The epidemiology of COVID-19 in ten Southeast Asian countries

Sanjay Rampal, MBBS, PhD[1], Lekhraj Rampal*, MBBS, DrPH[2], Vivek Jason Jayaraj, MPH[1,3], Angsumita Pramanick, MBBS, MRCOG[4], Mahesh Choolani, MBBS, MRCOG[4], Liew Boon Seng, MD, MS (Neurosurgery)[5], Arundhati Gosavi, MBBS, MRCOG[4], Sakda Arj-Ong Vallibhakara, MD, PhD[6,7],

[1]Centre for Epidemiology and Evidence-based Practice, Department of Social and Preventive Medicine, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia, [2]Department of Community Health, Faculty of Medicine and Health Sciences, University Putra Malaysia, [3]Ministry of Health Malaysia, Putrajaya, Malaysia, [4]Department of Obstetrics and Gynecology, National University Hospital, Singapore, [5]Department of Neurosurgery, Hospital Sungai Buloh, Selangor, [6]Faculty of Medicine, Bangkokthonburi University, Bangkok, Thailand, [7]Child Injury and Safety Injury Prevention (CSIP), Faculty of Medicine Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

ABSTRACT

Introduction: Periodic benchmarking of the epidemiology of COVID-19 in the Association of Southeast Asian Nations (ASEAN) countries is critical for the continuous understanding of the transmission and control of COVID-19 in the region. The incidence, mortality, testing and vaccination rates within the ASEAN region from 1 January 2020 to 15 October 2021 is analysed in this paper.

Methods: COVID-19 data on cases, deaths, testing, and vaccinations were extracted from the Our World in Data (OWID) COVID-19 data repository for all the ten ASEAN countries. Comparative time-trends of the epidemiology of COVID-19 using the incidence rate, cumulative case fatality rate (CFR), delay-adjusted case fatality rate, cumulative mortality rate (MR), test positivity rate (TPR), cumulative testing rate (TR) and vaccination rate was carried out.

Results: Over the study period, a total of 12,720,661 cases and 271,475 deaths was reported within the ASEAN region. Trends of daily per capita cases were observed to peak between July and September 2021 for the ASEAN region. The cumulative case fatality rate (CFR) in Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam, was of 0.9% (N=68), 2.2% (N=2,610), 3.5% (N=142,889), 0.1% (N=36), 1.2% (N=27,700), 4.0% (N=18,297), 1.6% (N=40,424), 0.1% (N=215), 1.7% (N=18,123), and 2.6% (N=21,043), respectively. CFR was consistently highest between January-June 2020. The cumulative mortality rate (MR) was 9.5, 13.7, 51.4, 0.2, 80.3, 32.4, 34.5, 1.6, 23.9 and 19.7 per 100,000 population, respectively. The cumulative test positivity rate (TPR) was 8.4%, 16.9%, 4.6%, 7.5%, 11.1%, 12.9%, 0.5%, 11.7%, and 3.6%, with the cumulative testing rate (TR) at 25.0, 90.1, 27.4, 917.7, 75.8, 177.8, 3303.3, 195.2, and 224.9 tests per 1,000 population in Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam, respectively. The percentage of population that completed vaccinations (VR) was 44.5%, 65.3%, 18.5%, 28.2%, 61.8%, 6.8%, 19.2%, 76.8%, 22.7%, and 10% in Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam, respectively.

Conclusion: In 2020, most countries in ASEAN had higher case fatality rates but lower mortalities per population when compared to the third quarter of 2021 where higher mortalities per population were observed. Low testing rates have been one of the factors leading to high test positivity rates. Slow initiation of vaccination programs was found to be the key factor leading to high incidence and case fatality rate in most countries in ASEAN. Effective public health measures were able to interrupt the transmission of this novel virus to some extent. Increasing preparedness capacity within the ASEAN region is critical to ensure that any future similar outbreaks can be dealt with collectively.

INTRODUCTION

The SARS-CoV-2 virus has become the gravest threat that the global population has faced in the 21st century.[1]

It has caused an unprecedented health, socio-economic and political crisis in many countries globally. Even the high-income countries struggled on how to tackle the crisis in their respective countries. A total of 248.5 million cases and 5.03 million deaths have been reported globally as of 6 November 2021.[2] It is very important to understand that the dynamics of the epidemic were varied widely across time and space. Cumulative incidence globally over 22 months has ranged from 1 to 22,233 cases per 100,000 population, whilst mortality rates over the same period have ranged from 3.1 to 599.2 deaths per 100,000 population.[3,4] Case fatality rate (CFR) estimates similarly varied geographically from 0-25%.[4] Testing rates ranged from 8.6 to 15,552.2 tests per 1,000 population.[3] The numbers of populations that have completed their vaccinations ranged from 0.04-100%.[3]

Important indicators of COVID-19 transmission include the incidence rate, case fatality rate, mortality rate, test positivity rate and population testing rate.[5] The longitudinal trends of these indicators may be associated with the availability of resources, health systems capacity, social dynamics,

changing scientific landscape, and resilience of the respective economies and communities. The benchmarking of these indicators may support policymakers and public health officials in mitigating the spread of the virus, particularly in managing resources and implementing timely control measures.[6,7] Regional benchmarking of the above-stated indicators may be useful in estimating the risk of transmission from neighboring countries. However, there is a paucity of systematic analysis on the epidemiology of COVID-19 in Southeast Asian (ASEAN) countries, as accessed via the WHO Global COVID-19 literature database. Periodic benchmarking of these indicators between ASEAN countries is critical for the continuous understanding of the transmission and control of COVID-19 in the region. In this study, we analysed the data on the recent incidence, mortality, testing and vaccination rates within the ASEAN region.

METHODS
Data
This study extracted data on COVID-19 infection from the Our World in Data (OWID) COVID-19 data repository from 1 January 2020 to 15 October 2021. The extracted data included: i) daily new cases, ii) daily new deaths, iii) daily new tests, iv) daily vaccinations, and v) mid-year population.

Data were extracted for the following ten countries: i) Brunei, ii) Cambodia, iii) Indonesia, iv) Laos, v) Malaysia, vi) Myanmar, vii) Philippines, viii) Singapore, ix) Thailand, and x) Vietnam. A single open-source data repository ensured better transparency and consistency of data management, analysis and interpretation.

Data analysis
Daily cases counts were first extracted and visualised within epidemiologic curves. Daily cases per capita per 100,000 population were estimated based on the following function:

$$\text{Daily cases per capita} = \frac{\text{Daily new cases (7-day moving average)}}{\text{Mid-year population}} \times 100{,}000$$

Indicators such as the mortality rate (MR), test positivity rate (TPR), testing rate (TR) and vaccination rate (VR) were tabulated quarterly. These indicators were calculated using the following equations:

$$\text{Mortality Rate} = \frac{\text{No. of reported mortalities (in time period)}}{\text{Mid-year population}} \times 100{,}000$$

$$\text{Test Positivity Rate} = \frac{\text{Reported cases (in time period)}}{\text{No. of individuals tested (in time period)}}$$

$$\text{Testing Rate} = \frac{\text{Average no of individuals tested per day (in time period)}}{\text{Mid-year population}} \times 1{,}000$$

$$\text{Vaccination Rate} = \frac{\text{Maximum cumulative number of completed vaccinations (in time period)}}{\text{Mid-year population}} \times 100$$

A delay-adjusted case fatality rate (CFR) was then estimated to adjust the delay between reporting and death for mortalities.[8] A time-lagged delay distribution was estimated utilising an updated Malaysian dataset from GitHub that had complete information on dates of reporting and death. This time-lagged distribution of reporting to death was assumed to follow a Poisson distribution with a mean of 9.7 days (SD: 10.4 days). The time-lagged distribution was assumed to fit the delay profile of all the ten countries studied.

A back-projection method was carried out to estimate the unobserved death curve at the reported date. It utilised a time series of daily deaths and the empirically estimated time-lagged delay distribution from reporting to death. The counts of deaths (N_t) are assumed to follow a Poisson process and are independent within the linear Poisson model for observed counts (Y_t). A Poisson deconvolution projects the unobserved infection distribution by disaggregating the reported deaths backwards.

Poisson deconvolution:

$$\mu_t = \sum_{i=1}^{t} \lambda_i f_{t-1}, where$$

$\mu_t = E[Y_t]$, $\lambda = E[N_i]$ and,

Y_t = number of deaths diagnosed at time t,

N_i = number of deaths at time t,

f_d = probability that the duration of delay is d units of time long

A non-parametric maximum likelihood estimation estimated the unobserved infection curve from reported data.[9-11] This estimation assumes that the deaths are independent and follows an identical Poisson distribution. Based on back-projection of deaths, an adjusted CFR is more accurate than crude CFR as it better estimates the risk set of incident deaths.[9,12] Visualisations and analyses utilised the "tidyverse", "epitools"," caret", ""tableOne", and "EpiEstim" packages in R 4.1.[13]

RESULTS
In the study period a total 10,251, 116,140, 4,233,014, 31,188, 2,377,033, 485,646, 2,705,792, 141,772, 1,762,186, and 857,639 cases were observed in Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam, respectively. A total 68, 2,610, 142,889, 36, 27,770, 18,297, 40,424, 215, 18,123, and 21,043 deaths were observed in Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam, respectively. (Figure 1)

Cambodia, Laos, Thailand and Vietnam were all observed to report similar trends with large increases of transmission beyond April 2021. Brunei was observed to report increasing trends beyond July 2021. Singapore and Myanmar were observed to have two distinct waves of transmission of COVID-19 while, Malaysia, Indonesia and the Philippines had three distinct waves of transmission. Trends of daily per capita cases were observed to peak between July and September 2021 for all countries within the ASEAN region. The highest daily per capita cases of 67 cases per 100,000 population was observed in Malaysia. (Figure 2)
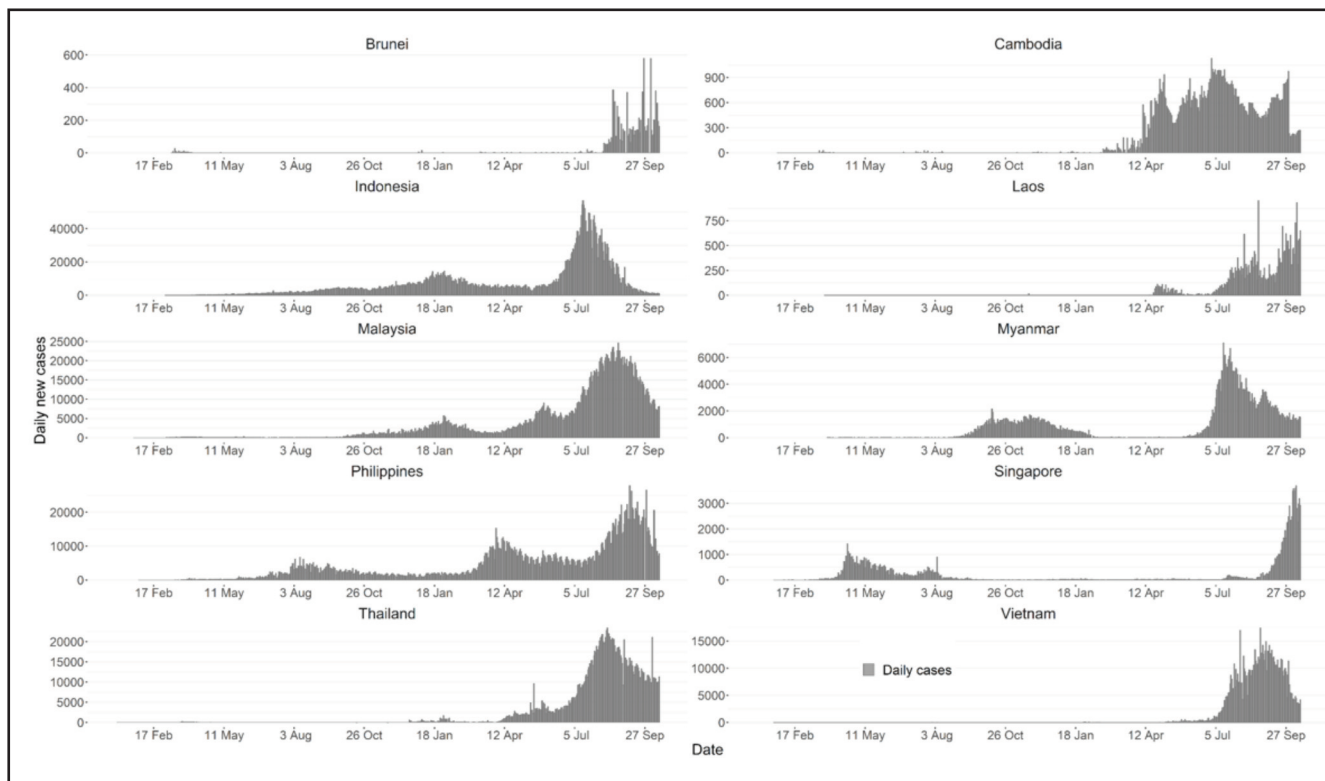
Fig. 1: Epidemiologic curves of cases in all ASEAN countries between 1st January 2020 to 15th October 2021.
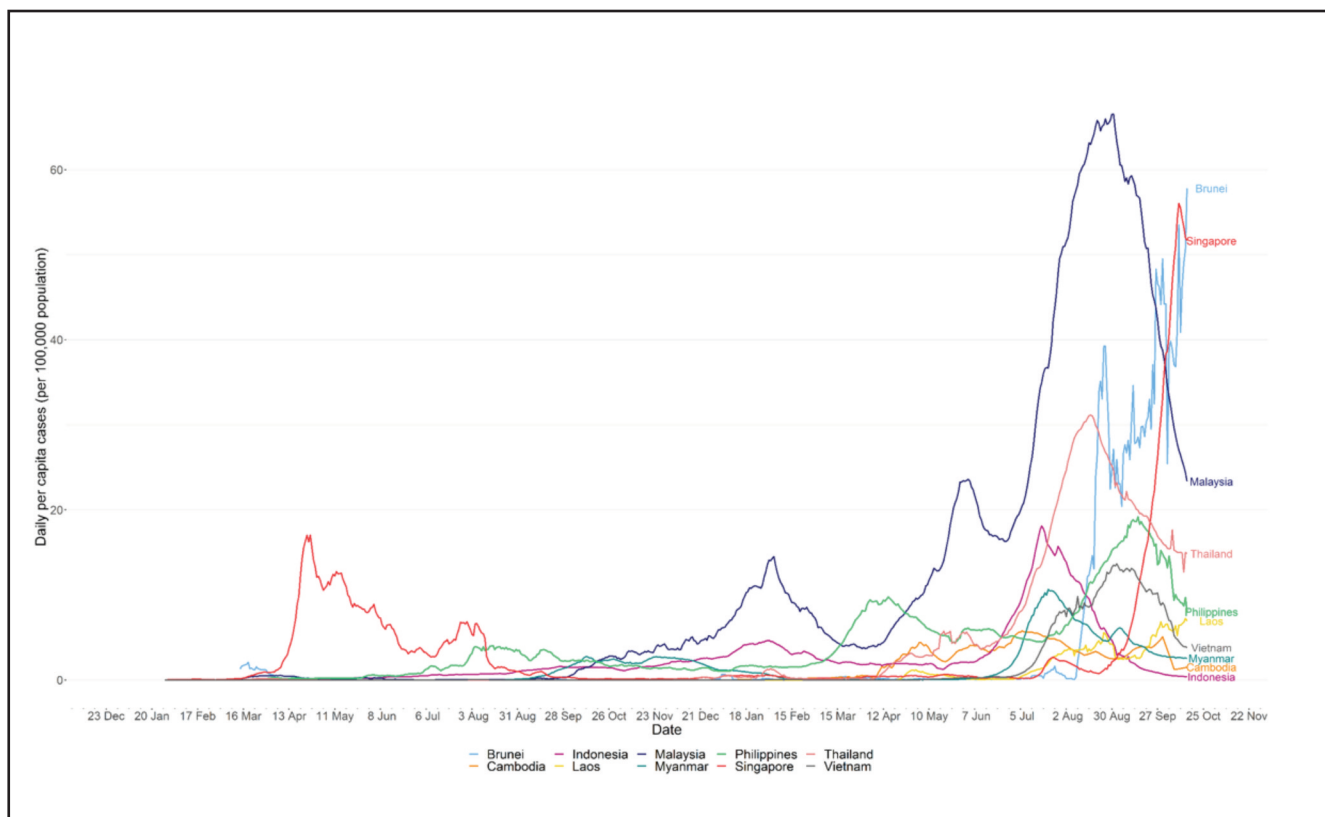

Fig. 2: Daily per capita cases (7-day moving average per 100,000 population) of ASEAN countries between 1st January 2021 to 15th October 2021.

Table I: Covid-19 burden of mortality in ASEAN between January 2020 and September 2021

Location	Cumulative	Period						
		Jan-March 2020	Apr-Jun 2020	Jul-Sep 2020	Oct-Dec 2020	Jan-Mar 2021	Jan-Mar 2021	Jan-Mar 2021
Case fatality rates*								
Brunei	0.9	0.8	17.1	0.0	0.0	0.0	0.0	0.9
Cambodia	2.2	0.0	0.0	0.0	0.0	1.3	1.8	2.6
Indonesia	3.5	18.7	6.0	3.7	2.8	2.5	3.5	3.9
Laos	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Malaysia	1.2	2.6	0.9	1.5	0.4	0.3	1.2	1.5
Myanmar	4.0	12.0	1.1	4.6	2.1	2.1	3.4	4.8
Philippines	1.6	10.4	3.2	1.8	2.0	2.0	1.7	1.2
Singapore	0.1	0.7	0.0	0.0	0.2	0.1	0.3	0.3
Thailand	1.7	4.4	3.4	9.7	11.1	3.6	2.1	1.6
Vietnam	2.6	0.0	0.0	4.9	0.0	0.0	0.5	2.7
Mortality rates**								
Brunei	9.5	0.2	0.5	0.0	0.0	0.0	0.0	8.8
Cambodia	13.7	0.0	0.0	0.0	0.0	0.1	3.5	10.1
Indonesia	51.4	0.0	1.0	2.8	4.1	6.8	6.4	30.2
Laos	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Malaysia	80.3	0.1	0.2	0.0	1.0	2.4	11.9	64.6
Myanmar	32.4	0.0	0.0	0.6	4.3	1.0	0.2	26.3
Philippines	34.5	0.1	1.1	3.8	3.4	3.6	10.2	12.3
Singapore	1.6	0.1	0.4	0.0	0.0	0.0	0.1	1.0
Thailand	23.9	0.0	0.1	0.0	0.0	0.0	2.8	21.0
Vietnam	19.7	0.0	0.0	0.0	0.0	0.0	0.0	19.6

* Case fatality rates, %, was delay adjusted to reflect a more valid population at risk of the case fatality
** Mortality rates (per 100,000 population)

Table II: Covid-19 testing indicators in ASEAN between January 2020 and September 2021

Location	Cumulative	Period						
		Jan-March 2020	Apr-Jun 2020	Jul-Sep 2020	Oct-Dec 2020	Jan-Mar 2021	Apr-June 2021	Jul-Sep 2021
Test positivity ratios (%)								
Brunei	NA	NA	NA	NA	NA	NA	NA	NA
Cambodia	8.4	NA	NA	NA	NA	NA	10.2	6.1
Indonesia	16.9	28.4	12.4	15.7	15.9	21.4	14.2	17.1
Laos	4.6	NA	NA	NA	NA	NA	0.4	6.4
Malaysia	7.5	4.0	0.7	0.4	3.9	3.9	5.4	11.5
Myanmar	11.1	NA	0.4	7.3	7.4	2.4	11.8	19.8
Philippines	12.9	NA	5.3	9.8	5.6	8.5	14.4	20.3
Singapore	0.5	NA	6.3	0.7	0.0	0.1	0.0	0.6
Thailand	11.7	3.0	0.3	0.1	0.7	1.3	4.5	25.4
Vietnam	3.6	0.5	0.0	0.1	0.1	NA	0.5	4.3
Cumulative testing rates (per 1,000 population)								
Brunei	NA	NA	NA	NA	NA	NA	NA	NA
Cambodia	25.0	NA	NA	NA	NA	NA	13.9	11.1
ndonesia	90.1	0.0	1.6	5.3	10.4	13.0	16.9	42.9
Laos	27.4	NA	NA	NA	NA	NA	8.3	19.1
Malaysia	917.7	2.1	26.0	19.7	80.1	180.4	227.7	228.6
Myanmar	75.8	NA	1.3	3.3	27.6	13.2	2.2	28.3
Philippines	177.8	NA	5.6	25.3	25.9	29.0	41.5	50.3
Singapore	3303.3	NA	111.1	359.5	435.7	564.7	816.9	1015.3
Thailand	195.2	0.8	8.3	5.8	7.7	23.7	73.3	67.8
Vietnam	224.9	0.4	1.7	8.4	0.4	NA	29.0	185.0

Testing data is available up to 12 July 2021 for Cambodia, 26 September 2021 for Indonesia, and 18 September for Thailand. Testing data for Laos is missing between 7 July 2021 and 31 August 2021.
NA: Data not available

Table III: Proportion of total population completed vaccinations in ASEAN between January 2021-September 2021

Location	Period		
	Jan-Mar 2021	Apr-June 2021	Jul-Sep 2021
Brunei	0.0	3.3	44.5
Cambodia	1.4	18.0	65.3
Indonesia	1.3	4.9	18.5
Laos	0.0	7.2	28.2
Malaysia	0.7	7.1	61.8
Myanmar	0.1	2.8	6.8
Philippines	0.0	2.4	19.2
Singapore	6.4	35.5	76.8
Thailand	0.0	4.0	22.7
Vietnam	0.0	0.2	10.0

Vaccination data is available till 25 September 2021 for Myanmar and 22 September 2021 for Thailand.

The cumulative CFR rate was 0.9%, 2.2%, 3.5%, 0.1%, 1.2%, 4.0%, 1.6%, 0.1%, 1.7%, and 2.6%, in Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam, respectively. The delay-adjusted CFR was consistently highest between January-June 2020. Peak delay-adjusted CFR of 18.7% was observed in Indonesia between January-March 2020, followed by peaks of 17.1% and 12.0% between April-June 2020 in Brunei and January-March 2021 in the Philippines. MR trend trajectories within the region is 'U' shaped with a peak in early 2020 followed by another smaller peak in mid-2021. (Table I)

The cumulative mortality rate (MR) was 9.5, 13.7, 51.4, 0.2, 80.3, 32.4, 34.5, 1.6, 23.9 and 19.7 per 100,000 population in Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam, respectively. MR was consistently highest between July-September 2021. Peak MR of 64.6 deaths per 100,000 population was observed in Malaysia between July-September 2021, followed by peaks of 30.2 and 26.3 deaths per 100,000 population between July-September 2021 in Indonesia and Myanmar, respectively. CFR trend trajectories within the region were upgoing with a sharp rise of deaths in September 2021. (Table I)

The cumulative test positivity rate (TPR) was 8.4%, 16.9%, 4.6%, 7.5%, 11.1%, 12.9%, 0.5%, 11.7%, and 3.6% in Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam, respectively. The majority of countries within the region reported peak TPRs between July-September 2021. A peak TPR of 25.4% was observed in Indonesia between January-March 2020, followed by peaks of 25.4% and 20.3% between July-September 2021 in Thailand and the Philippines, respectively. Six of the ten highest TPRs were observed in Indonesia. The TPR trend trajectories within the majority of the region was 'U' shaped with peaks between January-March 2020 and July-September 2021. (Table II)

The cumulative testing rate (TR) was 25.0, 90.1, 27.4, 917.7, 75.8, 177.8, 3303.3, 195.2, and 224.9 tests per 1,000 population in Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam, respectively. TR was consistently highest between April-September 2021. Peak TR of 1,015.3 tests per 1,000 population was observed in Singapore between July-September 2021. Six of the ten peak TR were observed in Singapore. This was followed by a peak TR of 228.6 and 185.0 tests per 1,000 population in Malaysia and Vietnam,

respectively. TR trend trajectories within the region were upgoing with a sharp rise in tests between July-September 2021. (Table II)

The percentage of completed vaccinations (VR) was 44.5%, 65.3%, 18.5%, 28.2%, 61.8%, 6.8%, 19.2%, 76.8%, 22.7%, 10% in Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam, respectively. Peak VR of 76.8% was observed in Singapore between July-September 2021, followed by 65.3% in Cambodia and 61.8% in Malaysia. VR trend trajectories within the region were upgoing with a sharp rise in vaccination between July-September 2021. The sharpest increase in vaccinations was observed in Malaysia between April-September 2021. (Table III)

The following are brief accounts from the respective ASEAN nations.

Brunei
A large Malaysia-based religious event led to a large cluster of cases in Brunei in early March 2020.[14] In response to this incident, Brunei implemented strong non-pharmaceutical interventions such as prohibitions of social gatherings and movement restrictions as early as 10 March 2020.[15,16] This led to a rapid decrease in transmission before the staged reopening of almost all sectors by July 2020. Effective public health and social measures led to the eradication of local transmission within Brunei lasting for more than one year. Local transmission emerged again on 7 August 2021.[17] Despite the tightening of measures, transmission had increased within the country. As of 30 September, Brunei reported the highest daily per capita cases within the region. Brunei does not share data on testing statistics which is an important mediator of effective disease control.[18]

Cambodia
Despite the reported lack of intense non-pharmaceutical interventions in Cambodia, only 83 cases of local transmission were reported between 27 January 2020 and 15 February 2021.[19-21] However, from 20 February 2021, a total of 112,651 cases and 2,319 deaths were reported. In response, the government of Cambodia implemented highly restrictive public health and social measures that have been criticised for leaving thousands of Cambodians at breaking point.[22] Additionally, despite reporting high levels of testing, data on testing had not been made available until April 2021.[20] However, Cambodia has reported one of the fastest

vaccination rates in the region- second behind only to Singapore as of September 2021.

Indonesia

Indonesia reported its first case on 2 March 2020. The early approach to disease control within the country utilised a diverse set of containment strategies, including international travel restrictions, school closures, movement restrictions and personal infection prevention measures that differed by region.[21-23] Transmission as such was never fully interrupted and has been comparatively one of the highest within the region. However, overwhelmingly high transmission led to the introduction of a national partial lockdown on 1 April 2021. The lockdown measures were eventually tiered into four levels, and as of 18 July 2021, Indonesia has been at level four; the highest stage of lockdowns in the country.[17] Additionally, testing rates have been one of the lowest within the region, and test positivity rates have been correspondingly higher than most other countries within the region.

Laos

Laos was the last country in ASEAN to report local transmission of COVID-19. The government began containment measures as early as 6 March 2020 and implemented restrictive public health and social measures on 29 March 2021.[24] These measures were followed by the phased reopening of almost all sectors, which led to only 23 cases being observed as of September 2020.[18] Despite no data being available on testing over this period, seroprevalence studies suggest that transmission was likely low in 2020.[24,25] However, beginning from April 2021, transmission began to increase, leading to restrictive public health measures being implemented again on 22 April 2021. Testing per capita is one of the lowest in the ASEAN region, suggesting potentially an undercounting of cases and deaths in 2021.

Malaysia

The first case of COVID-19 was detected in Malaysia on 25 January 2020. It was traced back to three Chinese nationals who previously had close contact with an infected person in Singapore.[26] They had travelled into Malaysia via Singapore on 24 January 2020. They were treated at the Sungai Buloh Hospital, Selangor, Malaysia.[26] Larger clusters were detected from those who attended a massive religious *(tabligh)* gathering at Masjid Sri Petaling Selangor between 27 February 2020 till 3 March 2020, which an estimated 15,000 or more participants attended. By 14 April 2020, there were 4,987 confirmed cases and 82 deaths.[27] The *tabligh* cluster had at that time contributed to the bulk of cases in Malaysia.

This increase in infections was met by rapidly implemented, high-intensity suppression measures that successfully terminated transmission.[28-29] A series of prison and immigration depot outbreaks coupled with the loosening of restrictions due to a state-elections led to a surge in cases within the country in September 2020.[30,31] Despite prolonged high-intensity suppression within the country, transmission was never fully interrupted leading to a third and fourth wave of infections in April and July 2021. Suppression was likely to have been ineffective due to several factors, including more transmissible variants, poor governance, and pandemic fatigue.[32-34] In comparison to all other countries within ASEAN, Malaysia has not performed well in terms of per capita deaths and cases. This burden of disease has led to a prioritisation of public health control measures. Malaysia reports the second-highest testing rate, the second-lowest test positivity, and the third-highest vaccination rate within the region. Additionally, recent thrusts by the Ministry of Health, Malaysia, in increasing data transparency has meant Malaysia now reports the most complete, publicly available surveillance data in the entire region.

Myanmar

Containment measures were implemented as early as 13 March 2020. The first case of local transmission was reported on 23 March 2020, and subsequent increases in transmission led to a nationwide implementation of restrictive public health and social measures as of 18 April 2020. These measures led to rapid decreases in local transmission of COVID-19.[35-36] A phased reopening was implemented beginning on 3 May 2020. However, a rise in cases within the state of Rakhine attributed to migrant movements with bordering Bangladesh led to an increase in the intensity of restrictions on 16 August 2020.[23,37] As transmission spread, different control measures were observed at the regional level. However, as reductions in transmission were observed in January 2020, a military coup was reported in Myanmar on 1 February.[37] Widespread social activism led to conflicts between the military and the public within the country.[38,39] The government, in response, imposed national movement restrictions and curfews.

In early July 2021, cases began increasing again, although cases have since begun decreasing, despite regional strife and limited resources.[40] Myanmar has been transparent with testing data. As of July-September 2021, Myanmar has reported nearly three times the number of tests per capita rate of neighbouring Laos and Cambodia.

Philippines

The Philippines has utilised sustained and intense public health measures since 10 March 2020. The government utilised a five-level system of staged restrictions suppressing transmission across the country.[41] Despite the sustained restrictions, transmission was one of the highest in the region, with one of the highest CFRs.[42,43] Additionally, test positivity was one of the highest within the region, with testing rates being one of the lowest.[44]

Singapore

Drawing lessons from the SARS 2003 pandemic, Singapore had a well organised public health preparedness and response during the COVID-19 pandemic, potentially one of the best in the region.[23] Implementation of control measures started on 2 January 2020, one of the earliest in the region. A robust policy consisting of early detection, contact tracing and isolation of infected individuals remained cornerstones of effective containment of infection. Early detection and management of cases has resulted in a low mortality rate, one of the lowest rates in the world.[43] A "Circuit Breaker" to ensure safe distancing was implemented on 3 April 2021, and with a gradual decrease in cases, a controlled reopening continued from June 2020 to May 2021. A state of

"Heightened Alert" was initiated due to an increase in the number of cases in May 2021.[17] Singapore has commenced a four-step plan to gradually open up the economy, progressively emerging as a ''COVID-19 resilient'' nation. Travel restrictions have been eased for fully vaccinated individuals, progressing to increase in size limits for events and further reduced strict border controls. The ultimate goal is to reach a new normal life with optimal vaccination, and sporadic cases of COVID-19 infection occurring without disrupting community life. Singapore's preparedness and response to COVID-19 have been exemplary within the region and globally.[42]

Thailand

Thailand reported its first COVID-19 cases on 13 January 2020- the first case reported outside of China. Three major clusters of super-spreaders seeded large outbreaks in March 2020, leading to the implementation of strong public health and social measures that successfully interrupted transmission.[45,46] A phased reopening of all sectors began on 1 May 2020 and transmission remained well controlled until outbreaks seeded by migrants in December 2021 led to increased transmission.[47] An increase in restrictions decreased transmission, which led to the loosening of restriction on 4 February 2021. However, the circulation of a more transmissible variant in July 2021 led to an increase in restrictions aiming to stifle transmission.[17] Despite being considered as having one of the most mature public health systems in the region, the more transmissible delta variant has led to an overwhelmed healthcare system in Thailand.[23]

Vietnam

The first case within Vietnam was reported on 23 January 2020. In response to the increasing transmission, the government utilised several strong public health measures to interrupt the transmission.[48] As cases quickly decreased, the government attempted a phased reopening of all sectors high degrees of success, leading to almost 100 days with no local transmission.[49,50] Despite cases being reported after 25 July 2020, the magnitude of transmission remained low until July 2021.[50] Transmission in July 2021 surged as the more transmissible delta began increasing the number of cases and deaths being reported. In response, increased restrictions were imposed to reduce the transmission. Despite relatively low resources, Vietnam remains one of the best performing countries within the region with regards to surveillance, testing, vaccinations, good governance and high population trust.[42,51,52]

DISCUSSION

The ASEAN region reported distinct differences in the COVID-19 pandemic profile compared to the rest of the world. As the pandemic started in 2019 in China and spread westwards, the magnitude of cases in ASEAN countries remained relatively low when compared with the rest of the world in 2020. This could be attributed to the presence of pandemic preparedness, and population memory of a lesson learnt from the SARS 2003 pandemic which had caused significant mortality in Asia. This promoted a quick and consolidated response which was publicly accepted, and adhered to.

The B.1.617.2 - Delta variant was first detected in India in December 2020, and by May 2021, became the predominant COVID-19 strain globally. With the emergence of the COVID-19 Delta variant in ASEAN countries, we saw an upsurge in cases and increasing mortality. However, the mortality rate in ASEAN still remained below the average world mortality of 65 deaths per 100,000 population. Demographic differences like younger population and genetic susceptibility could account for this difference. In 2020, most countries in ASEAN had higher case fatality rates especially between January–March 2020 but lower mortalities per population when compared to the peak of new cases during the period between July-September 2021 where higher mortalities per population were observed but with similar case fatality rates.

Some of the ASEAN countries launched large scale screening and testing while some nations conducted tests based on higher probability of infection, accounting for the differences in detection rates as those with higher testing rates detected larger proportions of asymptomatic cases, and those testing more severe cases were less likely to detect mildly symptomatic or asymptomatic cases. Higher detection of asymptomatic cases likely leads to lower case fatality rates, while there is also evidence that early detection, supportive management, and treatment leads to less severity and mortality. In addition, the case fatality rate may also be affected by factors such as population risk factors, population density, availability and effectiveness of quality healthcare infrastructure.

Tests per million people, and tests per confirmed case, weakly correlates with population mortality and case fatality rate. The proportion of critical cases moderately correlates with tests per confirmed case and tests per million people. Test positivity rate and proportion of severe disease in the nonvulnerable groups may be useful in predicting upsurge in cases and an increasing trend should act as an indicator to heighten control measures.

During the COVID-19 wave in 2021, Brunei, Malaysia, Singapore, and Thailand detected more than 30 cases per 100,000 population, with a high total cumulative testing rate ranging from 195-3,303 tests per 1,000 population, resulting in a cumulative case fatality rate ranging from 0.1% for Singapore to 1.7% for Thailand. Meanwhile, Cambodia, Indonesia, Myanmar, Philippines, and Vietnam had less than 25 cases per 100,000 population, conducted 25 - 224 tests per 1,000 population, and with a cumulative case fatality rate ranging from 1.6% (Philippines) to 3.6% (Indonesia). The countries with higher caseloads did not have higher mortality, as a higher testing rate would likely detect more asymptomatic and mild cases. Selective testing of symptomatic or severe cases could have contributed to lower case numbers in the countries with an apparent lower case load, lower testing rate, and higher mortality. The slow initiation of vaccination programs was found to be the key factor leading to the high incidence and case fatality rate in most ASEAN countries. This was shown by the low vaccination rates (below 20%) in the second quarter year (except Singapore) before the peak of new cases in the third quarter of 2021.

CONCLUSION

In 2020, most countries in ASEAN had higher case fatality rates but lower mortality rates per population when compared to the third quarter of 2021 where higher mortality rates per population and lower case fatality rates were observed. Lower testing rates have been one of the factors leading to higher test positivity rates. Delayed initiation of vaccination programs may be a key factor for the recent higher incidence rates in many ASEAN countries.

A varied set of responses have been implemented within the ASEAN region to interrupt the transmission of COVID-19. The World Health Organization (WHO) has developed strict guidelines to adhere to during the pandemic. Thus far, there remains no safe and effective medicine against COVID-19. Every nation within the ASEAN region leveraged heavily on strong public health and social measures in the early response to the pandemic, which was largely successful in each country. However, contextual factors such as political stability, public health preparedness, pandemic fatigue, and access to resources have led to different scenarios of transmission within individual countries.

Most of the ASEAN countries have been unable to contain the transmission despite the prolonged use of strong public health and social measures. All ASEAN countries have had periods with large increases in local transmission driven mainly by the more transmissible Delta variant since May 2021. The authorities should also continue looking out for new Covid-19 clusters to control the spread of the virus.

Benchmarking between nations in the ASEAN region highlights several important lessons. Effective public health measures can be very useful in interrupting the transmission of this novel virus. Nonetheless, maintaining strong public health measures over a prolonged period can be very challenging. Extraordinary demands on healthcare workers have intensified burnout among healthcare workers. The surging hospital admissions due to COVID-19 have led many national health care systems to the brink of collapse. Increasing the resources available to build preparedness within the region is critical in ensuring any future outbreaks can be dealt with collectively. As we continue to learn to live with this virus, it is critical that ASEAN nations increase information transparency and collaborative efforts, thus increasing the effectiveness of a collective regional response to the COVID-19 pandemic.

As the world continues to combat the COVID-19 pandemic, the way forward is through regional collaboration so that no country is left behind. The ASEAN countries should continue to share their experiences, resources and importantly provide timely support to fellow countries in need. Stronger regional partnerships and strategic pooling of resources may make ASEAN countries better prepared for the coming evolution of this pandemic.

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