An Epidemiological Analysis of COVID-19 cases from Jan to July 2020 in Kelantan, Malaysia

Hazlienor Mohd Hatta¹, Nik Mohd Hafiz Mohd Fuzi², Nur Dalilah Mohd Zin¹, Afiq Izzudin A Rahim¹, Najihah Mahfuzah Zakria³, Suhaiza Sulaiman⁵, Abdul Haris Muhammad¹, Zaini Hussin¹

¹Kelantan State Health Department, Ministry of Health, Malaysia
²Communicable Disease Control (CDC) Unit, Kelantan State Health Department, Ministry of Health, Malaysia
³Community Health Department, Universiti Sains Malaysia (USM)
⁴Pasir Mas District Health Office, Kelantan, Ministry of Health, Malaysia
⁵Surveillance Unit, Kelantan State Health Department, Ministry of Health, Malaysia

Hazlienor Mohd Hatta
Corresponding author
Kelantan State Health Department,
Kota Bharu, Kelantan, Malaysia
E-mail: drhazlienor@hotmail.com

Abstract

As the global battle against COVID-19 rages on, Malaysia’s concerted effort in stemming the spread is commendable. This study characterized the epidemiology of COVID-19 aiming towards understanding the disease in a local setting for better preparation and management. A nation-based e-COVID reporting system was used to collect data on laboratory-confirmed COVID-19 cases in Kelantan from January to July 2020. Information from investigation reports was also reviewed.
Analyses comprised of the estimation of incidence and case-fatality rate, summary of demographic and clinical characteristics including the age and sex distributions, construction of the epidemiological curve and choropleth map, and appraisal of healthcare usage. Multiple logistic regression was used to determine the risk factors for Intensive Care Unit (ICU) admission. A total of 166 cases reported in Kelantan until July 2020. Cases peaked during March before steadily declining and were concentrated in the capital. The age-adjusted incidence rate was 9.4/100,000 populations with a case-fatality rate of 2.4%. The median age was 37 years and 78% were male. The predominant symptoms were fever and cough while 25% of cases were asymptomatic. About 57% of cases were identified by active case detection and 97% had exposure risk. Potentially infected cases were isolated within a median of 7 days after exposure, even before the diagnosis. All cases were hospitalized with a median of 14 bed days, while 12% admitted to ICU, and 3% required mechanical ventilators. Significant factors for ICU admission were older age (AOR: 1.05, 95% CI: 1.02, 1.09, \( P = 0.001 \)) and diabetes mellitus (AOR 4.55, 95% CI: 1.36, 15.25, \( P = 0.014 \)). Although all ages appeared susceptible to COVID-19, older age and diabetic patients were more vulnerable. Kelantan’s targeted approaches of prompt identification and isolation of potentially infected individuals have been effective in limiting the transmission, allowing sufficient healthcare capacity in managing the pandemic.

**Keywords:** Epidemiology, COVID-19, ICU Admission, Malaysia

1. Introduction

The emergence of a new virus in Wuhan, the capital of Hubei province in China was first discovered when a cluster of pneumonia cases among patients who had visited a wet seafood market was reported there in December 2019 (WHO, 2019). Initially known as the 2019 novel Coronavirus (2019-nCoV), the virus was soon confirmed as a new kind of coronavirus belonged to the same Betacoronavirus genus as severe acute respiratory syndrome coronavirus (SARS-CoV) and the Middle East Respiratory Syndrome Coronavirus (MERS-CoV); later officially named as SARS-CoV-2 virus (Petrosillo et al., 2020). It caused the Coronavirus Disease 2019 (COVID-19), a clinical syndrome characterized by respiratory illness with a wide spectrum of severity, ranging from asymptomatic infection to severe interstitial pneumonia and acute respiratory distress syndrome (ARDS) (Sun et al., 2020). The incidence of COVID-19 has significantly multiplied in China and the virus has rapidly spread to other countries, and on 11th March 2020, it was declared a pandemic (Hanaei & Rezaei, 2020). As of this writing, it has infected approximately 54.5 million people with over a million associated deaths (WHO, 2020a). Malaysia had recorded its first case on 25th January 2020 involving 3 patients of Chinese nationality from Wuhan (Che Mat et al, 2020) and as of 31st July 2020, 8,976 confirmed cases along with 125 deaths were reported (MOH, 2020e).

Based on phylogenetic tree analysis, SARS-CoV-2 is closely related to SARS-CoV that is responsible for the SARS disease, and the Bat SARS-like Coronavirus that was previously isolated from horseshoe bat in China (Petrosillo et al., 2020). Despite the high virological similarity between the SARS-CoV-2 and SARS-CoV, the characteristics and course of the illness vary for both diseases. SARS-CoV-2 is associated with milder infection of which the fatality rate of COVID-19 is 4.6%, which is lower than that of SARS (9.4%) and MERS (34.4%) (Munster et al., 2020; Wu & McGoogan, 2020). However, the virus is widely transmitted in the community whereas SARS-CoV and MERS-CoV were often associated with nosocomial infections (De Wit et al., 2016; Lee & Hsueh, 2020; Wu & McGoogan, 2020). The best estimated basic reproductive number (\( R_0 \)) of
COVID-19 is 2.5 (CDC, 2020) that is higher than that of SARS (1.7 to 1.9) and MERS (0.8 to 1.3) (Petrosillo et al., 2020). The mode of transmission for SARS-CoV-2 is similar to that of SARS and MERS which is by respiratory droplet but with more efficient human to human transmission. Sixty-four per cent of documented clusters in China were among familial households but infection resulted from short-term exposure has been observed (Wu & McGoogan, 2020). The transmissions via faeces, urine, or breastmilk are still under study as SARS-CoV-2 has been detected in these samples (WHO, 2020c). The risk of blood borne transmission is low and intrauterine transmission has not been reported (WHO, 2020c; Zimmermann & Curtis, 2020).

In Malaysia, the first and second wave of COVID-19 disease has been curbed as demonstrated by the flattening of the curve and decrement of the daily new cases (MOH, 2020d). The limitation on international travel and movement control restrictions among other implemented public health measures has slowed down the spread of COVID-19 in the country. However, global new cases are constantly on the rise as more countries have reopened their borders and resume travel activity (WHO, 2020a). The recent upsurge of international travel has also increased the number of its imported cases leading to a resurgence involving local transmission (MOH, 2020d).

Kelantan is located in North-eastern Peninsular Malaysia (Fig.1), internationally bordered by Narathiwat Province of Thailand to the north, and domestically bordered by Terengganu to the south-east, Perak to the west and Pahang to the south, with a population over 1.9 million (DOSM, 2019). About 94.7% of its people are Malays and Muslim with a male to female ratio of 1.00:0.98 (DOSM, 2019). It has a lot of tourist attractions with a high volume of international and domestic travelling activities (DOSM, 2019), making it constantly at threat for imported cases. The information in regards to outbreak patterns and risk factors for infection, clinical features and severity of the disease, and effective measures to reduce the transmission are limited at the start of this pandemic as SARS-CoV-2 is a new virus.

Various protocols were then developed to facilitate systematic and rapid data collections as well as analyses across the globe to provide a better comprehension of the disease and subsequently guide the implementation of various measures (WHO, 2020b). However, international epidemiological studies should be cautiously interpreted as not only the disease is very dynamic but its characteristic is heavily influenced by different methods of case detection, testing rate, health system capacity, and implementation of public health measures that vary from country to country (Lai et al., 2020). Hence, it is important to characterize the key epidemiological features of COVID-19 at the local level towards a better understanding of the disease to be prepared for impending outbreaks with specific countermeasures.

The general objective of this study is to describe the epidemiological characteristic of COVID-19 disease in Kelantan, specifically: 1) to determine the incidence of COVID-19 disease and susceptible population in Kelantan; 2) to describe the socio-demographic and clinical characteristic of COVID-19 cases in Kelantan; 3) to identify the factors
under study which associated with admission to Intensive Care Unit (ICU) among COVID-19 cases in Kelantan.

2. Materials and Methods

Case Identification

Since SARS-CoV-2 was identified, suspected cases were screened from 26th January 2020 onward. All confirmed cases diagnosed in Kelantan were notified to the Ministry of Health (MOH) of which all investigation records pertaining to the case were required to be submitted to the state’s COVID-19 Crisis Preparedness Response Centre (CPRC) as part of the epidemiological investigation implemented under the Prevention and Control of Infectious Disease Act 1988 (Act 342) (MOH, 2020a) and were compiled in a master database. Similar information was also available in the nation-based e-COVID portal.

The study population comprises all cases screened for SARS-CoV-2 infection in Kelantan that were reported to the MOH from 1st January 2020 till 30th July 2020. All confirmed COVID-19 cases diagnosed in Kelantan were included in this study. Cases hospitalized outside Kelantan and had positive Rapid Test Kit Antigen (RTK-Antigen) but negative Reverse Transcription Polymerase Chain Reaction (RT-PCR) tests conducted before 23rd July 2020 were excluded.

The incidence rate was estimated using the annual mid-year population of Kelantan that was based on the adjusted Population and Housing Census of Malaysia 2010 made available at the Department of Statistic Malaysia (DOSM)’s official portal (DOSM, 2019).

Case definition

A COVID-19 confirmed case was defined as a person with laboratory confirmation of infection with the COVID-19 of which nasal and pharyngeal swab specimens or blood samples tested positive for 2019-nCoV nucleic acid using real-time RT-PCR assay (MOH, 2020a). As per national guidelines, any cases with positive RTK-Antigen from 23rd July 2020 (until 17th August 2020) would also be considered as a confirmed case (MOH, 2020b, 2020c).

A person was considered high risk for COVID-19 if they developed an acute respiratory infection (sudden onset of respiratory infection with at least one of the following: shortness of breath, cough, or sore throat with or without fever and travelled to or resided in a foreign country within 14 days before the onset of illness or if they attended an event associated with known COVID-19 outbreak (MOH, 2020). A person was considered as close contact if they live in the same household as a COVID-19 patient or working together in close proximity or sharing the same classroom environment or travelling together with COVID-19 patient in any kind of conveyance or if they had healthcare-associated exposure without appropriate Personal Protective Equipment (PPE) (including providing direct care for COVID-19 patients, working with health care workers infected with COVID-19, visiting patients or staying in the same close environment of a COVID-19 patient) (MOH, 2020a). To detect sporadic cases, syndromic surveillance for COVID-19 was implemented since February 2020 involving Severe Acute Respiratory Illness (sARI) cases admitted to hospitals or patients with Influenza-like Illness (ILI) attending selected sentinel government health clinics.
An Epidemiological Analysis of COVID-19 cases from Jan to July 2020 in Kelantan, Malaysia

Cases were considered as symptomatic if they develop a fever (temperature of \( \geq 37.5 \) °C or subjective), cough, sore throat, breathlessness, runny nose, myalgia, headache, diarrhoea (\( \geq 3 \) loose stools in 24 hours), vomiting, abdominal pain, or other symptoms not otherwise specified on the case report form. Cases were considered to have known comorbid if any of the following conditions are reported as “yes”: hypertension, diabetes mellitus, chronic kidney disease, cardiovascular or respiratory disease, immunocompromised, or any other disease not otherwise specified. Severe cases were those who had evidence of hypoxemia requiring supplemental oxygen or critical illness with respiratory failure requiring mechanical ventilation, shock, multi organ failure, or death (Dong et al., 2020; Huang et al., 2020). The observation in regards to active case detection (health staff systematically reach out and screen the cases for COVID-19) and passive case detection (patients seeking care or screening for COVID-19 at health facilities) were made (Postigo, 2011).

**Statistical Analysis**

The epidemiological curve for all cases was constructed by plotting the number of cases versus the date of symptom onset. Onset-to-diagnosis curves were constructed by fitting a log-normal distribution to data on both the onset and diagnosis dates. The crude case fatality rate was calculated as the total number of death cases (numerator) divided by the total number of cases (denominator) presented as a percent. Only cases with symptom onset and definite exposure were included in the analyses of incubation periods.

Descriptive data were expressed as mean and standard deviation for normally distributed variables or median along with interquartile range (IQR) for non-normally distributed data while categorical data were expressed as frequency and percentage. Student \( t \)-test was used to compare means while Mann-Whitney \( U \)-test was used to compare non-normally distributed variables. Categorical variables were compared using \( X^2 \) or Fisher’s Exact test. The age adjustment was done by means of direct standardization and was calculated for all age groups. Multivariable binary logistic regression analyses were used to assess the association between age, gender, race, risk and exposure, symptom, underlying comorbidity, and the dependent variable of ICU admission. The odds ratio (OR) along with the 95% confidence interval (CI) were reported. A \( P \)-value of less than 0.05 was regarded as statistically significant. All statistical analyses were performed using SPSS 25.0 for Windows.

The study Ethics was registered with the National Medical Research Register (NMRR-20-1624-55900), in compliance with current guidelines and received ethical approval from the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia.

3. Results

A total of 166 laboratory-confirmed COVID-19 cases were diagnosed in Kelantan till 31st July 2020. Out of these, 165 cases were tested positive for COVID-19 using RT-PCR, and only 1 case was confirmed as a COVID-19 case using RTK-Antigen. The age-adjusted incidence rate was 9.4/100,000 populations with a crude case fatality rate of 2.4%. The characteristics of all cases were summarized in Table 1 and Table 2.
Epidemiological and Clinical Characteristics

The geographical distribution of COVID-19 cases across 10 districts in Kelantan was depicted in Fig. 2. The majority of the cases were concentrated in the capital (56.6%). Cases peaked during March before steadily declining with occasional cases reported since (Fig. 3). The median age was 37 years (range 3 months to 80 years) and 78% were male. Around 92.2% of cases were diagnosed on the first RT-PCR test while the remaining 7.8% were tested positive on subsequent sampling. Eighty per cent of cases in Kelantan were associated with Masjid Seri Petaling (MSP) mass gathering that took place from 27th to 29th February 2020. The gathering has led to the Seri Petaling cluster; the largest cluster in Malaysia to date affecting 3,375 cases all over the country (38.9% of all cases as of 8th July 2020) within the span of 11th March till 8th July 2020 [6]. It has also contributed to clusters in neighbouring Brunei and Indonesia [6]. Fifty-four (32.5%) cases in this study were participants of the gathering while 79 (47.6%) cases were their close contacts that could be traced up to the fifth generation of transmission. Another 10.8% of the cases were exposed to the infection while visiting affected countries. Among 4 cases that were pregnant at the time of diagnosis, no vertical transmission was reported during the study period.

![Figure 2: Geographical distribution of COVID-19 cases across 10 districts in Kelantan - From January 1st to July 31st, 2020.](image-url)
An Epidemiological Analysis of COVID-19 cases from Jan to July 2020 in Kelantan, Malaysia

Figure 3: Epidemiological curve of COVID-19 in Kelantan through 31st July 2020, (A) by date of diagnosis, type of transmission and daily cumulative cases, n=166, (B) by date of onset of symptoms among symptomatic cases and relation to MSP mass gathering occurring between March 27-29, 2020, n = 123. MCO = Movement Control Order.

Over 57% of cases were identified by active case detection. 45.2% were screened based on risk assessment and 50.0% from contact tracing. About 67.4% of the contacts of confirmed cases were household contacts while the rest were social contacts. The remaining 4.8% were detected via nationwide syndromic surveillance activities implemented at sentinel sites that warranted cases with Severe Acute Respiratory Illness (sARI) or Influenza-Like Illness (ILI) to be screened for COVID-19. Potentially infected cases were isolated within a median of 7 days after exposure even before being diagnosed with COVID-19. The distribution of these characters was the same across both general ward and ICU admission.

**Clinical Characteristics**

1) **Incubation Period:** The average incubation period was 7.0 days (95% CI: 5.98, 8.07 days) and ranging from 1 to 28 days. It was shorter among cases aged below 20 years (4.8 days, 95% CI: 0.35, 9.15 days) compared to age group 20 to 59 years (7.1 days, 95% CI: 5.71, 8.49 days) and ≥ 60 years (7.6 days, 95% CI: 5.99, 9.33 days). Among 118 symptomatic cases with a known exposure, 87.3% developed symptoms within 14 days after exposure while a longer incubation period was seen among cases with atypical presentations in comparison to usual respiratory symptoms (26.7% vs 7.8%, $P = 0.046$).

2) **Symptoms and Comorbidities:** Around 74.1% of cases were symptomatic of which 25.9% had single symptoms and 48.2% had multiple. A quarter of cases were asymptomatic while 7.2% were pre-symptomatic at diagnosis. Younger age tended to have an asymptomatic presentation. Fever and cough were the predominant symptoms among symptomatic cases of all ages. However, adult of age 60 years and above were significantly presented with fever ($X^2 = 10.149, P = 0.006$) and sore throat ($X^2 = 6.610, P = 0.037$) in comparison to other age group. Atypical presentation includes malaise (2.4%), anosmia (1.2%), and diarrhoea (1.2%). Seventeen per cent of cases presented with
single comorbidity and 10.8% had multiple, while 71.7% had no underlying comorbidities. Hypertension and diabetes mellitus were the most prevalent diseases among those with comorbidities. The proportion of patients with any documented underlying medical conditions were significantly increasing with age (P = <0.001).

3) Outcome: All 166 laboratory-confirmed COVID-19 cases were hospitalized in designated government hospitals; 93.4% were admitted as soon as the diagnosis was made while 6.6% who were symptomatic were hospitalized even before laboratory confirmatory test results for COVID-19 were obtained. Twelve per cent of cases were severe requiring ICU admission while 88.0% were mild and were admitted to the general ward. The majority of severe cases had known comorbidity in comparison to mild cases (65.0% vs 23.3%, P <0.001) and of age 60 years and older compared to the younger patient (33.3% vs 5.0%, P <0.001). Out of 12.0% that required supplemental Oxygen, only 3.0% required mechanical ventilation of which the majority were elderly aged 60 years and above (Table 3).

Risk Factors for ICU Admission

Higher rates of ICU admission were seen among adults aged ≥60 years compared to <60 years (33.3% vs 5.0%, P <0.001), and among patients with comorbidities in comparison to no comorbidity (X² = 15.079, P = P <0.001). About 33.3% of cases had multiple while 24.1% had single comorbid. Primary outcome results indicated a significantly higher rate of ICU admission among patients with diabetes mellitus and hypertension (Table 1). No association was found between the type of exposure and ICU admission (X² = 3.633, P = 0.304). Among all the studied factors, only age and diabetes mellitus were found to be significantly increasing the odds of ICU admission among COVID-19 cases. An increase of a year of age has a significant association with the risk of ICU admission with 1.05 times the odds when adjusted for diabetes. Additionally, diabetic patients were 4 times more likely to require ICU admission (Table 2).

4. Discussion

The incidence of COVID-19 in Kelantan is lower than United States (316/100,000 in July) (Boehmer et al., 2020) and its case fatality rate is comparable to China (2.3%) (Wu & McGoogan, 2020) but lower than Italy (7.7%), Europe (4.2%) and Asia in general (3.8%) (Bhagavathula et al., 2020). Based on a systematic review and meta-analysis involving 22,595 participants, the pooled average incubation period of SARS-CoV-2 was 6.14 days (95% CI: 5.34, 6.94) in China that is comparable to our study population, whereas it was 4.5 days (95% CI: 3.9, 5.2) globally. This study supports the WHO-established quarantine period of 14 days (Jiang et al., 2020) but a longer duration could be justified in extreme cases as the incubation period ranges from 1-28 days. About 12.3% of cases had an incubation period beyond 14 days and this has also been observed by studies in China about 11.5% as in (Jiang et al., 2020) and 12.7% as in (Guan et al., 2020). In this study, a longer incubation period was seen among cases with atypical presentation such as anosmia and diarrheoa. Studies have demonstrated that faecal-oral and faecal-mucosal transmission are possible and researchers have correlated infection transmitted by a gastro-intestinal route such as during dinner parties to be associated with a longer incubation period in comparison to those transmitted via respiratory droplets (Jiang et al., 2020; Tian et al., 2020). Further studies exploring different factors associated with prolonged incubation period would be beneficial in determining the effective quarantine period for the different subgroups of populations.
An Epidemiological Analysis of COVID-19 cases from Jan to July 2020 in Kelantan, Malaysia

Table 1: Characteristics Of COVID-19 Cases in Kelantan Based on Type of Hospitalization - From 1st January to 31st July 2020 (n = 166).

| Characteristic                        | Type of Hospitalization | Total (n = 166) | P-Value |
|---------------------------------------|-------------------------|-----------------|---------|
|                                       | General Ward (n = 146)  | ICU Admission (n = 20) |        |
|                                       | n (%)                   | n (%)           |         |
| Age, years (IQR)                      | 33.0 (28.3)             | 61.0 (16.5)     | 37 (33.0) | < 0.001
| Sex                                   |                         |                 |         |
| Male                                  | 114 (78.1)              | 15 (75.0)       | 129 (77.7) | 0.777
| Female                                | 32 (21.9)               | 5 (25.0)        | 37 (22.3) |
| Race                                  |                         |                 |         |
| Malay                                 | 141 (96.6)              | 20 (100.0)      | 161 (97.0) | 0.999
| Others                                | 5 (4.4)                 | 0 (0.0)         | 5 (3.0)   |
| Local cases                           | 73 (50.0)               | 12 (60.0)       | 85 (51.2) | 0.401
| Imported cases                        | 21 (14.4)               | 3 (15.0)        | 81 (48.8) |
| Known Exposure                        |                         |                 |         |
| Mass gathering                        | 50 (34.2)               | 4 (20.0)        | 54 (32.5) | 0.440
| Contact with confirmed cases          | 74 (49.3)               | 12 (60.0)       | 86 (51.8) |
| Travel to affected area               | 18 (12.3)               | 1 (0.0)         | 19 (11.4) |
| No Known Exposure                     | 7 (4.8)                 | 7 (4.8)         | 7 (4.2)   |
| Active case detection                 | 86 (58.9)               | 9 (45.0)        | 95 (57.2) | 0.239
| Passive case detection                | 60 (41.1)               | 11 (55.0)       | 71 (42.8) | 0.999
| Case screening                        |                         |                 |         |
| High Risk Screening                   | 69 (47.3)               | 6 (30.0)        | 75 (45.2) | 0.185
| Contact Tracing                       | 71 (48.6)               | 12 (60.0)       | 83 (50.0) |
| Syndromic Surveillance                | 6 (4.1)                 | 2 (10.0)        | 8 (4.8)   |
| Presentation at diagnosis             |                         |                 |         |
| Symptomatic                           | 94 (64.4)               | 17 (85.0)       | 111 (66.9) | 0.172
| Presymptomatic                        | 11 (7.5)                | 1 (5.0)         | 12 (7.2)  |
| Asymptomatic                          | 41 (28.1)               | 2 (10.0)        | 43 (25.9) |
| Comorbid                              |                         |                 |         |
| Diabetes Mellitus                     | 9 (6.2)                 | 7 (35.0)        | 16 (9.6)  | 0.001
| Hypertension                          | 13 (8.9)                | 7 (35.0)        | 20 (12.0) | 0.004
| Chronic Kidney Diseases               | 2 (1.4)                 | 2 (10.0)        | 4 (2.4)   | 0.072
| Respiratory diseases                  | 3 (2.1)                 | 0 (0.0)         | 3 (1.8)   | 0.999
| Neoplasm                              | 2 (1.4)                 | 0 (0.0)         | 2 (1.2)   | 0.999
| Others                                | 12 (8.1)                | 1 (5.0)         | 13 (7.8)  | 0.999
| No Presenting comorbid                | 112 (76.7)              | 7 (35.0)        | 119 (71.7) | < 0.001
| Median days from exposure to onset (IQR) | 5.0 (7.00)       | 6.0 (6.00)       | 5.0 (7.00) | 0.621
| Median days from exposure to isolation (IQR) | 7.0 (10.00)    | 9.0 (9.00)       | 7.0 (10.00) | 0.300
| Median days from exposure to hospitalization (IQR) | 12.0 (9.00)    | 6.0 (4.00)       | 11.0 (9.00) | 0.009

157
Male predominance seen in this study was also observed during the initial phase of the pandemic of which 60-73% of male cases were reported in China (Kopel et al., 2020), but recent sex-disaggregated data has shown little differences between gender in term of incidence (Kopel et al., 2020). Although no significant difference between gender in regards to outcomes reported in this study, the mortality of COVID-19 is consistently 1.5- to 2-fold higher in the male in comparison to females based on the reports in the United States, Europe, and China (Mauvais-Jarvis, 2020). In addition to the heightened innate and adaptive immune response to viral infections in female than in male, the lack of the SARS-CoV-2 antibody production in male patients especially at earlier phases would also contribute to disease aggravation (Klein et al., 2020; Mauvais-Jarvis, 2020; Zeng et al., 2020).

In keeping with other reports, COVID-19 associated ICU admission and fatality increased markedly with increasing age while younger patients had milder presentations (Cummings et al., 2020; L. Kim et al., 2020). A study analyzing 72,314 COVID-19 cases in China has also documented over 80% of deaths occurring among adults of age 60 years and above (Wu & McGoogan, 2020).

| Variables                          | B    | Adjusted OR (95 % CI) | P-value* |
|------------------------------------|------|-----------------------|----------|
| Age (Years)                        | 0.05 | 1.05 (1.02, 1.09)     | 0.001    |
| Diabetes Mellitus (Yes vs No)b     | 1.52 | 4.55 (1.36, 15.25)    | 0.014    |

OR = Odd Ratio. CI = Confidence Interval. *Likelihood Ratio test, bthe reference category.
Table 3: Characteristics of COVID-19 Cases in Kelantan Based on Age Distribution - From 1st January to 31st July 2020 (n = 166).

| Characteristic            | 0 to 19 (n = 22) | 20 to 59 (n = 105) | ≥60 (n = 39) | Total (n = 166) | P-value |
|---------------------------|------------------|--------------------|-------------|----------------|---------|
| **Symptom**               |                  |                    |             |                |         |
| Fever                     | 5 (22.7)         | 46 (43.8)          | 25 (64.1)   | 76 (45.8)      | 0.006<sup>e</sup> |
| Cough                     | 3 (13.6)         | 17 (16.2)          | 3 (7.7)     | 23 (13.9)      | 0.534<sup>f</sup> |
| Runny nose                | 1 (4.5)          | 30 (28.6)          | 13 (33.3)   | 44 (26.5)      | 0.037<sup>g</sup> |
| Sore throat               | 1 (4.5)          | 11 (10.5)          | 8 (20.5)    | 20 (12.0)      | 0.174<sup>f</sup> |
| Myalgia                   | 0 (0.0)          | 8 (7.6)            | 5 (12.8)    | 13 (7.8)       | 0.194<sup>f</sup> |
| Headache                  | 0 (0.0)          | 1 (1.0)            | 1 (2.6)     | 2 (1.2)        | 0.367<sup>f</sup> |
| Diarrhoea                 | 1 (4.5)          | 1 (1.0)            | 1 (2.6)     | 2 (1.2)        | 0.302<sup>f</sup> |
| Anosmia                   | 1 (4.5)          | 1 (4.5)            | 0 (0.0)     | 2 (1.2)        | 0.006<sup>f</sup> |
| Asymptomatic              | 10 (45.5)        | 31 (29.5)          | 2 (5.1)     | 43 (25.9)      | 0.002<sup>f</sup> |
| **Health Care Use**       |                  |                    |             |                |         |
| ICU admission             | 1 (4.5)          | 6 (5.7)            | 13 (33.3)   | 86 (51.8)      | <0.001<sup>f</sup> |
| General ward admission    | 21 (95.5)        | 99 (94.3)          | 26 (66.7)   | 19 (11.4)      |         |
| Any Oxygen supplementation| 1 (4.5)          | 6 (5.7)            | 13 (43.3)   | 20 (12.0)      | <0.001<sup>f</sup> |
| Nasal cannulae            | 0 (0.0)          | 3 (2.9)            | 4 (10.3)    | 7 (4.2)        | <0.001<sup>f</sup> |
| VM                        | 0 (0.0)          | 3 (2.9)            | 4 (10.3)    | 7 (4.2)        |         |
| HFM                       | 0 (0.0)          | 0 (0.0)            | 1 (2.6)     | 1 (0.6)        |         |
| Mechanical ventilation    | 1 (4.5)          | 0 (0.0)            | 4 (10.3)    | 5 (3.0)        |         |
| No Oxygen supplementation | 21 (95.5)        | 99 (94.3)          | 26 (66.7)   | 146 (88.0)     |         |
| **Outcome**               |                  |                    |             |                |         |
| Mild                      | 21 (95.5)        | 99 (94.3)          | 26 (66.7)   | 146 (88.0)     | <0.001<sup>f</sup> |
| Severe                    | 1 (4.5)          | 6 (5.7)            | 13 (33.3)   | 20 (12.0)      |         |
| Recovery                  | 22 (100.0)       | 105 (100.0)        | 35 (89.7)   | 162 (97.6)     | 0.005<sup>f</sup> |
| Death                     | 0 (0.0)          | 0 (0.0)            | 4 (10.3)    | 4 (2.4)        |         |

<sup>f</sup><sup>Analysis by Chi-square Test. P < 0.05 was considered statistically significant.</sup>

Fever and cough were consistently reported as the predominant symptoms (Feng et al., 2020; Huang et al., 2020). However, gastrointestinal, olfactory, and gustatory symptoms among our study population were lower than most of the studies that recorded diarrhoea at around 12 to 19% (Kim et al., 2020) and anosmia at less than 8% (Lechien et al., 2020). Reports from China, Italy, and the United States have also demonstrated that hypertension and diabetes mellitus were the two most frequent comorbidities among COVID-19 patients (Cummings et al., 2020; L. Kim et al., 2020).

Other studies have also shown that diabetes consistently increases the risk of ICU admission by 2- to 3-fold (Mauvais-Jarvis, 2020). Diabetes is also found to be strongly associated with more severe
outcomes among SARS and MERS patients previously [31]. It is suggested that meta-inflammation characteristics of the diabetic patient including elevation of Interleukin-6 (IL-6), C-Reactive Protein (CRP), ferritin, along with hypercoagulability, have facilitated the development of inflammatory cytokine storm leading to the deterioration of COVID-19 patients compared to the non-diabetic patient [31]. This is very concerning as the prevalence of overall raised blood glucose in Kelantan is high at 19.5% among adults aged 18 years and above while 9.7% are known as diabetic (NIH, 2019). Although we have found a significant association between hypertension and ICU admission early in the study, after adjusting for demographic and clinical factors, it is not an independent risk factor for ICU admission. This finding was also observed by other researchers (L. Kim et al., 2020; Roncon et al., 2020).

Rapid diagnosis and isolation have been proven to be effective in controlling the transmission of COVID-19. Kelantan was capable of running 17,748 RT-PCR and 3,298 RTK-Antigen along with 4,013 RTK-Antibody at government health facilities alone as of 31st July 2020 with additional support from private clinics. The period of symptom onset to diagnosis in Kelantan was relatively shorter than in Korea (7 days) and China (10 days) (Peck, 2020). Besides, potentially infected individuals were identified and isolated early even before the diagnosis was made. The high proportion of asymptomatic cases in Kelantan (25.9%) in comparison to other studies (around 4% in the United States) (Stokes et al., 2020) was a challenge but its strategy of targeted screening based on prompt risk assessments and contact tracing instead of relying on screening based on symptoms have paid off.

Other measures that may expedite Kelantan in curbing its 1st wave of COVID-19 transmission includes:

1) National and state-level Movement Control Orders (MCOs).
2) Aggressive testing and quarantine of travellers at international and domestic borders.
3) Targeted screening and triaging based on frequently revised and updated risk stratification at all healthcare facilities.
4) Addition of sentinel sites for syndromic surveillance (screening patients with symptoms compatible with COVID-19) other than sites already included in the national surveillance system.
5) Easily accessible sampling collection centres at all-district.
6) Active case detection, intense contact tracing, and follow-ups.
7) A strict quarantine period of 14 days for the person at risk under surveillance by local authorities.
8) The healthcare facilities were sufficiently prepared with the implementation of health facilities surge plans.

These strategies had allowed Kelantan to respond within its surge capacities, including hospitalizing all confirmed cases and symptomatic suspected cases hence limiting the transmission in the communities.

It should be noted that there were some limitations to this study. First, gastrointestinal symptoms, olfactory and gustatory dysfunction were not recognized as COVID-19 associated symptoms until later (Hajikhani et al., 2020), hence it may not be routinely assessed during the beginning of the pandemic and may not be reported. Second, as the proportion of ICU cases were relatively small, different outcomes between genders could not be fully understood. Third, information regarding risk factors that have been demonstrated to be associated with different outcomes among COVID-
An Epidemiological Analysis of COVID-19 cases from Jan to July 2020 in Kelantan, Malaysia

19 cases, such as smoking status and obesity were not recorded. Furthermore, other than respiratory samples (nasopharyngeal, oropharyngeal, nasal swab, tracheal aspirate, or sputum) and serum, no other body samples such as faeces or urine were tested for COVID-19, hence, different routes of transmission couldn’t be assessed.

A comprehensive study on larger cases of male and female patients would help to understand the different outcomes between gender while including smoking status and body mass index in the assessment would help in identifying vulnerable populations. Further study is required to determine factors associated with a longer incubation period among COVID-19 cases to facilitate optimum quarantine period.

5. Conclusion

The age-adjusted incidence rate for COVID-19 in Kelantan was 9.4/100,000 populations with a crude case fatality rate of 2.4%. A high proportion of cases were male and concentrated in the capital. About 75% per cent of cases were symptomatic of which fever and cough were the predominant symptoms. All ages appeared susceptible but older age and diabetic patients were more vulnerable to COVID-19 with higher odds for ICU admission and severe outcomes. Kelantan’s early identification and rapid isolation approach for potentially infected individuals have been effective in curbing the transmission; allowing sufficient healthcare capacity to respond to the pandemic. This approach has been implemented throughout the country.

6. Acknowledgement

The authors gratefully acknowledge the use of service and facilities of the Crisis Preparedness and Response Centre of Kelantan and the Kelantan State Health Department. We would like to thank the Director General of Health Malaysia for his permission to publish this article. This research received no specific funding from any agency or profit sectors. All researchers declared no conflict of interest.

References

Bhagavathula, A. S., Rahmani, J., Aldhaleei, W. A., Kumar, P., & Rovetta, A. (2020). Global, Regional and National Incidence and Case-fatality rates of Novel Coronavirus (COVID-19) across 154 countries and territories: A systematic assessment of cases reported from January to March 16, 2020. medRxiv, 2020.2003.2026.20044743. doi:10.1101/2020.03.26.20044743

Boehmer, T. K., DeVies, J., Caruso, E., van Santen, K. L., Tang, S., Black, C. L., . . . Lozier, M. (2020). Changing age distribution of the COVID-19 pandemic—United States, May–August 2020. Morbidity and Mortality Weekly Report, 69(39), 1404.

CDC. (2020, 10 July 2020). Coronavirus Disease 2019: COVID-19 Pandemic Planning Scenarios. Retrieved from https://www.cdc.gov/coronavirus/2019-ncov/hcp/planning-scenarios.html

Che Mat, N. F., Edinur, H. A., Abdul Razab, M. K. A., & Safuan, S. (2020). A single mass gathering resulted in massive transmission of COVID-19 infections in Malaysia with further international spread. Journal of Travel Medicine, 27(3). doi:10.1093/jtm/taaa059
Cummings, M. J., Baldwin, M. R., Abrams, D., Jacobson, S. D., Meyer, B. J., Balough, E. M., . . . Hastie, J. (2020). Epidemiology, clinical course, and outcomes of critically ill adults with COVID-19 in New York City: a prospective cohort study. The Lancet.

De Wit, E., Van Doremalen, N., Falzarano, D., & Munster, V. J. (2016). SARS and MERS: recent insights into emerging coronaviruses. Nature Reviews Microbiology, 14(8), 523.

Dong, Y., Mo, X., Hu, Y., Qi, X., Jiang, F., Jiang, Z., & Tong, S. (2020). Epidemiology of COVID-19 among Children in China. Pediatrics, 145(6), e20200702. doi:10.1542/peds.2020-0702

DOSM. (2019). Current Population Estimates, Malaysia, 2018-2019. Retrieved from https://www.dosm.gov.my/v1/index.php?r=column/cone&menu_id=RU84WGQxYkVPeVpodUZtTkpdnBmZz09

Feng, Z., Li, Q., Zhang, Y., Wu, Z., Dong, X., Ma, H., . . . Wang, D. (2020). The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19)—China, 2020. China CDC Weekly, 2(8), 113-122.

Guan, W.-j., Ni, Z.-y., Hu, Y., Liang, W.-h., Ou, C.-q., He, J.-x., . . . Hui, D. S. (2020). Clinical characteristics of coronavirus disease 2019 in China. New England Journal of Medicine, 382(18), 1708-1720.

Hajikhani, B., Calcagno, T., Nasiri, M. J., Jamshidi, P., Dadashi, M., Goudarzi, M., . . . Mirsaeidi, M. (2020). Olfactory and gustatory dysfunction in COVID-19 patients: A meta-analysis study. Physiological Reports, 8(18), e14578. doi:https://doi.org/10.14814/phy2.14578

Hanaei, S., & Rezaei, N. (2020). COVID-19: Developing from an Outbreak to A Pandemic. Archives of medical research, 51(6), 582-584. doi:10.1016/j.arcmed.2020.04.021

Huang, X., Wei, F., Hu, L., Wen, L., & Chen, K. (2020). Epidemiology and Clinical Characteristics of COVID-19. Arch Iran Med March, 23(4), 268-271. doi:10.34172/aim.2020.09

Jiang, X., Niu, Y., Li, X., Li, L., Cai, W., Chen, Y., . . . Wang, E. (2020). Is a 14-day quarantine period optimal for effectively controlling coronavirus disease 2019 (COVID-19)? medRxiv, 2020.2003.20036533. doi:10.1101/2020.03.15.20036533

Kim, J., Thomsen, T., Sell, N., & Goldsmith, A. J. (2020). Abdominal and testicular pain: An atypical presentation of COVID-19. The American Journal of Emergency Medicine, 38(7), 1542.e1541-1542.e1543. doi:10.1016/j.ajem.2020.03.052

Kim, L., Garg, S., O’Halloran, A., Whitaker, M., Pham, H., Anderson, E. J., . . . Langley, G. E. (2020). Risk Factors for Intensive Care Unit Admission and In-hospital Mortality among Hospitalized Adults Identified through the U.S. Coronavirus Disease 2019 (COVID-19)-Associated Hospitalization Surveillance Network (COVID-NET). Clinical Infectious Diseases. doi:10.1093/cid/ciaa1012
An Epidemiological Analysis of COVID-19 cases from Jan to July 2020 in Kelantan, Malaysia

Klein, S. L., Dhakal, S., Ursin, R. L., Deshpande, S., Sandberg, K., & Mauvais-Jarvis, F. (2020). Biological sex impacts COVID-19 outcomes. PLoS pathogens, 16(6), e1008570.

Kopel, J., Perisetti, A., Roghani, A., Aziz, M., Gajendran, M., & Goyal, H. (2020). Racial and gender-based differences in COVID-19. Frontiers in public health, 8, 418.

Lai, C.-C., Wang, C.-Y., Wang, Y.-H., Hsueh, S.-C., Ko, W.-C., & Hsueh, P.-R. (2020). Global epidemiology of coronavirus disease 2019 (COVID-19): disease incidence, daily cumulative index, mortality, and their association with country healthcare resources and economic status. International Journal of Antimicrobial Agents, 55(4), 105946. doi:https://doi.org/10.1016/j.ijantimicag.2020.105946

Lechien, J. R., Chiesa-Estomba, C. M., De Siati, D. R., Horoi, M., Le Bon, S. D., Rodriguez, A., . . . Saussez, S. (2020). Olfactory and gustatory dysfunctions as a clinical presentation of mild-to-moderate forms of the coronavirus disease (COVID-19): a multicenter European study. European archives of oto-rhino-laryngology : official journal of the European Federation of Oto-Rhino-Laryngological Societies (EUFOS) : affiliated with the German Society for Oto-Rhino-Laryngology - Head and Neck Surgery, 277(8), 2251-2261. doi:10.1007/s00405-020-05965-1

Lee, P.-I., & Hsueh, P.-R. (2020). Emerging threats from zoonotic coronaviruses—from SARS and MERS to 2019-nCoV. Journal of Microbiology, Immunology and Infection.

Mauvais-Jarvis, F. (2020). Aging, Male Sex, Obesity, and Metabolic Inflammation Create the Perfect Storm for COVID-19. Diabetes, 69(9), 1857. doi:10.2337/dbi19-0023

MOH. (2020a). Guideline COVID-19 Management; No.5/2020 update on 3 July 2020. Ministry of Health, Malaysia

MOH. (2020b). Guideline on COVID-19 Testing Using Antigen Rapid Test Kit For the Health Facilities, Ministry of Health Version 3.0. Ministry Of Health, Malaysia.

MOH. (2020c). Guideline on COVID-19 Testing Using Antigen Rapid Test Kit For the Health Facilities, Ministry of Health Version 4.0. Ministry Of Health, Malaysia.

MOH. (2020d). Kenyataan Akhbar Ketua Pengarah Kesihatan 9 Julai 2020 – Situasi Semasa Jangkitan Penyakit Coronavirus 2019 (COVID-19) di Malaysia. Retrieved 9 July 2020, from Ministry of Health, Malaysia https://kpkesihatan.com/2020/07/09/kenyataan-akhbar-kpk-9-julai-2020-situasi-semasa-jangkitan-penyakit-coronavirus-2019-covid-19-di-malaysia/

MOH. (2020e). Updates on The Coronavirus Disease 2019 (COVID-19) Situation In Malaysia: 31 July 2020 [Press release]. Retrieved from https://kpkesihatan.com/2020/07/31/kenyataan-akhbar-kpk-31-julai-2020-situasi-semasa-jangkitan-penyakit-coronavirus-2019-covid-19-di-malaysia/

Munster, V. J., Koopmans, M., van Doremalen, N., van Riel, D., & de Wit, E. (2020). A Novel Coronavirus Emerging in China — Key Questions for Impact Assessment. New England Journal of Medicine, 382(8), 692-694. doi:10.1056/NEJMp2000929
NIH. (2019). Non-Communicable Diseases: Risk Factors and Other Health Problem. *National Health and Morbidity Survey, Technical Report - Volume I.*

Peck, K. R. (2020). Early diagnosis and rapid isolation: response to COVID-19 outbreak in Korea. *Clinical Microbiology and Infection, 26*(7), 805-807. doi:10.1016/j.cmi.2020.04.025

Petrosillo, N., Viceconte, G., Ergonul, O., Ippolito, G., & Petersen, E. (2020). COVID-19, SARS and MERS: are they closely related? *Clinical Microbiology and Infection, 26*(6), 729-734. doi:10.1016/j.cmi.2020.03.026

Postigo, J. A. R. (2011). Active Screening for Cutaneous Leishmaniasis: Diagnosis, Detection And Surveillance. Retrieved from https://www.who.int/leishmaniasis/surveillance/en/

Roncon, L., Zuin, M., Rigatelli, G., & Zuliani, G. (2020). Diabetic patients with COVID-19 infection are at higher risk of ICU admission and poor short-term outcome. *Journal of Clinical Virology, 127*, 104354. doi:https://doi.org/10.1016/j.jcv.2020.104354

Stokes, E. K., Zambrano, L. D., Anderson, K. N., Marder, E. P., Raz, K. M., Felix, S. E. B., . . . Fullerton, K. E. (2020). Coronavirus Disease 2019 Case Surveillance—United States, January 22–May 30, 2020. *Morbidity and Mortality Weekly Report, 69*(24), 759.

Sun, J., He, W.-T., Wang, L., Lai, A., Ji, X., Zhai, X., . . . Su, S. (2020). COVID-19: Epidemiology, Evolution, and Cross-Disciplinary Perspectives. *Trends in Molecular Medicine, 26*(5), 483-495. doi:https://doi.org/10.1016/j.molmed.2020.02.008

Tian, Y., Rong, L., Nian, W., & He, Y. (2020). Review article: gastrointestinal features in COVID-19 and the possibility of faecal transmission. *Alimentary Pharmacology & Therapeutics, 51*(9), 843-851. doi:https://doi.org/10.1111/apt.15731

WHO. (2019). PHEIC Global research and innovation forum: towards a research roadmap.

WHO. (2020a). Coronavirus disease (COVID-2019) situation reports-171.

WHO. (2020b). Tracking Public Health and Social Measures: A Global Dataset. *World Health Organization.*

WHO. (2020c). *Transmission of SARS-CoV-2: implications for infection prevention precautions: scientific brief, 9 July 2020.*

Wu, Z., & McGoogan, J. M. (2020). Characteristics of and Important Lessons from the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. *JAMA, 323*(13), 1239-1242. doi:10.1001/jama.2020.2648

Zeng, F., Dai, C., Cai, P., Wang, J., Xu, L., Li, J., . . . Wang, L. (2020). A comparison study of SARS-CoV-2 IgG antibody between male and female COVID-19 patients: A possible reason underlying different outcome between sex. *Journal of Medical Virology, 92*(10), 2050-2054. doi:https://doi.org/10.1002/jmv.25989
Zimmermann, P., & Curtis, N. (2020). Coronavirus Infections in Children Including COVID-19: An Overview of the Epidemiology, Clinical Features, Diagnosis, Treatment and Prevention Options in Children. *The Pediatric infectious disease journal*, 39(5), 355-368. doi:10.1097/INF.0000000000002660