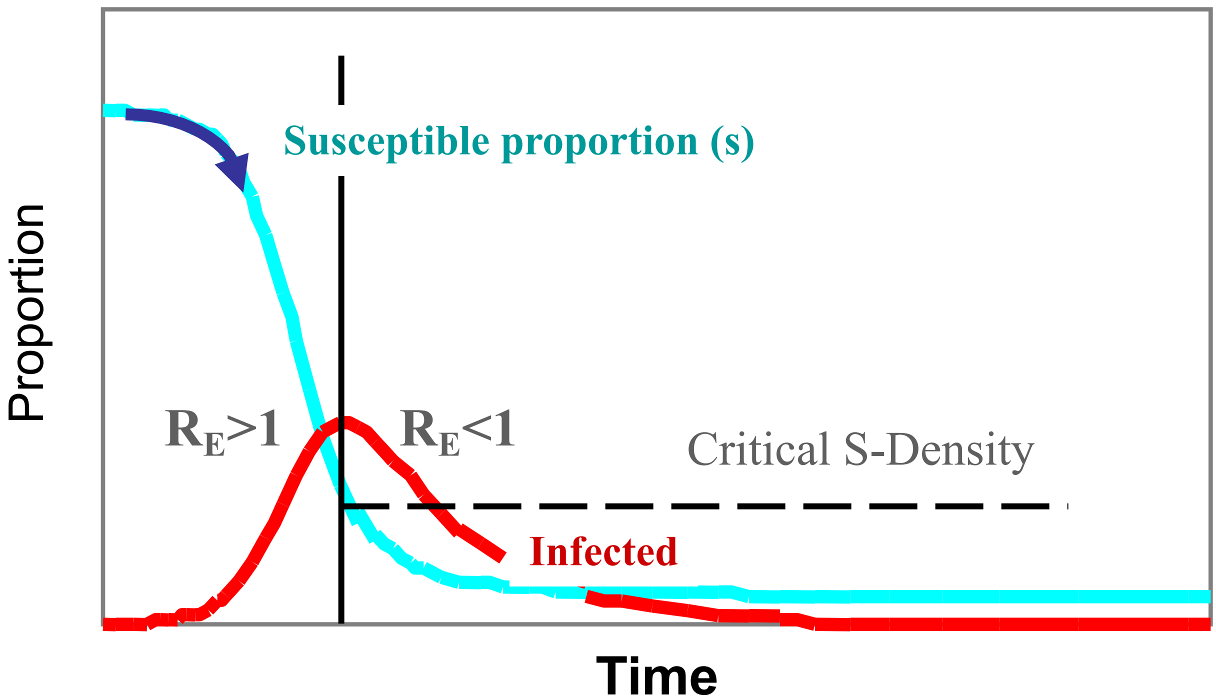
The anatomy of the simple epidemic



- Initial exponential growth with rate R_0
- Infection depletes the pool of susceptibles
- *effective reproductive ratio* R_E decreases
- R_E drops with susceptibles proportion: $R_E = R_0 s$. (eg R_0=18, s=0.5 makes R=9 secondary cases)
- R_E <1: Cases fall and epidemic dies out

The S-I-R model

Change in S = + new births – new infections - deaths

Per infectious rate of contact with others * Probability of Infection given contact * Probability that 'contactee' is suceptible * Number of infectious

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Transmisssion rate, β

$$\frac{dS}{dt} = \nu N - \beta \frac{S}{N} I - \mu S$$

ν = natality rate

μ = mortality rate

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Transmission rate, β

$$\frac{dS}{dt} = \nu N - \beta \frac{S}{N} I - \mu S$$

ν = natality rate

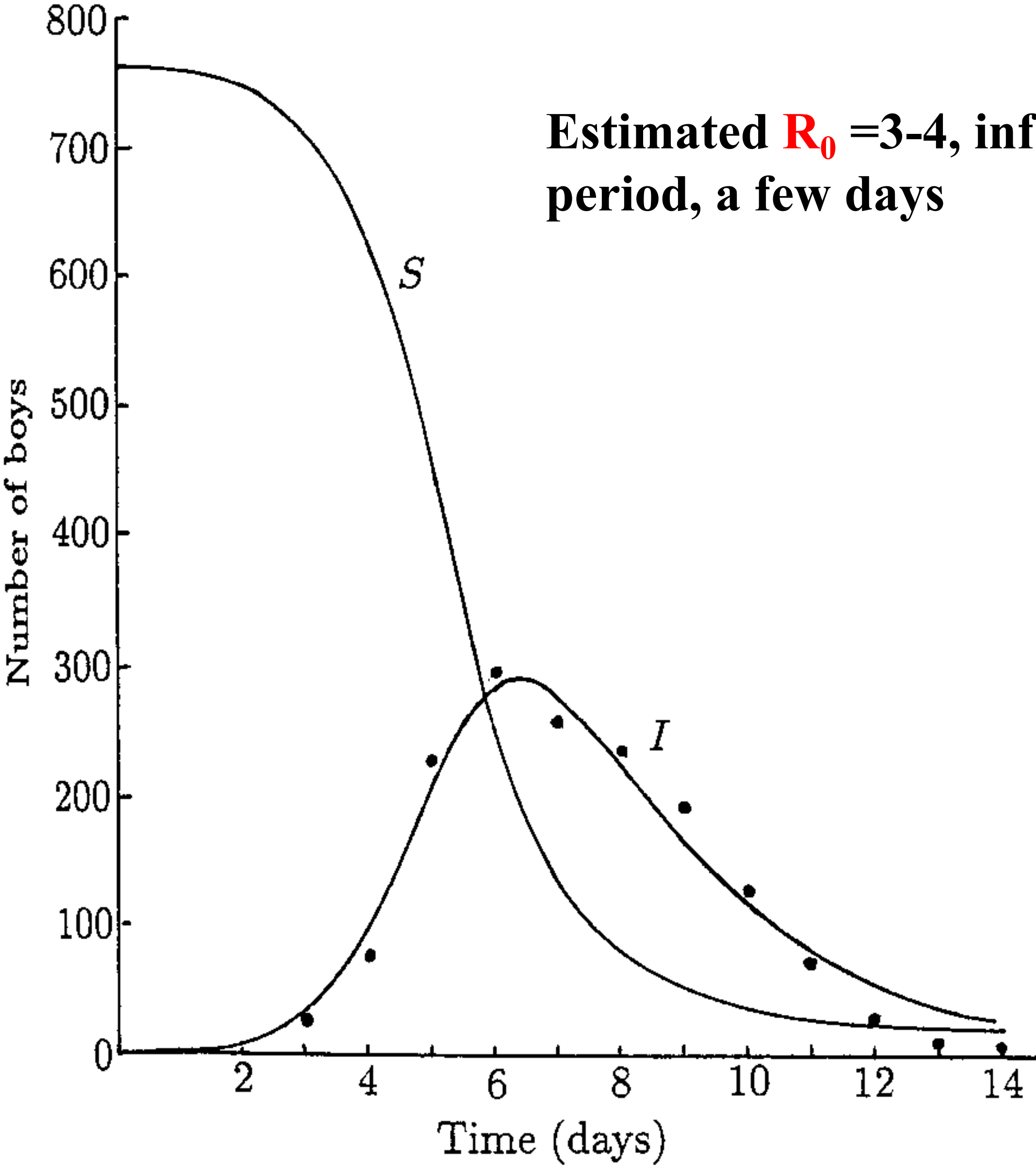
μ = mortality rate

Change in I = + new infections – new recovered - deaths

$$\frac{dI}{dt} = \beta \frac{S}{N} I - \gamma I - \mu I$$

$$\gamma = \frac{1}{\text{latent+infectious period}}$$

Ex. Outbreak of flu in a British boarding school



Estimated R_0 =3-4, infectious period, a few days

The Lancet, 4th March 1978

In-host immunology -> population flows

In-host dynamics -> population flows