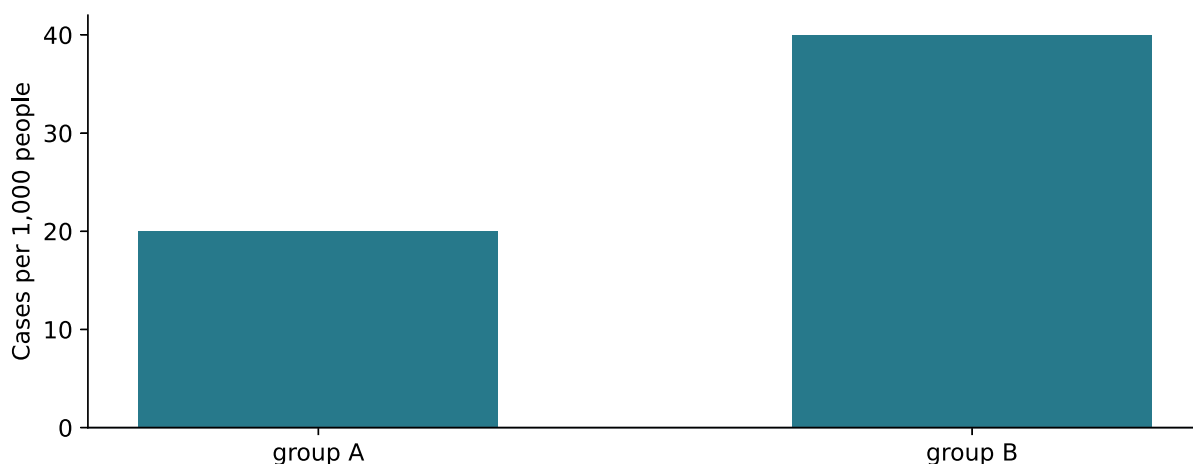
1 Key knowledge and worked examples

■ What would explain this observation?

- An antibiotic may help against a bacterial infection but fail against a viral illness. Treatment depends on the causal organism and the evidence supporting diagnosis.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- **Pathogens** cause infectious disease. Physical barriers, phagocytosis and specific immune responses reduce infection. Antibodies bind particular **antigens**. Vaccination exposes the immune system to antigen safely enough to develop memory.
- pathogen: An agent that causes disease; antigen: A structure recognized by a specific immune response.



■ Choose evidence that can test it

- After vaccination, memory cells can support a faster secondary response. Antibiotic resistance arises through heritable variation and selection; an individual bacterium does not choose to become resistant because it needs to survive.
- Use published infection data to compare rates per equal population size. Distinguish prevalence at a time from new cases over a period. In school, use safe simulations or approved cultures rather than collecting unknown pathogens.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: 18 cases occur in 900 people. Rate per 1,000 = cases / population $\times$ 1,000. Rate = $18/900 \times 1,000 = 20$ cases per 1,000. A second group with 10 cases in 250 people has 40 per 1,000, even though it has fewer cases.

Example:

12 cases occur among 600 people. Find cases per 1,000 people. Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- Antibiotics do not act on viruses in the same way they act on bacteria. A vaccine is not an immediate cure for an established infection.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

Every antibiotic is effective against every viral infection. This claim is false: Antibiotics do not act on viruses in the same way they act on bacteria. A vaccine is not an immediate cure for an established infection.

Key:

Disease transmission and immune response: After vaccination, memory cells can support a faster secondary response. Antibiotic resistance arises through heritable variation and selection; an individual bacterium does not choose to become resistant because it needs to survive.

2 Practice

2.1 What explains the spread of antibiotic resistance? Choose one answer.

- **A** Bacteria deliberately change all their genes
- **B** Resistant variants survive and reproduce more successfully
- **C** Antibiotics turn viruses into bacteria

[1]

2.2 12 cases occur among 600 people. Find cases per 1,000 people. Show the relation, substitution and units.

[2]

2.3 Decide whether this claim is true and justify: Every antibiotic is effective against every viral infection.

[2]

2.4 An agent that causes disease: write the technical term.

[1]

3 Exam-style questions

3.1 Fictional samples report 12 cases in 600 people and 8 in 200. Compare rates and identify what else is needed before concluding one exposure caused disease. [4]

Solutions

2.1 B After vaccination, memory cells can support a faster secondary response. Antibiotic resistance arises through heritable variation and selection; an individual bacterium does not choose to become resistant because it needs to survive.

2.2 rate per 1,000 = $12/600 \times 1,000 = 20$.

2.3 False. Antibiotics do not act on viruses in the same way they act on bacteria. A vaccine is not an immediate cure for an established infection.

2.4 pathogen. pathogen means An agent that causes disease.

3.1 Rates 20 and 40 per 1,000. Compare time windows, definitions, sampling and confounders. These proportions do not establish causation or an individual diagnosis.