BERKALA KEDOKTERAN

doi: 10.20527/jbk.v19i1.15724

LITERATURE REVIEW

OPEN ACCES

Flattening The Epidemic Curve from a Statistical and Epidemiological Approach in Malaysia

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Abstract:

Epidemic curves will help decision-makers and the public to give a picture and pattern of the outbreak. It will create a path to explore the epidemiology of Covid-19. One of the highlights is the onset of illness. One of the approaches is to track the progression of Covid-19 in Malaysia. In Malaysia, the numbers and figures began to convey a message about the epidemic progression and put in efforts to stop the pandemic. The disease pattern grows exponentially. Hence, proper lines of rapid strategies are there to flatten the curve.

Keywords: Epidemic curve; Epidemiology; Covid-19

Introduction

The prolonged health threat called Covid-19 cast a troubling health concern. The virus had spread throughout the globe even without warning. Every country should practice health precautionary and safety measures to reduce the transmission of the virus.

Hence, China was the first to issue a health warning about Covid-19. They had also attempted to halt the spreading of the disease. At first, the doctors and health practitioners labeled it as a respiratory illness called pneumonia. It strikes a chord since the numbers were uplifting to 7500 cases across the globe in five different countries located in several regions. It was a zoonotic transmission from bats instead of pangolins. However, the statement remains questionable without a concrete reason to back it up.

China, Iran, Italy, South Korea, and Japan had set the records straight with a whopping total number of cases and deaths. The global health threat can be transmitted to another person by people infected by it. The main target for the virus to occur is the epithelial cells. The virus via the fecal-oral route, aerosol, and fomites may cause the other person to get infected.

The droplet transmission was through cough and sneezing. The larger particles are heavier than the air forcing them to land on the surface. The air droplets of cough and sneezing may end up getting the disease.

Covid-19 was primarily diagnosed based on the detection of SARS-CoV-2 RNA by nucleic acid amplification tests (NAATs), commonly known as transcription polymerase chain reaction (RT-PCR) from the upper respiratory tract [1,2,3].

However, there are no specified treatments were proven to be effective in fighting against the disease. Until now, scientists and health practitioners are still researching the best providence of cure during the pandemic. The most recent solution is to get vaccinated. The same goes for medications and vaccinations undergoing approval for treating the disease.

There are also other mitigation strategies and self-cautionary measures provided during the pandemic. Travel across the continents was enclosed and restricted to stop spreading the disease. The transmission of the disease will not be putting the population at risk. Wash hands using soap and water or an alcohol-based sanitizer with 60% alcohol for at least 20 seconds as it breaks the outer protective layer of the virus. The disinfection of public areas is also one of the recommendations for controlling the spreading of Covid-19. A mask is mandatory nowadays as it protects droplets from an asymptomatic infected person. Keeping a distance may also minimize contact between people in crowded places and at large gatherings. Governments had also imposed social distancing measures that may contain themselves during the outbreak. Self-quarantine in 14 days is manageable if someone with Covid-19 travelled back from other countries during the pandemic.

This study aims to summarise the scenarios of Covid-19 in Malaysia. Besides that, the responses and the challenges occurred while facing the pandemic. Hence, there are stages of recovery to reduce the transmission of the pandemic. Based on the epidemic curve, there is an exponential growth of Covid-19 cases in Malaysia. The epidemic curve is a tool kit for tracing the exposure time of the illness as well as the natural phenomena of Covid-19 itself.

Incubation Period of Covid-19

The epidemic curve will assist researchers in gaining some insight into numbers on the confirmed cases, deaths, and recoveries in Malaysia. Other than lockdowns and travel restrictions, there were government bodies that properly studied some strategies to contain the virus and to ensure the protection of their jobs and livelihoods. The incubation period is the time between being infected and experiencing any symptoms [4]. Then, the testing for Covid-19 too early after exposure may produce false negative results [4]. Most people with Covid-19 are no longer contagious after five days after they first have symptoms and have been fever free for at least three days [4]. Besides that, the timeline for Covid-19 varies for each person. For instance, Older adults and people with underlying medical comorbidities are at higher risk of getting Covid-19 [5]. The first day after the exposure through five days without experiencing any symptoms [4]. Therefore, Covid has an incubation period of up to 14 days after becoming infected until the emergence of symptoms [4]. Overall, the people of Covid-19 are based on the severity of their illness from mild to moderate symptoms [5]. The possible symptoms are as follows [5]:

(A) Fever or chills
(B) Cough
(C) Shortness of breath or difficulty breathing
(D) Fatigue
(E) Muscle or body aches
(F) Headache
(G) Loss of taste and smell
(H) Sore throat
(I) Congestion or runny nose
(J) Nausea or vomiting
(K) Diarrhea

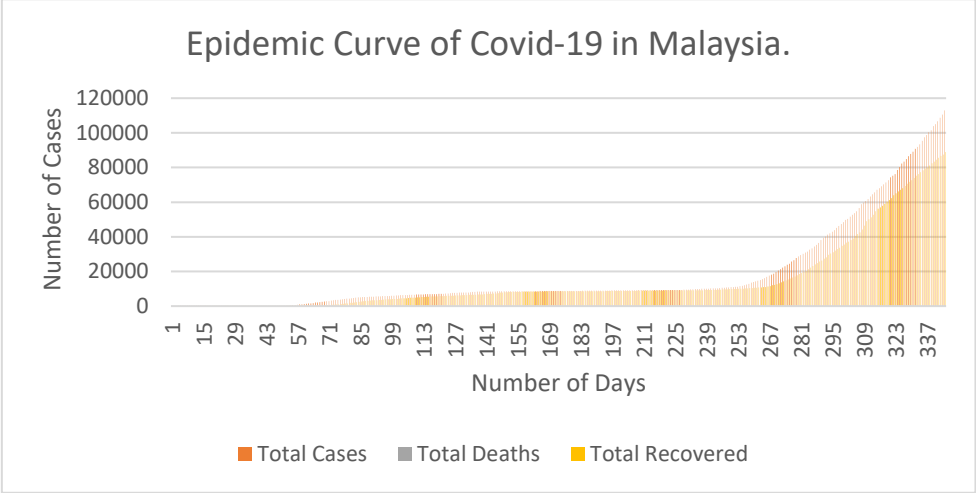

Figure 1: Total cases, death, and recovery vs. time (no. of days).

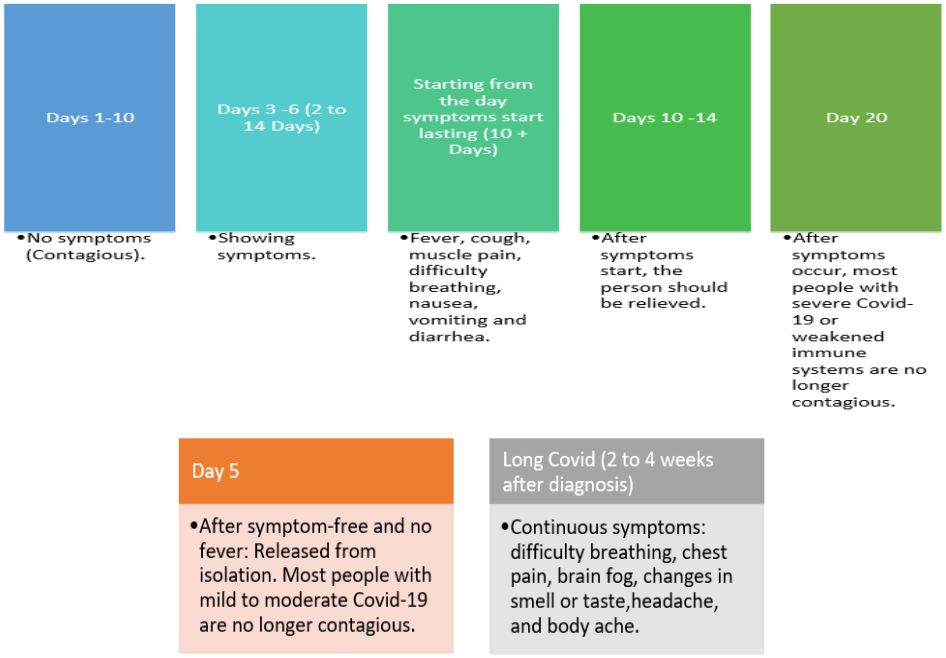

Figure2. Covid-19 Incubation Timeline.[4]

Covid-19's Responses in Malaysia

The first wave of infection took place on 24th January 2020 in Malaysia detecting 22 new cases, 12 had a travel history to other countries and regions that are affected as well [6]. There were 11 days with no cases dated from 16 to 26 February 2020 [6]. Further, the second wave took place in Malaysia from 27 February 2020 onwards [6]. On 29th April 2020, Malaysia recorded a total of 5945 confirmed cases and 100 deaths. Then, 4087 cases have been recovered leaving behind 40 cases in intensive care units and 18 needing ventilatory support. Large gatherings for the celebration of Ramadan and Wesak day have been refrained and every individual with their family members are following the Movement Control Order by not visiting with each other during the seasons. On 8th May 2020, there is a total of 6535 confirmed cases along with 107 deaths. 4864 recovered cases and 18 cases are in the intensive care units (ICUs). Hence, the Ministry of Health (MOH) in Malaysia attempted to do massive screening tests accommodating 2.5 million immigrant workers for Covid-19. Based on the result, there were 22,339 non-Malaysians screened for Covid-19 leaving 986 (4.4%) who tested positive. During this time, Conditional Movement Control Order (CMCO) had been extended until 9th June 2020. Under CMCO, people are allowed to travel within the territory of each state in Malaysia and most of the economic sectors were opened about Standing Operating Procedures (SOP) as implemented by the Government. Social activities, such as sports and religious gatherings were restricted. As of 17th May 2020, the total number of confirmed cases had escalated to 6894 and 113 deaths. There were 5571 recovered cases and 13 cases are in the ICUs. To date, the National Fatwa Committee had agreed to permit Muslims to perform their weekly Friday, nightly Tarawih, and Eid al-Fitr prayers in Federal territories under strict conditions. Each one of the prayer gatherings cannot exceed 30 people. Only those in the age range of 15 and 70 years old are permitted to enter the mosque. Mosque will be operated approximately an hour before the call to prayer and closed after all prayers are done. There were an escalated

number of 7137 confirmed cases and 115 deaths roaming across Malaysia dated the 22nd of May 2020. 5859 were reported to be recovered and 9 cases were in ICUs. Seven days afterward (29th May 2020), there were 7732 confirmed cases and 115 deaths recorded in Malaysia. There were 6235 cases of recovery and 8 cases were in ICUs. As of the 28th of May 2020, there is a percentage of 24.4% of total cases among non-Malaysians. Based on the total tests undergone, 31,204 were among non-Malaysians, of which 5.9% (1858 cases) were positive. In June, dated as of 7th June 2020, this brings a total of 8322 confirmed cases and 117 deaths. There were 6674 recovery cases and 6 cases are in ICUs. The Recovery Movement Control Order (RMCO) began its operation on 10th June 2020 until 31 August 2020. Under RMCO, interstate travel, the reopening of morning and night markets, and the permissible of all social, religious, business, and educational activities are all under SOPs. Besides that, the Malaysian government had sped up the screening and testing of foreign workers, including both registered and undocumented foreign workers in detention centers. On 3rd June 2020, 400 detainees tested positive for Covid-19. On 11th July 2020, there were 8704 confirmed cases and 122 deaths. However, the number of recoveries is 8515 cases and there were only 3 cases reported at ICUs. There were two teaching modes, including in-school sessions and home-based learning adhered to the SOPs. Universities will also be opening soon in October 2020 and international students are allowed to travel back to Malaysia pending the Covid-19 testing. Border restrictions are cut down to allow interstate travel and domestic flights to reoperate during the month. On 9th July 2020, there were 63,776 non-Malaysian have been tested, of which, 4.1% (2582 cases) are positive. Among them, 0.9% of cases were undergone treatment and 98.9% (2553 cases) recovered. Five deaths were reported among non-Malaysians. On 19th July 2020, there are 8779 confirmed cases and 123 deaths in Malaysia. Thus, there are 8553 recovered cases and 2 cases admitted at ICUs. There was a total of 65,595 non-Malaysian who underwent testing, of which 4.0% (2617 cases) were positive. Among them, 1.5% (40 cases) were still under treatment and 98.3% (2572 cases) have recovered. The number of confirmed cases had accumulated to 8840 and 123 deaths on 23rd July 2020. The number of recoveries is 8574 and 2 cases are in the intensive care unit. The government had imposed a mandatory to wear a mask in public places starting from 1st August 2020. There was a total of 916,340 individuals had been tested and 8840 of them turned out to be positive cases of Covid-19. Apart from that, 66,568 non-Malaysians were tested, and 4.0% (2632 cases) were positive. Among them, there were 1.9% (49 cases) are still under treatment, and 98.0% (2578) have been discharged. Starting from 24th July 2020, travellers are not required to undergo testing upon their arrival in Malaysia. All incoming travellers (Malaysians and foreigners) must undergo a 14-day mandatory quarantine at the government-designated facilities and be tested using the polymerase chain reaction test (rt-PCR) upon arrival. In the earliest month of August 2020, the number of confirmed cases had accumulated to 8976 and there were 125 recorded deaths. The number of discharged is 8644 and 3 cases are in intensive care units. On 28th July 2020, 949,141 individuals have been tested of which 8943 of them turned out to be positive cases. 68,557 non-Malaysians were tested, and 2663 were positive cases for Covid-19. Cambodia had temporarily banned all flights from Malaysia and Indonesia starting 1st August 2020 since the previous incident of transmission. The

positive cases that may have entered Cambodia via Kuala Lumpur were all transit passengers at Kuala Lumpur International Airport (KLIA) and were not Malaysians. Around 1000 were added to the figure of confirmed cases totalling up to 9083 and 125 recorded deaths as reported on 9th August 2020. 8784 cases have been discharged and 1 case was in the intensive care unit. On the 4th of August 2020, 991,333 individuals have undergone testing, of which there were 72, 036 non-Malaysians. Among them, there were 2679 positive cases of Covid-19. On 15th August 2020, there were 9175 confirmed cases and 125 deaths in Malaysia. 8831 cases have been recovered from Covid-19 and 6 cases are in the intensive care unit. There had been a total of 9267 confirmed cases and 125 deaths in Malaysia on 23rd August 2020. 8959 were recovered from Covid-19 and 9 cases were hospitalized in the intensive care unit. There were 9334 confirmed cases and 126 deaths recorded. 9048 of them were discharged from hospitals and 7 cases are in the ICUs. The RMCO had been rescheduled to end on 31st December 2020. On 6th September 2020, there is a huge total of 9397 confirmed cases of Covid-19 in Malaysia including 128 deaths recorded. There were 9115 recovered and had been discharged while 6 cases had been admitted to ICUs. Further, the Ministry of Health in Malaysia has voiced out that imported cases in Malaysia may increase due to the winter season. Imported cases in Malaysia had increased numbers. On 13th September 2020, there were 9915 confirmed cases of Covid-19 in Malaysia and 128 recorded deaths. There were 9196 discharged from the hospitals and 9 cases were reported to have been admitted to the ICUs. On 20th September 2020, the number reaches 10,219 confirmed cases and there were 130 recorded deaths in Malaysia. There were 9355 recovered cases and 12 cases were in the ICUs. According to the Ministry of Health in Malaysia, older adults are vulnerable to Covid-19 infection. However, younger individuals with chronic diseases have been associated with more severe symptoms, disease, and serious complications, including ICU admissions. In the next seven days that is on 27th September 2020, a total of 10,919 confirmed cases of Covid-19 in Malaysia. There were 134 recorded deaths altogether. There were 9835 recovered cases and 6 cases are in the ICUs.

Vaccination and Recoveries

Malaysia awaits the vaccination to be distributed. As of 4th October 2020, the total brings up to 12,381 confirmed cases of Covid-19 in Malaysia. The total number of deaths is 137. There were 10,283 recovered cases while 28 cases were reported from the ICUs. The total number of confirmed cases is 20,498 and there were 187 deaths reported on 18th October 2020. There were 13,262 discharges and 86 cases in the ICUs. This brings the total up to 26,565 confirmed cases and a total of deaths 229 on 25th October 2020. There were 17134 recovered cases and 99 emergency cases in the ICUs. Hence, the Ministry of Health in Malaysia closely monitored their recoveries to study the side effects and complications associated with Covid-19. Malaysia has to ensure secure access to a Covid-19 vaccine supply in the first quarter of 2021. The frontline workers from the healthcare and security sectors, such as doctors, nurses, police, prison staff, and immigration personnel were categorized as the first recipients to enroll in the vaccination program. On 1st November 2020, there has been a total surge of 32,505 confirmed cases of Covid-19 in Malaysia. Further, 249 death cases were recorded. There was a total of 22,220 recovered cases and 97 emergency cases in the ICUs. On 8th November 2020, there

were 40,209 confirmed cases and the total number of deaths increased to 286. The recovered cases bring up a total of 28,234 while there were 94 ICU emergency cases. The upcoming monsoon season, at the end of the year, may lead to an immense threat of Covid-19 transmission in respected areas. As of 15th November 2020, there were 47,417 confirmed cases of Covid-19 in Malaysia. The total of deaths on the same date had increased to 309. The recovered cases had a slightly lower number than the number of confirmed cases with a total of 34,785. There were 104 emergency cases in ICUs during that day. The Ministry of Education in Malaysia had decided to close all schools until 17th December 2020 based on a review of the current school term and holidays in 2020. The decision had also been made based on the analysis conducted using the data on positive Covid-19 cases, close contacts, and quarantine among students, teachers, and school staff. Health authorities are also responsible for the approval of vaccination for Covid-19 once it is safe and effective before being distributed across the country. The greatest priority will be given to the front-line workers who had combated Covid-19, elderly citizens, and persons with comorbidities. In the final month, December, on the 6th December 2020, there were 72,694 confirmed cases of Covid-19 and 382 recorded deaths in Malaysia. There were 61,273 discharges and 126 emergency cases in the ICU units. After two weeks, on 20th December 2020, the confirmed cases of Covid-19 had reached 93,309 in Malaysia. This is followed by 437 death cases, 77,309 recovered cases, and 116 emergency cases in the ICUs. As of 27th December 2020, there were 105,096 confirmed cases of Covid-19 in Malaysia with a recorded total death of 452. Besides that, many had also regained their health with a total of 84,411 recovered cases from Covid-19. There were 111 emergency cases in the ICUs on the same date. The vaccination rollout has yet to receive approval based on the procedures confronted by the National Pharmaceutical Regulatory Agency (NPRA) for further requests. Then, the Ministry of Health of Malaysia reported a detection of a Covid-19 mutation strain, A701B, consisting of 60 samples linked to the Benteng Lahad Datu (LD) cluster in Sabah. The Ministry of Health Malaysia found that there is a lack of conjunction with the mutation impact on virus infectivity. The mutated strain was previously detected in South Africa, Australia, the Netherlands, and Singapore.

Discussion

The world explored the data analysis on Covid-19 [7]. They explained that "flattening the curve" represents the general concept of reducing the number of infections caused by the virus. Epidemiologists coined the term "flattening the curve" to study the reasons behind the frequent occurrence of a disease in different populations [7]. At an early stage of a pandemic, there is a group of susceptible individuals to the infection [7]. Hence, it was depicted that an exponential graph of a compounding scenario where one infected person had a snowball effect upon another [7]. Some factors contribute to the likelihood of having an infection. Hence, the growth rate depends on the average number of people one person can spread the virus and the time it takes for those people to become infectious [7]. Exponential growth models are closely aligned with reality if the number of infected individuals in a large population is small in number [7]. For instance, the first emergence of the virus in Wuhan [7]. So as Italy or Iran [7]. Therefore, the models were not robust and viable for a larger population. The likelihood of an infected person contacting there is a susceptible

person decline showing a growing fraction of people is discharged and provided with a protective level of immunity [7].

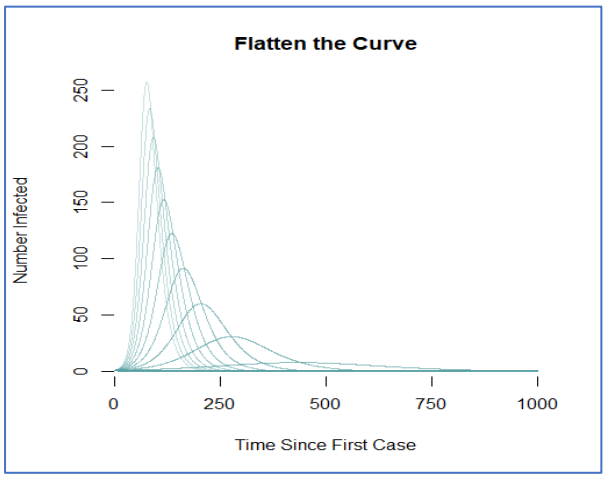

Figure 3. Flatten the curve. [7]

Short History

History had repeated itself. History has shown that taking steps may help communities and individuals to slow down the spreading of coronavirus [8]. As mentioned before, social activities got cancelled due to the health threat imposed by the virus. A medical historian named Howard Markel studied the effectiveness of similar responses to past epidemics [8]. The term "flattening the curve" describes the gradual steps taken in reducing the number of cases of Covid-19 [8]. If the curve is thinner, it is not a good sign since there are many sick people in a short time [8,9]. They are not taking enough steps to prevent the virus from spreading from one another [8]. A higher curve indicates more cases of Covid-19 happening at the same time. The lower curve shows few people diagnosed with Covid-19 over a long time.

Steps to Flatten the Curve

Hence, there are six possible ways to flatten the curve sustainably [10]. The first step is to expand and speed up the testing kits and supplies, medical devices, and protective equipment for healthcare workers [10]. The expanded facilities are for those who seek treatment [10]. In the next 30 to 45 days it is needed to grasp as much as to stimulate rapid investment in building up the efforts at any cost [10]. The second is to modify the social distancing principles [10]. The intention is to ensure workers and students get the best out of it within 45 to 90 days [10]. One of the usual ways is to enable lower-risk individuals to get back to work while minimizing their risk at their workplaces [10]. It is possible to achieve herd immunity across the broader population and allow much of the society and economy sectors to operate healthily [10]. The modification of the operating model by adapting to a more invasive environment [8]. For instance, the involvement of artificial intelligence to detect high-risk individuals to be self-quarantined to avoid further outbreaks while respecting their privacies [10]. Adapting regulatory and support frameworks, will protect their businesses, workers, customers, and students [10]. It also includes testing and the obligation to stay-at-home order. Coronavirus-related lawsuits for medical professionals to act in a good way [10]. The investment in opportunities and support of innovators [10]. It requires adaptive frameworks to respond if there are any mutations to the virus [10]. They may increase their communications by bringing the community together for further preparations in facing the next challenge.

However, to flatten the curve by putting a halt to Covid-19 cases in the population [9]. It depends on many factors, such as how contagious Covid-19 is, how many people are vulnerable, and how quickly they get sick. Keeping a distance from each other, self-isolation, and quarantine may reduce the chances of transmission [9]. For the time being, there are no vaccines or medications for Covid-19. However, practicing proper self-hygiene, isolating suspected cases, and social distancing might do the trick [7]. Super

spreaders as infected individuals who may have many attempts in contact tracing [7].

Vaccination

As of August 2021, Malaysia administered 13.6 million doses of the Covid-19 vaccine [11]. During the previous month of July 2021, there were 12.33 million doses, and 5.08 million in June 2021 [11]. The numbers are soaring to 34.75 million doses of the Covid-19 vaccine since late February [11]. On 31st August 2021, 15.03 million individuals aged 18 years and above received their inoculation twice [11]. Then, 46% of the population in Malaysia had taken double dosages [11]. In the meantime, 4.69 million people had received the first dose while 3.75 million had registered and awaited their first appointment [11].

There are still parents who are up against the vaccination for Covid-19. Unvaccinated children should also have access to education [12]. The government should consider the matter to facilitate unvaccinated children in attending their schools [12]. This is for their overall well-being [12]. Some parents are still hesitating about it. Based on the situation, this will put children at risk if left unvaccinated.

Further, it is not negotiable to solve the matter in their hands by using mandatory laws [12]. However, there are ways to approach parents who are unwilling to jump in the water by guiding them with the information and running campaigns to support their visualization [12]. Healthcare providers may improve their communication with clients [12]. Parents are there for them to overcome their fears and doubts when receiving a vaccination. Therefore, there is a bright side for children to receive lifesaving vaccines instantly from the public and private sectors [12].

Impact on Children

Children are good survivors of the pandemic if there are different variants of the mutated coronavirus, Covid-19 [13]. Infected children tend to be less sick than infected adults [13]. However, CDC stated that there were more hospital beds for children with Covid-19 in early January than at any previous time during the pandemic [13]. Coronavirus is a highly contagious virus rather than a more virulent one [13]. There is a high rate of unvaccinated children [13]. The Omicron cases, severe illness among infected children remains extremely rare [13]. Plus, the death rate for Americans under 18 is static at about 0.01% [13].

The immune system weakens and becomes dysregulated as they age [13]. The difference between children and adults in terms of immune response to the virus SARS-CoV-2 in their airways and blood [13,14]. There are two layers of protection, such as the innate and adaptive responses [13].

Innate immune response has macrophages and other specialized cells that detect and react rapidly to harmful signals from bacteria and viruses [13]. The first line of defence includes responses, such as the release of interferons by nonimmune cells [13]. However, if viral or bacterial intruders invade the wall of innate immunity, the adaptive immune system will initiate specific attacks on pathogens with T and B cells [13]. A child's immune response is agile and quick at the same time. If there is a new pathogen, some part of these right receptors will identify the attacker and then divide and expand into an army of memory T cell clones [13]. It is a repetitive process in a lifetime to build an immunological memory [13].

Children had another protective mechanism which is a strong innate immune response and plentiful naive T cells [13,14,15]. Thus, the T cells do not further develop into memory cells among children

[13]. The reactivity of interferons in battling SARS-CoV-2 surpassed the induced interferon response [13,16]. The virus disrupts several steps in the protein production process that boosts interferon response by more than 1,000-fold on virus detection [13,17].

Older people have far fewer cells that can effectively target and respond to a novel virus, SARS-CoV-2 [13]. Further, Covid-19 tends to be more severe among overweight people [13]. Hence, children tend to have fewer fat cells than adults [13]. Children's responses may progress as followed by the onslaught of respiratory infections plus at least for those who enrolled in daycares and schools [13].

Conclusions

In conclusion, the importance of Statistics cannot be overemphasised as a tool to understand and prevent the spread of Covid-19. In the initial stages, the policymakers had to introduce Movement Control Order (MCO) to contain the exponential spread of Covid-19. After the containment which cannot go on forever, the policymakers have to take into consideration the economic factor to ensure the economic growth is not stagnated and thereby also have to apply Statistics to narrow the restrictions to targeted areas only. To do this, the most effective tool would be the statistical data to determine the numbers and also the locations for the health services to plan their resources according to combat the pandemic.

As shown above, applied Statistics not only was an important tool to tackle the first and second phases but needless to say would be also crucial to predict and plan for the coming third wave.

Acknowledgments

The author appreciates and is grateful for the comments and suggestions from the reviewers and readers.

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