Clinical Characteristics of SARS-CoV-2 Infections Involving 325 Hospitalized Patients outside Wuhan

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Abstract

Background/Objective To date, the clinical features of SARS-CoV-2 infections were reported mainly based on cases in Wuhan. We aimed to report the clinical features of SARS-CoV-2 infections outside Wuhan. Methods We analyzed 325 SARS-COV-2 infection patients hospitalized in Shanghai Public Health Clinical Center. The epidemiological, demographic, and clinical data were compared between severe and non-severe cases. Results Of 325 patients, the median age was 51 years, 167 (51.4%) were men, and 107 (32.9%) had underlying diseases. 159 (48.9%) visited Wuhan or had contacted with people from Wuhan, but 57 (17.5%) had no clear epidemiological history. Compared with non-severe patients (n=299, 92%), severe patients (n=26, 8%) were older, had more common underlying disorder, more common lymphopenia, and higher D-dimer, creatine kinase, lactate dehydrogenase, aspartate aminotransferase, total bilirubin, blood urea nitrogen, creatinine, procalcitonin, C-reactive-protein, and troponin I level. The common complications included secondary infection (12.3%), acute cardiac injury (9.2%), ARDS (5.5%), acute kidney injury (5.8%), and shock (4.9%). To Mar 12, 311 (95.7%) patients were discharged, 3 (0.9%) died, and 11 (3.4%) still hospitalized. Conclusions The severity rate and fatality rate were low if the measures (early isolation, early diagnosis and early management) were undertaken at the early time of the outbreak.

Background

Since November 2019, the rapid outbreak of 2019 novel coronavirus disease (COVID-19), which caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has become a global public health emergency. Human-to-human transmission has been confirmed for SARS-CoV-2 [1]. To date, the novel coronavirus has spread to different countries worldwide, and the number of confirmed cases and death cases has been quickly growing [2]. As of March 12th, 2020, there have been 118,326 confirmed cases and 4,292 deaths globally, among them, 80,955 confirmed cases and 3,162 deaths in China [2].

The clinical features of SARS-CoV-2 infection have been studied in Wuhan, China. First, Huang et al reported the clinical characteristics and outcomes of 41 initial patients with SARS-CoV-2 infection who were linked to the Wuhan Hua-nan Seafood Market [3]. Subsequently, Chen et al reported the epidemiological and clinical characteristics of 99 cases of SARS-CoV-2 pneumonia in Wuhan Jinyintan Hospital [4]. After that, Wang et al reported the clinical characteristics of 138 hospitalized patients with SARS-CoV-2-infected pneumonia at Zhongnan Hospital of Wuhan University in Wuhan, China [5]. Recently, Guan et al reported the clinical characteristics of 1099 patients with confirmed SARS-CoV-2 infection, 71.8% came in contact with people from Wuhan, and 43.95% were local residents of Wuhan [6]. In a word, all these studies were based on cases in Wuhan, China. There is a lack of data outside Wuhan.

Although Chang et al reported the clinical features of 13 SARS-CoV-2 infection patients outside Wuhan [7], it is limited by small sample sizes and lack of data in severe patients. To date, little is known about the

clinical characteristics of SARS-CoV-2 infection outside Wuhan. Therefore, in this study, we report the clinical features of 325 confirmed SARS-CoV-2 infection patients hospitalized in Shanghai, China.

Methods

Patients

A total of 325 consecutive patients with confirmed SARS-CoV-2 infection hospitalized in Shanghai Public Health Clinical Center, a designated tertiary teaching hospital for the diagnosis and treatment of confirmed SARS-CoV-2 infection in Shanghai, China, from January 20th, 2020 to February 29th, 2020, were enrolled. The 325 SARS-CoV-2 infection patients were grouped into severe cases (n = 26) and non-severe cases (n = 299). The clinical outcomes were monitored up to March 12, 2020, the final date of follow-up.

Diagnostic criteria

Patients with possible SARS-CoV-2 infection were quarantined, and throat swab samples were sent to the Chinese Center for Disease Control and Prevention for detection of SARS-CoV-2. A confirmed case was defined as a positive result with SARS-COV-2 nucleotides using real-time polymerase-chain-reaction assay according to the WHO guidance [8]. Severe patients were identified as any one of the followings: (1) Respiratory rates ≥ 30/min; (2) Oxygen saturation ≤ 93% in a resting state; (3) Oxygenation index (PaO2/FiO2) ≤ 300 mmHg; (4) Require mechanical ventilation; (5) Shock; (6) Combined with other organ failures and needed treatment in ICU.

Acute respiratory distress syndrome (ARDS) was defined according to the Berlin definition [9]. Acute cardiac injury was defined as the serum troponin I was above the 99th percentile upper limit of normal [3]. Acute kidney injury (AKI) was defined according to the KDIGO clinical practice guidelines [10]. Secondary infection was defined as the patients had clinical symptoms or signs of nosocomial infection, and a positive culture of a new pathogen from a lower respiratory tract specimen or blood samples taken ≥ 48 h after admission [11].

Data collection

We reviewed the medical records including clinical charts, nursing records, laboratory findings, and radiological tests for the 325 SARS-CoV-2 infection patients. The data about demographics, epidemiological histories, clinical characteristics, laboratory findings, radiological manifestations, complications, and clinical outcomes were obtained with data collection forms.

Statistical analysis

The normality test was performed for continuous variables using the Kolmogorov-Smirnov test. Non-normal distribution continuous variables were expressed as medians and interquartile ranges (IQR), and compared with the Mann-Whitney U test. Categorical variables were showed as the counts and

percentage, and compared by chi-square test. All significance tests were two-tailed, and $p < 0.05$ was considered statistically significant. All statistical analyses were done using SPSS software version 15.0 (SPSS Inc. USA).

Results

Demographics and Epidemiological Characteristics of Enrolled Patients

The demographics and epidemiological characteristics of enrolled patients were presented in Table 1. The median age was 51 years (IQR, 36–64 years), and 167 (51.4%) were men. 216 (66.5%) of patients were aged 15–59 years, 75 (23.1%) were aged 60–69 years, and 34 (10.5%) were aged ≥ 70 years. 26 and 299 patients were categorized into severe and non-severe subgroups, respectively. The median age was significantly higher in severe cases as compared with non-severe cases (65 vs 49 years, $p < 0.001$). The proportion of male patients in severe cases was significantly higher than that in non-severe cases (76.9% vs 49.2%, $p = 0.007$).

Table 1
Demographics and epidemiological characteristics of SARS-CoV-2 infection patients

	Total (N = 325)	**Severe (N = 26)**	**Non-severe (N = 299)**	**P**
Age (years)	51 (36–64)	65 (63–76)	49 (35–63)	< 0.001
15–59	216 (66.5%)	5 (19.2%)	211 (70.6%)	
60–69	75 (23.1%)	10 (38.5%)	65 (21.7%)	
≥ 70	34 (10.5%)	11 (42.3%)	23 (7.7%)	
Sex				0.007
Male	167 (51.4%)	20 (76.9%)	147 (49.2%)	
Female	158 (48.6%)	6 (23.1%)	152 (50.8%)	
Epidemiological history				
Contact with Wuhan and personnel	159 (48.9%)	12 (46.2%)	147 (49.2%)	0.768
Contact with confirmed or possible patients	87 (26.8%)	7 (26.9%)	80 (26.8%)	0.985
Contact with cities around Wuhan	21 (6.5%)	0	21 (7.0%)	0.162
Visited Wenzhou, Zhejiang	1 (0.3%)	0	1 (0.3%)	0.768
Unknown original	57 (17.5%)	7 (26.9%)	50 (16.7%)	0.190
Comorbidities	107 (32.9%)	18 (69.2%)	89 (27.4%)	< 0.001
Hypertension	78 (24%)	12 (46.2%)	66 (22.1%)	0.006
Diabetes	30 (9.2%)	5 (19.2%)	25 (8.4%)	0.066
Cardiovascular disease	18 (5.5%)	5 (19.2%)	13 (4.3%)	0.002
Chronic liver disease	5 (1.5%)	1 (3.8%)	4 (1.3%)	0.319
COPD	4 (1.2%)	2 (7.7%)	2 (0.6%)	0.002
Chronic kidney disease	4 (1.2%)	2 (7.7%)	2 (0.6%)	0.002
Malignancy	3 (0.9%)	1 (3.8%)	2 (0.6%)	0.104
Cerebrovascular disease	2 (0.6%)	2 (7.7%)	0	< 0.001

COPD, Chronic obstructive pulmonary disease; The P values indicate differences between severe and non-severe patients. $P < 0.05$ was considered statistically significant.

159 (48.9%) patients visited Wuhan or maintained contact with individuals from Wuhan, 87 (26.8%) patients had been contact with confirmed or possible SARS-CoV-2 infection patients, 21 (6.5%) patients visited or came in contact with individuals from cities around Wuhan, but 57 (17.5%) patients had no clear epidemiological history. There was no statistic difference was found in the epidemiological history between severe and non-severe cases ($p > 0.05$).

107 (32.9%) patients had underlying diseases, including hypertension (78 [24%]), diabetes (30 [9.2%]), cardiovascular disease (18 [5.5%]), chronic liver disease (5 [1.5%]), chronic obstructive pulmonary disease (COPD) (4 [1.2%]), chronic kidney disease (4 [1.2%]), malignancy (3 [0.9%]), and cerebrovascular disease (2 [0.6%]). Compared with non-severe cases, severe cases were more likely to have underlying comorbidities, including hypertension (46.2% vs 22.1%, $p = 0.006$), cardiovascular disease (19.2% vs 4.3%, $p = 0.002$), COPD (7.7% vs 0.6%, $p = 0.002$), chronic kidney disease (7.7% vs 0.6%, $p = 0.002$), and cerebrovascular disease (7.7 vs 0, $p < 0.001$).

Clinical Features and Outcomes of SARS-CoV-2 Infection Patients

The clinical features and outcomes of patients were showed in Table 2. The common symptoms of SARS-CoV-2 infection were fever (263 [80.9%]), dry cough (167 [51.4%]), and fatigue (62 [19.1%]). Less common symptoms were anorexia (36 [11.1%]), myalgia (35 [11%]), pharyngalgia (31 [9.5%]), dyspnea (28 [8.6%]), coryza (27 [8.3%]), diarrhea (17 [5.2%]), nausea (9 [2.8%]), and headache (9 [2.8%]). There was no statistic difference was found in the symptoms between severe group and non-severe group, besides dyspnea (30.8% vs 6.7%, $p < 0.001$).

Table 2
Clinical features and outcomes of SARS-CoV-2 infection patients

	Total (N = 325)	Severe (N = 26)	Non-severe (N = 299)	P
Symptoms				
Fever	263 (80.9%)	24 (92.3%)	239 (79.9%)	0.124
Dry cough	167 (51.4%)	13 (50%)	154 (51.5%)	0.883
Fatigue	62 (19.1%)	6 (23.1%)	56 (18.7%)	0.588
Anorexia	36 (11.1%)	2 (7.7%)	34 (11.4%)	0.566
Myalgia	35 (11%)	2 (7.7%)	33 (11.0%)	0.598
Pharyngalgia	31 (9.5%)	1 (3.8%)	30 (10.0%)	0.303
Dyspnea	28 (8.6%)	8 (30.8%)	20 (6.7%)	< 0.001
Coryza	27 (8.3%)	0	27 (9.0%)	0.110
Diarrhea	17 (5.2%)	0	17 (5.7%)	0.212
Nausea	9 (2.8%)	0	9 (3.0%)	0.370
Headache	9 (2.8%)	0	9 (3.0%)	0.370
Asymptomatic infection	18 (5.5%)	0	18 (6.0%)	0.198
Incubation period (days)	7 (4–10)	10 (5–10)	7 (4–10)	0.824
Radiologic manifestation				
Abnormality	307 (95.5%)	26 (100%)	281 (94%)	0.182
No abnormality	18 (5.5%)	0	18 (6.0%)	0.182
Prognosis				
Hospitalisation	11 (3.4%)	9 (34.6%)	2 (0.7%)	< 0.001
Discharge	311 (95.7%)	14 (53.8%)	297 (99.3%)	< 0.001
Death	3 (0.9%)	3 (11.5%)	0	< 0.001

The P values indicate differences between severe and non-severe patients. $P < 0.05$ was considered statistically significant.

The median incubation period was 7 days (IQR, 4 to 10). There was no statistic difference in incubation period between severe and non-severe cases ($p = 0.824$). 307 (95.5%) patients manifested as pneumonia on admission, and common radiologic manifestations were ground-glass opacity and bilateral patchy shadow. 18 (6%) patients in non-severe group had no abnormal radiological manifestations. As of Mar

12, 2020, among the 325 enrolled patients, 311 (95.7%) patients were discharged, 3 (0.9%) died, and 11 (3.4%) still hospitalized, including 9 severe patients and 2 non-severe patients. Non-severe cases have higher rate of discharge (99.3% vs 53.8%, $p < 0.001$), and lower fatality rate (0 vs 11.5%, $p < 0.001$) than severe cases.

Laboratory Findings of SARS-CoV-2 Infection Patients

The laboratory findings of patients were presented in Table 3. The blood counts of patients on admission showed leucopenia (white blood cell count $< 4 \times 10^9$/L; 84 [25.8%] patients) and lymphopenia (lymphocyte count $< 1 \times 10^9$/L; 131 [40.3%] patients). The lymphopenia is more common in severe cases than non-severe cases (88.5% vs 36.1%, $p < 0.001$). Severe patients had higher D-dimer (1.2 vs 0.40 ng/mL, $p < 0.001$), creatine kinase (221 vs 78 U/L, $p < 0.001$), lactate dehydrogenase (399 vs 224 U/L, $p < 0.001$), aspartate aminotransferase (45 vs 23 U/L, $p < 0.001$), total bilirubin (10.3 vs 8.0 umol/L, $p < 0.001$), blood urea nitrogen (5.10 vs 4.37 mmol/L, $p = 0.028$), creatinine (80 vs 62 umol/L, $p = 0.002$), procalcitonin (0.16 vs 0.03 ng/mL, $p < 0.001$), C-reactive protein (53 vs 7.8 mg/L, $p < 0.001$), and troponin I (0.22 vs 0.04 ng/mL, $p < 0.001$) levels on admission than non-severe cases.

Table 3
Laboratory Findings of SARS-CoV-2 infection patients

	Total (n = 325)	Severe (n = 26)	Non-severe (n = 299)	P value
White blood count (10^9/L)	4.9 (3.9-6.0)	5.4 (3.6–10.1)	4.9 (4.0-5.9)	0.292
< 4 × 10^9/L	84 (25.8%)	9 (34.6%)	75 (25.1%)	0.287
lymphocyte count (10^9/L)	1.12 (0.79–1.49)	0.65 (0.48–0.87)	1.15 (0.85–1.53)	< 0.001
< 1 × 10^9/L	131 (40.3%)	23 (88.5%)	108 (36.1%)	< 0.001
Platelet (109/L)	182 (144–227)	157 (121–211)	182 (145–228)	0.166
D-dimer (ng/mL)	0.43 (0.29–0.78)	1.2 (0.74–2.23)	0.40 (0.28–0.69)	< 0.001
Creatine kinase (U/L)	82 (57–131)	221 (113–417)	78 (55–118)	< 0.001
LDH (U/L)	229 (193–291)	399 (336–499)	224 (192–270)	< 0.001
ALT (U/L)	22 (15–34)	26 (19–39)	21 (15–33)	0.066
AST (U/L)	24 (19–33)	45 (26–52)	23 (19–32)	< 0.001
> 40 U/L	58 (17.8%)	14 (53.8%)	44 (14.7%)	< 0.001
Total bilirubin (umol/L)	8.2 (6.6–10.5)	10.3 (8.6–13.8)	8.0 (6.5–10.3)	< 0.001
BUN (mmol/L)	4.41 (3.55–5.45)	5.10 (4.04–9.80)	4.37 (3.54–5.31)	0.028
Creatinine (umol/L)	63 (51–75)	80 (57–117)	62 (50–75)	0.002
> 111 umol/L	15 (4.6%)	7 (26.9%)	8 (2.7%)	< 0.001
Procalcitonin (ng/mL)	0.03 (0.02–0.06)	0.16 (0.06–0.62)	0.03 (0.02–0.05)	< 0.001
≤ 0.05	244 (75.1%)	5 (19.2%)	239 (79.9%)	< 0.001
> 0.05 to < 0.5	73 (22.5%)	13 (50%)	60 (20.1%)	< 0.001
≥ 0.5	8 (2.5%)	8 (30.8%)	0	< 0.001
C-reactive protein (mg/L)	8.7 (1.9–25.8)	53 (26–87)	7.8 (1.6–20.7)	< 0.001

LDH, lactate dehydrogenase; ALT, alanine aminotransferase; AST, aspartate aminotransferase; BUN, blood urea nitrogen; The P values indicate differences between severe and non-severe patients. P < 0.05 was considered statistically significant.

	Total (n = 325)	Severe (n = 26)	Non-severe (n = 299)	P value
Troponin I, (ng/mL)	0.05 (0.030–0.10)	0.22 (0.07–0.31)	0.04 (0.02–0.09)	< 0.001

LDH, lactate dehydrogenase; ALT, alanine aminotransferase; AST, aspartate aminotransferase; BUN, blood urea nitrogen; The P values indicate differences between severe and non-severe patients. P < 0.05 was considered statistically significant.

Table 4
Complications and Treatments of SARS-CoV-2 infection patients

	Total (n = 325)	Severe (n = 26)	Non-severe (n = 299)	P value
Complications				
Secondary infection	40 (12.3%)	21 (80.8%)	19 (6.4%)	< 0.001
Acute cardiac injury	30 (9.2%)	14 (53.8%)	16 (5.4%)	< 0.001
Acute kidney injury	19 (5.8%)	7 (26.9%)	12 (4%)	< 0.001
ARDS	18 (5.5%)	18 (69.2%)	0	< 0.001
Shock	16 (4.9%)	16 (61.5%)	0	< 0.001
Treatments				
Antiviral therapy	296 (91.1%)	26 (100%)	270 (90.3%)	0.096
Antibiotic therapy	125 (38.5%)	26 (100%)	99 (33.1%)	< 0.001
Antifungal treatment	13 (4%)	11 (42.3%)	2 (0.6%)	< 0.001
Glucocorticoid	69 (21.2%)	24 (92.3%)	45 (15.1%)	< 0.001
Immunoglobulin	67 (20.6%)	25 (96.2%)	42 (14.0%)	< 0.001
Noninvasive ventilation	11 (3.4%)	11 (42.3%)		
IMV	15 (4.6%)	15 (57.7%)		
CKRT	3 (0.9%)	3 (11.5%)		
ECMO	7 (2.2%)	7 (26.9%)		

ARDS, acute respiratory distress syndrome; IMV, invasive mechanical ventilation; CKRT, continuous kidney replacement therapy; ECMO, extracorporeal membrane oxygenation; The P values indicate differences between severe and non-severe patients. P < 0.05 was considered statistically significant.

Levels of aspartate aminotransferase were increased in 58 (17.8%) patients, including 14 (53.8%) severe patients and 44 (14.7%) non-severe patients. Levels of creatinine were increased in 15 (4.6%) patients,

including 7 (26.9%) severe patients and 8 (2.7%) non-severe patients. Most patients had normal procalcitonin levels (≤ 0.05 ng/mL; 244 [75.1%]) on admission, and 8 (30.8%) of 26 severe patients had procalcitonin ≥ 0.5 ng/mL, all of them had secondary infection.

Complications and Treatments of SARS-CoV-2 infection patients

The common complications included secondary infection (40 [12.3%]), acute cardiac injury (30 [9.2%]), AKI (19 [5.8%]), ARDS (18 [5.5%]), and shock (16 [4.9%]). Severe cases were more likely to have these complications than non-severe cases. 296 (91.1%) patients received antiviral agents including Kaletra (Lopinavir/Ritonavir), Truvada (Emtricitabine/Tenofovir), Thymopeptides, Arbidol, and Chinese medicine. In addition, 125 (38.5%) patients received antibacterial therapy, 13 (4%) received antifungal therapy, 69 (21.2%) received glucocorticoid therapy, and 67 (20.6%) received human immunoglobulin therapy. In the 26 severe cases, 11 (42.3%) patients received noninvasive ventilation, 15 (57.7%) received invasive mechanical ventilation, 3 (11.5%) received continuous kidney replacement therapy, and 7 (26.9%) received extracorporeal membrane oxygenation therapy.

Discussion

This cohort of 325 laboratory-confirmed SARS-CoV-2 infection patients in Shanghai, China, provides information on the epidemiology, clinical characteristics, laboratory findings, complications, and clinical outcomes of SARS-CoV-2 infection outside Wuhan. Most patients visited Wuhan or cities around Wuhan, or maintained contact with confirmed or possible SARS-CoV-2 infection patients, but 57 patients (17.5%) had no clear epidemiological history, suggesting human-to-human transmission had happened in Shanghai. Our results provided evidence supporting the close monitoring and preventive measures should be performed in Shanghai to prevent spread of SARS-CoV-2.

In this study, most of the patients were aged 15–59 years, and only 34 patients were older than 70 years. This might be related to limited travel of older patients rather than decreased susceptibility. Fever (80.9%), cough (51.4%), and fatigue (19.1%) are the common clinical manifestations in this study, consistent with previous studies including Wuhan patients, which also showed fever (83-98.6%), cough (59.4–82%), and fatigue (69.6%) are the most common clinical manifestations [3–5]. There was no statistic difference was found in the symptoms between severe and non-severe cases, besides dyspnea (30.8% vs 6.7%, $p < 0.001$). Previous studies also found that patients treated in the ICU were more likely to have dyspnea (63.9% vs 19.6%, $p < 0.05$) compared with non-severe patients [3–5].. The results suggested that dyspnea might be an early signal for disease severity progression.

13 (4.3%) patients in non-severe sub-group had no radiologic abnormality, and all patients in severe sub-group had radiologic abnormality. 18 (6.0%) patients in non-severe sub-group were asymptomatic, and all patients in severe sub-group had fever, cough, or fatigue. The 18 asymptomatic patients were potential transmission sources, and transfered SARS-CoV-2 to their close contacts. The findings remained

consistent with the latest reports, including pneumonia was not mandatory for SARS-CoV-2 infection [6], and human-to-human transmission happened from asymptomatic individuals [14]. Our results advocate the focus that identifying and managing asymptomatic patients is important to stop the spread of SARS-CoV-2 outbreak.

In this study, for the 325 SARS-CoV-2 infection patients in Shanghai, China, the severity rate is 8%, and the fatality rate is 0.9%, which was lower than that reported from Wuhan. Huang et al included 41 SARS-CoV-2 infection patients in Wuhan Jinyintan Hospital, and reported 13 (32%) patients were admitted to an ICU and 6 (15%) died [3]. Chen et al included 99 SARS-CoV-2 pneumonia patients in Wuhan Jinyintan Hospital, and reported 17 (17%) patients developed ARDS, and 11 (11%) patients died [4]. Wang et al included 138 SARS-CoV-2-infected pneumonia patients at Zhongnan Hospital of Wuhan University in Wuhan, China, and reported 36 (26.1%) patients were transferred to the ICU and 6 (4.3%) died [5]. Our results outside Wuhan suggested that the severity rate and fatality rate of SARS-CoV-2 infection were low if the measures (early isolation, early diagnosis, and early management) were undertaken at the early time of the outbreak. The lack of health workers and delayed central diagnosis, treatment and isolation might have led to the increased severity rate and fatality rate in Wuhan, China.

The current SARS-CoV-2 outbreak is the third epidemic caused by coronavirus in the 21st century, following severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). The fatality rate of SARS is more than 40% in patients over 60 years [12], and the fatality rate of MERS is 30% [13]. The reported mortality rate of SARS-CoV-2 infection fluctuated from a low of 4.3% to a high of 15% in Wuhan, China [3–5], which is lower than that reported from SARS and MERS. The outbreak of SARS-CoV-2 infection may be attributable to relatively late identification of the etiologic agent, the highly contagious of SARS-CoV-2, and the relatively weak ability of the host to clear the virus while asymptomatic

Our study has some limitations. Firstly, 11 (3.4%) patients were still hospitalized. Those patients need to be followed up, and further outcomes need to be noted. Secondly, this study is a single-center study. Thirdly, there were no children patients in this study, because the SARS-CoV-2 infection children hospitalized at the Children's Hospital of Fudan University, a designated hospital for children in Shanghai.

Conclusion

In conclusion, SARS-CoV-2 caused a spread of outbreak with human-to-human transmission in Shanghai, a city outside Wuhan, with a median incubation period of 7 days. The common symptoms include fever, dry cough, and fatigue. The measures (early isolation, early diagnosis, and early management) were undertaken at the early time of the outbreak, contributed to the decreased transmission and a relatively low severe rate and fatality rate in Shanghai, China.

Abbreviations

COVID-19

2019 novel coronavirus disease
SARS-CoV-2
severe acute respiratory syndrome coronavirus 2
ARDS
acute respiratory distress syndrome
AKI
acute kidney injury
IQR
interquartile ranges
ICU
intensive-care unit
SARS
severe acute respiratory syndrome
MERS
Middle East respiratory syndrome

Declarations

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Authorship contributions:

Study concept and design: QL, JL Z, YL, LC, and HZ L.

Data collection: QL, WX L, XY Z, YP J, and LL.

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Drafting of the manuscript: QL, JL Z, and YL

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Consent for publication

All authors read and approved the manuscript.

Competing Interests

The authors declare no competing financial and/or non-financial interests.

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Availability of data and materials

We declared that materials described in the manuscript, including all relevant raw data, will be freely available to any scientist wishing to use them for non-commercial purposes, without breaching participant confidentiality. The supporting data can be accessed from Liang Chen (corresponding author), E-mail: chenliang@shphc.org.cn

Declarations

This manuscript had contained Ethics approval and consent to participate, Consent for publication, Availability of data and materials, Competing interests, Funding, Authors' contributions, and Acknowledgements.

Ethics approval and consent to participate

This study was approved by the ethics board of Shanghai Public Health Clinical Center. The verbal informed consents were obtained from all participants, and the clinical diagnosis and treatment complied with the Helsinki declaration. No children (under 16 years old) were enrolled in this study.

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