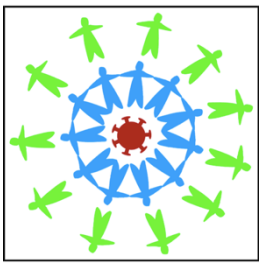
THE EPIDEMIOLOGY ADVENTURE: BEING A DISEASE DETECTIVE
31.3.2020



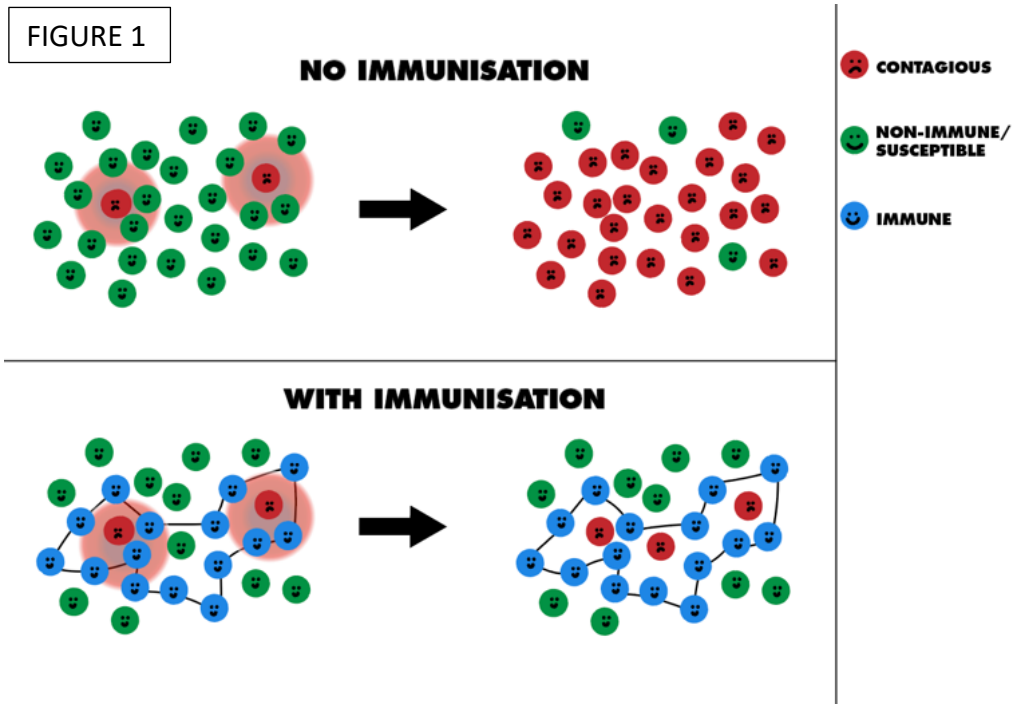
Episode 3: Public Health Policies and "Herd Immunity"

More and more we hear about herd immunity as a possible strategy against Covid-19. Herd immunity is also known as community immunity, population immunity, social immunity or group immunity. The general idea behind this strategy is to build a social wall against the virus. It is a goal for diseases for which we have vaccines but it can also be created in a natural way.

How can social immunity be built up?

As a proportion of people develop immunity (either through vaccination or natural immunity), the infection is unable to propagate effectively in the population and so the transmission is slowed. But there may be some secondary cases or even short chains of infection that remain within the population. These chains are sooner or later broken, hence the infection is not dying out. Eliminating infections will only be achieved with widespread vaccination, by using tried, tested and extremely safe vaccines. However, as there is currently no vaccine for Covid-19 herd immunity can only be achieved by allowing individuals to fall ill and recover, thereby developing natural immunity against the virus (FIGURE 1).

FIGURE 1

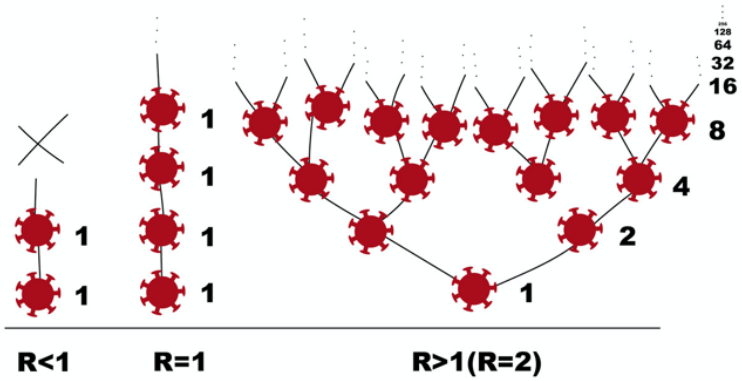


How many people do have to get immune in order to protect the others?

A very rough estimate suggests that we will only reach herd immunity to Covid-19 when approximately 60-70% of the population develop immunity. To determine this level of herd immunity, epidemiologists use a concept which is the "reproductive ratio or R_0". As Michele explained in a previous episode, R_0 is the number of people that are likely to be infected by a single case when a new pathogen appears in a community with no prior immunity (FIGURE 2). This number is higher at the beginning. For example, R_0=2 means that after the first case there

will be 2, then 4, then 8, 16, 32 ..... etc. But by the time half the population is immune, on average half the people exposed from a single case will be immune and therefore only one person per infected person gets the infection. The numbers will decrease over time and the disease will actually die out fairly quickly. By this time, 60-70% of the immune population could be protecting 30-40% of the vulnerable population. R_0 for Covid-19 has been reported to be 2.0 to 3.0 (2.0-2.5 according to WHO). R_0 is therefore used as a common unit of potential transmission.

FIGURE 2 : R_0



Is it possible to achieve a controlled social immunity for Covid-19?

It could be possible and in fact, although **it is not a goal by itself**, and in fact this may be the natural outcome of the disease as there are no current measures that can make the virus disappear. At this time the novel coronavirus has spread across the world and countries have to decide on the best way to respond taking into account various different options whilst safely protecting their citizens, health systems and infrastructures. Think about how many people would have to be immune in your country. If the science tells us that about 60% of the population needs to develop immunity, that would mean around 28 million people in Spain, 49 million in Germany or 36 million in Italy and the United Kingdom. If all these cases occur at the same time, in a very tall and sudden peak, the healthcare facilities would become overwhelmed and even healthcare providers themselves infected and not able to provide proper care. Furthermore, it would not be possible to control the infection spreading to 'high risk' people.

For all these reasons different measurements are in place to delay the peak of the disease, so that those people who suffer the more severe forms of the disease are able to be cared for properly. Measures include preventing infections through early detection of the source and contacts, social distancing, etc. Controlling the spread of Covid-19 is one of the strategies considered in international health policies.

Covid-19 health policy

Health policy refers to decisions, plans, and actions that are undertaken to – in this specific case – prepare for and respond to Covid-19. For these decisions scientists and policy makers need epidemiological knowledge based on data together with the expertise of specialists

from different backgrounds. There are two possible strategies: (a) mitigation with maximum control or (b) suppression. In theory there is a third option which is doing nothing, but this does not apply to Covid-19.

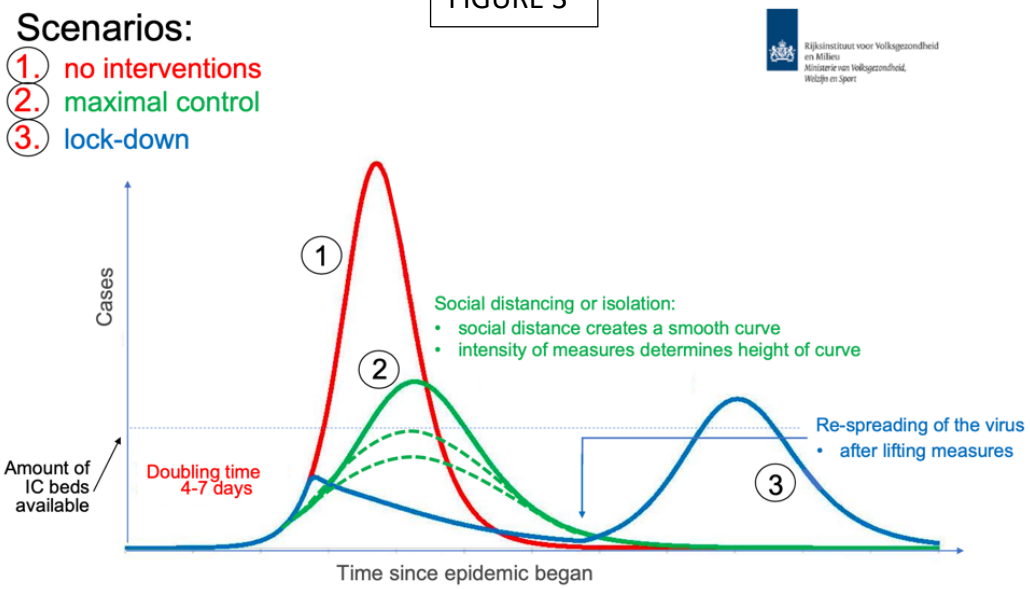
Mitigation or maximum control of the virus: the aim is not to interrupt transmission completely, but to reduce the health impact and build herd immunity. The reproductive value (R_0) of the virus is reduced but not below 1. This strategy leads to a decline in case numbers and transmission drops to low levels (FIGURE 3). Depending on how citizens respond to measurements, which highly likely varies between countries and even communities, government interventions are put in place. Mitigation policies could include the combination of hygiene rules, home isolation of suspected cases, home quarantine of suspected cases and social distancing.

The advantages of the strategies are:

- Most people will experience minor symptoms and will recover
- Most people will build immunity and create herd immunity
- The capacity of the health system is not overwhelmed and able to treat vulnerable patients.

Suppression (lock-down) or maximum containment of the virus: tries to eliminate human-to human transmission by reducing the reproductive value (R_0) to below 1. Measurements could be home isolation of cases, social distancing, household quarantine and school and university closures. The main challenge is that the measures have to be maintained for as long as the virus is circulating or until a vaccine is available. Transmission rebounds if interventions are relaxed. Social and economic challenges are also present and may also have an impact on health at medium-long term.

FIGURE 3



Source: Dutch Government: https://www.tweedekamer.nl

What is the best strategy?

There is no easy policy decision to make as consequences and the impact of these decisions are difficult to foresee for an unknown or new virus. Response to measurements varies among countries and communities. Policy makers and scientists use epidemiological data and tools to create scenarios and predict the impact. Above FIGURE 3 shows the scenarios from the Dutch National Institute for Public Health and Environment (RIVM). The scenarios are shown by number of cases and time. The 'amount of available intensive care beds' is the threshold in order to make decisions. The Dutch government has chosen the maximum control scenario that should be adjusted considering the progress of the outbreak. This seems to be the most chosen strategy among different European countries. As new information is available it is included in the reports so the government can decide whether to ease restrictions or implement stricter measures.

Please excuse any oversights I may be blind to and feel free to contact me and let me know of any "errors and omissions" in this article.

Any questions, please send me an email and I will answer them in the next publication.

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