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Insights into Variations in COVID-19 Infections in Malaysia

(Pandangan tentang Variasi dalam Jangkitan COVID-19 di Malaysia)

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ABSTRACT

The present study aims to visualize the variations in the number of confirmed daily COVID-19 infections during the third wave in Malaysia through the application of control charts. This study also attempts to propose the target number of daily new cases that would bring the pandemic situation in Malaysia under control by utilizing the confirmed daily cases in Malaysia starting from 8th September 2020 until 30th June 2021. A modified Shewhart control chart was adopted to monitor the variations before and after the commencement of National Immunisation Programme (NIP). The chart shows a declining trend in the number of cases after the rollout of NIP whereby several days were brought to a state of statistical-in-control. But in less than three months after NIP commencement, there were huge variations in COVID-19 cases leading to drastic increase in the mean number of cases. These signal the presence of unnatural or assignable causes of variations which could be attributed to failure of curbing the risks of transmission, existence of various variants in the community, easing of containment measures and less adherence to the COVID-19 Standard Operating Procedures (SOPs). Significant shifts in the mean values prompt the development of a 3-phase modified Shewhart control chart. From the 3-phase chart, a series of daily number new cases that can be set as the target value to bring the pandemic situation in Malaysia under control, while flattening the epidemiological curve in the very near term.

Keywords: Control charts; COVID-19; variation study

ABSTRAK

Kajian ini bertujuan untuk menggambarkan variasi dalam jumlah jangkitan COVID-19 harian yang disahkan semasa gelombang ketiga pandemik ini di Malaysia melalui penggunaan carta kawalan. Dengan menggunakan kes harian bermula 8 September 2020 sehingga 30 Jun 2021, kajian juga cuba mencadangkan sasaran bilangan kes baru harian yang mungkin dapat membawa kepada keadaan pandemik yang lebih terkawal di Malaysia. Kajian ini mengadaptasi carta kawalan Shewhart yang diubah suai untuk memantau variasi bilangan kes sebelum dan selepas bermulanya Program Imunisasi Kebangsaan (NIP). Carta dihasilkan menunjukkan trend penurunan bilangan kes selepas pelancaran NIP dengan beberapa hari telah dikesan berada pada keadaan statistik-dalam-kawalan. Pun begitu, dalam masa kurang daripada tiga bulan selepas NIP dilancarkan, didapati terdapat variasi yang besar dalam kes COVID-19 yang menyebabkan peningkatan drastik dalam purata bilangan kes. Ini memberi isyarat hadirnya punca variasi luar biasa yang boleh dikaitkan dengan kegagalan membendung risiko penularan, kewujudan pelbagai varian baru dalam komuniti, pelonggaran langkah membendung serta kurangnya pematuhan kepada Prosedur Operasi Piawai (SOP) COVID-19. Anjakan ketara dalam nilai purata telah mendorong kepada pembangunan carta kawalan Shewhart ubah suai 3 fasa. Hasil daripada carta ini digunakan untuk membuat beberapa saranan mengenai bilangan kes baru harian yang boleh dijadikan sebagai sasaran dalam usaha membawa keadaan pandemik di Malaysia yang lebih terkawal, di samping usaha melandaikan lengkungan epidemiologi untuk tempoh terdekat ini.

Kata kunci: Carta kawalan; COVID-19; kajian varians

INTRODUCTION

Since December 2019, the outbreak of coronavirus disease 2019 (COVID-19) has become a global public health threat. On 30th January 2020, the World Health Organization (WHO) declared a public health emergency on the high risk of human-to-human transmission and that the impact of COVID-19 predicted to be very high (WHO 2020a). This was followed by the declaration of COVID-19 as a pandemic on 11th March 2020 (WHO 2020b). As of 30th June 2021, WHO reported that the number of positive COVID-19 cases has reached 181,546,224 while the number of deaths has reached 3,938,258 in 212 countries across the globe (WHO 2021).

In Malaysia, the first case of COVID-19 reported on 25th January 2020, involved three China tourists who just entered Malaysia two days before the case was reported (Elengoe 2020). Since then, Malaysia was hit by three waves of COVID-19 before the end of 2020: (1) the wave reports to last around 16th February 2020 with 22 cases identified and there were 11 days with no cases between 16th February 2020 and 26th February 2020; (2) started on 27th February until the 30th June 2020 (Rampal & Liew 2021). The Malaysian government introduced a nationwide lockdown on 18th March 2020 that was the Phase 1 Movement Control Order (MCO) throughout the country to contain the spread of the pandemic. This 'lockdown' seemed to slow down the spread as the number of new confirmed cases of COVID-19 per day showed a declining trend where the goal to flatten the epidemiological curve was successfully achieved; (3) reported to begin on 8th September 2020 (Rampal & Seng 2020) where it started to strain the health systems and the economy. The resurgence in the new infections has taken a toll on the front-liners and challenges faced by healthcare workers and other front-liners was horrendous. The daily number of confirmed cases continued to soar to more than 4,000 in January 2021, followed by record high levels of cases in the following months. As for the month of June 2021 where the country was still at the third wave, there were only 3 days reported with daily cases below 5,000 and the national real-time reproductive number (Rt) has climbed back to be above 1.0.

As one of the earliest countries in Southeast Asia to receive the COVID-19 vaccine (Idrus 2021), Malaysia is hopeful that its vaccination program will restore the situation in the country back to normal. Nevertheless, until the effectiveness of vaccines and preventive measures is gauged, healthcare workers who are in close contact with a suspect or a person under investigation (PUI) are at high risk of exposure to the virus. In a propagated source outbreak, many peaks are to be encountered and successive waves may involve more and more people until the pool of susceptible people is exhausted. It is important to note that flattening the curve does not mean eradicating of the disease because the pandemic will be around for a while (Rampal 2020).

COVID-19 has a very dynamic structure and spreads rapidly as reported by WHO (2020c). The virus can spread from an infected person to other people when they are in close contact that is within 1 metre (short-range). Infections occur when aerosols or droplets containing the virus that remain suspended in the air are inhaled especially in poorly ventilated and/or crowded indoor settings. Moreover, transmission occurs when people touch surfaces that have been contaminated by the virus as they later touch their eyes, nose or mouth without cleaning their hands. Also reported is the dynamic structure of virus variants that are emerging further explain why some new variants of concern are more transmissible than the earlier ones (WHO 2020c). As such, the number of confirmed cases varies due to differences in epidemiological surveillance and detection capacities between countries. Since the effectiveness of vaccine rollout remain uncertain, it requires an effective planning of health infrastructure and services, where the rate of disease spread should be controlled. For this reason, the estimation of total confirmed cases and possible new cases in the future is vital for managing and directing the demand to the health system. Estimating the expected burden of disease is essential for public health officials to effectively and timely manage medical care and other resources needed to overcome the pandemic. Such estimates can direct the intensity and type of interventions needed to alleviate the pandemic. Without effective monitoring of pandemic, various efforts would not mount desirable outcomes. To measure how effective the preventive response has been and how to invest resources more scientifically and efficiently should be judiciously addressed. For this purpose, the mostly applied statistical process control (SPC) tool, control charting technique is proposed to monitor the spread of COVID-19.

Statistical control charts have been applied successfully to address various quality problems in different fields, such as healthcare, manufacturing industries, the education sector and human well-being (Mohammed et al. 2001). Control charts are the widely applied statistical process control (SPC) tool as it promotes the understanding of variations in processes and products as well as provides signals when these variations likely to cause problems and need to be addressed (Montgomery 2019). As variations can best be described in statistical terms (Hoerl & Snee 2012), statistical control charting technique can be utilized as the tool to recognize changes in the level of COVID-19 cases and enable the public-health actions to be undertaken in reducing the unnecessary morbidity and mortality rates. Control chart applications in health care setting is evident since the late 1980's (Berwick 1989). Of late, the application of control charts is emerging in various fields that includes healthcare systems to monitor the performance of hospital, pre- and post-operative complications, and number of infections (Clemente et al. 2016; Gomes et al. 2011; Inkelas et al. 2021; Suman & Prajapati 2018). Recently, a study has used hybrid Shewhart chart (c-chart and i-chart) to detect the start and end of exponential growth in reported deaths within a geographic area and illustrates the various growth phases in the process of reported deaths (Perla et al. 2020). The application of control charts in epidemics is still very limited in Malaysia, therefore this study will utilize the control charts in understanding the variation in COVID-19 infection cases in Malaysia. Considering the uncertainties lingering the pandemic despite the availability of vaccines and some expect the virus that causes COVID-19 to become endemic, the corona virus is here to stay (Phillips 2021). Henceforth, it is very crucial to identify the 'target in-control' number of daily cases to successfully flatten the curve in the very near term. As such, the general aim of this study is to give insights into the variations in number of daily new cases recorded during the third wave in Malaysia through the application of statistical control chart and to identify the target number of daily new cases that would bring the pandemic situation in Malaysia under control.

Materials and Methods

The daily data on COVID-19 cases is being published since 25th January 2020 by the National Crisis Preparedness and Response Centre (CPRC) of Malaysia Ministry of Health (MOH). Other than the confirmed daily and cumulative cases data, the number of recovered cases and deaths as well as cases requiring Intensive Care Units (ICU) care and ventilator support are also publicly made available in the report published by CPRC. This study utilizes the number of confirmed daily cases in Malaysia starting from 8th September 2020 when the third wave of COVID-19 began until 30th June 2021. So, there are a total sample points of 296 days. The data is divided into two phases of analysis that are before and after the rollout of the National Immunisation Programme (NIP), which commenced on 26th February 2021. Both phases employ the Shewhart control chart with modification (Arantes et al. 2003) by utilizing SAS JMP 15 statistical software. The following section details out Shewhart control charting technique and its modification as recommended by Arantes et al. (2003).

Modified Shewhart Control Chart

Shewhart control chart is the classic statistical process control tool used to determine if a process is in a state of 'statistical' control based on variations that occur in process variables over time. The control chart contains a centerline that represents the average value of a quality characteristic corresponding to the in-control state where only common variation is present (Montgomery 2019). Common cause variations result from a normal process where the activities, materials, and other parameters operate as what have been designed for a normal production process. The other two lines on the control chart are upper and lower control limit (UCL and LCL). Located within plus/minus three standard deviations of the average value, the UCL and LCL of process variables x in the Shewhart control chart for individual observations are derived by: $UCL_X = \overline{X} + 3\sigma$; $LCL_X = \overline{X} - 3\sigma$ where $\overline{X}$ is the average or mean value, and σ is the standard deviation of the process data. UCL and LCL represent the 'permissible' range of values to denote the 'process' is in control. Ideally, process data plotted around the center line and within the UCL and LCL depicts process variations which are in a state of statistical control and considered as stable. The process variables represent the process quality characteristics of interest and are usually gathered from process samples at regular time intervals. This traditional Shewhart control chart model is based on a zero-order polynomial. It assumes variations in process data lying within the control limits are the results of random or natural causes whereas the irregular variations of sample points lying beyond the control limits are the results of unnatural or assignable causes (as termed in the control charting techniques). While the random causes of variations are inherent types of variations, the unnatural variations are referred to as fluctuations and interruptions that generally signal problems in a process operation (Benneyan et al. 2003). In a two-phase Shewhart control charting scheme, Phase I is the stage where processes are iteratively brought into the state of statistically in-control from which the process parameters are estimated to be applied during Phase II for actual process monitoring purposes (Montgomery 2019). Studies have shown this chart is very effective to use when there are large shifts in the process mean ($>1.5\sigma$) (Hawkins & Zamba 2003 citing Pyzdek 1999; Montgomery 2019). Shewhart control chart is constructed based on the statistical assumption of normally distributed data and this is generally valid for variable data. Nonetheless it is not valid for counting process data where in most cases, such data follows Poisson or Binominal distributions (Das 2003). Due to such setback, Arantes et al. (2003) proposed a correction on the traditional model by incorporating the approximation of Poisson distribution for normal distribution. To validate any changes in the mean number of cases between phases, the non-parametric Kruskal-Wallis and Tukey-Kramer HSD tests will be applied. This is, particularly, this case where the normality distribution of data set is questionable (Kenkel 1989; Levine et al. 2018).

The proposed model by Arantes et al. (2003) is a modified Shewhart control chart. This chart consists of five control limits, instead of three in traditional model. Like the standard Shewhart chart, the center line is the average or sample mean of the process; . But the modified Shewhart consists of the lower and upper alert limits and the lower and upper control limits:

Upper/Lower Alert Limit: $UAL_x = \overline{x} \pm 2s$; Upper/ Lower Control Limit: $UCL_x = \overline{x} \pm 3s$; where $s = \sqrt{\overline{x}}$ is the estimate of the standard deviation of the quality variable of interest. In the case of a Poisson distribution, the mean and the variance are equal. In this study, quality variable of interest is the daily new cases reported in Malaysia. Phase I corresponds to the period between 8th September 2020 and 25th February 2020, where the limits are computed accordingly and are plotted in the chart. In this study where the concern is on higher number of cases, any sample points exceeding the UCL or two consecutive sample points above the CL or UAL are the main concern signaling statistical instability that trigger the need to identify root cause of problem. But more importantly, this study aims to provide the insights into the variations in the daily number of new cases hence ascertain the target number of daily new cases that would progressively bring the pandemic situation in Malaysia under control.

Results and Discussion

Figure 1 illustrates the trend of daily confirmed new COVID-19 infections in Malaysia from 8th September 2020 until 30th June 2021, which corresponds to the period of third wave of pandemic in Malaysia. This figure depicts the starting date of MCO 2.0 implementation on 13th January 2021 and the commencement of NIP on 26th February 2021. As of the last date of study period, 30th June 2021, there were 742,514 cumulative cases reported.

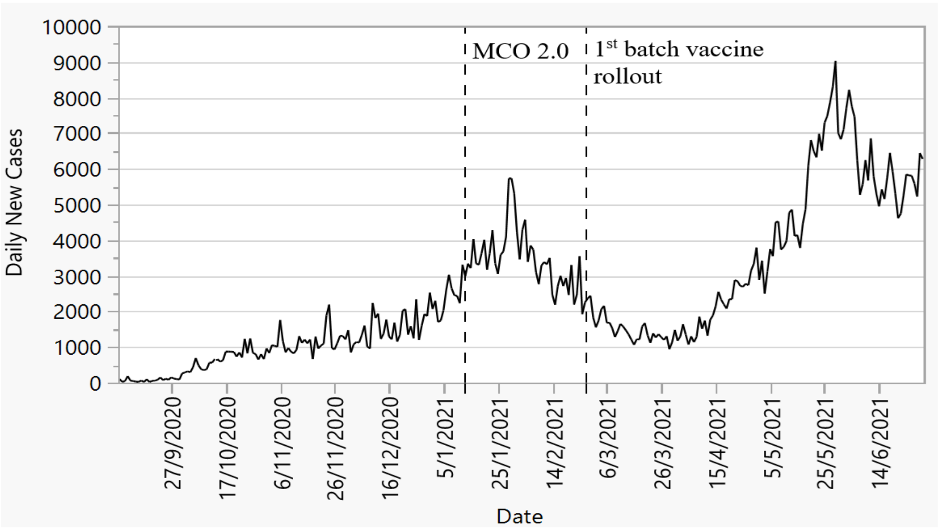


FIGURE 1. Distribution of daily COVID-19 cases in Malaysia during the third wave

In order to study the variations in the number of COVID-19 cases during the third wave of pandemic outbreak in Malaysia, the study period is put into two phases: Phase I (before NIP) and Phase II (after NIP). There are a total of 284,233 cases reported in Phase I and 458,281 cases in Phase II. Table 1 presents the descriptive statistics on number of cases during Phase I and Phase II. It is apparent that statistics of COVID-19 cases in Phase I largely differ from Phase II. There were 171 days in Phase I compared to 125 days in Phase II. The mean number of confirmed COVID-19 cases in Phase II is more than twice the number of confirmed cases during Phase I. While the minimum cases for Phase I is only 20 cases, the lowest number of cases during Phase II is close to 1000 cases (941 cases). This contributes to large variations in Phase II compared to Phase I. This is shown by large difference in the value of range (maximum - minimum) and standard deviations between Phase I (range = 5,708; σ =1,303) and Phase II (range = 8,079; σ = 2,218). But the coefficient of variations (ratio between standard deviation and mean) is relatively higher for Phase I (78.4%) compared to Phase II (60.5%) signifying larger dispersions around the mean of Phase I. In both phases, where the distributions are discrete, as the mean is farther out in the long tail than is the median (Phase I: mean = 1,662 > median = 1,229; Phase II: mean = 3,666 > median = 2,881), the datasets confirm to be skewed and do not fit normal distribution (von Hippel 2005). This justifies the application of Modified Shewhart Control chart proposed by Arantes et al. (2003) deliberated earlier.

TABLE 1. Descriptive statistics of COVID-19 cases during the third wave in Malaysia

	N	#Cases	Mean	Std. dev	Median	Min	Max	CV
Phase I	171	284,233	1,662.18	1,303.33	1,229	20	5,728	0.784
Phase II	125	458,281	3,666.25	2,218.52	2,881	941	9,020	0.605

N = number of days; #Cases = Total number of Cases; Std. dev = standard deviation; Min = The minimum number of cases; Max = The maximum number of cases; CV = coefficient of variation

MODIFIED SHEWHART CONTROL CHART

Based on Arantes et al. (2003), the estimated mean and the square root mean as standard deviation from Phase I were utilized to compute the five limits: CL = 1,662.18, LAL = 1,580.64, UAL = 1,743.72, LCL =1,539.91 and UCL =1,784.45. Figure 2 illustrates Phase I and initial Phase II of the Modified Shewhart control chart of daily new COVID-19 cases during the third wave in Malaysia.

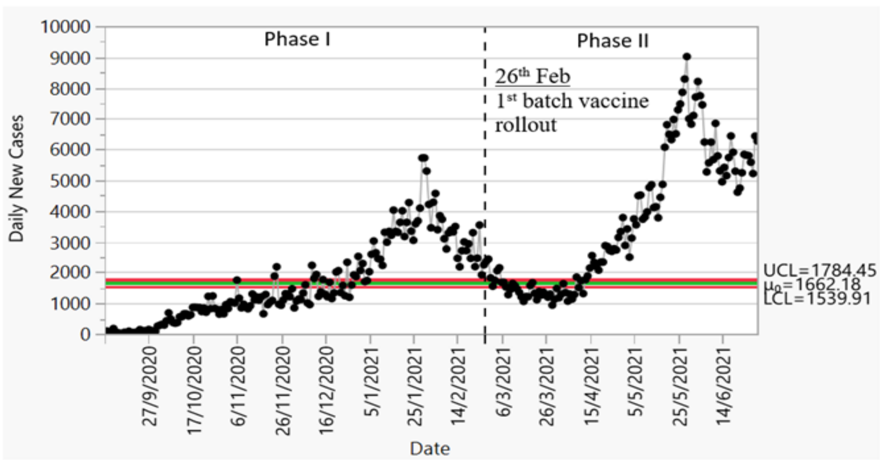


FIGURE 2. Phase I and Phase II of modified Shewhart control chart

The limits computed from Phase I are incorporated into Phase II to monitor the variation in COVID-19 cases after the commencement of NIP on 26th February 2021 until the end of study period 30th June 2021 (The LAL and UAL are not drawn in the chart due to small gaps in between the limits). Based on the sample points plotted in Figure 3, the process was statistically in control between the period of 6th March 2021 and 13th April 2021 (Figure 3).

Nevertheless, from 14th April 2021, all the sample points go beyond the UCL of 1,784.45 and this continues until the end of June as shown in Figure 2. The chart in Figure 2 depicts a sharp increase in the COVID-19 cases on 17th May, demarcating a swarm of data set thereafter towards the end of the study period. To further analyze the situation, while retaining Phase I dataset, Phase II

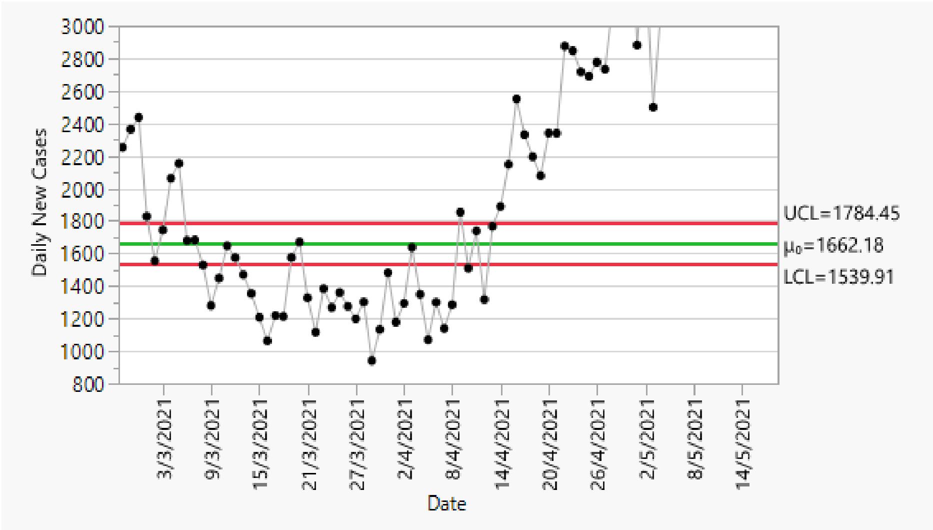


FIGURE 3. In-control days during Phase II modified Shewhart control chart (after the NIP)

dataset is further divided into two sets: revised Phase II and Phase III. Table 2 presents the new descriptive statistics for Phase I, Phase II and Phase III. The Kruskal Wallis and Tukey-Kramer HSD test conducted for three data sets of Phase I and the revised Phase II and Phase III, confirm that the mean of these data sets are different (Kruskal Wallis: Chi-square = 124.43; p-value <0.001; Tukey-Kramer HSD: p-values<0.00 for all pairs). The three-phase modified Shewhart control chart plotted from these data sets is shown in Figure 4. This figure illustrates different average estimated for each phase where the highest is for Phase III while Table 3 presents the corresponding CL, LCL and UCL for each phase of the modified Shewhart control chart.

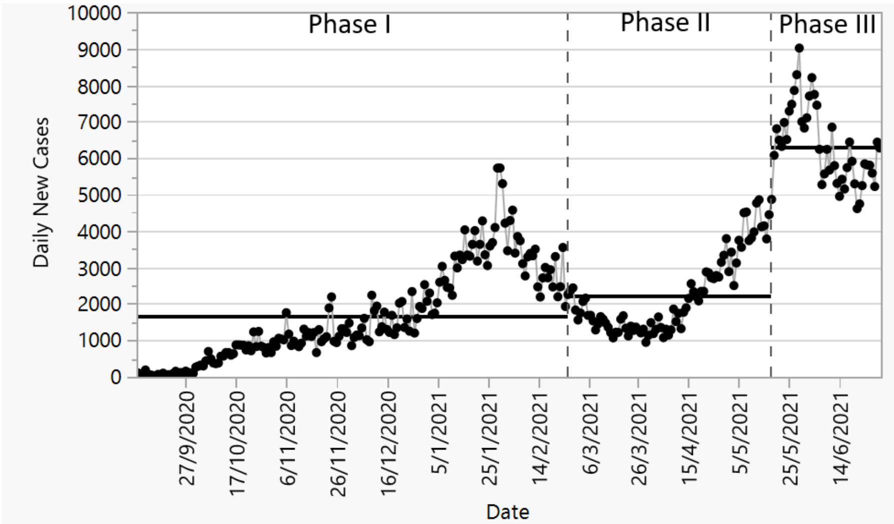
TABLE 2. Descriptive statistics of third wave COVID-19 cases in Malaysia in three-phase modified Shewhart control chart

	N	#Cases	Mean	Std. dev	Median	Min	Max	CV
Phase I	171	284,233	1,662.18	1,303.33	1,229	20	5,728	0.784
Phase II	81	180,858	2,232.82	1,061.97	1,828	941	4,855	0.476
Phase II	44	277,423	6,305.07	1,048.40	6,240	4,611	9,020	0.166

TABLE 3. Control limits of 3-phase modified Shewhart control chart

	N	CL (Mean)	Std. dev*	LCL	UCL
Phase I	171	1,662.18	40.77	1,539.91	1,784.45
Phase II	81	2,232.82	47.25	2,091.06	2,374.57
Phase III	44	6,305.07	79.40	6,066.86	6,543.28

*std. dev refers to the square root of the respective mean of each phase



Mean = Phase I: 1,662.18; Phase II: 2,232.82; Phase III: 6,305.07

FIGURE 4. The revised (3-phase) modified Shewhart control chart for daily COVID-19 cases during the third wave in Malaysia

The onset of third wave in Malaysia on 8th September 2020 cast a significant strain on the health system as the cases persistently show increasing trend for a period of more than three months. The decision for MCO2.0 on 13th January 2021 (in all states except Sarawak and Perlis which have been subject to 'Recovery Movement Control' as reported by Chen and Yeo (2021)) nonetheless results in a gradual decline in number of cases for around two weeks after its implementation. The rollout of Malaysia vaccination programme on 26th February 2021 could have further affected the COVID-19 curve to continue plummeting to below the 2000-mark. This is because, typically, it would take around two weeks after full-vaccination for the body to build immunity against COVID-19 (CDCP 2021). One month after the commencement of NIP, there were 104,931 fully inoculated individuals (MOH 2021). Table 4 presents the number of vaccine recipients observed during the study period.

TABLE 4. Number of individuals vaccinated between 26th February 2021 and 30th June 2021

Date	Recipients of first dose	Fully vaccinated	Date	Recipients of first dose	Fully vaccinated
26-Feb-21	5,299	0	30-Apr-21	877,646	544,018
5-Mar-21	99,616	28	7-May-21	1,028,693	651,072
12-Mar-21	250,509	38	14-May-21	1,182,244	732,310
19-Mar-21	384,334	792	21-May-21	1,387,452	849,243
26-Mar-21	443,124	93,557	28-May-21	1,725,364	987,012
2-Apr-21	498,468	241,758	4-Jun-21	2,208,016	1,122,420
9-Apr-21	558,750	360,971	11-Jun-21	2,835,178	1,267,758
16-Apr-21	671,589	434,301	18-Jun-21	3,810,071	1,520,583
23-Apr-21	771,829	489,108	25-Jun-21	4,924,334	1,898,770

The drastic increase in the total number of recipients of two doses between 6th March 2021 and 13th April 2021 seemed to better contain the pandemic as shown in Figure 1. The trend of vaccination program, somehow, have slowed down after 9th April where the number of individuals fully vaccinated only increase at a rate of 16% per week on average until the end of June. Appallingly, the number of new infections began its exponential course until it reaches the highest of 9,020 cases recorded on 29th May 2021.

During the spread of COVID-19 pandemic, the health authorities and decision makers of the related ministries and agencies need the indications or signals to intensify safety protocols and implementing containment measures to curb the spread of the pandemic. With huge uncertainties lingering the pandemic, ineffective monitoring of COVID-19 cases may exacerbate the situation in the near term. With the latest development on vaccine rollout, new variants, and COVID-19 disease itself, the progression is toward a transition to normalcy (Charumilind et al. 2021). It means that COVID-19 is here to stay. Aptly, control charting scheme technique is the tool to measure and understand variations in the number of COVID-19 infections. To effectively use control chart for monitoring purposes, it is imperative to determine the common/natural and assignable/unnatural cause variations. As for this study, failures to curb the risks of COVID-19 infections are the root cause of variations in its transmissions.

Throughout the earlier stage of pandemic emergence, MCO was enforced to break the chain of COVID-19, while media actively spreads the hashtag #stayhome to increase awareness at all levels of society to curb the spread of COVID-19 (Ain Umaira et al. 2020). In addition, self-imposed prevention strategies have played a substantial role in pandemic control and in many countries, these mitigation approaches were very much encouraged because it was proved to be among the effective tools in preventing the infection transmissions. This mitigation approach limit movement at the population level as well as the physical proximity between people which brings about to community lockdown. The other strategy is to contain the spread of COVID-19 implemented through mass tracing of close contacts of people who had been diagnosed with the virus (Ansah et al. 2021). Sound implementation of these two strategies are means to control COVID-19 infection cases. As such, in the context of control charting, these are the controllable causes or the common cause of variations.

The resurgence of pandemic, especially after 14th April 2021, caused a significant variation in the pandemic related to causes beyond the normal transmission. When the majority of reported COVID-19 cases did not belong to any clusters, they were categorized under sporadic or airborne cases. Due to the fact that some cases caused by variants that already exist in the community, it can be hardly traced or hard to control. These beyond-the-normally-controlled causes of transmissions are the assignable cause of variations. Other possible assignable causes are such as easing of lockdown measures, insensitive behaviour and wrong attitude of public towards the severity of the pandemic and less adherence to the COVID-19 Standard Operating Procedures (SOPs). A hike in COVID-19 cases beginning from the middle of March towards April 2021 was reported could have been caused by the new variants. These variants of concern that have increased in transmissibility are difficult to control. In control charting context, the presence of such uncontrollable causes is also known as the assignable variations.

TABLE 5. Proposed target number of daily cases based on control limits of 3-phase modified Shewhart control chart

Phase/Limits of modified Shewhart control chart		Proposed target number of daily cases	
Current level	-		> 9,000
UCL/Phase III	6,543	Target 1	6,500
CL/Phase III	6,305	Target 2	6,300
LCL/Phase III	6,067	Target 3	6,000
UCL/Phase II	2,375	Target 4	2,500
CL/Phase II	2,233	Target 5	2,200
LCL/Phase II	2,091	Target 6	2,000
UCL/Phase I	1,784	Target 7	1,700
CL/Phase I	1,662	Under Control	1,500

The assignable or unnatural causes of variations that caused persistent increase in daily COVID-19 infections could indicate that the cases were not effectively monitored and properly addressed. As such, preventive intervention and control measures could have been taken more seriously to curb more infections to occur. The burden of pandemic could be much reduced by studying any possible persistent upward trend which form as signals to alert the authorities on the growing number of COVID-19 cases. The modified Shewhart control chart demonstrates the pandemic situation in Malaysia is still at an alarming level, despite the acceleration in vaccination programme as shown by the daily number of vaccines administered. Nonetheless, vast variations in the daily cases as shown by the three-phase modified Shewhart control chart in Table 3 provide some insights to propose the target numbers to achieve as daily new cases Based on the UCL and LCL of each phase in Table 3, the proposed target numbers of daily cases for Malaysia to progressively attain an 'under-control' pandemic situation are depicted in Table 5. These could be the evidence-based guidelines to be set as targets to better contain the infections and eventually bring the pandemic situation in Malaysia under control to transition towards accepting Covid19 as endemic disease.

Conclusion

Understanding variations in the daily new cases is of critical importance to detect a potential resurgence at an earlier point. This is because unprecedented spikes in daily cases represents risk to both hospitals and patients as it could ultimately cast headwinds on the mean preventive measures. This study delves into the applications of modified Shewhart statistical control chart with its preventive features from constant variation monitoring. Variations in the number of daily cases could give insights into the problem situation when it triggers the signals that assignable cause is present and cause the mean number of cases to go up. This would be very useful to the public health authorities since it allows decisions to be made before the sample points surpasses the control limits. The employment of the Shewhart chart is useful in providing real-time feedback for health care workers and policymakers who are responsible for the pandemic control. In this context, an appropriate assessment of the control chart could provide an early warning system to help detect variations that could lead to potential exponential growth in the number of infections. It would be worthwhile if the chart had been prepared during the early stage of pandemic as the increasing trend would have been spotted sooner and earlier intervention may have reduced the size of infection or even prevented the significant resurgence of COVID-19 cases in Malaysia.

Insights from such variations in number of daily cases would assist the health authorities to effectively judge whether a paradigm shift is required to enhance the preventive measures to contain the pandemic. This paradigm shift is required to reassess the overall situation, re-strategize, and move ahead as the country is at a critical stage of the pandemic. At the point of time when this article is written (July 2021), the daily cases have, again, breached the 9000-mark. Some potential factors to be noted include: (1) speeding-up of mass testing procedures (including processing time of COVID test, turnaround times and effective contract-tracing efforts), (2) acceleration of vaccination program to achieve herd immunity, (3) expedition of mobilization of the communities, non-governmental organizations (NGOs) and the private sector in managing the pandemic; and (3) improvisation in risk communication between the health authorities and public community. With strong policies and strategies to appropriately use the public health measures that includes more equitable distribution of vaccines, and continuous individual supports from all walks of life, the aim to keep the transmission at minimum level can be eventually achieved to concede COVID-19 shift from pandemic to endemic.

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