Table 1.2 Approximate serial intervals, basic reproduction numbers and implied crude herd immunity thresholds (calculated as $1-1/R_0$) for common potentially vaccine-preventable diseases. Estimates drawn from [16, 12, 17, 18, 19, 20]. Adapted from Fine, 1993.[14]

Infection	Serial interval (range)	R_0	Herd immunity threshold (%)
Diphtheria	2–30 days	6–7	85
Influenza	2–4 days	2–4	50–75
Malaria	20 days	5–100	80–99
Measles	7–16 days	12–18	83–94
Mumps	8–32 days	4–7	75–86
Pertussis	5–35 days	12–17	92–94
Polio	2–45 days	2–4,* 8–14†	‡
Rubella	7–28 days	6–7	83–85
Smallpox	9–45 days	5–7	80–85
Tuberculosis§	Months–years	–	–

* populations with good hygiene; † populations with poor hygiene.[20]

‡ The herd immunity threshold for polio is controversial because immunity to infection is not solid.

§ R_0 and herd immunity threshold for tuberculosis are not well defined because of changes in contact over time and the long serial interval, as well as controversial issues over immunity and the extent of reinfection.

for which $R_0 > 1$ is introduced into a totally susceptible population, the incidence rises as each infectious person leads to more than one other infectious person. The incidence decreases once the susceptible population has been depleted so much so that the proportion that is susceptible is less than $1/R_0$ and the net reproduction number is less than one.

Though real life is typically rather more complicated than described by these thresholds (which assume a randomly mixing population), the relationship is nonetheless an important one.[15] We will meet it repeatedly in the pages which follow.

1.4 Models

A model is just a simplified representation of a complex phenomenon. We are all familiar with the use of models in various contexts—by architects, economists and many branches of biomedicine—for example, the use of laboratory animals as models when carrying out research on drugs or toxic materials. The more complex a phenomenon is, or the more difficult and expensive it is to study, or the greater the ethical implications of carrying out research, then the greater is the motive to explore models. Through logic, infectious diseases in humans are obvious subjects for modelling—they are difficult and expensive, and ethically