

Exercise walk-through

8.5

Host–pathogen interaction and transmission

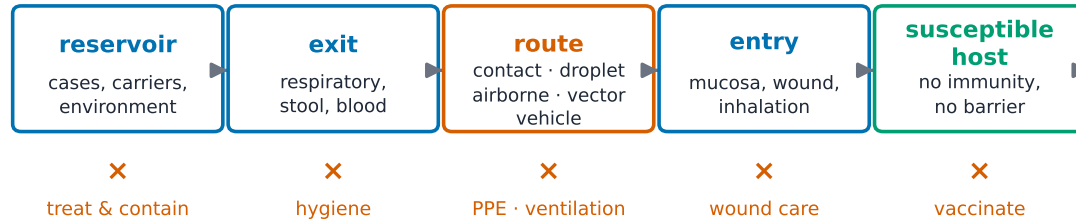
University Medicine

Transmission: the chain and R_0

- 1 **Chain** Reservoir → exit → route (contact, droplet, airborne, vector, vehicle) → entry → susceptible host.
- 2 **R_0 clock** Measles ~12-18, SARS-CoV-2 ancestral ~2.5-3, influenza ~1.3; doubling time = $SI \times \log 2 / \log R_0$ (flu ~5-7 d, measles ~2.5-3 d).
- 3 **Outbreak page one** 54/120 ill = 45% **attack rate**; stratify once by dish (85% vs 10%) and the vehicle is named.

The chain of infection with its transmission routes

carriers make reservoirs silent — sick patients are not the only source



break any ONE link → transmission stops

R_0 (secondary cases, fully susceptible population):

measles	12-18
SARS-CoV-2 (ancestral)	2.5-3
influenza	1.3

doubling $t_d \approx SI \cdot \log 2 / \log R_0$
 flu ~5-7 d · measles ~2.5-3 d

Five links; break any one and transmission ends.

Exercises 2.1-2.3

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]

Exercises 2.1-2.3

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

2.1

- Reservoir → exit → route → entry → susceptible host ✓.

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

2.2

- $36/90 = 0.4 = 40\%$ ✓.

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

2.3

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

Exercise 3.1

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]

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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 ✓.

Exercise 3.2

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]

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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 ✓.