Potential trajectories for COVID-19 in the next 6 months

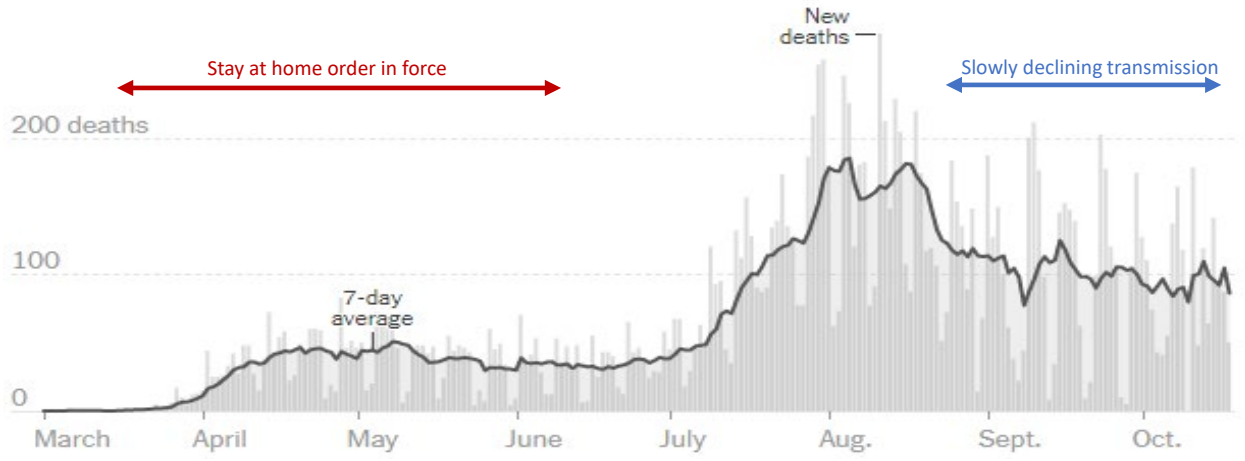
The dynamics of the current "second wave" of COVID-19 transmission have important differences from the first wave. Until interventions were introduced in mid-March, the reproduction number, R, of the virus was close to 3 and the epidemic was doubling every 3-4 days. Lockdown abruptly reduced contact rates between people in different households, causing R to fall to approximately 0.6.

Now we are seeing epidemic growth again across the UK, but at a much lower rate - characterised by R=1.2-1.5 and doubling times in the 2-3 week range. The lower reproduction number reflects the ongoing large impact of controls. Population contact rates remain at about half of pre-lockdown levels, as measured by the CoMix contact survey. Infection rates are growing because a 50% reduction is insufficient to control the spread of this virus. With a basic reproduction number of 3, controls need to reduce infectious contacts by two thirds.

As the additional control measures announced recently take effect, we hope that R may be pulled down further - perhaps to 1.1 or lower. With R at such low levels, even limited accumulation of population immunity will start reducing the average susceptibility of the population, slowing transmission. When R is 1.1, only 9% of the remaining susceptible (i.e. not previously infected) population need to be infected for R to fall to 1, solely as a result of the natural dynamics of the epidemic. At this point, in some sense, population immunity has caused the epidemic to plateau. However, this is very different from a classic "herd-immunity" scenario, where an epidemic has run through a population with limited impact of control measures:

- The decline in infection rates seen after cases plateau will be slow, driven by gradual accumulation of population immunity - potentially leading to a long, relatively flat plateau of relatively high incidence unless measures are further intensified to drive incidence down.
- There will be very limited room to relax interventions, since the absolute level of population immunity reached will likely still be low. In the example where interventions cause R to be reduced to 1.1 and population immunity then gradually reduces R to 1, changes in effective contacts will be responsible for over 90% of control and immunity for less than 10%. Relaxing measures will therefore easily cause R to exceed 1 once more.
- This relaxation following peaking of infection rates could be due to spontaneous behaviour change or government-induced. In either case it could result in a prolonged period of high incidence, with associated pressures on health services and deaths.

Trends seen in a number of US states in recent months (e.g. Florida, see below) are suggestive of this type of dynamics



Daily reported COVID-19 deaths in Florida, USA (© *New York Times*) with lockdown period indicated