

8.5 Host–pathogen interaction and transmission

Name: _____ Class: _____ Date: _____

Total: 24 marks

KEY WORDS chain of infection • attack rate

Objective

Compute transmission: the chain, attack rates and R_0 .

1 Key knowledge and worked examples

■ The chain of infection

Reservoir → exit → route (contact, droplet, airborne, vector, vehicle) → entry → susceptible host ✓. Break any ONE link and transmission stops; carriers make reservoirs silent.

■ Worked example: the R_0 clock

$t_d \approx \text{SI} \times \log 2 / \log R_0$: influenza ($R_0 \approx 1.3$, SI 2–3 d) doubles in ~5–7 d; measles ($R_0 \approx 15$, SI ~11 d) in ~2.5–3 d ✓. Wedding arithmetic: $54/120 = 45\%$ attack rate.

2 Practice

2.1 List the five links of the chain, in order. [3]

2.2 36 of 90 picnic attendees fall ill – the attack rate? [3]

2.3 Why can a reservoir be a healthy person? [3]

3 Exam-style questions

3.1 A fictional banquet: 200 attendees, 92 develop gastroenteritis within 48 h; of the 100 who ate the seafood course, 78 fell ill; of the 100 who did not, 12 fell ill.

Calculate the overall attack rate ($92/200 = 46\%$) and the stratified rates (78 % vs 12 %). Name the likely vehicle and justify. Explain which link of the chain the kitchen's intervention breaks. [8]

3.2 A fictional ward: influenza with $R_0 \approx 1.3$, serial interval ~ 2.5 days.

Calculate the doubling time ($t_d \approx 2.5 \times \log 2 / \log 1.3 \approx 6.6$ days). Explain why isolation lowers the effective R , not R_0 . Explain why a measles importation ($R_0 \approx 15$, SI ~ 11 d) into a susceptible ward would outrun the same measures. [7]

Solutions

2.1

- Reservoir $\rightarrow$ exit $\rightarrow$ route $\rightarrow$ entry $\rightarrow$ susceptible host ✓.

2.2

- $36/90 = 0.4 = 40\%$ ✓.

2.3

- Carriers shed organisms without being sick – silent reservoirs (typhoid's chronic carriers) ✓.

3.1

- Overall: $92/200 = 46\%$ ✓.
- Stratified: $78/100 = 78\%$ (seafood eaters) vs $12/100 = 12\%$ (non-eaters) ✓.
- The 66-point gap names the seafood course as the vehicle.
- Removing/cooling the vehicle breaks the ROUTE (vehicle transmission) – one link, transmission ends ✓.

3.2

- $t_d \approx 2.5 \times 0.693/0.262 \approx 6.6$ days ✓.
- R_0 is intrinsic to the parasite-population pair; isolation and immunity lower the effective R actually realised ✓.
- Measles: $t_d \approx 11 \times 0.693/2.71 \approx 2.8$ days – doubling every ~ 3 days outruns isolation and tracing ✓.