



## Cluster of COVID-19 Cases in a Workplace: the First Cluster of a Workplace-related Outbreak in Malaysia, 2020

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### Abstract

In the early stages of the COVID-19 crisis, there was no specific guideline for handling an outbreak if it occurred in a workplace. This study aimed to describe the first and one of the largest clusters linked to a business corporate in Malaysia. A descriptive analysis was conducted using surveillance data from the Petaling District Health Office notified between 28 Feb and 22 Mar 2020. All cases and contacts were identified through surveillance, epidemiological investigation, and laboratory investigation. The total number of confirmed cases and close contacts were 63 and 1,536, respectively. The respondents were mainly Malay, male, and the mean age was 46 years. Of the 63 positive cases, 48 (76%) were reported to have symptoms during the investigation, while the remaining 15 cases (24%) were asymptomatic. The main clinical manifestations were fever (52%), cough (37%), sore throat (27%) and shortness of breath (27%). The mean incubation period was 3.5 days. Due to the timely prevention and control measures carried out by the Petaling District Health Office, the chain of transmission was interrupted as the last case was reported on 19 Mar 2020.

**Keywords:** COVID-19 outbreak, workplace, cluster, Malaysia

### Introduction

An outbreak of pneumonia was reported in Wuhan city, China at the end of December 2019.<sup>1</sup> This pneumonia is caused by a new type of coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).<sup>2</sup> Following the report of the outbreak, the virus quickly spread to many other countries including Thailand, Japan and Korea.<sup>1</sup> By the end of January, the coronavirus disease 2019 (COVID-19) was declared public health emergency of international concern, as it has been detected in as many as 19 countries, mostly in Asia.<sup>3</sup>

The first COVID-19 case in Malaysia was a foreigner from China and reported on 25 Jan 2020.<sup>4</sup> The next seven cases were also foreigners.<sup>5</sup> The ninth case was the first Malaysian and was reported at the beginning of February 2020.<sup>6</sup> He was a 42-year-old businessman who had travelled to Singapore from 16 to 23 Jan 2020.

He was the index case of the first local transmission cluster in Malaysia.<sup>7</sup>

The Ministry of Health (MOH) of Malaysia established a COVID-19 surveillance system prior to the report of the first case in Malaysia. The guidelines defined persons under investigation (PUI) of COVID-19 as having fever or acute respiratory infection (sudden onset of at least one of shortness of breath, cough, or sore throat); and a travel history to affected countries (China, South Korea, Japan, Italy, Iran) in the 14 days before the onset of illness or having close contact within 14 days before illness onset with a confirmed COVID-19 case. The latter denoted a person with laboratory confirmation of SARS-CoV-2 infection. This case definition was used at all international points of entry, clinics and emergency departments, and hospitals in Malaysia.<sup>8</sup> All COVID-19 PUI and detected cases must be notified to the relevant District

Health Office (DHO) within 24 hours.<sup>8</sup> Once a notification is verified, the DHO would then proceed with an epidemiological investigation.<sup>8</sup> For surveillance of overseas returnees, thermal scanners are used at airports to screen inbound passengers. Those who have fever are then held for further investigation.

Malaysia was free of COVID-19 cases from 15 Feb 2020 for 11 days before the second wave of the disease arrived in late February 2020.<sup>9</sup> Most of the early cases in the second wave were initially imported and sporadic.<sup>10</sup> However, a case notified on 28 February to Petaling DHO in Selangor State, Malaysia, was later found to be linked to a cluster from a business corporate in Malaysia.<sup>11</sup>

As of 27 Feb 2020, there were only 25 positive cases in Malaysia. However, by 15 March, 428 cases had been reported.<sup>9</sup> These cases were mostly related to two big clusters, namely the “Tabligh cluster” and a corporate cluster—the one we report here. At that time, there was no specific guideline from the Ministry of Health for corporate companies on handling disease outbreaks. There was no movement restriction or order to work from home until the Movement Controlled Order (MCO) was initiated on 18 Mar 2020. This decision was made after a large increase of cases during the second wave.

The objective of this study was to describe the detection and management of this COVID-19 corporate cluster in Malaysia by the Petaling DHO to control the transmission. We also report the socio-demographic and clinical characteristics of the positive cases in this cluster.

## Methods

### Study Design

We describe all positive cases and their contacts linked to the first known case notified from 28 Feb to 22 Mar 2020 that were related to the workplace cluster. All contacts of these notified cases were traced and investigated. All cases and contacts were identified through surveillance, epidemiological investigation, and laboratory investigation.

### Study Area

The area of this study was Petaling District in Selangor State, Malaysia. This district is about 25 kilometers from Kuala Lumpur. The outbreak occurred at a company in Kuala Lumpur but most of the cases lived in Petaling District. Thus, the cases were notified under Petaling DHO based on their home addresses.

## Epidemiological Investigation

The epidemiological investigation included case investigation and active case detection through contact tracing. All cases and close contacts of the cases in this study up to 14 days from the dates of diagnoses were interviewed via phone to obtain details of their socio-demographic characteristics, symptoms and date of onset, movement and travel history including date of exposure, and comorbidities. Date of onset was self-reported and defined as the date any symptoms related to COVID-19 developed, such as fever, cough, sore throat, abdominal discomfort, shortness of breath and diarrhea. Date of exposure was defined as the last date of contact with a known COVID-19 case or last date of travelling, if any. Confirmed cases were additionally asked for details of all their close contacts. In the subsequent 14 days, all cases and the close contacts were monitored daily for their condition via phone calls.

For this cluster, the PUI were defined as any person (symptomatic and asymptomatic) that was related to the confirmed case within 14 days before the case was diagnosed positive. PUI also included contacts of the cases. A cluster was defined as an unusual aggregation of health events that are grouped together in time and space and reported to a health agency.<sup>12</sup>

All contacts that were traced were asked to have a throat or nasal swab done regardless of whether they were symptomatic or not. They were given a quarantine letter until results of the swab was known. If the result was positive, the person was admitted to hospital and isolated. Those who were asymptomatic and had a negative result were quarantined in their house for 14 days and asked to have a second swab performed on day 13 from the last exposure if they developed symptoms. An order to work from home was given by the employer to those who needed to work during the quarantine period after discussing with the health team. If a contact had two consecutive negative results, they were issued a quarantine release order.<sup>8</sup>

### Laboratory Investigation

All PUI were asked to provide a nasopharyngeal and oropharyngeal swab samples. Symptomatic persons were asked to have a repeat test performed if the first was negative. For those who remained asymptomatic for 14 days, a single test was performed. For confirmed cases notified by private institutions, the initial test sample was repeated for confirmation. All specimens were tested in public health and hospital laboratories capable of running reverse transcriptase polymerase chain reaction (RT-PCR) for SARS-CoV-2.<sup>8</sup>

## Management of PUI and Cases

All PUI identified through contact tracing were given a quarantine order for 14-day home surveillance. However, those who were clinically ill, immunocompromised, or pregnant, with uncontrolled medical illnesses, younger than 2 years or older than 65 years, not suitable for home surveillance, or a symptomatic close contact of a confirmed case regardless of disease severity, were admitted. Those who fulfilled the admission criteria, or were under home surveillance and tested positive for SARS-CoV-2, and all confirmed COVID-19 cases referred from private hospitals, were transported by a rapid response team using a designated ambulance to one of the nearest COVID-19 designated public hospitals.

The affected workplace was disinfected by the Petaling DHO and closed down for two weeks between 28 Feb and 13 Mar 2020.

## Data Analysis

Descriptive statistics were used to describe all COVID-19 cases in this corporate cluster. The attack rate was calculated by dividing the number of confirmed cases by the number of cases and close contacts. The incubation period (in days) was calculated from the date of last exposure to the date of onset for symptomatic cases and presented using the mean with standard deviation (SD) and median with interquartile range (IQR). An epidemic curve was created using Microsoft Excel. A transmission network showing the chains of transmission in the cluster was created using R Software.

## Results

The first notified case in the cluster was a 53-year-old male who developed symptoms on 27 Feb 2020. He visited a private hospital in Petaling District on the same day. His swab sample was taken and a positive result was reported on 28 February. Contact tracing was done starting on 29 February where one of his contacts (later determined to be the index case) was discovered to have symptoms on 18 February, making him the first generation of contacts in this cluster. The first notified case was exposed to the index case on 24 February during an office meeting. Both of them were working in the same company. The index case was diagnosed on 2 March, but developed symptoms on 18 February. The first notified case had a history of going to Shanghai, China on 14 to 17 January, which was more than a month before he developed symptoms, while the index case had a history of going to Surabaya, Indonesia on 24 to 28 January, which was three weeks before he developed symptoms. He also went to Sarawak in early February (2 to 4 Feb 2020).

During the investigation, the total number of people at the meeting that was held in the company on 24 February was 19. Out of these, 13 were board members and six were presenters. All of the board members were sitting in the meeting room together for two hours while the six presenters were called on one at a time to give a presentation. The total time for each presentation was 10–15 minutes. Among the 19 attendees, 16 were diagnosed positive for SARS-CoV-2, which included all of the board members and three presenters. The index case was one of the board members. Some of the presenters had body contact with each other, such as hand shaking, and all had stayed close (less than one meter) to the index case, which included conversations during the presentations.

From 28 February to 22 March, 1,536 people were traced by the Petaling DHO and were linked to the cluster. These individuals were identified after they were notified to the DHO. The total number of COVID-19 cases from this cluster was 126 resulting in an attack rate of 8.2%. Half of the positive cases (n=63) lived in Petaling District while the others were transferred to a DHO according to their house addresses.

Table 1 shows the socio-demographic characteristics of the 63 positive cases who lived in Petaling District. All but one was Malaysian nationals, 51 were of Malay ethnicity and the mean (SD) age as 46 (16.2) years.

**Table 1. Socio-demographic characteristics of COVID-19 cases of a workplace cluster in Petaling District, Malaysia (n=63)**

	n	%
<b>Nationality</b>		
Malaysian	62	98
Others	1	2
<b>Gender</b>		
Male	31	49
Female	32	51
<b>Ethnicity</b>		
Malay	51	81
Chinese	6	10
Indian	5	8
Others	1	2
<b>Age (years), mean (SD)</b>	<b>46 (16.2)</b>	
<b>Age groups (years)</b>		
<30	13	21
30-39	8	13
40-49	9	14
50-59	19	30
60 and above	14	22

Table 2 shows the distribution of clinical characteristics. Most (76%) were symptomatic with common symptoms being fever (52%) followed by cough (37%), sore throat (27%) and shortness of breath (27%). The mean incubation period was 3.5 days and most of the cases developed symptoms during the peak of the epidemic (26–28 February). Most were admitted to a general ward with only one requiring intensive care due to shortness of breath and oxygen desaturation. No fatalities were seen up until 22 March.

**Table 2. Clinical characteristics of COVID-19 cases of a workplace cluster in Petaling District, Malaysia (n=63)**

	n	%
<b>Symptom status</b>		
Symptomatic	48	76
Asymptomatic	15	24
<b>Symptoms</b>		
Fever	33	52
Cough	23	37
Sore throat	17	27
Shortness of breath	17	27
Runny nose	7	11
Arthralgia	4	6
Diarrhea	4	6
Myalgia	3	5
Lethargic	2	3
Headache	0	0
Abdominal Pain	0	0
<b>Incubation period (days)</b>		
Mean (SD)	3.5 (3.0)	
Median (IQR)	3.0 (3.0)	
<b>Comorbidities</b>		
Hypertension	14	22
Diabetes mellitus	4	6
Dyslipidaemia	3	5
Heart Disease	1	2
Cancer	1	2
Lung disease	1	2
None	40	63
<b>Ward</b>		
General	62	98
Intensive care unit	1	2
<b>Outcome</b>		
Alive	63	100
Death	0	0

Figure 1 illustrates the epidemic curve of this cluster. For symptomatic cases, the date of onset of illness was used while the date of diagnosis was used for asymptomatic cases. The peak occurred on 27 February and the last case was reported on 19 Mar 2020.

Figure 2 depicts the transmission chains among positive cases. Each of the generations are differentiated by a different color. There were 17 cases confirmed in the first generation of contacts, 22 in second generation, 15

in the third, six in the fourth and two in the fifth generation. The first generation included cases from the company meeting in which the index case attended on 24 February and his family members. The attack rate for the first generation was 83%.

## Discussion

We reported the first COVID-19 cluster in a workplace population in Malaysia. The index case was reported to have a travel history overseas to Surabaya, Indonesia from 24 to 28 Jan 2020. At that time, there was no reported positive cases in Indonesia. He developed symptoms after returning to Malaysia on 18 February, suggesting that if he was infected before returning to Malaysia, then thermal scanning devices in the airport may miss some inbound passengers who are infected and asymptomatic. During our investigation, the index case also mentioned that his previous office area was closed for disinfection of unknown reason. He claimed that some of the staff were not feeling well and that the office's clients were mostly foreigners.

From the history taking, the index case was already symptomatic when he attended the meeting on the 24 February. He then infected the other 15 people in that meeting despite the fact that some did not have a close conversation nor body contact with the index case. This showed that being in a close environment for a certain period of time will render a person susceptible for infection; being less than a meter from the index case is therefore not a necessary requirement. This is because coronaviruses can be transmitted indirectly as they can persist on fomite surfaces for at least 3 days, especially if the environment is conducive, such as lack of sunlight.<sup>14</sup> A study from China reported that strong airflow from an air conditioner may have propagated the droplets of an infected person to other people in the confined space.<sup>15</sup>

From the result of this outbreak, the mean incubation period was 3.5 days, suggesting that a person will develop symptoms 3 to 4 days after being exposed. A study in China reported a median incubation period of 3 days,<sup>16</sup> a result similar to ours. The World Health Organization states that the average incubation period of COVID-19 ranges from 1-14 days.<sup>17</sup> In this Petaling cluster, 48 (76%) of the 63 positive cases developed symptoms while 15 (24%) were asymptomatic. In a report of COVID-19 cases in China, only 1% were asymptomatic.<sup>18</sup> Asymptomatic cases are still infective and able to transmit the disease to others.<sup>19</sup> In another study, it was shown that asymptomatic cases may develop symptoms during their hospital admission while some will remain asymptomatic.<sup>16</sup>

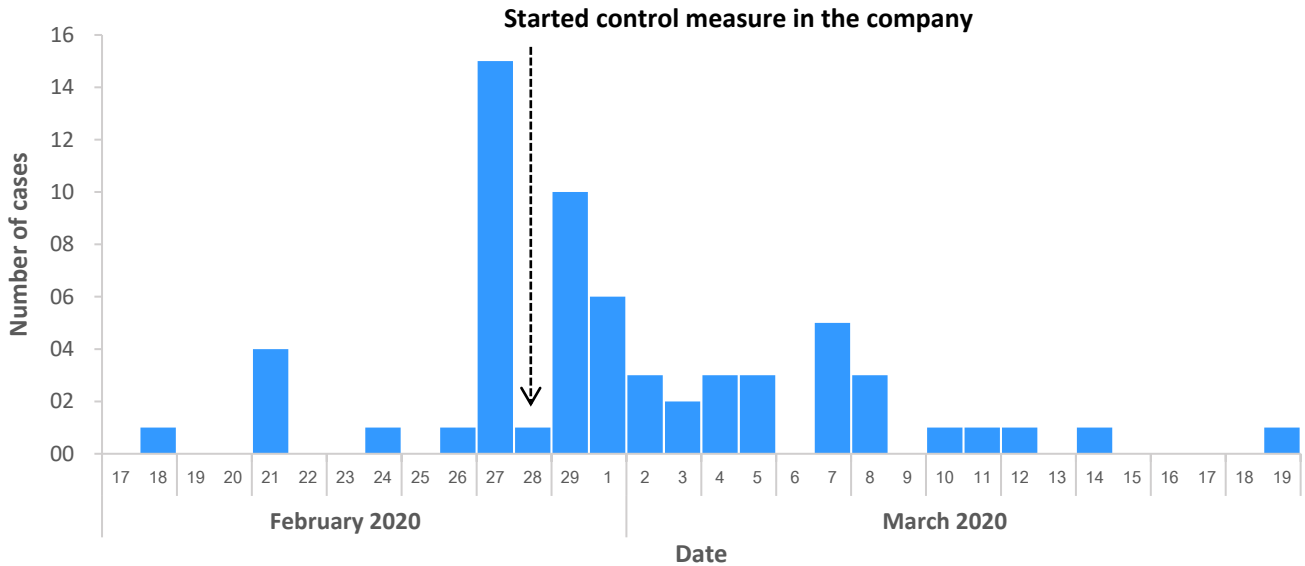


Figure 1. Epidemic curve of COVID-19 cases of a workplace cluster in Petaling District, Malaysia (February – March 2020) (n=63)

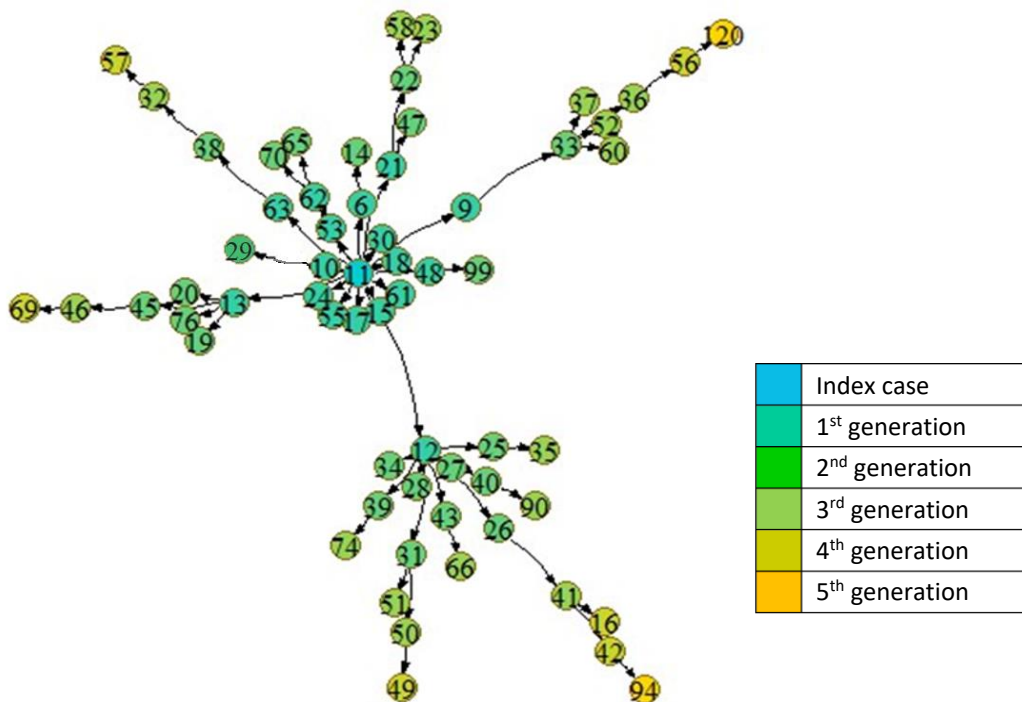


Figure 2. Generations of transmission based on the epi-link (n=63)

In our study, the majority of cases (52%) were aged 50 years or above. This is possibly due to the characteristic of the cluster as most were higher level executives. One third of the cases had comorbidities such as hypertension and diabetes mellitus. Other studies reported that the severity of the disease will increase if the infected person has underlying comorbidities.<sup>20</sup> In this cluster, only one case required intensive care. This patient had a history of hypertension and diabetes mellitus.

Petaling DHO was able to trace cases up to the 5<sup>th</sup> generation of contacts suggesting that SARS-CoV-2 is a highly infectious virus. One study reported that the

average amount of secondary cases that one case can infect in a completely susceptible population (known as the basic reproduction number,  $R_0$ ) ranges from 2.0 to 3.1<sup>21</sup> and while another study reported an  $R_0$  value of 2.68.<sup>22</sup>

This workplace cluster ended within a duration of less than a month. The DHO carried out a workplace risk assessment and identified workers deemed as close contacts with the confirmed COVID-19 index case. Based on the hierarchy of control measures, from the most effective to least effective, each of these workers were issued a quarantine letter and isolated from the hazard. Isolation is a form of engineering control and

is effective as it prevents workers from exposure to the given biological hazard (SARS-CoV-2) and also further prevents disease transmission.<sup>23</sup> Administrative control in the form of job rotation was also implemented in which workers took turns to work from home. Besides that, both employer and employees were engaged for hazard communication including advice on social distancing and proper hand hygiene using hand sanitizers. The workplace was put under temporary closure to allow for disinfection by the DHO and the company was closed for two weeks. The employers were allowed to work from home and also advised to practice gate keeping, involving screening all workers for fever and acute respiratory symptoms before entering the office premises. The quarantine letter was issued to all contacts of the positive cases, thus reducing the risk of disease transmission. This is consistent with the local regulations, the Occupational Safety and Health Act (OSHA) 1994, where it is the duty of employers to ensure the safety, health and well-being of their employees.<sup>24</sup> The control measures taken in this outbreak focused on the prevention of further spread and breaking the chain of transmission. All these measures can be employed when similar outbreaks occur in other workplaces.

There were limitations for our study. First, we did not follow up the cases once they were admitted to the hospital. Patients might have developed symptoms in the hospital and the descriptive report was based on the positive cases registered in Petaling District and not for the whole of the cluster due to data availability. Second, no environmental samples were taken to assess for the presence of the virus on the surfaces of fomites at the workplace.

## Conclusion

A cluster of COVID-19 in a workplace setting was curbed within three weeks due to control efforts by the Petaling DHO with mutual co-operation by the employer and other related DHO. They did all the necessary measures to prevent the outbreak from escalating.

## Recommendations

From this study, outbreak control measures have to be done quickly and efficiently to minimise disease transmission. Health authorities must strictly enforce the regulations. It is advisable for the government to close all international borders until the number of cases has reduced to an acceptable level, or at least after herd immunity against SARS-CoV-2 has been achieved. After more than a year of the pandemic, the residents are advised to practice new norms such as wearing face masks, performing hand hygiene and

maintaining physical distancing, even after vaccination.

## Conflict of interest

The authors declare there is no conflict of interest for this publication.

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## Ethical approval

Ethical approval for the study was obtained from the Medical Research and Ethics Committee (MREC) and registered with our National Medical Research Registry with registration number NMRR-20-720-54598.

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## References

1. World Health Organization. Novel Coronavirus (2019-nCoV): Situation Report, 1 [Internet]. Geneva: World Health Organization; 2020 Jan 21 [cited 2020 Apr 20]. <[https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200121-sitrep-1-2019-ncov.pdf?sfvrsn=20a99c10\\_4](https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200121-sitrep-1-2019-ncov.pdf?sfvrsn=20a99c10_4)>
2. World Health Organization. Naming the coronavirus disease (COVID-19) and the virus that causes it [Internet]. Geneva: World Health Organization; 2020 [cited 2020 Apr 20]. <[https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-\(covid-2019\)-and-the-virus-that-causes-it](https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it)>
3. World Health Organization. Novel Coronavirus (2019-nCoV): Situation Report, 11 [Internet]. Geneva: World Health Organization; 2020 [cited 2020 Aug 31]. <<https://apps.who.int/iris/handle/10665/330776>>

4. Official Portal Ministry of Health Malaysia. Ministry of Health Malaysia Press Statement on 25 January 2020 - Detection of New Confirmed Cases of 2019 Novel Coronavirus (2019-nCoV) in Malaysia [Internet]. Putrajaya (MY): Ministry of Health Malaysia; 2020 Jan 25 [cited 2020 Apr 28]. <[http://www.moh.gov.my/index.php/database\\_stores/store\\_view\\_page/21/1301](http://www.moh.gov.my/index.php/database_stores/store_view_page/21/1301)>. Malay.
5. Official Portal Ministry of Health Malaysia. Ministry of Health Malaysia Press Statement on 30 January 2020 - Current Situation of 2019 Novel Coronavirus (2019-nCoV) in Malaysia [Internet]. Putrajaya (MY): Ministry of Health Malaysia; 2020 Jan 30 [cited 2020 Apr 28]. <[http://www.moh.gov.my/index.php/database\\_stores/store\\_view\\_page/21/1306](http://www.moh.gov.my/index.php/database_stores/store_view_page/21/1306)>. Malay.
6. Official Portal Ministry of Health Malaysia. Malaysia Press Statement on 9 February 2020 - Current Situation of 2019 Novel Coronavirus (2019-nCoV) in Malaysia [Internet]. Putrajaya (MY): Ministry of Health Malaysia; 2020 Feb 9 [cited 2020 Apr 28]. <[http://www.moh.gov.my/index.php/database\\_stores/store\\_view\\_page/21/1311](http://www.moh.gov.my/index.php/database_stores/store_view_page/21/1311)>. Malay.
7. Pung R, Chiew CJ, Young BE, Chin S, Chen MI, Clapham HE, et al. Investigation of three clusters of COVID-19 in Singapore: implications for surveillance and response measures. *Lancet*. 2020;395(10229):1039-46. doi:10.1016/S0140-6736(20)30528-6
8. Malaysia Ministry of Health. Guideline COVID-19 Management [Internet]. Version 4. Putrajaya (MY): Ministry of Health, Malaysia; 2020 [updated 2020 Feb 26]. Annex 8, the infection prevention and control (IPC) measures when corona virus disease (COVID-19) infection is suspected or confirmed; [cited 2020 Apr 29]. p.46-55. <[http://www.moh.gov.my/moh/resources/Penerbitan/Garis%20Panduan/Pengurusan%20KEsihatan%20&%20kawalan%20pykit/2019-nCoV/Bil%204%20%202020/Annex%208%20%20IPC\\_26022020.pdf](http://www.moh.gov.my/moh/resources/Penerbitan/Garis%20Panduan/Pengurusan%20KEsihatan%20&%20kawalan%20pykit/2019-nCoV/Bil%204%20%202020/Annex%208%20%20IPC_26022020.pdf)>
9. Hashim JH, Adman MA, Hashim Z, Mohd Radi MF and Kwan SC. COVID-19 Epidemic in Malaysia: Epidemic Progression, Challenges, and Response. *Front. Public Health*. 2021; 9:560592. doi: 10.3389/fpubh.2021.560592
10. Official Portal Ministry of Health Malaysia. Ministry of Health Malaysia Press Statement on 27 February 2020 - Current Situation of Coronavirus Disease (COVID-19) in Malaysia [Internet]. Putrajaya (MY): Ministry of Health Malaysia; 2020 Feb 27 [cited 2020 Apr 29]. <[http://www.moh.gov.my/index.php/database\\_stores/store\\_view\\_page/21/1332](http://www.moh.gov.my/index.php/database_stores/store_view_page/21/1332)>. Malay.
11. Official Portal Ministry of Health Malaysia. Ministry of Health Malaysia Press Statement on 1 March 2020 - Current Situation of Coronavirus Disease (COVID-19) in Malaysia [Internet]. Putrajaya (MY): Ministry of Health Malaysia; 2020 Mar 1 [cited 2020 Apr 29]. [http://www.moh.gov.my/index.php/database\\_stores/store\\_view\\_page/21/1335](http://www.moh.gov.my/index.php/database_stores/store_view_page/21/1335).
12. Centers for Disease Control and Prevention. Guidelines for Investigating Clusters of Health Events. *MMWR* [Internet]. 1990 Jul 27 [cited 2020 Apr 2]; 39(RR-11):1-16. <<https://www.cdc.gov/mmwr/preview/mmwrhtml/00001797.htm>>
13. World Health Organization. Modes of transmission of virus causing COVID-19: implications for IPC precaution recommendations [Internet]. Geneva: World Health Organization; 2020 Mar 29 [cited 2020 Apr 28]. <<https://www.who.int/news-room/commentaries/detail/modes-of-transmission-of-virus-causing-covid-19-implications-for-ipc-precaution-recommendations>>
14. Lu J, Gu J, Li K, Su W, Lai Z, Zhou D, et al. COVID-19 Outbreak Associated with Air Conditioning in Restaurant, Guangzhou, China, 2020. *Emerg Infect Dis*. 2020 Jul;26(7):1628-31. doi:10.3201/eid2607.200764
15. Hu Z, Song C, Xu C, Jin G, Chen Y, Xu X, et al. Clinical characteristics of 24 asymptomatic infections with COVID-19 screened among close contacts in Nanjing, China. *Sci China Life Sci*. 2020 May;63(5):706-11. doi:10.1007/s11427-020-1661-4
16. World Health Organization. Q&As on coronaviruses disease (COVID-19). Geneva: World Health Organization; 2020 [cited 2020 Apr 28]. <<https://www.who.int/news-room/q-a-detail/q-a-coronaviruses>>
17. Wu Z, McGoogan JM. Characteristics of and Important Lessons from the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72314 Cases from the Chinese Center for Disease Control and Prevention. *JAMA*. 2020 Apr 7;323(13):1239-42. doi:10.1001/jama.2020.2648

18. Bai Y, Yao L, Wei T, et al. Presumed Asymptomatic Carrier Transmission of COVID-19. *JAMA*. 2020 Apr 14;323(14):1406-7. doi:10.1001/jama.2020.2565
19. Guan WJ, Liang WH, Zhao Y, Liang HR, Chen ZS, Li YM, et al. Comorbidity and its impact on 1590 patients with COVID-19 in China: A Nationwide Analysis. *Eur Respir J*. 2020 May; 55(5):2000547. doi:10.1183/13993003.00547-2020
20. Majumder MS, Mandl KD. Early Transmissibility Assessment of a Novel Coronavirus in Wuhan, China. SSRN [Preprint]. 2020 Jan 24. doi:10.2139/ssrn.3524675
21. Wu JT, Leung K, Leung GM. Nowcasting and forecasting the potential domestic and international spread of the 2019-nCoV outbreak originating in Wuhan, China: a modelling study. *Lancet*. 2020;395(10225):689-97. doi:10.1016/S0140-6736(20)30260-9
22. Cividino M. Occupational Health Services: Communicable Disease Prevention and Management – Part 1: Overview of Occupationally Acquired Infections, Biological Hazard Risk Assessment and Hierarchy of Control Measures. *Ontario Occup Heal Nurses Assoc*. 2017 Spring/Summer;36(1):4-10.
23. Occupational Safety and Health (OSHA) Act and Regulations 1994. 22nd ed. MDC Publishers Sdn Bhd; 2014.