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Covid-19 Pandemicity

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Abstract*— The COVID-19 pandemic, first reported in Wuhan, China in late 2019, quickly became a global crisis. Countries implemented broad public health policies, while local governments adapted strategies to suit diverse community needs. In Indonesia, COVID-19 was declared a national disaster based on legal frameworks emphasizing public safety. The pandemic revealed systemic inequalities and highlighted the crucial role of both national and local governance in crisis response.

Keywords: COVID-19, public health policy, local governance, Indonesia, disaster management, pandemic response.

I. INTRODUCTION

The first transmission of Sars-Cov 2 was reported to occur in the city of Wuhan, which is a city in China. This case was reported in the late 2019, and since then, the outbreak has spread worldwide, since the late of 2019 to date. It has now spread to other countries, as reported by CNN on must-know information about corona virus transmission (hereinafter referred to as COVID-19) [1]. Due to its rapid transmission, the phenomenon was later addressed as pandemic[3]. The number of cases increasing within a short time requires an urgent action. However, there is no specific medication to date to treat the COVID-19 infection. The World Health Organization (WHO) states that Europe has become the center of COVID-19 pandemic transmission, with more cases of infections and deaths from COVID19 than those recorded in China (WHO, 2020).

In the first months of the pandemic, we see countries struggled to find tolerable, if not the most effective, measures to 'flatten' the COVID-19 epidemic curve so that health facilities will not be overwhelmed. In response to the threat of the pandemic, public health policies included epidemiological and socio-economic factors. The success or failure of these policies exposed the strengths or weaknesses of governments as well as the range of inequalities in the society. [2]

National governments followed by implementing large-scale 'blanket' policies to control the pandemic while local government units (LGUs) have to consider granular policies as well as real-time interventions to address differences in the local COVID-19 transmission dynamics due to heterogeneity and diversity in communities. Some policies in place, such as voluntary physical distancing, wearing of face masks and face shields, mass testing, and school closures, could be effective in one locality but not in another [5][6]Subnational governments like LGUs are confronted with a health crisis that have economic, social and fiscal impact. Local health facilities that are already in place in the urban area managed to oversee the urban areas which have been hot spots of the COVID-19 pandemic. However it is noted that the rural communities are deprived of such local health facilities. The importance of localv narratives in addressing subnational concerns are apparent from published experiences in the United States [7][8][10].

As such, many countries have since announced COVID-19 to be a national disaster. For example in Indonesia, the basis for the government to announce COVID-19 as a national disaster is Law No. 24 of 2007 concerning Disaster Management. In the preamble, letter a, the a quo law states: "The Republic of Indonesia is responsible for providing protection to the country and all Indonesian citizens, including protection for life and livelihood against disasters to achieve general welfare." The description of the preamble considering the letter a is in line with the legal adage which states that, "Salus populi suprema lex esto", which means "people's safety is the highest priority" [9][11]

In Indonesia, another basis for this decision is Law No. 6 of 2018 concerning Health Quarantine. Glory Augusta E.M. Sianipar in his paper states: "Quarantine aims to be one of the frameworks for implementing Indonesia's human development as a whole. Health protection for all Indonesian citizens is required, including for those living in strategic islands and at international trade routes because in these areas, the import-export activities as well as migration constantly take place" [14][15][16]

In the Philippines, the number of cases exceeded 473,000 as of 2021. As countries worldwide would face the continuing threat of the COVID19 pandemic, national governments and health ministries formulate, implement and revise health policies and standards based on recommendations by world health organization (WHO), with the experiences of other countries, and on-the-ground experiences[12][13][18]. Early health measures were initially aimed at preventing and reducing transmission in populations at risk. These steps taken differ in scale and speed among the different countries, as some countries have more resources and are more prepared in terms of healthcare capacity and availability of stringent policies [17][19][20]

In the Philippines, the Inter-Agency Task Force on Emerging Infectious Diseases (IATF) was convened by the

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national government in January 2020 to monitor a viral outbreak in Wuhan, China. The first case of local transmission of COVID-19 was confirmed on March 7, 2020. Following this, on March 8, the entire country was placed under a State of Public Health Emergency. By March 25, the IATF released a National Action Plan to control the spread of COVID-19. A community quarantine was initially put in place for the national capital region (NCR) starting March 13, 2020 and it was expanded to the whole island of Luzon by March 17. The initial quarantine was extended up to April 30. Several quarantine protocols were then implemented based on evaluation of IATF [22][24]

- Community Quarantine (CQ) refers to restrictions in mobility between quarantined areas.
- In Enhanced Community Quarantine (ECQ), strict quarantine is implemented and movement of residents is limited to access essential goods and services. Public transportation is suspended. Only economic activities related to essential and utility services are allowed. There is heightened presence of uniformed personnel to enforce community quarantine protocols.
- Modified Enhanced Community Quarantine (MECQ) is implemented as a transition phase between ECQ and GCQ. Strict home quarantine and suspension of public transportation are still in place. Mobility restrictions are relaxed for work-related activities. Government offices operates under a skeleton workforce. Manufacturing facilities are allowed to operate with up to 50% of the workforce. Transportation services are only allowed for essential goods and services.
- In General Community Quarantine (GCQ), individuals from less susceptible age groups and without health risks are allowed to move within quarantined zones. Public transportation can operate at reduced vehicle capacity observing physical distancing. Government offices may be at full work capacity or under alternative work arrangements. Up to 50% of the workforce in industries (except for leisure and amusement) are allowed to work.
- Modified General Community Quarantine (MGCQ) refers to the transition phase between GCQ and the New Normal. All persons are allowed outside their residences. Socio-economic activities are allowed with minimum public health standard.

[21][25][26][28]

A number of issues arise during the implementations, which makes it reasonable for the local government to have difficulty determining COVID-19 as a national disaster. This refers to the normal budget regulations that actually do not apply to the current COVID-19 emergency situations. Instead, specific regulations are required regarding the procedures, mechanisms and ways to use the budget, which will allow the social aid can be used properly. Considering a large amount of budget allocated for handling COVID-19, appropriate regulations, transparency, and accountability are critical to avoid budget misuse. [29][30]

II. COVID-19 IN MALAYSIA

At the moment of the article written, this pandemic infection has infected more than 83 million people and led to more than 1.8 million reported death cases in over 200 countries in the world. Malaysia, being one of the developing countries in the world, could not escape this ongoing worldwide pandemic outbreak of COVID-19. According to the Malaysian Ministry of Health (MOH), as of December 31, 2020, the number of COVID-19 cases reported in Malaysia were 113,010 with 471 deaths, and the numbers have since increased by leaps and bounds. [31][32]

During these challenging times, healthcare workers (HCWs) play an important role in delivering care and services for the clinical management of COVID-19 patients. These are the frontline workers who are either directly or indirectly involved in the healthcare systems and include doctors and nurses as well as health assistants, medical laboratory technicians and medical waste handlers, among others. Employees in the healthcare industry are exposed to various health and safety hazards in their routine work, such as biological (e.g. HIV and COVID19) and chemical exposure. Therefore, HCWs must adhere to infection control guidelines including the use of proper personal protective equipment (PPE) to protect themselves from direct contact with COVID-19 patients. Such direct contact, particularly during aerosol-gathering procedures such as endotracheal intubation, extubation, non-invasive ventilation and exposure to open-circuit aerosols, leads to serious occupational health risks to HCWs. Hence, the WHO and the Centre for Disease Control (CDC) in the USA have issued several guidelines to protect HCWs during the COVID-19 pandemic, including listing them under priority level 3 for COVID-19 testing [33][34][35][36]

As of 8 October 2021, more than 237 million cases have been reported with over 4.8 million deaths worldwide. As the COVID-19 pandemic progresses, several countries globally have reported super spreading events that have attributed to the exponential rise in COVID-19 cases. These events are likely to cause the observed sudden surge of cases due to increase disease transmission at mass gatherings and overcrowding events at particular localities. In addition, infected individuals with higher disease transmissibility would further increase the risk of larger outbreaks. Mass gatherings including political events, conferences, and sporting events are known to be super spreading events that have resulted in large COVID-19 outbreaks in several countries (Herng et al. 2022).

In Malaysia, the first wave of COVID-19 that lasted for a month started as a result of imported cases on 25 January 2020 and reported a total of 22 cases. A much larger second wave started on 27 February 2020, following a 4-day mass gathering at Sri Petaling, Kuala Lumpur. Tis mass gathering resulted in a massive transmission of COVID-19 infection in Malaysia which subsequently caused the largest COVID-19

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cluster during the second wave with 3375 confrmed cases with 34 deaths reported. Currently, Malaysia is facing the third COVID-19 wave which was triggered by the Sabah state electoral process on 26 September 2020 resulting in several mass gatherings and population movement [37]

The first COVID-19 case in Malaysia was detected on 25 January 2020, and 21 more were reported in the following days. After 15 February 2020, no new cases were reported during the subsequent 11 consecutive days, and cases during the second wave, which started on 27 February 2020 were unrelated and had no epidemiological link to any of the first 22 cases. Thus, these 22 cases were regarded as the first wave, and later cases were categorized as the second COVID-19 wave of infections. Therefore, the first wave was an isolated event because there was no epidemiological link between the first wave and second wave, as evidenced by the 11 days' gap of no cases between the two waves and the variations in the factors that resulted in these waves, wherein the first wave was due to importation of the virus into Malaysia by travellers from other countries (i.e., China, Singapore) whereas the second wave was due to mass gathering events. With Malaysia experiencing several waves of COVID-19, there is a need to analyse the data in the first wave to better understand its dynamics, which subsequently resulted in the ending of that cluster of cases [38]

Thus, the first wave of the COVID-19 pandemic in Malaysia has been studied extensively and the epidemiological link was established. Most of the cases during the first wave of COVID-19 in Malaysia were equally distributed across both genders and were predominantly adults aged 19 years and above. Early studies from China, India and Malta reported higher proportions of males among their COVID-19 cases. Regarding age distribution, similar findings were reported in previous studies. This finding can be attributed to higher risk of acquiring infection among adults in this age group due to increased exposure at work or travelling to work as well as underlying co-morbidities. However, it was too early and the numbers too small to establish gender predisposition in COVID-19 infections [39]

The majority of COVID-19 cases during the first wave were imported cases from China, who travelled to Malaysia via air either directly or indirectly. Upon arrival into Malaysia, only a small proportion of these infected individuals were successfully detected through active screening at the point of entry. Two asymptomatic cases were detected only through targeted testing of Malaysians evacuated from Wuhan. This suggests that points of entry screening were unable to detect the majority of COVID-19 cases entering Malaysia. There could be several reasons for this. The nature of screening at entry points that rely mainly on thermal screening and self-health declaration are subject to many limitations. Firstly, individuals who are infected, but remain asymptomatic throughout the disease progression would not be routinely detected via screening at entry points, as in this study, two cases remained asymptomatic throughout. Likewise, those who are incubating the disease and thus pre-symptomatic at arrival or symptomatic but afebrile and provide inaccurate self-health declarations would also not be detected. A study estimated 46% (95% CI: 36 to 58%) of infected travellers would not be detected, depending on incubation period, sensitivity of exit and entry screening, and due to asymptomatic status of the disease. Therefore, thermal screening and self-health declaration at entry points is useful, but has limited effectiveness in preventing entry of the diseased individuals into the country [40]

Quarantine of suspected cases and isolation of confirmed cases are two important strategies for disease containment. In the first wave, cases that were symptomatic at point of arrival in Malaysia were isolated earlier compared to asymptomatic cases (mean of 3.3 days vs. 7.6 days after arrival). This finding is reassuring, as the risk of disease transmission is reduced due to the early isolation of infected individuals. Similar findings have been reported in China whereby cases were admitted within 2 days after onset of symptoms. Among the reasons contributing to early isolation of symptomatic individuals is the presence of symptoms among these individuals that increase their chances of being detected upon screening at entry points. Moreover, symptomatic individuals are more likely to seek treatment from health facilities, therefore increasing their chances of being detected. Asymptomatic individuals were isolated one week on average after arrival in Malaysia. This is concerning, as there is a possibility of ongoing disease transmission by these asymptomatic individuals prior to being isolated. Therefore, one of the ways to enhance the detection of asymptomatic individuals is through a comprehensive and effective contact tracing system [40]

In this study, a total of 343 close contacts were identified, traced, tested, isolated and strictly quarantine for 20 of the COVID-19 cases. From this finding, it is evident that extensive contact tracing was conducted during the first wave of COVID-19 in Malaysia. As a result, 9 cases were identified, and five clusters were detected from contact tracing. This confirms the presence of epidemiological links among the cases during the first wave of COVID-19 in Malaysia. In addition, following the comprehensive contact tracing performed, asymptomatic and symptomatic individuals were detected and isolated early on, therefore, preventing community transmission. Thus, this indicates that extensive contact tracing is an important measure that would address the shortcomings of entry point screening. However, a study of COVID-19 contact tracing in Taiwan reported a low transmission rate of COVID-19 in their cohort and suggested that most transmissions occur very early in the disease, even before symptoms manifest, such that probability of infection of contacts decreases over time [39]

Clustering of cases were similarly reported in China, South Korea, Singapore, and Japan (Ghazali et al. 2022). As transmission of COVID-19 is mainly through respiratory

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droplets, individuals in close proximity have increased chances of getting infected. This highlights the importance of early contact tracing in order to detect more potential cases and enable immediate isolation of the positive ones. Suspected cases or PUIs who are not admitted should be home quarantined until declared fit for release. Therefore, in order to break and eventually prevent sustained local transmission, it is crucial that the COVID-19 clusters be identified early on so that effective preventive and control measures can be initiated in a timely manner. There were eight cases with no clear epidemiological links, as these cases acquired the infection outside Malaysia and therefore establishing an epidemiological link was not possible due to international constraints. This is because all eight were imported cases, hence links to these cases could not be established as they were infected by a source outside of Malaysia, and prompt isolation prevented further transmission. Had there been isolated cases of probable local transmission, this would cause more alarm, as it would suggest on-going local transmission. In view of contact tracing pointing to sources outside Malaysia and the limitations of entry point screening, there is a need to stem importation of cases [40]

In order to limit further importation of COVID-19 cases into Malaysia, international travel restrictions were imposed beginning 18 March 2020, 50 days after the first COVID-19 cases was detected in Malaysia. This was in addition to the 14-day self-quarantine measure that had already been imposed on travellers entering Malaysia beginning from 4 January 2020 (Kenyataan Akhbar KPK 4 Mac 2020). The city of Wuhan in China, the initial epicentre of the COVID-19 outbreak was placed under lockdown just 3 days after official confirmation of human-to-human transmission. Singapore began barring short-term visitors from entering and transiting in the country on 22 March 2020, and Thailand on 26 March 2020 (Ghazali et al. 2022). Chinazzi et al. (2020) ran simulations to model the international spread of COVID-19 using the global epidemic and mobility model (GLEAM) which showed international travel restriction would reduce importation of cases initially, however the effect would not be sustained unless coupled with other public health and behavioural interventions, which proved to be true.

With entry point screening, quarantine and contact tracing in place, the transmission dynamics during the first wave of COVID-19 did not allow for the outbreak to be self-sustaining due to the small number of cases and effective early containment and control measures. Furthermore, most were imported cases which were identified and isolated early, thereby reducing the risk of community transmission. This was established by the extended SEIR model, wherein the outbreak parameters for the first wave model determined an R value of 0.9 which resulted in model fit and case trajectory that showed a quick decay in cases and cessation of the outbreak. Wherein during the first wave, cases were only observed for 22 days, following which the outbreak ended and no cases were reported subsequently for 11 days. Similarly, during the severe acute respiratory syndrome (SARS) outbreak from 2002 to 2003, Malaysia reported a small number of cases (n = 5) compared to other countries (i.e., Canada, China, Singapore) and this was attributed to the institution of similar robust effective control measures as in the first wave of COVID-19 [40]

However, measures such as active screening, extensive contact tracing and prompt isolation/quarantine may not be as effective in subsequent waves due to larger case numbers, overwhelmed health care systems and variation in outbreaks propagation factors (i.e., mass gathering events and the introduction of new variants of concern.) The case numbers during the first wave were much lower compared to the second (n = 10,125) and third (n = 2,751,305). Similarly, the first wave lasted for a shorter duration compared to the second (n = 206 days) and third (n = 468 days). The first wave occurred as a result of imported cases entering Malaysia from China and Singapore, while subsequent waves occurred as a result of mass gathering events and introduction of new variants of concern. With regard to disease transmissibility, the first wave reported much lower disease transmissibility (R0 = 0.9) compared to the second (highest Rt = 3.4) and third (highest Rt = 1.72). In addition, the outbreak control measures transitioned from containment (first wave) to mitigation strategies during subsequent COVID-19 waves in Malaysia. Containment measures such as early detection, isolation/quarantine and extensive contact tracing were effective in controlling the outbreak during the first wave as there were low case numbers, the majority of which were imported cases that were identified, tested, and isolated early. In addition, the extensive contact tracing performed enabled the quarantine of close contacts and detection of additional cases, which subsequently prevented local transmissions. During subsequent waves of COVID-19, mitigation strategies were instituted, as there were more cases with higher disease transmissibility that were attributed to mass gathering events and the introduction of new variants of concern [41]

Nevertheless, this paper provides evidence that instituting early detection, isolation, and contact tracing measures, especially during the initial stage of an outbreak (when cases are low in numbers), did reduce disease transmission and subsequently contained the outbreak early on during the first wave. The limitations of this study include the small number of COVID-19 cases during the first wave. We acknowledge that a smaller data set could affect the estimation of the disease transmissibility (R0) during the first wave. Nevertheless, as COVID-19 is a novel disease, it was important to describe the epidemiological characteristics of the first wave despite the small data set to improve our understanding on the initial evolution and progression of the COVID-19 pandemic in Malaysia, as there has been no published studies on the first wave in Malaysia. Despite the

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small number of case during the first wave, this study was able to describe the initial epidemiological characteristic of the first wave (in terms of case/close contacts/spatial spread/disease transmissibility) and provide an explanation as to the lower number of cases during and early termination of the first wave [42]

Daily Rt values were estimated from 1 February 2020 to 8 November 2020 to quantify the temporal changes in the transmission intensity of the COVID-19 outbreak in Malaysia. Th Rt was calculated by adopting and modifying the Rt algorithm developed by Anne Cori et al. This method produces statistically robust R values which incorporates uncertainty in the distribution of the serial interval using the earlier-mentioned EpiEstim EXCEL spreadsheet and calculates the Rt values using locally validated parameters (Cori et al. 2013) The Rt values were estimated using daily case numbers sourced from the Crisis Preparedness Response Centre (CPRC), Ministry of Health Malaysia (MOH) [43].

The parameters and input data used in this algorithm to estimate the daily Rt values are (i) prior distribution mean, (ii) standard deviation, (iii) serial intervals, and (iv) daily COVID-19 case numbers. These parameter values were obtained from literature and validated for use in the Malaysian context. The generated Rt values for the frst, second and third COVID-19 outbreak waves, and mass gathering events in Sri Petaling and Sabah, and the MCO phases were described in terms of the median, highest and lowest Rt values, and median Rt trends. Changes in the Rt point estimates and its 95% confdence intervals for each wave and corresponding events throughout its duration were quantifed in terms of percentage increase or decrease by ftting a linear equation to the Rt trends of each wave using the EXCEL trend line function. The daily percentage of increase or decrease is calculated based on the gradient of the linear equation whereby a negative gradient indicates a reducing trend and a positive gradient indicates an increasing trend. Te Rt values estimated during the frst and second COVID-19 waves in Malaysia were generated using all reported cases. However, for the third wave, we estimated the Rt values using only community cases and excluded detention case clusters to specifcally measure only the effects of mass gathering events and not detention clusters in the community [40][41][42]

To provide real-time daily Rt updates, the algorithm was automated by developing a web-based application using the R programming sofware with incidence, xts, shiny and jsonlite packages. This application extracts the parameters and case data from relevant sources such as the National Security Council Malaysia (MKN) and MOH COVID-19 portals (MOH, 2021). Automated parsing and structuring of extracted data were done in shiny server-side backend processing. Sourced data from MKN/MOH portals were transformed into a time series format using the incidence and xts packages of R, and the reactive function provided by R's shiny application allowfor reactive computation of outcomes based on user input or default parameters. Data syncing and back-end computations were done to ensure the stability and ease of use of this application. This automated process updates the latest Rt values and minimizes inconsistencies due to human error. The reactive function from shiny enables cycle updates every second through the enveloped function which refreshes the required data and computes the Rt values resulting in real-time Rt updates. Tis process begins by using the jsonlite package to reformat the data sourced from MKN/MOH portal into an R readable format that is compatible with the algorithm. Preprocessed data were then ftted into the EpiEstim package for calculation of the real-time Rt values [43]

As for the second wave, a total of 206 Rt values were estimated with the highest and lowest values were estimated at 3.40 (95% CI 1.47, 6.14) and 0.28 (95% CI 0.23, 0.33) on 29 February 2020 and 11 June 2020 respectively. The range was between Rt=0.28 to 3.40 with a median Rt=1.00. Te median daily Rt reduction of 0.43% (95% CI 0.32, 0.60) was observed from 27 February 2020 to 19 September 2020 (second wave). During the second wave, there was a total of six events observed, a mass gathering in Sri Petaling (disease propagation event) and another five MCO phases (disease control events). As for the mass gathering event in Sri Petaling Gathering, a total of 18 Rt values were estimated with the highest and lowest values were estimated at Rt=3.40 (95% CI 1.47, 6.14) and Rt=1.37 (95% CI 1.12, 1.64) on 29 February 2020 and 12 March 2020 respectively. Te range was between Rt=1.37 to 3.40 with a median Rt=1.95. The median daily Rt increase of 2.82% (95% CI 2.50, 2.90) was observed during this event. During the MCO phase 1, a total of 14 Rt values were estimated with the highest and lowest values were estimated at Rt=1.84 (95% CI 1.70, 1.98) and Rt=1.06 (95% CI 1.00, 1.12) on 18 March 2020 and 30 March 2020 respectively. The range was between Rt=1.06 to 1.84 with a median Rt=1.25. The median daily Rt reduction of 5.27% (95% CI 4.76, 5.80) was observed during this event [43]

As for MCO phase 2, a total of 14 Rt values were estimated with the highest and lowest values were estimated at Rt=1.10 (95% CI 1.04, 1.17) and Rt=0.89 (95% CI 0.84, 0.95) on 3 April 2020 and 10 April 2020, respectively. The range was between Rt=0.89 to 1.10 with a median Rt=1.02. The median daily Rt reduction of 1.00% (95% CI 0.95, 1.02) was observed during this event [43]

For the MCO phase 3, a total of 14 Rt values were estimated with the highest and lowest values were estimated at Rt=0.94 (95% CI 0.88, 1.00) and Rt=0.64 (95% CI 0.58, 0.70) on 16 April 2020 and 21 April 2020 respectively. The range was between Rt=0.64 to 0.94 with a median Rt=0.78. Te median daily Rt reduction of 1.10% (95% CI 0.94, 1.29) was observed during this event.

While for the CMCO phase, a total of 42 Rt values were estimated with the highest and lowest values were estimated at Rt=1.69 (95% CI 1.56, 1.83) and Rt= 0.55 (95% CI 0.49,

0.62) on 26 May 2020 and 2 June 2020 respectively. The range was between Rt=0.55 to 1.69 with a median Rt=0.94. The median daily Rt increase of 0.43% (95% CI 0.41, 0.44) was observed during this event [43]

Finally, during the RMCO phase, a total of 83 Rt values were estimated with the highest and lowest values were estimated at Rt=1.37 (95% CI 1.03, 1.61) and Rt=0.28 (95% CI 0.23, 0.33) on 22 July 2020 and 11 June 2020 respectively. The range was between Rt=0.28 to 1.37 with a median Rt=0.93. The median daily Rt increase of 0.48% (95% CI 0.39, 0.58) was observed during this event. The highest estimated Rt during the second wave of COVID-19 was 3.40, this was for the Sri Petaling event. Following this event, the Rt started to drop for each phase of the MCO to reach a median value of Rt=0.93 for the RMCO. The reduction from the highest estimated Rt during the Sri Petaling event (Rt=3.40) as a result of the various phases of MCO for the second wave of COVID-19 ranged from 63.2% to 77.1%. The highest recorded Rt in Selangor State following the Sri Petaling Mass Gathering event was Rt=3.80 (95% CI 3.01–4.68) on 19 March 2020 as shown in Fig. 7. Following this event, the Rt started to reduce daily by 6.30% to reach Rt=0.83 (95% CI 0.73–0.94) by 15 April 2020 following the institution of the MCO phase 1 and 2 [44]

Since the Rt estimation algorithm in this study generated valid daily Rt values that are essential in monitoring and assisting in the control of the COVID-19 pandemic in Malaysia, we developed an automated web application that uses the validated algorithm to estimate daily real-time Rt values for Malaysia. In the absence of a real-time COVID-19 transmissibility monitoring system in Malaysia, this automated application assists the surveillance system by providing daily Rt values in real time to the health authorities and the public. Providing regular COVID-19 Rt updates allows for evidence-based adjustment of control measures, enables the assessments of the efectiveness of control measures and assists in the accurate forecasting of COVID-19 case trends in Malaysia. In addition to this, continuous access of Rt values to the public via the MySejahtera mobile application and the MOH COVID-19 website would increase public awareness and compliance to the COVID-19 Standard Operating Procedures (SOPs). The Rt estimation algorithm is an important intervention developed in this study which assists in the control of the COVID-19 pandemic in Malaysia [45][46]

III. CONCLUSION

It has been shown that there are multiple steps which can be taken in order to prevent the pandemic COVID-19 from spreading like wild fires in Malaysia, and in the world. Thus far, the steps taken in the early phases of COVID-19 have shown limited capability of containing the virus. The spread of disease can also be fueled by non-compliance to SOPs (i.e. improper use of face mask, poor practice of physical distancing, poor hand hygiene and cough ethics), poor ventilation and environmental factors (i.e. temperature, relative humidity, pollution, solar radiation). Furthermore, studies provided evidence that the MCOs were able to reduce the daily Rt values, especially MCOs with higher stringency levels would correspondingly result in decreasing Rt values. Studies have demonstrated the applicability and utilization of the Rt estimation algorithm in this paper in assisting both the health authorities and the public to monitor and control the COVID-19 pandemic in Malaysia) [47]. These measures combined with mass vaccination of the population at risk will be able to ensure a smoother transition of what looks like a never-ending pandemic.

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