

5.1 Disease transmission and immune response

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS pathogen • antigen

Objective

Disease transmission and immune response. Original classroom practice for IB HL; not an official IB paper.

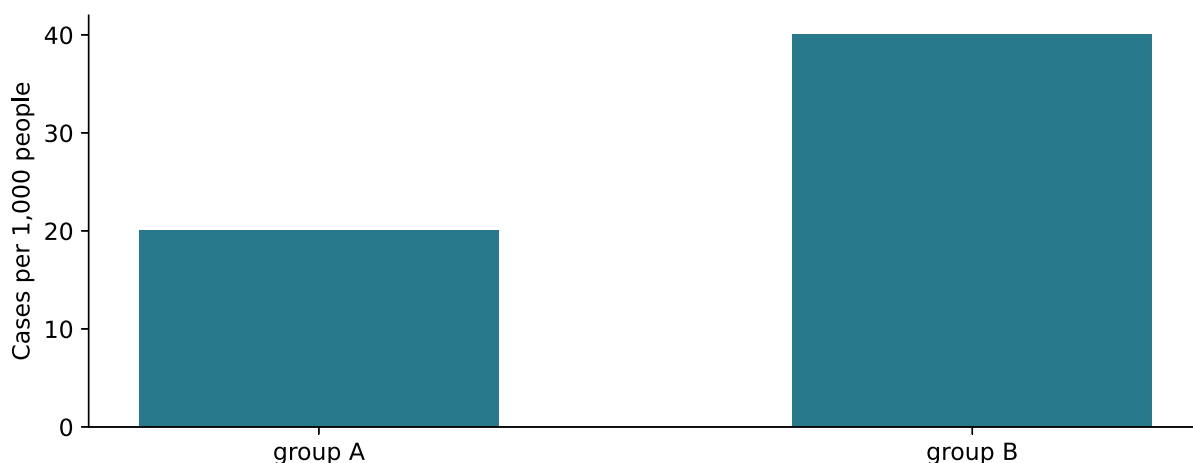
1 Key knowledge and worked examples

■ 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.
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■ 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.

In the lab: 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

- 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.

Your turn: 12 cases occur among 600 people. Find cases per 1,000 people.

■ 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.

Not true: Every antibiotic is effective against every viral infection. Antibiotics act on bacterial structures and processes that viruses do not have, so they cannot cure a viral infection. Using them against viruses adds selection pressure for resistance without benefit.

Key:

- Pathogens cause infectious disease.
- After vaccination, memory cells can support a faster secondary response.
- Watch for: antibiotics do not act on viruses in the same way they act on bacteria.

■ Write from 16 cases per 1000

- 8 cases occur among 500 people.
- Find the rate per 1000. A smaller case count can still be a higher rate.

2 Practice

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

- **A** Resistant variants survive and reproduce more successfully
- **B** Bacteria deliberately change all their genes
- **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 A Resistance spreads because resistant variants survive antibiotic treatment and reproduce, so their proportion rises; this is selection acting on existing variation. Bacteria do not change their genes deliberately, and antibiotics have no effect that turns viruses into bacteria.

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

2.3 False. Antibiotics act on bacterial structures and processes that viruses do not have, so they cannot cure a viral infection. Using them against viruses adds selection pressure for resistance without benefit.

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.