R0 What is it and how do our actions affect it?

Education in Chemistry
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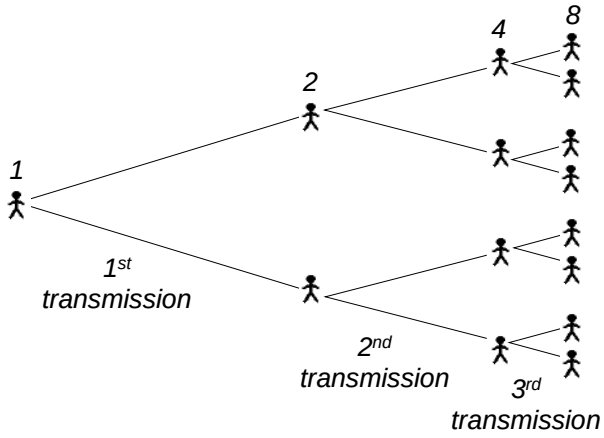
In an attempt to control the spread of the coronavirus, governments around the world are implementing strategies to reduce something called the R0 value. But what exactly is the R0 value and how can our actions change it?

1. The basic reproduction number, R0 is described as;

R0 = the average number of cases of an infection directly generated by one case in a population, where all individuals are susceptible to infection.

For every one person with the virus it is an indication of how many they will go on to infect.

For example if a virus has an R0 value of 2, after 3 transmissions 8 people (2^3) will be infected.



By reducing the R0 value below 1 the virus will eventually be eradicated.

a. If the R0 value in a population of 10 people known to be carrying the infection is reduced to 0.5, show diagrammatically that after 4 transmissions the number of people with the infection will be less than 1.

It is possible to calculate the number of people infected after t transmissions using the equation: $N_t = N_0 \times {R_0}^t$

where N_t = the number of people infected after t transmissions
N_o = the number of people infected initially
R_o = the basic reproduction number
t = the number of transmissions

b. If 150,000 people in a population are known to be infected calculate the number of people who will be infected, N_t, after 10 transmissions when:

i. R0 = 0.8 ii. R0 = 0.5 iii. R0 = 0.2

2. One simple way to estimate the R0 value can be described using the equation:

$$R0 = \beta \times \tau$$

where β = the average number of infection producing contacts per unit time

τ = the mean length of time an individual is infectious

By reducing one or other of β or τ , or both of them, the R0 value is reduced.

It is possible to reduce the average number of infection producing contacts per unit time, β by either;

1. reducing the number of contacts per unit time
   or
2. reducing the proportion of contacts that produces infection

a. Look at **Table 1** which lists some of the interventions introduced around the world, each of which reduce β. For each intervention listed, decide if it **reduces the number of contacts per unit time** or **reduces the proportion of contacts that produces infection**.

Some extra rows have been left at the bottom of the table. Add in other interventions that you can think of that have been put in place to reduce β.

Table 1

Intervention	Reduces the number of contacts per unit time	Reduces the proportion of contacts that produces infection
Cancelling sporting events		
Disinfecting trolley handles in the supermarket		
Closing schools		
Limiting outdoor exercise to once a day		
Closing restaurants		
Handwashing		
Finding a vaccine		

b. Using the equation for calculating R0 predict, and explain, the impact each of the changes below is likely to have on the R0 value

i. introducing the compulsory wearing of face masks when outdoors

ii. relaxing lockdown rules to allow small group gatherings of 10 people or less

c. An alternative approach to fighting the virus is called herd immunity. Herd immunity refers to a situation where enough people have immunity to an infection to be able to effectively stop that disease from spreading.

Explain how herd immunity stops the virus spreading.