https://doi.org/10.33591/sfp.46.4.u4

UNIT NO. 4

THE IMPORTANCE OF SOCIAL DISTANCING

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ABSTRACT

As countries battle the COVID-19 pandemic, it is important to understand why certain public health policies and practices are adopted. This article seeks to explain basic communicable disease epidemiological concepts such as Reproductive Ratio, Serial Interval and Incubation Period. The article also demonstrates the effects of exponential growth on cluster size. These concepts help us to better understand the "disease dynamics" of COVID-19 and so enable us to understand better the policies and practices employed to combat COVID-19, e.g. social distancing, personal hygiene and mask-wearing.

Keywords
Reproductive Ratio, Serial Interval, Incubation Period, Social Distancing

SFP2020; 46(4) : 23-25

INTRODUCTION

After Coronavirus Disease (COVID-19) hit our shores with the first case on 23rd January 2020, Singapore introduced a slew of measures to enforce social distancing in its bid to stop the spread of the communicable disease. Increasingly severe social distancing measures culminated in the introduction of Circuit Breaker measures on 21st April, which has now been extended to 1st June 2020.

To understand why is social distancing so important, we need to understand some basic concepts of communicable disease epidemiology, or the "disease dynamics" of COVID-19.

REPRODUCTIVE RATIO (REPRODUCTION NUMBER)

Reproductive ratio (Ro) is the average number of new cases a case of the diseases will infect; it is also defined as the expected number of secondary infections arising from a single individual during his entire infectious period. It is the "natural" state of a communicable disease where disease control measures have not been put in place and there is no vaccine or cure for the disease (i.e. everyone is susceptible to the disease if exposed to it). World Health Organisation (WHO) estimates the basic reproductive ratio for COVID-19 to be between 2 and 2.5.[1]

The effective reproductive ratio (Rt) can be lesser or greater than Ro. With an effective intervention, Rt can be <1, in which the size of the outbreak shrinks with time. Conversely, if Rt >1, the size of the outbreak increases with time. Under certain unfavorable conditions, Rt can be > Ro (e.g. on cruise ships or foreign worker dorms).

MEDIAN INCUBATION PERIOD

Incubation period is the time taken for an infected person to show signs and symptoms of the disease after he has been exposed to the communicable disease infectious agent. The median incubation period would be when 50 percent of the cases have developed signs and symptoms. The current local understanding for COVID-19 is that the median incubation period can be as short as four days.[2] The WHO estimates it to be about five to six days.[3]

SERIAL INTERVAL

Serial Interval refers to the time between successive cases in a chain of transmission. The serial interval for COVID-19 was thought to be about five to six days (WHO website).[1] Some estimates of the serial interval for COVID-19 is four days. [4]

Communicable disease control is a race against time, or rather, a race against the serial interval. Speed is the essence. The longer you miss picking up a cluster, the greater the size of the cluster. You are fighting with an exponential enemy.

Unlike reproductive ratio, serial interval is an "intrinsic feature" of the disease that cannot be easily altered by our behaviour.

MEDIAN INCUBATION PERIOD AND SERIAL INTERVAL

In the case of COVID-19, both the median incubation period and the serial interval is estimated to between five to six days. This would imply that only half of the cases would have displayed signs and symptoms (i.e. median) even though a significant proportion of cases would have already transmitted the disease to the next generation of cases. This means that COVID-19 has a significant propensity for asymptomatic or pre-symptomatic transmission. If this was not the case, the serial interval would be significantly longer than the median incubation period.

Table 1 illustrates the critical importance of detecting a cluster as early as possible and put in containment measures to limit the spread of the disease and growth of the cluster size.

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Table 1. Dealing with an Exponential Enemy

Serial Interval	5	5	5	5	5	5	4	4	4	4	4	4
Reproductive Ratio (Ro)	1	1.25	2	2.5	3	4	1	1.25	2	2.5	3	4
Days Elapsed	15	15	15	15	15	15	16	16	16	16	16	16
Cumulative Cluster Size	4	5	15	25	40	85	5	8	31`	64	121	341
Days Elapsed	30	30	30	30	30	30	28	28	28	28	28	28
Cumulative Cluster Size	7	15	127	406	1093	5461	8	19	255	1016	3280	21,845

Note:
1. The above numbers are simplified because it omits persons being cured or dying from the disease.
2. Mathematical formula: cumulative cluster size = 1 + Rt + Rt2 + Rt3 + Rt4....Cluster size is rounded down to nearest whole number

If R=1, each case only spreads to another case and the cluster size does not grow. If the serial interval is five days, after 30 days, the cumulative cluster size is only seven because there have been six generations of transmission. However, if left unchecked, the cluster would have grown to 127 (assuming that the Ro is 2). In the case where the effective reproductive ratio is raised to 3 or 4, such as in the cramped conditions of a cruise ship or a dormitory, the cluster size would grow to the thousands. If the serial interval is shortened to four days, the cluster size can be a catastrophic ~21,000 after just 28 days.

The numbers are far manageable if we manage to pick up cases after about two weeks and not four weeks. The size of the cluster at two weeks is a small fraction of the cluster after four weeks.

This table demonstrates the frightening power of exponential growth. Our education and experience are such that most of us are wired to appreciate linear or geometric growth, but not exponential growth. Left to ourselves, our minds usually tend to underestimate the realities of exponential growth.

MEASURES TO FIGHT COVID-19

Table 1 also demonstrates why social distancing remains the most important measure – it has an exponential effect on cutting down cases. For example, if we normally meet an average of 100 persons a day, and the Ro is 2, the effective reproductive ratio (Rt) can be halved to 1 by meeting up with less people (i.e. meeting 50 persons) in a day. If good social distancing is practiced, the Rt can be reduced to 0.5 (i.e. meeting 25 persons a day). If this is practiced by the whole community, the cluster size will quickly decrease with time.

Personal hygiene is also very important, but does not have an exponential punch like social distancing. The evidence of wearing of masks by the community is that it only has an incremental effect on reducing transmission.

Do note that social distancing concerns do not apply to a doctor with respect to patients as long as appropriate steps are taken so that all exposure is considered PROTECTED exposure. (i.e. wear enough PPE for the exposure time).

Social distancing is different from PHYSICAL distancing. When essential services are offered, there needs to be physical distancing – clinic waiting area, queueing in hawker centres etc. Social distancing is about meeting less people in our daily lives. Physical distancing is keeping an appropriate distance between people and us when we HAVE to meet in the course of taking part in essential services, whether as a provider or a consumer.

COMPARISON BETWEEN SARS AND COVID-19

During the severe acute respiratory syndrome (SARS) outbreak in 2003, the situation was very dire. Tan Tock Seng Hospital (TTSH) was closed and converted into SARS Central, causing 20 percent of restructured hospital acute bed capacity to be occupied. Singapore had fewer general hospitals in the public healthcare system then. With Tan Tock Seng Hospital (TTSH) closed and converted into a SARS central, Singapore was down to four general hospitals: Singapore General Hospital (SGH), Changi General Hospital (CGH), Alexandra Hospital (AH) and National University Hospital (NUH).

Although there was an outbreak in SGH, SGH could not be converted to another SARS Central. Singapore General Hospital continued with urgent and emergency work throughout the SARS period.

Hence, although the number of COVID-19 patients is more than 20,000 in Singapore, low-risk young (especially the foreign workers staying in dormitories) patients are moved quickly and housed in community isolation, care and recovery facilities so that the number of patients that remain in isolation and under treatment in our public general hospitals remain between 1000 to 1600, or less than 20 percent of total bed complement. This is to ensure that our public general hospital system is not overwhelmed. It is reassuring that the number of COVID-19 patients that require ICU at any one time has not exceeded 30 since the pandemic started. The public general system is estimated to have about 500 ICU beds which are equipped with ventilators.

CONCLUSION

The sum of all our efforts, from a medical or healthcare perspective, to battle the scourge of COVID-19 can be summarised into two points:

- At the public health and community level: we have to keep effective reproductive ratio (Rt) < 1, so the size of the outbreak diminishes with time.
- At the clinical and hospital level: to keep our fatalities down by not allowing our ICU services from being overwhelmed, and to prevent our public hospital system from also being overwhelmed with too many patients through the use of community facilities.

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LEARNING POINTS

- **Epidemiological concepts like Reproductive Ratio, Median Incubation Period and Serial Interval of the COVID-19 virus is key to understanding how social distancing works as shown in the Cluster Table in the article. The key determinants of a cluster size are the Reproductive Ratio and the Serial Interval.**
- **The Serial Interval cannot be altered much because it is an intrinsic characteristic of the pathogen. On the other hand, the effective reproductive ratio or Rt can be altered very significantly by intervention. For example, if we normally meet 100 persons a day on the average and the natural Ro is 2.5, then halving the number of persons by social distancing would effectively cut the Ro to a Rt of 1.25.**
- **Social distancing therefore remains the most important measure of control as it has an exponential effect on cutting down cases and clusters. It is about meeting less people in our daily lives. Physical distancing is really keeping an appropriate distance between people and us when we HAVE to meet in the course of taking part in essential services.**
- **Personal hygiene is very important, but does not have an exponential punch like social distancing. The evidence of wearing of masks by the community is that it only has an incremental effect on reducing transmission.**
- **At the public health and community level, by keeping effective reproductive ratio (Rt) less than 1, the size of the outbreak diminishes with time. At the clinical and hospital level, by not allowing our ICU and health services from being overwhelmed, fatalities would be minimised.**