

Exercise walk-through

7.4

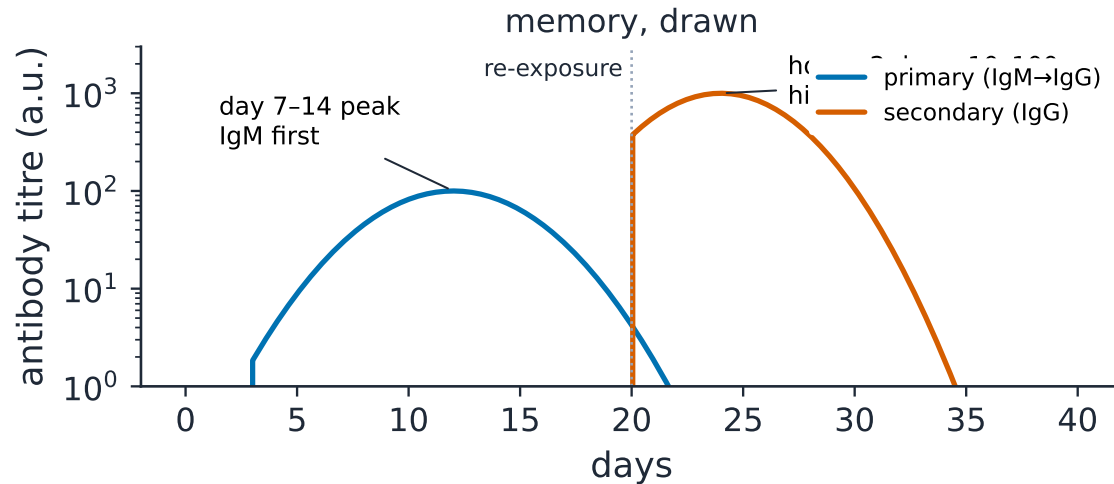
Immunological memory and vaccination

University Medicine

Immunological memory: the curve

- 1 **Primary** Lag 4–7 d, IgM→IgG, peak day 7–14, modest titre.
- 2 **Secondary** Hours–2 d, IgG at once, 10–100× higher, higher affinity: memory cells wait at higher frequency, pre-matured.
- 3 **Herd** Threshold $1 - 1/R_0$: measles (R_0 12–18) → 92–95%; influenza (1.3) → ~25% - one equation sets policy.

Immunological memory - figure



Primary vs secondary **antibody** curves (log scale).

Exercises 2.1-2.3

2.1 Which Ig class dominates a secondary response? [3]

2.2 Compute the herd threshold for $R_0 = 4$. [3]

2.3 Why does a 3-dose schedule exist for hepatitis B? [3]

Exercises 2.1-2.3

2.1 Which Ig class dominates a secondary response? [3]

2.1

- IgG ✓.

2.2 Compute the herd threshold for $R_0 = 4$. [3]

2.2

- $1 - 1/4 = 75\%$ ✓.

2.3 Why does a 3-dose schedule exist for hepatitis B? [3]

2.3

- Dose 1 primes, 2 boosts, 3 matures affinity and catches slow responders ✓.

Exercise 3.1

3.1 A serology shows day 5 IgM positive/IgG negative and day 16 IgM positive/IgG fourfold rise (fictional).

Interpret both timepoints (acute primary infection, seroconverting). Explain the class and titre pattern from the primary curve. State what a stable single IgG titre would mean.

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3.1

- Day 5: early primary – IgM first ✓. Day 16: seroconversion with class switch ✓.
- Primary curve: IgM within days, IgG rising to peak 7–14, titre modest; the fourfold IgG rise dates the response.
- Stable IgG alone: past infection or vaccination (no rise, no IgM).

Exercise 3.2

3.2 A region's measles vaccine coverage drops from 95 % to 84 % (fictional).

Compute the susceptible fraction above threshold (needed $\leq \sim 5\text{--}8\%$; now 16 %). Explain why outbreaks follow (R_0 12–18). State what coverage the region must restore and why influenza policy differs ($\sim 25\%$ threshold). [7]

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3.2

- Threshold herd $\approx 1 - 1/12$ to $1 - 1/18 = 92\text{--}95\%$ immune; at 84 % coverage susceptible $\approx 16\% > 5\text{--}8\%$ ✓.
- With R_0 12–18 each case infects >12 susceptibles: sustained transmission resumes.
- Restore $\geq 92\text{--}95\%$; influenza ($R_0 \approx 1.3$) needs only $\sim 25\%$, so its policy targets the vulnerable rather than transmission alone.