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Predictive parameters of potential COVID-19 without epidemiological clues and management strategy in resources limited setting

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ABSTRACT

Background

Managing potential COVID-19 patients is challenging when resources were limited. The objective of this study was to evaluate the predictive parameters and management strategy for potential COVID-19 cases who are without contact or travelling history.

Methods

Retrospective study of potential COVID-19 patients without direct contact or travelling history, admitted to Hospital Tuanku Ja'afar Seremban. Patients were risk-stratified to either low or medium risk and admitted to designated wards, respectively. They were categorised to severe acute respiratory infection (SARI); influenza-like illness (ILI); dengue fever or viral fever like (DVF); or none. Clinical, laboratory and radiological variables were evaluated for predictive value. Positive cases were isolated to negative pressure isolation rooms and the neighbouring patients underwent surveillance.

Results

812 patients were studied, with 478 fulfilled SARI, ILI, and DVF. 18 (2.2%) of them were COVID-19 positive, and all patients in "none" group were negative. Hypoxia without dyspnoea and medium risk criteria were significant in predicting COVID-19 with p<0.01 (OR 7.18; 95% CI 2.70, 19.13) and p<0.01 (OR 35.77; 95% CI 11.25, 113.71) respectively. Absolute lymphocyte count showed no predictive value (P=0.88 95% CI -0.78, 0.90). Absolute neutrophil count ≥10 x10^9/L cells (OR 0.11; 95% CI 0.01, 0.87) helped to exclude COVID-19. Chest radiograph of 16 (88.9%) COVID-19 patients showed heterogeneous Ill-defined opacities. No nosocomial transmission occurred during this study period.

Conclusion / Implication

Initial attention to predictive parameter, risk-stratification, clinical grouping strategy, and proper ward management helps in containment of COVID-19 and resources management without risk of nosocomial transmission.

Keywords: *COVID-19; predictive parameters; resources; risk-stratification; SARS-CoV-2*

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) which is responsible for the Coronavirus disease 2019 (COVID-19) has become a global crisis.[1] It was first reported in December 2019 as a cause of a cluster of pneumonia cases in Wuhan, a city in the Hubei province of China.[2] SARS-CoV-2 was suggested to be zoonotic in origin due to the large number of infected individuals who have been exposed to the wet market in Wuhan City, and subsequently further spread by human-to-human transmission.[3–5]

Although rigorous surveillance, early detection, isolation, and quarantine are crucial in preventing sustained transmission of COVID-19[6,7,] challenges remain. Such rigorous surveillance requires adequate resources (for e.g. testing kits, and swab) along with adequate staff to perform. Thus, without the availability of these resources, patients may still present to healthcare services with either pneumonia or influenza-like illness (ILI).[8] Therefore, it is essential for the frontline doctors to be able to diagnose potential COVID-19 cases and isolate them early while awaiting the SARS-CoV-2 result; in order to contain an outbreak and to prevent nosocomial transmission.[9] There is without doubt that close contact with positive cases of COVID-19 requires active surveillance but there may be a significant portion

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of patients that did not have such history of close contact and was later missed in the surveillance.[10,11] This poses a significant challenge to the frontline doctors whether to screen for COVID-19, when simultaneously there is a need for a balance between resource utilisation and case detection to avoid either an overuse of resources or an under-detection of COVID-19.[12] Furthermore, the number of suspected cases may exceed the capacity of negative pressure rooms available and thus, ward management strategy is essential in preventing nosocomial transmission.

We overcame these challenges by having a new broader screening criterion, risk-stratification of potential COVID-19 patients with clinical grouping strategy, initial admission to designated wards, and a set criterion for stepping down care to the general ward. The aim of this study was to identify the predictive parameters in diagnosing or excluding COVID-19 in patients without contact or travelling history, and to assess the effectiveness of risk-stratification and clinical grouping. Secondary objective was to assess the risk of nosocomial transmission in open general ward by maintaining social distancing and avoidance of aerosol generating procedure.

Methods

Study design

This was a retrospective study of patients admitted from 19th March 2020 to 1st May 2020 in Hospital Tuanku Ja'afar Seremban, a tertiary referral hospital for Negeri Sembilan in Malaysia. Suspected cases of COVID-19 who did not have close contact (less than 1 meter for more than 15 minutes) with confirmed cases of COVID-19 or travelling history from overseas were included into this study. Patients less than 12 years old were excluded from this study. Patients with close contact or travelling history to overseas were admitted to negative pressure rooms and excluded from this study as well.

Definition

a. A suspected case of COVID-19 referred to a patient who met the case-selection criteria.

b. In our study context, SARI was defined by the presence of respiratory signs and symptoms (e.g. cough, dyspnoea, wheezing and/or crepitation on auscultation) that suggest lower respiratory tract infection with or without fever. Acute exacerbation of chronic obstructive pulmonary disease (AECOPD) and acute exacerbation of bronchial asthma (AEBA), that were both infective and not infective in origin were included into this clinical group as well.

c. ILI was defined by clinical syndrome of upper respiratory tract infection (URTI) with or without fever. This requires at least 2 of the following:
   i. Fever
   ii. Cough
   iii. Runny nose
   iv. Sore throat

d. Dengue fever or viral fever like illness (DVF) was defined as clinical syndrome that suggests dengue fever or viral fever (e.g. fever, arthralgia, myalgia, vomiting and/or diarrhoea) without the presence of signs and symptoms of URTI (such as cough, sore throat, and/or runny nose).

e. Preceding URTI was defined by having symptoms of URTI within 1 week of presentation but was admitted for other illnesses.

f. Fever was defined as a temperature of 37.8°C or more.

g. Hypoxia was defined by oxygen saturation by pulse oximetry (SpO_2) <95% or arterial partial pressure oxygen (PaO_2) under room air of <80mmHg, or PaO_2/FiO_2 ratio of < 380. SpO_2 reading was favoured as a marker of hypoxia before PaO_2 and then followed by PaO_2/FiO_2 ratio.

h. Covid-19 detection was by oropharyngeal and nasopharyngeal swab or endotracheal tube aspiration if intubated. Samples were sent for reverse transcription polymerase chain reaction to detect SARS-CoV-2 RNA (RT-PCR SARS-CoV-2 RNA).

Standard of Care

Suspected cases were admitted to 2 designated wards (1 ward for low risk and 1 for medium risk). A "low" risk ward was an open general ward with 30 beds. A "medium" risk ward has 7 two-bedded and 2 single-bedded non-negative pressure rooms. In both wards, patients' beds and belongings were kept at least 1 meter apart. All patients were required to wear masks at all times if possible. Aerosol generating procedures such as nebulisation and non-invasive ventilation were discouraged in these wards. Nebulisation was replaced by spacer or aerochamber. If nebulisation is deemed necessary, patients were transferred to a negative pressure room. Patients who later had positive COVID-19 result were transferred to a negative pressure isolation room, and the neighbouring patients were put under surveillance with repeated oropharyngeal and nasopharyngeal swab for RT-PCR SARS-CoV-2 RNA on days 6-7 and symptoms were checked on day 14 from last contact.

Patients within the "SARI" and "ILI" groups were either discharged or stepped down to the general ward when they tested negative for COVID-19 and clinically improved. A second test for RT-PCR SARS-CoV-2 RNA was performed when there was no improvement after 48 hours. Patients within DVF or "none" categories were either discharged or stepped down to the general ward after the first negative test for COVID-19.

Risk stratification

Patients with a history of social gathering within 2 weeks of symptoms developed, direct contact with potential COVID-19 individuals but awaiting or unknown result, initial presentation suggestive of viral pneumonia, a healthcare worker or living with a healthcare worker, or peers who had symptoms of respiratory infection, were categorised into "medium" risk group. Absence of these mentioned risks were categorised into the "low" risk group.

New case selection criteria and clinical grouping

Previous case selection criteria which only included SARI and ILI have been revised. New case selection criteria for COVID-19 and clinical grouping included: (1) SARI, which consists of all pneumonia, and AECOPD or AEBA that is not due to pneumonia but requires admission; (2) ILI; (3) DVF; and (4) None. The "None" clinical group consisted of: (1) patient admitted for other reason but had either sore throat, cough or runny nose; (2) chest radiograph with suspected consolidation but absent of sign and symptoms of pneumonia; and (3) non-respiratory presentation but had medium risk criteria.

Statistical analysis

Univariate logistic regression, binary logistic regression and Chi-Square test were used to determine the associations of the measured variables with the outcome variable, SARS-CoV-2 RNA result (positive or negative). Student's *t*-test was used to compare means. $P<0.05$ was considered as statistically significant.

Variables associated with significant predictive values (positive or negative) of SARS-CoV-2 RNA (P<0.05) were included in the multivariable logistic regression model. However, the chest radiograph was excluded from the multivariable logistic regression model because it may not be readily available in the screening process of COVID-19. Variables measured include the presence of fever, hypoxia, hypoxia without dyspnoea, total white blood cell count (WBC), absolute neutrophil count (ANC), absolute lymphocyte count (ALC), chest radiograph characteristic and risk. All variables studied were the initial parameters upon admission.

Results

A total of 812 patients were included in this study, of which 337 patients fulfilled SARI, 78 ILI and 63 DVF. 334 of them did not fulfil any of these clinical groups. 15 out of 337 (4.5%) SARI, 2 out of 78 (2.6%) ILI, and 1 out of 63 (1.6%) DVF were tested positive for COVID-19. No cases from the "none" group were tested positive for COVID-19 (Table 1). Clinical background characteristics of patients within these clinical groups (SARI, ILI, DVF) are shown in Table 2. Only 27.8% of patients with COVID-19 upon admission experienced dyspnoea and 44.4% were hypoxic without dyspnoea.

There was a significant difference when comparing mean values of WCC (P=0.01 95% CI 0.79, 4.21) and ANC (P=0.02 95% CI 0.28, 3.24) between COVID-19 detected and undetected patients. Conversely, comparing mean values of ALC was not significant (P=0.88 95% CI -0.78, 0.90). Among the total of 63 patients categorised into DVF, 8 had negative dengue serology results and only 1 of them tested positive for COVID-19 (detailed results are provided in Supplementary Appendix in Table S1).

Among the chest radiograph findings, heterogeneous Ill-defined opacities was the most common (84.2%) radiological finding in COVID-19 positive patients followed by normal chest radiological finding (0.8%). Lobar consolidation, pleural effusion, reticular opacities, and fluid overload features did not yield any positive COVID-19 cases (Table 2) (Figure 1).

Presence of fever, hypoxia, preceding URTI, cough, dyspnoea, WCC, ANC, and ALC did not yield a significant predictive parameter in the univariate logistic regression analysis. However, presence of medium risk factor and hypoxic without dyspnoea were both significant; p<0.01 (OR 35.77; 95% CI 11.25, 113.71) and p<0.01 (OR 7.18; 95% CI 2.70, 19.13) respectively (Table S2).

Multivariate logistic regression analysis (Table 3) showed a significant predictive value with the presence of hypoxia without dyspnoea (OR 9.27; 95% CI 3.24, 26.56) and ANC≥10 x109/L cells (OR 0.11; 95% CI 0.01, 0.87) when assuming the risk factor was unknown. WBC, ALC, and ANC were excluded from such analysis in view of its close similarities with the parameter ANC≥10 x109/L cells cut off value.

During this study period, there was an accumulative number of 15 neighbouring patients that underwent surveillance (Table S3). All were negative of COVID-19 and absence of COVID-19 related symptoms. There was also an accumulative number of 6 staff members who developed mild URTI symptoms and tested negative for COVID-19.

Discussion

Risk stratification, and selection criteria for screening is a crucial part of COVID-19 outbreak containment strategy. A carefully designed strategy in targeting

case selection and isolation is not only able to capture suspected cases of COVID-19, prevent nosocomial transmission but also reduces unnecessary wastage of resources.[13] Although COVID-19 predominantly presented with respiratory symptoms with a wide range of severity [8,14-16], atypical presentation such as predominant gastrointestinal symptoms has been reported.[17,18] There were also concerns regarding COVID-19 mimicking as dengue fever.[19,20] Putting all these factors into consideration, we decided on having a relatively lower threshold for case selection, and introduced DVF as a new clinical group for surveillance. We were able to capture 1 positive COVID-19 case who presented like dengue fever, but dengue serology was negative. We recommend DVF to be incorporated in future policy as screening criteria.

All positive cases were either within the SARI, ILI or DVF clinical groups. Those that did not fulfil these criteria were all negative of COVID-19. We felt that examining between clinical groups would be more relevant as individual symptoms would have a wide range of overlap with many other diseases. Most literature available during this study period was focusing mainly on individual symptoms rather than clinical syndrome.[8,14,16,21] To our best knowledge, we have not identified any study done on clinical groups yet.

ILI was defined by the World Health Organization (WHO) as fever of ≥ 38°C and cough, with onset within the last 10 days; and SARI defined as history of a fever or measured fever of ≥ 38°C; and cough, with onset within the last 10 days and requires hospitalisation.[22,23] However, a study by Guan et al. on the clinical characteristics of COVID-19 in China showed that only 43.8% had fever upon admission.[8] Similar findings were reproduced in our study which showed that only 50% of COVID-19 patients had fever upon presentation. Hence, we revised our SARI definition from the beginning to include those without fever in order to prevent missing this group of patients.

Lymphopenia has been associated with severity of COVID-19.[24,25] It was even used as a clue to aid in the diagnosis of COVID-19.[24] It is important to know that different literature had slightly different definitions of lymphopenia (median ALC ranging somewhere between 0.8 to 1.1) and there was a significant portion of positive cases that do not have lymphopenia.[8,16,25,26] In this study, the median ALC among positive cases were relatively higher at 1.6. This may be a result of a small sample size among the positive cases. A study by Zhu et al. on the initial clinical features of suspected COVID-19 found that 29% of negative cases had lymphopenia (<1.1) and ALC was relatively higher among the negative cases.[27] However, no statistical analysis was performed, and thus we are unable to draw any significant comparison. We did not find ALC to be helpful in suspecting COVID-19 from this study. This finding was in concordance with a study by Zhao et al., where ALC showed no significant different between COVID-19 and non-COVID-19 pneumonia.[28]

ANC has been attempted in several studies to differentiate between viral and bacterial pneumonia.[29–31] A similar attempt was conducted during the SARS outbreak, where higher ANC made the diagnosis of SARS less likely.[32,33] In our study, a higher ANC at a cut-off point of $10x10^9$/L cells helped to exclude COVID-19. Nonetheless, ANC<10 does not make the diagnosis of COVID-19 likely. The median ANC among COVID-19 in this study was 5.1, which was compatible with the study in New York by Richardson et al., that showed a median of 5.3.[26] Up to this date, we were only able to identify 1 study comparing suspected COVID-19 with confirmed COVID-19 cases. This study by Zhu et al.,

the ANC were lower in confirmed cases, although no statistical analysis was performed.[27]

It is worth noticing that less than half COVID-19 patients experienced shortness of breath including severe illness, even though the majority had abnormalities either in chest radiograph or computerised tomography (CT) scan.[8,16,34,35] A study by. Yang et al. showed that only 1.34% had dyspnoea despite 9.4% having decreased oxygen saturation.[36] In our study, hypoxia without dyspnoea occurs more often in COVID-19 patients and appears to be a good predictor for suspecting COVID-19 even when considering all other factors.

There was no unifying terminology across current literature used to describe plain radiographs of COVID-19 with pneumonia; from ground glass opacities, ill-defined opacities, patchy shadowing, to bilateral consolidation.[8,37-39] Although chest radiograph is less sensitive than CT scan in diagnosing COVID-19 pneumonia, it remains an important tool as it has a certain degree of correlation with CT scan.[37] Moreover, it is generally not recommended for CT scan as a routine for COVID-19.[40] We found chest radiographs to be very helpful in diagnosing COVID-19 pneumonia while awaiting RT-PCR SARS-CoV-2 RNA test results.

There were a few limitations in our study. The sample size for positive cases was relatively small. This may be the result of the extensive contact tracing and surveillance done by our public health sector. Secondly, we may not have captured patients with very mild symptoms that have not presented to us but subsequently recovered. This group of patients may represent a significant portion of information that we are missing out. However, as the focus of this study was towards risk-stratification and suspecting COVID-19 when presented to healthcare facilities, the overall effect on decision making would not be altered.

It is important to realise that our strategy is not a replacement for contact tracing and rigorous surveillance. Symptoms-based screening would fail to capture many patients with COVID-19 because of asymptomatic carrier.[41-44] However, balancing between case selection and resources are crucial in policy and clinical decision. With the presence of an effective contact tracing and surveillance, more attention could be paid towards SARI, ILI, DVF, those with medium risk criteria, presence of hypoxia without dyspnoea, and suggestive chest radiograph as prioritised surveillance criteria in hospital. This would also help in resources distribution such as negative pressure isolation room prioritisation. Furthermore, allocation of patients in open general ward is a good alternative as shown in our study where no nosocomial transmission was reported when social distancing was kept and avoiding aerosol generating procedures.

In conclusion, initial risk-stratification, the presence of hypoxia without dyspnoea, and suggestive chest radiograph finding help in identifying COVID-19. Conversely, high ANC made the diagnosis of COVID-19 less likely. ALC was not helpful in suspecting COVID-19. Initial attention to predictive parameter, risk-stratification, clinical grouping strategy, and proper ward management helps in containment of COVID-19 and resources management without risk of nosocomial transmission. We recommend DVF as a new clinical group to be screened for COVID-19. A further study is required to assess incorporating predictive parameters into the decision-making algorithm.

Ethical Approval

This study was conducted in compliance with ethical principles outlined in the Declaration of Helsinki. This study was reviewed and approved by Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia.

Conflict of interest

The authors of this study declare that they each have no conflict of interest.

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Table 1: Clinical groups and COVID-19 detection rates*

			Clinical Group				
			SARI	**ILI**	**DVF**	**None**	**Total**
COVID-19	not detected	Frequency, n	322	76	62	334	794
	detected	Frequency, n	15	2	1	0	18
		(%) within Clinical Group	4.5	2.6	1.6	0.0	2.2
Total			**337**	**78**	**63**	**334**	**812**

**SARI denotes severe acute respiratory illness, ILI influenza like illness, and DVF dengue fever or viral fever like illness.*

Table 2: Clinical background characteristics of SARI, ILI and DVF*

Characteristic or Condition	COVID-19 Not Detected n=460	COVID-19 Detected n=18	P Value
Mean age, years	**53 ± 20.5**	**56 ± 10.5**	**N/A**
Gender, n (%)			
Male	257 (55.9)	11 (61.1)	N/A
Female	203 (44.1)	7 (38.9)	N/A
Coexisting condition, n (%)			
Bronchial Asthma	79 (17.2)	1 (5.6)	N/A
COPD	50 (10.9)	0 (0)	N/A
Diabetes Mellitus	134 (29.1)	9 (50)	N/A
Hypertension	194 (42.2)	13 (72.2)	N/A
Ischemic Heart Disease	44 (9.6)	3 (16.7)	N/A
Heart Failure	24 (5.2)	0 (0)	N/A
CKD/ESRD	32 (7)	3 (16.7)	N/A
Clinical Characteristic, n (%)			
Medium Risk	41 (8.9)	14 (77.8)	<0.01†
Fever	149 (32.9)	9 (50)	0.13†
Cough	289 (62.8)	13 (72.2)	0.42†
Dyspnoea	213 (47.4) §	5 (27.8)	0.10†
Hypoxia	164 (35.9)	10 (55.5)	0.09†
Hypoxia without dyspnoea	45 (10.0) §	8 (44.4)	<0.01†

(cont'd) Table 2: Clinical background characteristics of SARI, ILI and DVF*

WBC (x10^9/L cells)			
Median (IQR)	9.4 (6.5-13.2)	7.7 (5.9-10.3)	N/A
Mean ± SD	10.5 ± 6.9	8.0 ± 3.2	0.01‡ (95% CI 0.79, 4.21)
ANC (x10^9/L cells)			
Median (IQR)	6.0 (3.7-9.9)	5.1 (3.5-8.2)	N/A
Mean ± SD	7.5 ± 5.5	5.7 ± 2.8	0.02‡ (95% CI 0.28, 3.24)
ALC (x10^9/L cells)			
Median (IQR)	1.9 (1.1-2.9)	1.6 (1.2-2.5)	N/A
Mean ± SD	2.2 ± 1.5	2.1 ± 1.7	0.8‡ (95% CI -0.78, 0.90)
Chest radiograph characteristic [II], n (%)			
Normal Lung Parenchymal	252 (99.2)	2 (0.8)	N/A
Lobar Consolidation	54 (100)	0 (0)	N/A
Pleural Effusion with or without consolidation	21 (100)	0 (0)	N/A
Heterogeneous Ill-defined opacities	3 (15.8)	16 (84.2)	N/A
Fluid overload features	15 (100)	0 (0)	N/A
Predominant reticular opacities	68 (100)	0 (0)	N/A
Others	39 (100)	0 (0)	N/A
Radiograph not available	8 (100)	0 (0)	N/A

*Plus-minus values are mean ± SD. SARI denotes severe acute respiratory illness, ILI influenza like illness, DVF dengue fever or viral fever like illness, COPD chronic obstructive pulmonary disease, CKD chronic kidney disease, ESRD end-stage renal disease, WBC white blood cell, ANC absolute neutrophil count, ALC absolute lymphocyte count, and CI confidence interval. Fever, hypoxia, WBC, ANC, and ALC were all initial parameters upon admission. †Variables were compared with the Chi-Square test. ‡Variables were compared with student's t tests. §Total numbers not complete (11 missing data) due to certain cases were unable to obtain history such as delirium, or loss of consciousness. [II]. The first radiograph prior to admission was analysed.

Table 3: Multivariate analysis of selected variables (SARI, ILI & DVF)*

Variables	Co-efficient	Wald	P Value	OR	CI 95%
Fever	0.55	1.11	0.29	1.73	0.63 - 4.78
Hypoxia without dyspnoea	2.23	17.19	<0.01	9.27	3.24 - 26.56
Preceding URTI	0.20	0.68	0.77	1.22	0.32 - 4.63
Cough	0.58	1.03	0.31	1.78	0.58 - 5.41
ANC≥10x10^9/L cells	-2.22	4.37	0.04	0.11	0.01 - 0.87

*SARI denotes severe acute respiratory illness, ILI influenza like illness, DVF dengue fever or viral fever like illness, URTI upper respiratory tract infection, ANC absolute neutrophil count, OR odd ratio, and CI confidence interval. (Hosmer–Lemeshow Chi-squared=0.81, p=0.99).

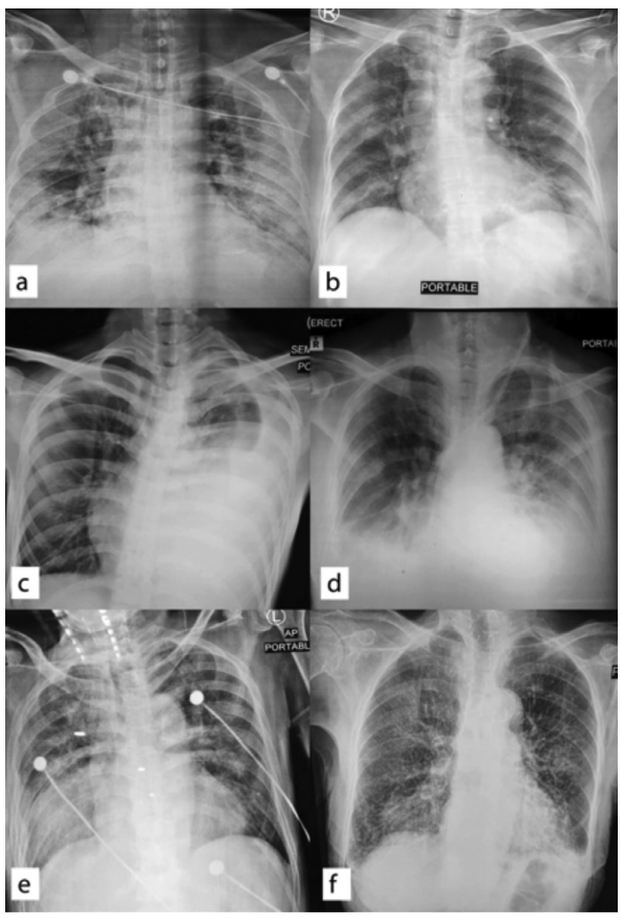

Figure 1. (a and b) Heterogeneous Ill-defined opacities. (c) Unilateral pleural effusion. (d) Fluid overload features. (e) Lobar consolidation. (f) Predominant reticular opacities.

Table S1. Dengue Serology Result*

Dengue Serology	Day of illness test was done (mean ± SD)	COVID-19 not detected	COVID-19 detected
All Negative	4.6 ± 1.3	7	1
IgG only Positive	4.8 ± 1.3	12	0
IgM only Positive	7.3 ± 2.1	3	0
IgM and IgG Positive	6.8 ± 3.0	5	0
Ns1 Antigen only Positive	4.3 ± 1.5	11	0
Ns1 Antigen and IgG Positive	5.8 ± 1.3	5	0
Ns1 Antigen and IgM Positive	6.0 ± 1.8	4	0
All Positive	4.0 ± 1.0	3	0
Result not available	-	13	0

*All dengue serology tests were performed with a rapid test kit.

Table S2. Univariate analysis of variables (SARI, ILI & DVF)*

Variables	Co-efficient	Wald	P Value	OR	CI 95%	
					Lower	Upper
Fever	0.71	2.19	0.14	2.04	0.79	5.25
Hypoxia	0.80	1.98	0.10	2.01	0.86	5.77
Preceding URTI	0.14	0.05	0.83	1.15	0.33	4.09
Cough	0.431	0.65	0.42	1.54	0.54	4.40
Dyspnoea	-0.85	2.55	0.11	0.43	0.15	1.22
Hypoxic without dyspnoea	1.97	15.57	<0.01	7.18	2.70	19.13
WBC	-0.09	2.77	0.10	0.92	0.82	1.02
WBC≥15 x10^9/L cells	-1.32	1.62	0.20	0.27	0.04	2.04
ANC	-0.08	1.84	0.18	0.92	0.82	1.04
ANC≥10 x10^9/L cells	-1.70	2.70	0.10	0.18	0.02	1.39
ALC	-0.03	0.03	0.87	0.97	0.70	1.36
Medium Risk	3.56	36.75	<0.01	35.77	11.25	113.71

*SARI denotes severe acute respiratory illness, ILI influenza like illness, DVF dengue fever or viral fever like illness, WBC white blood cell, ANC absolute neutrophil count, and CI confidence interval. All were initial parameters upon admission.

Table S3. COVID-19 result of neighbouring patient under surveillance*

Case ID	Duration of contact* (Hour)	COVID-19 test from last contact (Day)	COVID-19 Result	Symptoms at day 14
9	45	6	Negative	Asymptomatic
65	34	5	Negative	Asymptomatic
31	17	8	Negative	Asymptomatic
42	15	6	Negative	Asymptomatic
27	41	8	Negative	Asymptomatic
43	11	7	Negative	Asymptomatic
76	12	6	Negative	Asymptomatic
82	3	6	Negative	Asymptomatic
67	20	7	Negative	Asymptomatic
106	19	6	Negative	Asymptomatic
155	29	6	Negative	Asymptomatic
626	33	7	Negative	Asymptomatic
629	26	7	Negative	Asymptomatic
630	25	7	Negative	Asymptomatic

*Patients were kept minimum 1 meter apart. These include bed and personal belongings.