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Early View

Original article

Comorbidity and its impact on 1590 patients with Covid-19 in China: A Nationwide Analysis

Wei-jie Guan, Wen-hua Liang, Yi Zhao, Heng-rui Liang, Zi-sheng Chen, Yi-min Li, Xiao-qing Liu, Ru-chong Chen, Chun-li Tang, Tao Wang, Chun-quan Ou, Li Li, Ping-yan Chen, Ling Sang, Wei Wang, Jian-fu Li, Cai-chen Li, Li-min Ou, Bo Cheng, Shan Xiong, Zheng-yi Ni, Jie Xiang, Yu Hu, Lei Liu, Hong Shan, Chun-liang Lei, Yi-xiang Peng, Li Wei, Yong Liu, Ya-hua Hu, Peng Peng, Jian-ming Wang, Ji-yang Liu, Zhong Chen, Gang Li, Zhi-jian Zheng, Shao-qin Qiu, Jie Luo, Chang-jiang Ye, Shao-yong Zhu, Lin-ling Cheng, Feng Ye, Shi-yue Li, Jin-ping Zheng, Nuo-fu Zhang, Nan-shan Zhong, Jian-xing He

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Original article

Comorbidity and its impact on 1,590 patients with Covid-19 in China: A Nationwide Analysis

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Abstract

Background: The coronavirus disease 2019 (Covid-19) outbreak is evolving rapidly worldwide.

Objective: To evaluate the risk of serious adverse outcomes in patients with coronavirus disease 2019 (Covid-19) by stratifying the comorbidity status.

Methods: We analyzed the data from 1,590 laboratory-confirmed hospitalized patients 575 hospitals in 31 province/autonomous regions/provincial municipalities across mainland China between December 11th, 2019 and January 31st, 2020. We analyze the composite endpoints, which consisted of admission to intensive care unit, or invasive ventilation, or death. The risk of reaching to the composite endpoints was compared according to the presence and number of comorbidities.

Results: The mean age was 48.9 years. 686 patients (42.7%) were females. Severe cases accounted for 16.0% of the study population. 131 (8.2%) patients reached to the composite endpoints. 399 (25.1%) reported having at least one comorbidity. The most prevalent comorbidity was hypertension (16.9%), followed by diabetes (8.2%). 130 (8.2%) patients reported having two or more comorbidities. After adjusting for age and smoking status, COPD [hazards ratio (HR) 2.681, 95% confidence interval (95%CI) 1.424-5.048], diabetes (HR 1.59, 95%CI 1.03-2.45), hypertension (HR 1.58, 95%CI 1.07-2.32) and malignancy (HR 3.50, 95%CI 1.60-7.64) were risk factors of reaching to the composite endpoints. The HR was 1.79 (95%CI 1.16-2.77) among patients with at least one comorbidity and 2.59 (95%CI 1.61-4.17) among patients with two or more comorbidities.

Conclusion: Among laboratory-confirmed cases of Covid-19, patients with any comorbidity yielded poorer clinical outcomes than those without. A greater number of comorbidities also correlated with

poorer clinical outcomes.

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Key words: Mortality; cardiovascular disease; chronic obstructive pulmonary disease; diabetes; hypertension; malignancy

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Take-home message

The presence and number of comorbidities predicted clinical outcomes of Covid-19.

Introduction

Since November 2019, the rapid outbreak of coronavirus disease 2019 (Covid-19), which arose from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, has recently become a public health emergency of international concern [1]. Covid-19 has contributed to an enormous adverse impact globally. Hitherto, there have been 109,577 laboratory-confirmed cases and 3,809 deaths globally as of March 10th, 2020 [2].

The clinical manifestations of Covid-19 are, according to the latest reports [3-12], heterogeneous. On admission, 20-51% of patients reported as having at least one comorbidity, with diabetes (10-20%), hypertension (10-15%) and other cardiovascular and cerebrovascular diseases (7-40%) being most common [3,4,6]. Previous studies have demonstrated that the presence of any comorbidity has been associated with a 3.4-fold increased risk of developing acute respiratory distress syndrome in patients with H7N9 infection [13]. Similar with influenza [14-18], Severe Acute Respiratory Syndrome coronavirus (SARS-CoV) [19] and Middle East Respiratory Syndrome coronavirus (MERS-CoV) [20-28], Covid-19 more readily predisposed to respiratory failure and death in susceptible patients [4,5]. Nonetheless, previous studies have been certain limitations in

study design including the relatively small sample sizes and single center observations. Studies that address these limitations is needed to explore for the factors underlying the adverse impact of Covid-19.

Our objective was to evaluate the risk of serious adverse outcomes in patients with Covid-19 by stratification according to the number and type of comorbidities, thus unraveling the sub-populations with poorer prognosis.

Methods

Data sources and data extraction

This was a retrospective case study that collected data from patients with Covid-19 throughout China, under the coordination of the National Health Commission which mandated the reporting of clinical information from individual designated hospitals which admitted patients with Covid-19. After careful medical chart review, we compiled the clinical data of laboratory-confirmed hospitalized cases from 575 hospitals (representing 31.7% of the certified hospitals for admitting patients with Covid-19) between December 11th, 2019 and January 31st, 2020. The diagnosis of Covid-19 was made based on the *World Health Organization* interim guidance [29]. Because of the urgency of data extraction, complete random sampling could not be applied in our settings. All clinical profiles outside Hubei province were centrally provided by the National Health Commission. Three respiratory experts from Guangzhou were dispatched to Wuhan for raw data extraction from Wuhan JinYinTan Hospital where most cases in Wuhan were located. Our cohort included 132 patients from

Wuhan JinYinTan Hospital, and one each from 338 hospitals. Our cohort represented the overall situation as of Jan 31st, taking into account the proportion of hospitals (~ one fourth) and patient number (13.5%, 1,590/11,791 cases) as well as the broad coverage (covering all major provinces/cities/autonomous regions). Confirmed cases denoted the patients whose high-throughput sequencing or real-time reverse-transcription polymerase chain reaction (RT-PCR) assay findings for nasal and pharyngeal swab specimens were positive [3]. See *Online Supplement* for further details. The interval between the potential earliest date of transmission source (wildlife, suspected or confirmed cases) contacts and the potential earliest date of symptom onset (i.e., cough, fever, fatigue, myalgia) was adopted to calculate the incubation period. In light that the latest date was recorded in some patients who had continuous exposure to contamination sources, the incubation periods of less than 1.0 day would not be included in our analysis. The incubation periods were summarized based on the patients who had delineated the specific date of exposure.

The clinical data (including recent exposure history, clinical symptoms and signs, comorbidities, and laboratory findings upon admission) were reviewed and extracted by experienced respiratory clinicians, who subsequently entered the data into a computerized database for further double-check of all cases. Manifestations on chest X-ray or computed tomography (CT) was summarized by integrating the documentation or description in medical charts and, if available, a further review by our medical staff. Major disagreement of the radiologic manifestations between the two reviewers was resolved by consultation with another independent reviewer. Because the disease severity reportedly predicted poorer clinical outcomes of avian influenza [13], patients were classified as having severe or non-severe Covid-19 based on the 2007 *American Thoracic Society* / *Infectious Disease Society of America* guidelines [30], taking into account its global acceptance for severity

stratification of community-acquired pneumonia although no validation was conducted in patients with viral pneumonia. The predictive ability of the need for ICU admission and mortality has been validated previously [31,32]. Briefly, severe cases denoted at least one major criterion (septic shock requiring vasoactive medications, or respiratory failure requiring mechanical ventilation), or at least three minor criteria (respiratory rate being 30 times per minute or greater, oxygen index being 250 or lower, multiple lobe infiltration, delirium or loss of consciousness, blood urea nitrogen level being 20 mg/dl or greater, blood leukocyte count being 4,000 per deciliter or lower, blood platelet count being 100,000 per deciliter or lower, body temperature being lower than 36 degrees, hypotension necessitating vasoactive drugs for maintaining blood pressure).

Comorbidities were determined based on patient's self-report on admission. Comorbidities were initially treated as a categorical variable (Yes vs. No), and subsequently classified based on the number (Single vs. Multiple). Furthermore, comorbidities were sorted according to the organ systems (i.e. respiratory, cardiovascular, endocrine). Comorbidities that were classified into the same organ system (i.e. coronary heart disease, hypertension) would be merged into a single category.

The primary endpoint of our study was a composite measure which consisted of the admission to intensive care unit (ICU), or invasive ventilation, or death. This composite measure was adopted because all individual components were serious outcomes of H7N9 infections [13]. The secondary endpoint was the mortality rate.

Statistical analysis

Statistical analyses were conducted with SPSS software version 23.0 (Chicago, IL, USA). No formal sample size estimation was made because there has not been any published nationwide data on

Covid-19. Nonetheless, our sample size was deemed sufficient to power the statistical analysis given its representativeness of the national patient population. Continuous variables were presented as means and standard deviations or medians and interquartile ranges (IQR) as appropriate, and the categorical variables were presented as counts and percentages. In light that no random sampling was conducted, all statistical analyses were descriptive and no *P* values would be presented for the statistical comparisons except for the Cox proportional hazards regression model. Cox proportional hazards regression models were applied to determine the potential risk factors associated with the composite endpoints, with the hazards ratio (HR) and 95% confidence interval (95%CI) being reported. Our findings indicated that the statistical assumption of proportional hazards analysis was not violated. Moreover, Cox regression model was considered more appropriate than logistic regression model because it has taken into account the potential impact of the various duration of follow-up from individual patients. The age and smoking status were adjusted for in the proportional hazards regression model because they have been recognized as the risk factors of comorbidities even in the general population. The smoking status was stratified as current smokers, ex-smokers and never smokers in the regression models.

Results

Demographic and clinical characteristics

The National Health Commission has issued 11,791 patients with laboratory-confirmed Covid-19 in

China as of January 31st, 2020. At this time point for data cut-off, our database has included 1,590 cases from 575 hospitals in 31 province/autonomous regions/provincial municipalities (see *Online Supplement* for details). Of these 1,590 cases, the mean age was 48.9 years. 686 patients (42.7%) were females. 647 (40.7%) patients were managed inside Hubei province, and 1,334 (83.9%) patients had a contact history of Wuhan city. The most common symptom was fever on or after hospitalization (88.0%), followed by dry cough (70.2%). Fatigue (42.8%) and productive cough (36.0%) were less common. At least one abnormal chest CT manifestation (including ground-glass opacities, pulmonary infiltrates and interstitial disorders) was identified in more than 70% of patients. Severe cases accounted for 16.0% of the study population. 131 (8.2%) patients reached to the composite endpoints during the study (**Table 1)**. Overall, the median follow-up duration was 10 days (interquartile range: 8, 14).

Presence of comorbidities and the clinical characteristics and outcomes of Covid-19

Of the 1,590 cases, 399 (25.1%) reported having at least one comorbidity. The prevalence of specific comorbidities was: hypertension (269; 16.9%), other cardiovascular diseases (53.7%) cerebrovascular diseases (30; 1.9%), diabetes (130; 8.2%), hepatitis B infections (28; 1.8%), chronic obstructive pulmonary disease (24; 1.5%), chronic kidney diseases (21; 1.3%), malignancy (18; 1.1%) and immunodeficiency (3; 0.2%). None of the cases had physician-diagnosed asthma. At least one comorbidity was seen more commonly in severe cases than in non-severe cases (32.8% vs. 10.3%). Patients with at least one comorbidity were older (mean: 60.8 vs. 44.8 years), were more likely to have shortness of breath (41.4% vs. 17.8%), nausea or vomiting (10.4% vs. 4.3%), and tended to have abnormal chest X-ray manifestations (29.2% vs. 15.1%) (**Table 1)**.

Clinical characteristics and outcomes of Covid-19 stratified by the number of comorbidities

We have further identified 130 (8.2%) patients who reported having two or more comorbidities. Two or more comorbidities were more commonly seen in severe cases than in non-severe cases (40.0% vs. 29.4%). Patients with two or more comorbidities were older (mean: 66.2 vs. 58.2 years), were more likely to have shortness of breath (55.4% vs. 34.1%), nausea or vomiting (11.8% vs. 9.7%), unconsciousness (5.1% vs. 1.3%) and less abnormal chest X-ray (20.8% vs. 23.4%) compared with patients who had single comorbidity (**Table 2)**.

Clinical characteristics and outcomes of Covid-19 stratified by organ systems of comorbidities

A total of 269 (16.9%), 59 (3.7%), 30 (1.9%), 130 (8.2%), 28 (1.8%), 24 (1.5%), 21 (1.3%), 18 (1.1%) and 3 (0.2%) patients reported having hypertension, cardiovascular diseases, cerebrovascular diseases, diabetes, hepatitis B infections, COPD, chronic kidney diseases, malignancy and immunodeficiency, respectively. Severe cases were more likely to have hypertension (32.7% vs. 12.6%), cardiovascular diseases (33.9% vs. 15.3%), cerebrovascular diseases (50.0% vs. 15.3%), diabetes (34.6% vs. 14.3%), hepatitis B infections (32.1% vs. 15.7%), COPD (62.5% vs. 15.3%), chronic kidney diseases (38.1% vs. 15.7%) and malignancy (50.0% vs. 15.6%) compared with non-severe cases. Furthermore, comorbidities were more common patients treated in Hubei province as compared with those managed outside Hubei province as well as patients with an exposure history of Wuhan as compared with those without (**Table 3)**.

Prognostic analyses

Overall, 131 patients (8.3%) reached to the composite endpoints during the study. 50 patients (3.1%)

died, 99 patients (6.2%) were admitted to the ICU and 50 patients (3.1%) received invasive ventilation. The composite endpoint was documented in 77 (19.3%) of patients who had at least one comorbidity as opposed to 54 (4.5%) patients without comorbidities. This figure was 37 cases (28.5%) in patients who had two or more comorbidities. Significantly more patients with hypertension (19.7% vs. 5.9%), cardiovascular diseases (22.0% vs. 7.7%), cerebrovascular diseases (33.3% vs. 7.8%), diabetes (23.8% vs. 6.8%), COPD (50.0% vs. 7.6%), chronic kidney diseases (28.6% vs. 8.0%) and malignancy (38.9% vs. 7.9%) reached to the composite endpoints compared with those without (**Table 3**).

Patients with two or more comorbidities had significantly escalated risks of reaching to the composite endpoint compared with those who had a single comorbidity, and even more so as compared with those without (all $P<0.05$, **Figure 1**). After adjusting for age and smoking status, patients with COPD (HR 2.68, 95%CI 1.42-5.05), diabetes (HR 1.59, 95%CI 1.03-2.45), hypertension (HR 1.58, 95%CI 1.07-2.32) and malignancy (HR 3.50, 95%CI 1.60-7.64) were more likely to reach to the composite endpoints than those without (**Figure 2**). Results of unadjusted analysis was presented in **Table E1-2**. Overall, findings of unadjusted and adjusted analysis were not materially altered. As compared with patients without comorbidity, the HR (95%CI) was 1.79 (95%CI 1.16-2.77) among patients with at least one comorbidity and 2.59 (95%CI 1.61-4.17) among patients with two or more comorbidities (**Figure 2**). Subgroup analysis by stratifying patients according to their age (<65 years vs. ≥65 years) did not reveal substantial difference in the strength of associations between the number of comorbidities and mortality of Covid-19 (**Table E3**).

Discussion

Our study is the first nationwide investigation that systematically evaluates the impact of comorbidities on the clinical characteristics and prognosis in patients with Covid-19 in China. Circulatory and endocrine comorbidities were common among patients with Covid-19. Patients with at least one comorbidity, or more even so, were associated with poor clinical outcomes. These findings have provided further objective evidence, with a large sample size and extensive coverage of the geographic regions across China, to take into account baseline comorbid diseases in the comprehensive risk assessment of prognosis among patients with Covid-19 on hospital admission.

Overall, our findings have echoed the recently published studies in terms of the commonness of comorbidities in patients with Covid-19 [3-7]. Despite considerable variations in the proportion in individual studies due to the limited sample size and the region where patients were managed, circulatory diseases (including hypertension and coronary heart diseases) remained the most common category of comorbidity [3-7]. Apart from circulatory diseases, endocrine diseases such as diabetes were also common in patients with Covid-19. Notwithstanding the commonness of circulatory and endocrine comorbidities, patients with Covid-19 rarely reported as having comorbid respiratory diseases (particularly COPD). The reasons underlying this observation have been scant, but could have arisen from the lack of awareness and the lack of spirometric testing in community settings that collectively contributed to the under-diagnosis of respiratory diseases [33]. It should be stressed that the observed frequency of comorbidity may also reflect the transmission dynamics within particular age groups, case detection or testing practices or hospital admission policies during the early phases of the epidemic. Consistent with recent reports [3-7], the percentage of patients with

comorbid renal disease and malignancy was relatively low. Our findings have therefore added to the existing literature the spectrum of comorbidities in patients with Covid-19 based on the larger sample sizes and representativeness of the whole patient population in China.

A number of existing literature reports have documented the escalated risks of poorer clinical outcomes in patients with avian influenza [14-18], SARS-CoV [19] and MERS-CoV infections [20-28]. The most common comorbidities associated with poorer prognosis included diabetes [25,29], hypertension [28], respiratory diseases [19,28], cardiac diseases [19,28], pregnancy [16], renal diseases [28] and malignancy [19]. Our findings suggested that, similar with other severe acute respiratory outbreaks, comorbidities such as COPD, diabetes, hypertension and malignancy predisposed to adverse clinical outcomes in patients with Covid-19. The strength of association between different comorbidities and the prognosis, however, was less consistent when compared with the literature reports [16,19,25,28]. For instance, the risk between cardiac diseases and poor clinical outcomes of influenza, SARS-CoV or MERS-CoV infections was inconclusive [16,19,25,28]. Except for diabetes, no other comorbidities were identified to be the predictors of poor clinical outcomes in patients with MERS-CoV infections [25]. Few studies, however, have explored the mechanisms underlying these associations. Kulscar et al showed that MERS-CoV infections resulted in prolonged airway inflammation, immune cell dysfunction and an altered expression profile of inflammatory mediators in diabetic mice models [27]. A network-based analysis indicated that SARS-CoV infections led to immune dysregulation that could help explain the escalated risk of cardiac diseases, bone diseases and malignancy [34]. Therefore, immune dysregulation and prolonged inflammation might be the key drivers of the poor clinical outcomes in patients with Covid-19 but await verification in more mechanistic studies.

It has been well accepted that some comorbidities frequently co-exist. For instance, diabetes [35] and COPD [36] frequently co-exist with hypertension or coronary heart diseases. Therefore, patients with co-existing comorbidities are more likely to have poorer baseline well-being. Importantly, we have verified the significantly escalated risk of poor prognosis in patients with two or more comorbidities as compared with those who had no or only a single comorbidity. Our findings implied that both the category and number of comorbidities should be taken into account when predicting the prognosis in patients with Covid-19.

Our findings suggested that patients with comorbidities had greater disease severity compared with those without. Furthermore, a greater number of comorbidities correlated with greater disease severity of Covid-19. The proper triage of patients should be implemented by carefully inquiring the medical history because this will help identify patients who would be more likely to develop serious adverse outcomes of Covid-19. Moreover, better protection should be given to the patients with COIVD-19 who had comorbidities upon confirmation of the diagnosis.

A main limitation was the self-report of comorbidities on admission. Under-reporting of comorbidities, which could have stemmed from the lack of awareness and/or the lack of diagnostic testing, might contribute to the underestimation of the true strength of association with the clinical prognosis. Under-reporting of comorbidities could also lead to over-estimation of strength of association with adverse outcome. However, significant under-reporting was unlikely because the spectrum of our report was largely consistent with existing literature [3-7] and all patients were subject to a thorough history taking after hospital admission. The relatively low age might help explain the low prevalence of COPD in our cohort. Moreover, the duration of follow-up was

relatively short and some patients remained in the hospital as of the time of writing. More studies that explore the associations in a sufficiently long time frame are warranted. Caution should be exercised when extrapolating our findings to other countries where there are outbreaks of Covid-19 since the prevalence of comorbidities may differ among different countries. Therefore, future studies that include an external validation of the results would be desirable. Although the temperature and systolic blood pressure differed between some subgroups, they were unlikely to be clinically relevant. Finally, because of the rapid evolving outbreak globally, ongoing studies with the inclusion of more patients would be needed to increase the statistical power and lend support to subgroup analyses stratified by the specific comorbidities (i.e. COPD) and their association with the risk of death.

Conclusions

Among laboratory-confirmed cases of Covid-19, patients with any comorbidity yielded poorer clinical outcomes than those without. A greater number of comorbidities also correlated with poorer clinical outcomes. A thorough assessment of comorbidities may help establish risk stratification of patients with Covid-19 upon hospital admission.

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Tables

Table 1: Demographics and clinical characteristics of patients with or without any comorbidities.

Variables	Any comorbidity		
	Total (n=1590)	**No (n=1191)**	**Yes (n=399)**
Age (years)	48.9±16.3	44.8±15.2	60.8±13.4
Incubation period (day)	3.6±4.2	3.7±4.3	3.5±3.9
Temperature on admission (℃)	37.4±0.9	37.4±0.9	37.3±0.9
Respiratory rate on admission (breath/min)	21.2±12.0	21.2±13.7	21.3±4.7
Heart rate on admission (beat/min)	88.7±14.6	88.5±14.7	89.2±14.4
Systolic pressure on admission (mmHg)	126.1±16.4	123.5±15.2	133.2±17.5
Diastolic pressure on admission (mmHg)	79.5±25.6	79±28.9	80.9±12.6
Highest temperature (℃)	38.3±1.6	38.3±1.1	38.2±2.6
Sex			
Male	904/1578 (57.3)	667/1182 (56.4)	237/396 (59.8)
Female	674/1578 (42.7)	515/1182 (43.6)	159/396 (40.2)
Smoking status			
Never/unknown	1479/1590 (93)	1127/1191 (94.6)	352/399 (88.2)
Former/current	111/1590 (7)	64/1191 (5.4)	47/399 (11.8)
Symptoms			
Fever	1351/1536 (88)	1002/1148 (87.3)	349/388 (89.9)
Conjunctival congestion	10/1345 (0.7)	7/1014 (0.7)	3/331 (0.9)
Nasal congestion	73/1299 (5.6)	59/979 (6)	14/320 (4.4)
Headache	205/1328 (15.4)	151/1002 (15.1)	54/326 (16.6)

Dry cough	1052/1498 (70.2)	775/1116 (69.4)	277/382 (72.5)
Pharyngodynia	194/1317 (14.7)	148/999 (14.8)	46/318 (14.5)
Productive cough	513/1424 (36)	363/1064 (34.1)	150/360 (41.7)
Fatigue	584/1365 (42.8)	435/1031 (42.2)	149/334 (44.6)
Hemoptysis	16/1315 (1.2)	9/991 (0.9)	7/324 (2.2)
Shortness of breath	331/1394 (23.7)	185/1041 (17.8)	146/353 (41.4)
Nausea/vomiting	80/1371 (5.8)	44/1025 (4.3)	36/346 (10.4)
Diarrhea	57/1359 (4.2)	39/1023 (3.8)	18/336 (5.4)
Myalgia/arthralgia	234/1338 (17.5)	174/1007 (17.3)	60/331 (18.1)
Chill	163/1333 (12.2)	129/1006 (12.8)	34/327 (10.4)
Signs			
Throat congestion	21/1286 (1.6)	16/973 (1.6)	5/313 (1.6)
Tonsil swelling	31/1376 (2.3)	22/1024 (2.1)	9/352 (2.6)
Enlargement of lymph nodes	2/1375 (0.1)	1/1027 (0.1)	1/348 (0.3)
Rash	3/1378 (0.2)	2/1032 (0.2)	1/346 (0.3)
Unconsciousness	20/1421 (1.4)	11/1063 (1)	9/358 (2.5)
Abnormal chest image			
Radiograph	243/1590 (15.3)	236/1566 (15.1)	44036 (29.2)
Computed tomography	1130/1590 (71.1)	1113/1566 (71.1)	17/24 (70.8)
Hubei			
Yes	647/1590 (40.7)	434/1191 (36.4)	213/399 (53.4)
No	943/1590 (59.3)	757/1191 (63.6)	186/399 (46.6)
Wuhan-contacted			
Yes	1334/1590 (83.9)	983/1191 (82.5)	351/399 (88)

No	256/1590 (16.1)	208/1191 (17.5)	48/399 (12)
Severity	254/1590 (16)	123/1191 (10.3)	131/399 (32.8)
Composite endpoint	131/1590 (8.2)	54/1191 (4.5)	77/399 (19.3)
Death	50/1590 (3.1)	15/1191 (1.3)	35/399 (8.8)
Admission to ICU	99/1590 (6.2)	45/1191 (3.8)	54/399 (13.5)
Invasive ventilation	50/1590 (3.1)	19/1191 (1.6)	31/399 (1.6)

Data are mean ± standard deviation, n/N (%), where N is the total number of patients with available data.

COPD=chronic obstructive pulmonary disease. ICU = intensive care unit.

Table 2: Demographics and clinical characteristics of patients with 1 or ≥2 comorbidities.

Variables	1 comorbidity (n=269)	≥2 comorbidities (n=130)
Age (years)	58.2±13.1	66.2±12.2
Incubation period (days)	3.2±3.1	4.0±5.2
Temperature on admission (℃)	37.4±0.9	37.1±0.9
Respiratory rate on admission (breath/min)	21.4±4.6	21.2±5
Heart rate (bit/minute)	90.2±14.6	87.2±13.7
Systolic pressure on admission (mmHg)	132.2±16.5	135.3±19.4

Diastolic pressure on admission (mmHg)	81.7±12.5	79.5±12.9
Highest temperature (℃)	38.2±3.0	38.4±0.8
Sex		
Male	158/268 (59.0)	79/128 (61.7)
Female	110/268 (41.0)	49/128 (38.3)
Smoking status		
Never/unknown	234/269 (87.0)	118/130 (90.8)
Former/current	35/269 (13.0)	12/130 (9.2)
Symptoms		
Fever	241/263 (91.6)	108/125 (86.4)
Conjunctival congestion	3/222 (1.4)	0/109 (0)
Nasal congestion	5/213 (2.3)	9/107 (8.4)
Headache	34/220 (15.5)	20/106 (18.9)
Dry cough	195/258 (75.6)	82/124 (66.1)
Pharyngodynia	33/218 (15.1)	13/100 (13.0)
Productive cough	101/241 (41.9)	49/119 (41.2)
Fatigue	97/227 (42.7)	52/107 (48.6)
Hemoptysis	4/219 (1.8)	3/105 (2.9)
Shortness of breath	79/232 (34.1)	67/121 (55.4)
Nausea/vomiting	23/236 (9.7)	13/110 (11.8)
Diarrhea	11/229 (4.8)	7/107 (6.5)
Myalgia/arthralgia	45/227 (19.8)	15/104 (14.4)
Chill	25/222 (11.3)	9/105 (8.6)
Signs		

Throat congestion	4/216 (1.9)	1/97 (1)
Tonsil swelling	5/234 (2.1)	4/118 (3.4)
Enlargement of lymph nodes	1/232 (0.4)	0/116 (0)
Rash	0/231 (0)	1/115 (0.9)
Unconsciousness	3/240 (1.3)	6/118 (5.1)
Abnormal chest image		
Radiograph	63/269 (23.4)	27/130 (20.8)
Computed tomography	200/269 (74.3)	96/130 (73.8)
Hubei		
Yes	120/269 (44.6)	93/130 (71.5)
No	149/269 (55.4)	37/130 (28.5)
Wuhan-contacted		
Yes	229/269 (85.1)	122/130 (93.8)
No	40/269 (14.9)	8/130 (6.2)
Severity	79/269 (29.4)	52/130 (40.0)
Composite endpoint	40/269 (14.9)	37/130 (28.5)
Deaths	15/269 (5.6)	20/130 (15.4)
Admission to ICU	31/269 (11.5)	23/130 (17.7)
Invasive ventilation	17/269 (6.3)	14/130 (10.8)

Data are mean ± standard deviation, n/N (%), where N is the total number of patients with available data.

COPD=chronic obstructive pulmonary disease. ICU = intensive care unit

Table 3: Demographics and clinical characteristics of patients stratified by different comorbidities.

	COPD		Diabetes		Hypertension		Cardiovascular disease		Cerebrovascular disease	
	No (n=1566)	Yes (n=24)	No (n=1460)	Yes (n=130)	No (n=1321)	Yes (n=269)	No (n=1531)	Yes (n=59)	No (n=1560)	Yes (n=30)
Age (year)	48.5±16.0	74.7±6.8	47.8±16.1	61.2±13.4	46.2±15.6	62.1±12.5	48.2±15.9	66.3±15.1	48.5±16.1	70.4±8.9
Incubation period (day)	3.6±4.2	4.5±3.2	3.6±4.1	3.8±5.0	3.6±4.2	3.6±4.1	3.7±4.2	3.3±3.7	3.6±4.2	3.8±3.4
Temperature on admission (℃)	37.4±0.9	37.3±0.9	37.4±0.9	37.2±1.0	37.4±0.9	37.2±0.9	37.4±0.9	37.3±1	37.4±0.9	36.9±0.8
Respiratory rate on admission (breath/min)	21.2±12.1	21.8±5.2	21.2±12.4	21.4±5.4	21.2±13.1	21.3±4.5	21.2±12.2	21.4±6.2	21.3±12.1	19.9±3.3
Heart rate (bit/minute)	88.6±14.6	90.2±12.8	88.6±14.6	89.1±14.3	88.6±14.7	89±14.3	88.8±14.6	86.4±14.9	88.8±14.6	84.5±11.4
Systolic pressure on admission (mmHg)	126±16.4	131±17.5	125.3±15.9	134.4±19.1	123.9±15.2	135.4±18.2	125.8±16.3	132.3±18.8	125.9±16.4	132.9±16
Diastolic pressure on admission (mmHg)	79.6±25.7	77±11.9	79.4±26.4	80.9±13.2	79.2±27.7	81±12.5	79.6±25.9	78.4±13.6	79.6±25.8	77.4±9.6
Highest temperature (℃)	38.3±1.6	38.5±0.6	38.3±1.7	38.4±0.8	38.3±1.3	38.2±2.7	38.3±1.7	38.5±0.8	38.3±1.6	38.2±1
Sex										
Male	884/1554	20/24	828/1449	76/129	748/1312	156/266	868/1520	36/58	881/1548	23/30

	(56.9)	(83.3)	(57.1)	(58.9)	(57)	(58.6)	(57.1)	(62.1)	(56.9)	(76.7)
Female	670/1554 (43.1)	4/24 (16.7)	621/1449 (42.9)	53/129 (41.1)	564/1312 (43)	110/266 (41.4)	652/1520 (42.9)	22/58 (37.9)	667/1548 (43.1)	7/30 (23.3)
Smoking status										
Never/unknown	1458/1566 (93.1)	21/24 (87.5)	1368/1460 (93.7)	111/130 (85.4)	1232/1321 (93.3)	247/269 (91.8)	1426/1531 (93.1)	53/59 (89.8)	1453/1560 (93.1)	26/30 (86.7)
Former/current	108/1566 (6.9)	3/24 (12.5)	92/1460 (6.3)	19/130 (14.6)	89/1321 (6.7)	22/269 (8.2)	105/1531 (6.9)	6/59 (10.2)	107/1560 (6.9)	4/30 (13.3)
Symptoms										
Fever	1331/1513 (88)	20/23 (87.0)	1239/1412 (87.7)	112/124 (90.3)	1113/1273 (87.4)	238/263 (90.5)	1308/1482 (88.3)	43/54 (79.6)	1328/1507 (88.1)	23/29 (79.3)
Conjunctival congestion	10/1325 (0.8)	0/20 (0)	9/1237 (0.7)	1/108 (0.9)	9/1120 (0.8)	1/225 (0.4)	10/1299 (0.8)	0/46 (0)	10/1320 (0.8)	0/25 (0)
Nasal congestion	72/1281 (5.6)	1/18 (5.6)	66/1195 (5.5)	7/104 (6.7)	62/1079 (5.7)	11/220 (5)	67/1253 (5.3)	6/46 (13.0)	73/1275 (5.7)	0/24 (0)

Headache	202/1309 (15.4)	3/19 (15.8)	187/1225 (15.3)	18/103 (17.5)	166/1106 (15)	39/222 (17.6)	197/1283 (15.4)	8/45 (17.8)	197/1303 (15.1)	8/25 (32.0)
Dry cough	1038/1474 (70.4)	14/24 (58.3)	972/1378 (70.5)	80/120 (66.7)	854/1238 (69)	198/260 (76.2)	1018/1442 (70.6)	34/56 (60.7)	1035/1469 (70.5)	17/29 (58.6)
Pharyngodynia	189/1300 (14.5)	5/17 (29.4)	182/1219 (14.9)	12/98 (12.2)	165/1102 (15)	29/215 (13.5)	185/1272 (14.5)	9/45 (20)	192/1296 (14.8)	2/21 (9.5)
Productive cough	502/1400 (35.9)	11/24 (45.8)	462/1309 (35.3)	51/115 (44.3)	403/1178 (34.2)	110/246 (44.7)	499/1373 (36.3)	14/51 (27.5)	504/1397 (36.1)	9/27 (33.3)
Fatigue	573/1347 (42.5)	11/18 (61.1)	529/1257 (42.1)	55/108 (50.9)	488/1143 (42.7)	96/222 (43.2)	564/1318 (42.8)	20/47 (42.6)	574/1344 (42.7)	10/21 (47.6)
Hemoptysis	15/1296 (1.2)	1/19 (5.3)	12/1214 (1.0)	4/101 (4.0)	12/1096 (1.1)	4/219 (1.8)	15/1268 (1.2)	1/47 (2.1)	16/1292 (1.2)	0/23 (0)
Shortness of breath	316/1371 (23)	15/23 (65.2)	277/1279 (21.7)	54/115 (47.0)	223/1154 (19.3)	108/240 (45)	310/1342 (23.1)	21/52 (40.4)	319/1366 (23.4)	12/28 (42.9)
Nausea/vomiting	77/1350	3/21	69/1264	11/107	55/1134	25/237	73/1321	7/50	79/1348	1/23

	(5.7)	(14.3)	(5.5)	(10.3)	(4.9)	(10.5)	(5.5)	(14.0)	(5.9)	(4.3)
Diarrhea	57/1338 (4.3)	0/21 (0)	48/1255 (3.8)	9/104 (8.7)	46/1129 (4.1)	11/230 (4.8)	53/1313 (4.0)	4/46 (8.7)	57/1336 (4.3)	0/23 (0)
Myalgia/arthralgia	231/1320 (17.5)	3/18 (16.7)	218/1234 (17.7)	16/104 (15.4)	188/1112 (16.9)	46/226 (20.4)	227/1294 (17.5)	7/44 (15.9)	233/1317 (17.7)	1/21 (4.8)
Chill	159/1313 (12.1)	4/20 (20.0)	151/1230 (12.3)	12/103 (11.7)	140/1111 (12.6)	23/222 (10.4)	161/1290 (12.5)	2/43 (4.7)	162/1310 (12.4)	1/23 (4.3)
Signs										
Throat congestion	21/1269 (1.7)	0/17 (0)	20/1189 (1.7)	1/97 (1)	18/1075 (1.7)	3/211 (1.4)	21/1245 (1.7)	0/41 (0)	21/1266 (1.7)	0/20 (0)
Tonsil swelling	31/1355 (2.3)	0/21 (0)	28/1265 (2.2)	3/111 (2.7)	25/1133 (2.2)	6/243 (2.5)	29/1326 (2.2)	2/50 (4.0)	31/1348 (2.3)	0/28 (0)
Enlargement of lymph nodes	2/1355 (0.1)	0/20 (0)	2/1267 (0.2)	0/108 (0)	2/1135 (0.2)	0/240 (0)	1/1325 (0.1)	1/50 (2.0)	2/1347 (0.1)	0/28 (0)

Rash	3/1357 (0.2)	0/21 (0)	2/1270 (0.2)	1/108 (0.9)	2/1141 (0.2)	1/237 (0.4)	3/1327 (0.2)	0/51 (0)	3/1351 (0.2)	0/27 (0)
Unconsciousness	18/1400 (1.3)	2/21 (9.5)	18/1309 (1.4)	2/112 (1.8)	12/1175 (1.0)	8/246 (3.3)	17/1371 (1.2)	3/50 (6)	19/1392 (1.4)	1/29 (3.4)
Abnormal chest image										
Radiograph	236/1566 (15.1)	7/24 (29.2)	218/1460 (14.9)	25/130 (19.2)	178/1321 (13.5)	65/269 (24.2)	231/1531 (15.1)	12/59 (20.3)	231/1560 (14.8)	12/30 (40)
Computed tomography	1113/1566 (71.1)	17/24 (70.8)	1034/1460 (70.8)	96/130 (73.8)	926/1321 (70.1)	204/269 (75.8)	1090/1531 (71.2)	40/59 (67.8)	1111/1560 (71.2)	19/30 (63.3)
Hubei										
Yes	633/1566 (40.4)	14/24 (58.3)	568/1460 (38.9)	79/130 (60.8)	491/1321 (37.2)	156/269 (58)	609/1531 (39.8)	38/59 (64.4)	623/1560 (39.9)	24/30 (80.0)
No	933/1566 (59.6)	10/24 (41.7)	892/1460 (61.1)	51/130 (39.2)	830/1321 (62.8)	113/269 (42)	922/1531 (60.2)	21/59 (35.6)	937/1560 (60.1)	6/30 (20.0)
Wuhan-contacted										

Yes	1312/156 6 (83.8)	22/24 (91.7)	1216/1460 (83.3)	118/130 (90.8)	1092/1321 (82.7)	242/269 (90)	1282/1531 (83.7)	52/59 (88.1)	1306/1560 (83.7)	28/30 (93.3)
No	254/1566 (16.2)	2/24 (8.3)	244/1460 (16.7)	12/130 (9.2)	229/1321 (17.3)	27/269 (10)	249/1531 (16.3)	7/59 (11.9)	254/1560 (16.3)	2/30 (6.7)
Severity	239/1566 (15.3)	15/24 (62.5)	209/1460 (14.3)	45/130 (34.6)	166/1321 (12.6)	88/269 (32.7)	234/1531 (15.3)	20/59 (33.9)	239/1560 (15.3)	15/30 (50)
Composite endpoint	119/1566 (7.6)	12/24 (50.0)	100/1460 (6.8)	31/130 (23.8)	78/1321 (5.9)	53/269 (19.7)	118/1531 (7.7)	13/59 (22.0)	121/1560 (7.8)	10/30 (33.3)
Deaths	44/1566 (2.8)	6/24 (25.0)	37/1460 (2.5)	13/130 (10.0)	22/1321 (1.7)	28/269 (10.4)	42/1531 (2.7)	8/59 (13.6)	44/1560 (2.8)	6/30 (20)
Admission to ICU	92/1566 (5.9)	7/24 (29.2)	80/1460 (5.5)	19/130 (14.6)	61/1321 (4.6)	38/269 (14.1)	91/1531 (5.9)	8/59 (13.6)	92/1560 (5.9)	7/30 (23.3)
Invasive ventilation	45/1566 (2.9)	5/24 (20.8)	39/1460 (2.7)	11/130 (8.5)	28/1321 (2.1)	22/269 (8.2)	44/1531 (2.9)	6/59 (10.2)	46/1560 (2.9)	4/30 (13.3)

	Hepatitis B infection		Malignancy		Chronic kidney disease		Immunodeficiency	
	No (n=1566)	**Yes (n=24)**	**No (n=1460)**	**Yes (n=130)**	**No (n=1321)**	**Yes (n=269)**	**No (n=1531)**	**Yes (n=59)**
Age (year)	48.9±16.3	50.8±14.8	48.7±16.2	63.1±12.1	48.8±16.2	63.7±14	48.9±16.3	51±21.7
Incubation period (day)	3.7±4.2	3±2.8	3.7±4.2	3.1±3.1	3.6±4.1	3.3±7.5	3.6±4.1	12.7±16.3
Temperature on admission (℃)	37.4±0.9	37.3±0.8	37.4±0.9	37.3±0.9	37.4±0.9	37.2±1	37.4±0.9	36.6±0.2
Respiratory rate on admission (breath/min)	21.2±12.1	21.2±3	21.3±12.1	20.2±1.6	21.3±12.1	19±2.8	21.3±12	19±1
Heart rate (bit/minute)	88.7±14.6	86.3±13.2	88.7±14.6	89.4±13.1	88.7±14.6	89.1±12.5	88.7±14.6	91±18.5
Systolic pressure on admission (mmHg)	126.1±16.4	124.8±14.7	126±16.4	128.3±14.5	125.9±16.3	135.4±20.5	126.1±16.4	127.3±7.4
Diastolic pressure on admission (mmHg)	79.6±25.7	78.3±13	79.5±25.7	81.2±8.8	79.5±25.7	79.8±14	79.5±25.6	84.7±15
Highest temperature (℃)	38.3±1.5	37.6±4.4	38.3±1.6	38.5±0.9	38.3±1.6	38.5±0.5	38.3±1.6	38±0.5
Sex								
Male	885/1550 (57.1)	19/28 (67.9)	893/1560 (57.2)	11/18 (61.1)	891/1559 (57.2)	13/19 (68.4)	904/1575 (57.4)	0/3 (0)

Female	665/1550 (42.9)	9/28 (32.1)	667/1560 (42.8)	7/18 (38.9)	668/1559 (42.8)	6/19 (31.6)	671/1575 (42.6)	3/3 (100)
Smoking status								
Never/unknown	1454/1562 (93.1)	25/28 (89.3)	1465/1572 (93.2)	14/18 (77.8)	1459/1569 (93)	20/21 (95.2)	1477/1587 (93.1)	2/3 (66.7)
Former/current	108/1562 (6.9)	3/28 (10.7)	107/1572 (6.8)	4/18 (22.2)	110/1569 (7)	1/21 (4.8)	110/1587 (6.9)	1/3 (33.3)
Symptoms								
Fever	1326/1508 (87.9)	25/28 (89.3)	1335/1519 (87.9)	16/17 (94.1)	1334/1516 (88)	17/20 (85)	1348/1533 (87.9)	3/3 (100)
Conjunctival congestion	9/1323 (0.7)	1/22 (4.5)	10/1330 (0.8)	0/15 (0)	10/1328 (0.8)	0/17 (0)	10/1343 (0.7)	0/2 (0)
Nasal congestion	73/1277 (5.7)	0/22 (0)	71/1285 (5.5)	2/14 (14.3)	73/1282 (5.7)	0/17 (0)	73/1297 (5.6)	0/2 (0)

Headache	202/1306 (15.5)	3/22 (13.6)	203/1314 (15.4)	2/14 (14.3)	203/1311 (15.5)	2/17 (11.8)	205/1326 (15.5)	0/2 (0)
Dry cough	1037/1472 (70.4)	15/26 (57.7)	1039/1481 (70.2)	13/17 (76.5)	1037/1479 (70.1)	15/19 (78.9)	1050/1495 (70.2)	2/3 (66.7)
Pharyngodynia	188/1294 (14.5)	6/23 (26.1)	193/1303 (14.8)	1/14 (7.1)	191/1300 (14.7)	3/17 (17.6)	193/1315 (14.7)	1/2 (50)
Productive cough	508/1401 (36.3)	5/23 (21.7)	504/1408 (35.8)	9/16 (56.3)	505/1407 (35.9)	8/17 (47.1)	512/1421 (36)	1/3 (33.3)
Fatigue	570/1340 (42.5)	14/25 (56)	577/1349 (42.8)	7/16 (43.8)	581/1350 (43)	3/15 (20)	583/1363 (42.8)	1/2 (50)
Hemoptysis	16/1293 (1.2)	0/22 (0)	15/1299 (1.2)	1/16 (6.3)	16/1300 (1.2)	0/15 (0)	16/1313 (1.2)	0/2 (0)
Shortness of breath	321/1370 (23.4)	10/24 (41.7)	323/1377 (23.5)	8/17 (47.1)	321/1375 (23.3)	10/19 (52.6)	330/1392 (23.7)	1/2 (50)

Nausea/vomiting	78/1349 (5.8)	2/22 (9.1)	78/1355 (5.8)	2/16 (12.5)	79/1351 (5.8)	1/20 (5)	80/1369 (5.8)	0/2 (0)
Diarrhea	55/1337 (4.1)	2/22 (9.1)	57/1343 (4.2)	0/16 (0)	56/1339 (4.2)	1/20 (5)	56/1356 (4.1)	1/3 (33.3)
Myalgia/arthralgia	232/1316 (17.6)	2/22 (9.1)	231/1322 (17.5)	3/16 (18.8)	233/1323 (17.6)	1/15 (6.7)	233/1336 (17.4)	1/2 (50)
Chill	161/1310 (12.3)	2/23 (8.7)	162/1318 (12.3)	1/15 (6.7)	161/1317 (12.2)	2/16 (12.5)	163/1331 (12.2)	0/2 (0)
Signs								
Throat congestion	21/1264 (1.7)	0/22 (0)	20/1271 (1.6)	1/15 (6.7)	21/1271 (1.7)	0/15 (0)	20/1284 (1.6)	1/2 (50)
Tonsil swelling	30/1353 (2.2)	1/23 (4.3)	30/1359 (2.2)	1/17 (5.9)	30/1356 (2.2)	1/20 (5)	31/1373 (2.3)	0/3 (0)
Enlargement of lymph nodes	2/1352 (0.1)	0/23	2/1359 (0.1)	0/16	2/1355 (0.1)	0/20	2/1372 (0.1)	0/3

		(0)		(0)		(0)		(0)
Rash	3/1355 (0.2)	0/23 (0)	3/1361 (0.2)	0/17 (0)	3/1360 (0.2)	0/18 (0)	3/1376 (0.2)	0/2 (0)
Unconsciousness	19/1397 (1.4)	1/24 (4.2)	20/1404 (1.4)	0/17 (0)	20/1401 (1.4)	0/20 (0)	20/1418 (1.4)	0/3 (0)
Abnormal chest image								
Radiograph	240/1562 (15.4)	3/28 (10.7)	239/1572 (15.2)	4/18 (22.2)	240/1569 (15.3)	3/21 (14.3)	243/1587 (15.3)	0/3 (0)
Computed tomography	1111/1562 (71.1)	19/28 (67.9)	1113/1572 (70.8)	17/18 (94.4)	1116/1569 (71.1)	14/21 (66.7)	1127/1587 (71)	3/3 (100)
Hubei								
Yes	638/1562 (40.8)	9/28 (32.1)	635/1572 (40.4)	12/18 (66.7)	631/1569 (40.2)	16/21 (76.2)	645/1587 (40.6)	2/3 (66.7)
No	924/1562 (59.2)	19/28 (67.9)	937/1572 (59.6)	6/18	938/1569 (59.8)	5/21	942/1587 (59.4)	1/3

				(33.3)		(23.8)		(33.3)
Wuhan-contacted								
Yes	1312/1562 (84)	22/28 (78.6)	1316/1572 (83.7)	18/18 (100)	1316/1569 (83.9)	18/21 (85.7)	1331/1587 (83.9)	3/3 (100)
No	250/1562 (16)	6/28 (21.4)	256/1572 (16.3)	0/18 (0)	253/1569 (16.1)	3/21 (14.3)	256/1587 (16.1)	0/3 (0)
Severity	245/1562 (15.7)	9/28 (32.1)	245/1572 (15.6)	9/18 (50)	246/1569 (15.7)	8/21 (38.1)	253/1587 (15.9)	1/3 (33.3)
Composite endpoint	128/1562 (8.2)	3/28 (10.7)	124/1572 (7.9)	7/18 (38.9)	125/1569 (8)	6/21 (28.6)	130/1587 (8.2)	1/3 (33.3)
Deaths	49/1562 (3.1)	1/28 (3.6)	47/1572 (3.0)	3/18 (16.7)	45/1569 (2.9)	5/21 (23.8)	50/1587 (3.2)	0/3 (0)
Admission to ICU	98/1562 (6.3)	1/28 (3.6)	94/1572 (6.0)	5/18 (27.8)	98/1569 (6.2)	1/21 (4.8)	98/1587 (6.2)	1/3 (33.3)

Invasive ventilation	48/1562 (3.1)	2/28 (7.1)	48/1562 (3.1)	2/18 (11.1)	49/1569 (3.1)	1/21 (4.8)	50/1587 (3.2)	0/3 (0)

Data are mean ± standard deviation, n/N (%), where N is the total number of patients with available data.

COPD=chronic obstructive pulmonary disease. ICU = intensive care unit

Figure legends

Figure 1. Comparison of the time-dependent risk of reaching to the composite endpoints

Figure 1-A, The time-dependent risk of reaching to the composite endpoints between patients with (orange curve) or without any comorbidity (dark blue curve);

Figure 1-B, The time-dependent risk of reaching to the composite endpoints between patients without any comorbidity (orange curve), patients with a single comorbidity (dark blue curve), and patients with two or more comorbidities (green curve).

Cox proportional hazard regression models were applied to determine the potential risk factors associated with the composite endpoints, with the hazards ratio (HR) and 95% confidence interval (95%CI) being reported.

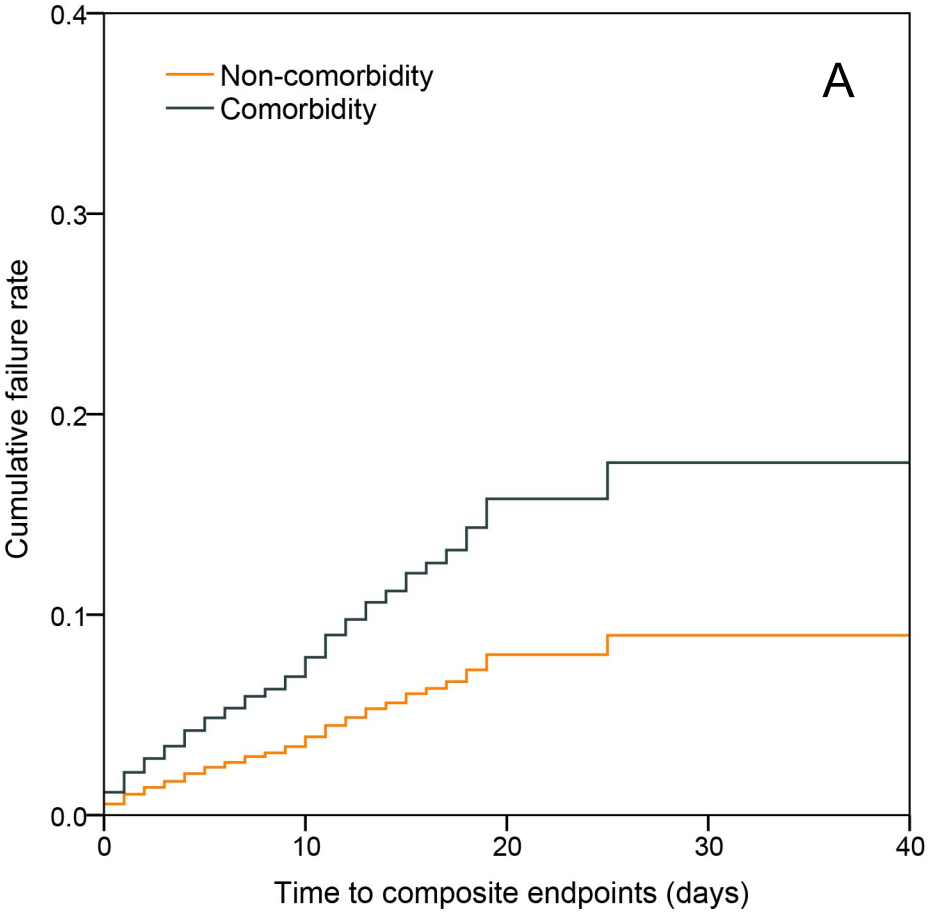
Figure 2. Predictors of the composite endpoints in the proportional hazards model

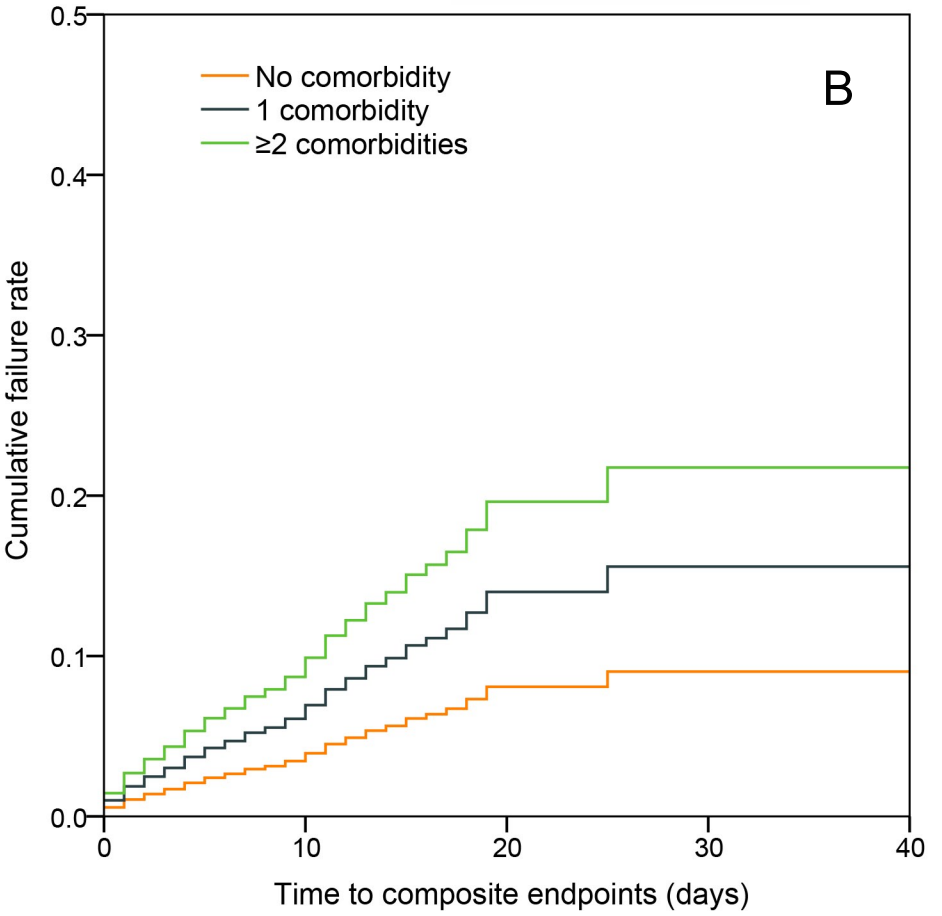
Shown in the figure are the hazards ratio (HR) and the 95% confidence interval (95%CI) for the risk factors associated with the composite endpoints (admission to intensive care unit, invasive ventilation, or death). The comorbidities were classified according to the organ systems as well as the number.

The scale bar indicates the HR.

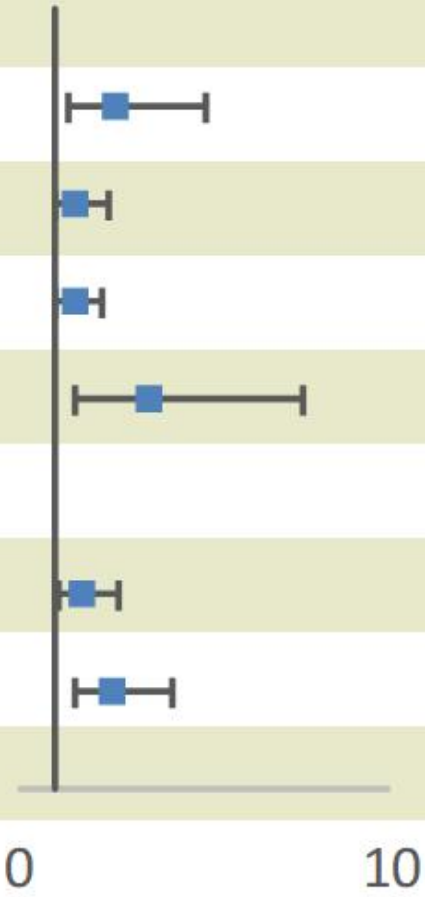
Cox proportional hazard regression models were applied to determine the potential risk factors associated with the composite endpoints, with the hazards ratio (HR) and 95% confidence interval (95%CI) being reported.

The model has been adjusted with age and smoking status


Non-comorbidity
Comorbidity
A
Cumulative failure rate
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
Time to composite endpoints (days)


No comorbidity
1 comorbidity
≥2 comorbidities
B
Cumulative failure rate
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
Time to composite endpoints (days)

Features		Hazard Ratio (95%CI)		P Value
Type of comorbidities				
COPD		2.681	(1.424-5.048)	0.002
Diabetes		1.586	(1.028-2.449)	0.037
Hypertension		1.575	(1.069-2.322)	0.022
Malignant tumor		3.501	(1.604-7.643)	0.002
Number of comorbidities				
1		1.789	(1.155-2.772)	0.009
2 or more		2.592	(1.611-4.171)	<0.001



Online Supplement

Comorbidity and its impact on 1,590 patients with COVID-19 in China: A Nationwide Analysis

Table E1. Unadjusted model for the association between the number of comorbidity and mortality in patients with Covid-19

Models for Comorbidity burden

	B	SE	Wald	df	P value	Exp(B)	95.0% CI	
							lower	upper
Model 1								
Comorbidity			60.558	2	<0.001			
Comorbidity 1	1.070	.209	26.162	1	<0.001	2.916	1.935	4.394
Comorbidity 2+	1.617	.217	55.705	1	<0.001	5.039	3.295	7.705
Model 2								
Comorbidity			16.595	2	<0.001			
Comorbidity 1	.630	.222	8.076	1	.004	1.877	1.216	2.898
Comorbidity 2+	.960	.243	15.592	1	<0.001	2.610	1.621	4.203
Age	.037	.007	28.512	1	<0.001	1.038	1.024	1.053
Model 3								
Comorbidity	.479	.120	16.069	1	<0.001	1.615	1.278	2.042
Age	.038	.007	28.562	1	<0.001	1.038	1.024	1.053
Smoking (yes vs. no)	.515	.254	4.098	1	.043	1.674	1.016	2.756

* Gender did not enter in the model

Table E2. Unadjusted model for the association between the categories of comorbidity and mortality in patients with Covid-19

Models for each comorbidity

								95.0% CI	
		B	SE	Wald	df	P value	Exp(B)	lower	upper
Step 1	Age	.050	.006	65.757	1	<0.001	1.051	1.039	1.064
Step 2	Malignancy	1.269	.393	10.416	1	.001	3.557	1.646	7.687
	Age	.048	.006	61.201	1	<0.001	1.050	1.037	1.062
Step 3	COPD	.943	.320	8.670	1	.003	2.568	1.371	4.812
	Malignancy	1.261	.394	10.256	1	.001	3.528	1.631	7.631
	Age	.044	.006	47.321	1	<0.001	1.045	1.032	1.058
Step 4	COPD	.962	.321	8.998	1	.003	2.618	1.396	4.909
	Diabetes	.591	.217	7.424	1	.006	1.806	1.180	2.763
	Malignancy	1.237	.396	9.774	1	.002	3.445	1.586	7.483
	Age	.040	.007	36.429	1	<0.001	1.041	1.027	1.055
Step 5	COPD	.963	.322	8.965	1	.003	2.619	1.395	4.920
	Diabetes	.502	.221	5.154	1	.023	1.652	1.071	2.547
	Hypertension	.421	.198	4.532	1	.033	1.524	1.034	2.246
	Malignancy	1.294	.399	10.529	1	.001	3.648	1.669	7.972
	Age	.036	.007	25.992	1	<0.001	1.036	1.022	1.051
Step 6	COPD	.986	.323	9.336	1	.002	2.681	1.424	5.048
	Diabetes	.461	.222	4.339	1	.037	1.586	1.028	2.449
	Hypertension	.455	.198	5.276	1	.022	1.575	1.069	2.322
	Malignancy	1.253	.398	9.896	1	.002	3.501	1.604	7.643

Age	.035	.007	24.755	1	<0.001	1.036	1.022	1.050
Smoking (yes vs. no)	.512	.258	3.940	1	.047	1.668	1.006	2.764

* sex, cardiovascular disease, cerebrovascular disease, chronic kidney disease, hepatitis, immunodeficiency disease did not enter in the model

Table E3. Subgroup analysis of the association between the number of comorbidity and mortality in patients with Covid-19

All patients

	B	**SE**	**Wald**	**df**	**P value**	**Exp(B)**	**95.0% CI**	
							lower	**upper**
Comorbidity			57.714	2	.000			
Comorbidity 1	1.009	.212	22.636	1	.000	2.744	1.811	4.159
Comorbidity 2+	1.599	.217	54.347	1	.000	4.947	3.234	7.566
Smoking (yes vs. no)	.549	.258	4.550	1	.033	1.732	1.046	2.870

Patients < 65 years old

Comorbidity			13.768	2	.001			
Comorbidity 1	.793	.298	7.104	1	.008	2.210	1.234	3.960
Comorbidity 2+	1.204	.388	9.613	1	.002	3.332	1.557	7.132
Smoking (yes vs. no)	.402	.432	.864	1	.353	1.495	.641	3.488

Patients >= 65 years old

	B	SE	Wald	df	P value	Exp(B)	95.0% CI

							lower	upper
Comorbidity			9.013	2	.011			
Comorbidity 1	.588	.347	2.875	1	.090	1.801	.912	3.554
Comorbidity 2+	1.002	.336	8.881	1	.003	2.724	1.409	5.265
Smoking (yes vs. no)	.428	.324	1.745	1	.187	1.534	.813	2.892

List of hospitals reporting the included cases

Wuhan Jinyintan hospital, Union Hospital Affiliated to Tongji Medical College of Huazhong University of science and technology, Wuhan Central Hospital, Wuhan first hospital, Chengdu Public Health Clinical Medical Center, Huangshi Central Hospital, Shenzhen Third People's Hospital, Wuhan Pulmonary Hospital, Tianyou Hospital Affiliated to Wuhan University of science and technology, Changsha First Hospital, The third people's Hospital of Hainan Province, Huanggang Central Hospital, Wenling first people's Hospital, Yichang Third People's Hospital, Taihe Hospital Affiliated to Hubei Medical College, Xiantao first people's Hospital, Wuhan Huangpi District People's Hospital, Jingzhou Chest Hospital, Jingzhou first people's Hospital, Shanghai Public Health Clinical Center, Beijing You'an Hospital Affiliated to Capital Medical University, Zhengzhou Sixth People's Hospital, Chongqing Three Gorges Central Hospital, The ninth Affiliated Hospital of Guangxi Medical University, Hangzhou Xixi hospital, Nanjing Second Hospital, Suzhou Fifth People's Hospital, The first hospital of Zhejiang Province, The Fifth Affiliated Hospital of Zhongshan University, Huangshi traditional Chinese medicine hospital, Yangjiang people's Hospital, Zhongxian hospital, the First Affiliated Hospital of Chongqing Medical University, Anqing Municipal Hospital, Changzhou Third People's Hospital, Guangzhou first people's Hospital, Harbin infectious diseases hospital, Tianmen first people's Hospital, Wuxi People's Hospital, Wuhan fifth hospital, Xishuangbanna Dai Autonomous Prefecture People's Hospital, Chongqing Iron and Steel General Hospital, Daye people's Hospital, Nanxishan Hospital of Guangxi Zhuang Autonomous Region, Jiaxing First Hospital, Jiangling people's Hospital, Jinzhong infectious disease hospital, Lanzhou Pulmonary Hospital, Liuzhou people's Hospital, Ma'anshan He county people's Hospital, The First Affiliated Hospital of Nanchang University, Ningbo Yinzhou people's hospital medical community, Shaoxing people's Hospital, Shijiazhuang fifth hospital, Taizhou Enze Medical Center, Xinyang Central Hospital, Yueyang No.1 People's Hospital, Zhanjiang Central People's Hospital, The First Affiliated Hospital of Zhengzhou University, Shenzhen Hospital of Chinese Academy of

Sciences, Chongqing Kaizhou District People's Hospital, Chongqing Changshou District People's Hospital, Chongqing Yunyang County People's Hospital, Ankang Central Hospital, Chenzhou Second People's Hospital, Datong Fourth People's Hospital, Dengzhou people's Hospital, Fengjie people's Hospital, Foshan first people's Hospital, Fuyang Second People's Hospital, Gongyi people's Hospital, Guangshan people's Hospital, Guoyao Dongfeng General Hospital, Hainan people's Hospital, The Second Affiliated Hospital of Hainan Medical College, The first people's Hospital of Xiaoshan District, Hangzhou, Huaihua first people's Hospital, Jiashan first people's Hospital, Lu'an people's Hospital, Affiliated Hospital of Qingdao University, Qingyuan people's Hospital, Quanzhou County People's Hospital, Rizhao people's Hospital, Shaodong people's Hospital, Shiyan Xiyuan Hospital, Tongling people's Hospital, Wenzhou People's Hospital, Wenzhou Central Hospital, The Second Affiliated Hospital of Wenzhou Medical University, Wuxi Fifth People's Hospital, Wuhan Youfu hospital, Xi'an eighth hospital, Xinxiang infectious disease hospital, Yangxin County People's Hospital, Yuebei Second People's Hospital, Yunnan infectious diseases hospital, Zhaoqing first people's Hospital, Zhaozhou County People's Hospital, Shao Yifu Hospital Affiliated to Zhejiang University School of Medicine, Zhijiang people's Hospital, People's Hospital of Dianjiang County, Chongqing, Chongqing Jiulongpo first people's Hospital, Chongqing Shizhu Tujia Autonomous County People's Hospital, The first people's Hospital of Wanzhou District, Chongqing, Yongchuan Hospital Affiliated to Chongqing Medical University, Anguo hospital, The Third Hospital of Peking University, peking university shenzhen hospital , BOLUO people's Hospital, Changde Lixian people's Hospital, Changde Second People's Hospital, Chenzhou Central Hospital, Chengjiang people's Hospital, Dalian Central Hospital, Danzhou people's Hospital, Dengzhou Central Hospital, Feidong County People's Hospital, Fuzhou Nanfeng County Hospital, Ganzhou Fifth People's Hospital, Gao'an people's Hospital, Public Security County People's Hospital, Affiliated Hospital of Guangdong Medical University, The Sixth Affiliated Hospital of Guangzhou Medical University, Affiliated Hospital of Guizhou Medical University, Hangzhou first people's Hospital, Hangzhou Lin'an District People's Hospital, Nanpi County Hospital of traditional Chinese medicine of Hebei Province, Henan people's Hospital, Hefeng County Central Hospital, Hohhot First Hospital, Huludao Central Hospital, The First Affiliated Hospital of Hunan Medical College, Shenzhen Union Hospital of Huazhong University of science and technology, Huaibei people's Hospital, Huangshi Second Hospital, Huangchuan people's Hospital, Huizhou Zhongda Huiya hospital, Huizhou Central People's Hospital, Jining first people's Hospital, Jianshi County People's Hospital, Fengcheng people's Hospital of Jiangxi Province, Jiangyou infectious diseases hospital, Jieyang people's Hospital, Jinhua Central Hospital, Jinzhong Pingyao people's Hospital, Jingjiang people's Hospital, The Second Affiliated Hospital of Kunming Medical University, Laifeng County Central Hospital, Yueqing people's Hospital, Lijiang people's Hospital, Lixin people's Hospital, The Fourth People's Hospital of Lianyungang, Linqu County People's Hospital, Linyi people's Hospital, Longxi first people's Hospital, Min Da Hospital, Minqing County General Hospital, Nantong Third People's Hospital, Nanyang Central Hospital, The First Affiliated Hospital of Nanyang Medical College, Nanyang

Oilfield General Hospital, Ningbo First Hospital, The Fourth People's Hospital of Ningxia, Pingxiang Second People's Hospital, Quzhou Kecheng District People's Hospital, Qujing maternal and child hospital, Ruian people's Hospital, The First Affiliated Hospital of Xiamen University, Shangcheng County People's Hospital, Shanghai Baoshan Dachang hospital, Shanghai Pudong New Area Gongli Hospital , People's Hospital of Yushan County, Jiangxi Province, Shangrao City, Xuanwu Hospital of Capital Medical University, Sichuan Mianyang 404 hospital, Sixian Hospital of traditional Chinese Medicine, Suihua First Hospital, Suiping County People's Hospital, Tianjin Fourth Central Hospital, Tianjin Haihe hospital, Tiantai County People's Hospital, Tongchuan Mining Bureau Central Hospital, Tongren people's Hospital, Weihai Central Hospital, The First Affiliated Hospital of Wenzhou Medical University, Wuzhou Third People's Hospital, Armed police Hubei provincial general team hospital, Xixian people's Hospital, Longshan County People's Hospital in Western Hunan, Xiangcheng first people's Hospital, The Sixth People's Hospital of Xinjiang Uygur Autonomous Region, The First Affiliated Hospital of Xinjiang Medical University, Xinmi Hospital of traditional Chinese Medicine, Xinxiang County People's Hospital, Xinye people's Hospital, Xinyang first people's Hospital, Xinyang Hospital of traditional Chinese Medicine, Xuanen County People's Hospital, Xinhua Hospital, Yili Prefecture, Yongzhou Central Hospital, Yuyao people's Hospital, Changchun infectious disease diagnosis and treatment center, Changsha eighth hospital, Changsha first people's Hospital, 921st Hospital of the joint service support force of the Chinese people's Liberation Army, Central theater General Hospital of the Chinese people's Liberation Army, The First Affiliated Hospital of China Medical University, The Third Affiliated Hospital of Zhongshan University, Zhongshan Second People's Hospital, Chongqing Chengkou people's Hospital, Chongqing Hechuan District People's Hospital, Chongqing Red Cross Hospital, Zhoushan women's and children's Hospital, Zhoukou infectious diseases hospital, Zhuzhou first people's Hospital, Zhumadian Central Hospital, Anlong people's Hospital, Anxi County Hospital, Anyang Fifth People's Hospital, Anyang People's Hospital, Anyuan people's Hospital, Badong County Ethnic hospital, Wuyuan County People's Hospital of Bayannur City, Baise people's Hospital, The First Affiliated Hospital of Bengbu Medical College, Baoding first Central Hospital, Changping District Hospital of Beijing Municipality, Changping District Hospital of traditional Chinese and Western medicine of Beijing, Beijing Chuiyangliu Hospital , Beijing Center for Disease Control and Prevention, Mentougou District Hospital of Beijing Municipality, Shunyi District Hospital of Beijing Municipality, Beijing Xicheng District Guangwai hospital, Oriental Hospital of Beijing University of traditional Chinese Medicine, Benxi Sixth People's Hospital, Binzhou Central Hospital, Bozhou people's Hospital, Cangnan Third People's Hospital, People's Hospital of Anxiang County, Changde City, Changde first people's Hospital, Chaoyang Second Hospital, Chengdu Handan people's Hospital, Chengde Third Hospital, Chizhou people's Hospital, Chongxin County People's Hospital, Chongyi people's Hospital, Affiliated Hospital of North Sichuan Medical College, Dazhou Central Hospital, Dali first people's Hospital, The Second Affiliated Hospital of Dalian Medical University, The First Affiliated Hospital of Dalian Medical University, Danyang people's Hospital, Daocheng

people's Hospital, Deqing people's Hospital, Dezhou Second People's Hospital, Dezhou people's Hospital, Dezhou Qingyun people's Hospital, Dingyuan County General Hospital, Dongfang people's Hospital, Dongguan Ninth People's Hospital, Dongguan Nancheng hospital, Dongyang people's Hospital, Enshi Central Hospital, Erlianhot hospital, Fangchenggang first people's Hospital, Nanzhuang hospital, Chancheng District, Foshan City, Foshan Nanhai District Third People's Hospital, Lishui hospital, Nanhai District, Foshan City, The First Affiliated Hospital of Fujian Medical University, Zhangzhou Hospital Affiliated to Fujian Medical University, Fuzhou Changle district hospital, Fuzhou Anle County Hospital, Fuzhou Fifth People's Hospital, Fuzhou Dongxiang District People's Hospital, Fuyang District First People's Hospital, Ganzhou Longnan County People's Hospital, Gaolan County People's Hospital, Gongcheng Yao Autonomous County People's Hospital, Gushi people's Hospital, Guang'an people's Hospital, Guangdong Hospital of traditional Chinese Medicine, Guangzhou Eighth People's Hospital, Guangzhou 12th people's Hospital, Shenzhen Hospital of Guangzhou University of traditional Chinese Medicine, People's Hospital of Guiding County, Hanjiang Hospital of Sinopharm, Harbin Acheng District People's Hospital, Nangang District People's Hospital of Harbin, The First Affiliated Hospital of Harbin Medical University, Haikou People's Hospital, Hainan West Central Hospital, Handan Sixth Hospital, Handan Central Hospital, Hanshan people's Hospital, Hangzhou Dingqiao hospital, The third people's Hospital of Yuhang District, Hangzhou, The first people's Hospital of Yuhang District, Hangzhou, Minzhou people's Hospital, Hefei Sixth People's Hospital (Hefei infectious diseases hospital), He Xian Memorial Hospital, Hebei Chest Hospital, Hechi people's Hospital, Hejin people's Hospital, The First Affiliated Hospital of Henan University of science and technology, Zhangye people's Hospital Affiliated to Hexi University, Heyuan people's Hospital, Heze Municipal Hospital, Heilongjiang provincial hospital , South Yunnan Central Hospital of Honghe Prefecture, Hulunbuir Manzhouli hospital, Hunan Youxian people's Hospital, The First Affiliated Hospital of Hunan University of traditional Chinese Medicine, China Resources WISCO General Hospital, Huaihua Chenxi County People's Hospital, Huai'an Fourth People's Hospital, Huainan Mashan infectious disease hospital, Huangshan people's Hospital, Huangshi fifth hospital, Huichang people's Hospital, Huining County People's Hospital, Huizhou first people's Hospital, Jixi people's Hospital, Qianan County People's Hospital of Jilin Province, Jinan Fourth People's Hospital, Jining second people's Hospital, Affiliated Hospital of Jining Medical College, Shunde Hospital Affiliated to Jinan University, Jiamusi Fujin Central Hospital, Huachuan County People's Hospital of Jiamusi, Jiahe County People's Hospital, Jianshi County Hospital of traditional Chinese Medicine, Jiangshan people's Hospital, People's Hospital of Le'an County, Jiangxi Province, Jiangxi Provincial People's Hospital, Jinxian County People's Hospital, Jingmen Chest Hospital, Kunming Second People's Hospital, Laixi people's Hospital, The second hospital of Lanzhou University, Lancang Second People's Hospital, Leping people's Hospital, Leshan people's Hospital, Lengshuijiang people's Hospital, Lianjiang county hospital, The first people's Hospital of Lianyungang, Liaoning Chaoyang Disease Control Center Hospital, Liaocheng people's Hospital, Linshui people's Hospital, Linhai

Second People's Hospital, Linxia people's Hospital, Linyi Lanshan District People's Hospital, Linying County People's Hospital, Liuyang people's Hospital, Loudi first people's Hospital, Loudi Central Hospital, Luzhou people's Hospital, Lushan County People's Hospital, The Third Affiliated Hospital of Army Medical University, The First Affiliated Hospital of Army Medical University, Luoping County People's hospital official website, Luoyuan County Hospital, Luohe Sixth People's Hospital, MAANSHAN Fourth People's Hospital, MAANSHAN Hospital of traditional Chinese Medicine, Coal Industry General Hospital, The first people's Hospital of Mengcheng County, Mianyang people's Hospital, People's Hospital of Mianchi County, Mudanjiang Second People's Hospital, The Second Affiliated Hospital of Nanchang University, Fuzhou Fifth Hospital Affiliated to Fuzhou Medical College of Nanchang University, Nanchong Central Hospital, Southern Hospital of Southern Medical University, The First Affiliated Hospital of Nanhua University, Public Health Hospital of Nanhua University, Nanhua Hospital Affiliated to Nanhua University, Xiangtan Hospital Affiliated to Nanhua University, Nanning Fourth People's Hospital, People's Hospital of Neihuang County, Ningbo Second Hospital, Community health service center, Baihe street, Jiangdong District, Ningbo City, Li Huili Hospital of Ningbo Medical Center, Mindong Hospital of Ningde City, Ningde Xiapu County Hospital, Ningdu County People's Hospital, Ningguo people's Hospital, People's Hospital of Ninglang Yi Autonomous County, Ouhai District Third People's Hospital, Pingdingshan infectious diseases hospital, Pingguo people's Hospital, Qiqihar seventh hospital, The First Affiliated Hospital of Qiqihar Medical College, Qidong Third People's Hospital, Qingdao Chengyang people's Hospital, Qingdao Huangdao District People's Hospital, The Fourth People's Hospital of Qinghai Province, Qingyuan people's Hospital, Quanjiao people's Hospital, Luojiang District Hospital of Quanzhou City, Queshan County People's Hospital, Renshou people's Hospital, Wulian people's Hospital of Rizhao, Rongcheng people's Hospital, Runan people's Hospital, Rushan people's Hospital, Sanming integrated hospital of traditional Chinese and Western Medicine, Zhongshan Hospital Affiliated to Xiamen University, Shandong Provincial Hospital , Shandong Chest Hospital, Shanxi Bethune hospital, Ruicheng County People's Hospital of Shanxi Province, The second hospital of Yuncheng City, Shanxi Province, The First Affiliated Hospital of Shantou University Medical College, Shantou Central Hospital, Shangluo Luonan people's Hospital, The Second Affiliated Hospital of Fudan, Shanghai, Renji Hospital Affiliated to Shanghai Jiaotong University School of Medicine, Ruijin Hospital Affiliated to Shanghai Jiaotong University School of Medicine, Shanghai 10th people's Hospital, Shanghai Fengxian District Central Hospital, Anting hospital, Jiading District, Shanghai, Shanghai Tongren Hospital, Shangrao Guangxin District People's Hospital, Shangrao people's Hospital, Shangrao Wannian County People's Hospital, Shangrao Yongxiu people's Hospital, Shenzhen Bao'an District Hospital of traditional Chinese Medicine, Shenzhen Sixth People's Hospital, Shenzhen Longgang District People's Hospital, Shenzhen Pingshan people's Hospital, Shenyang hospital, Shiyan people's Hospital, Shiyan integrated traditional Chinese and Western Medicine Hospital, The First Affiliated Hospital of Shihezi University Medical College, Shishi General Hospital, Shishou people's Hospital, Shuangfeng County People's Hospital, West China

Hospital of Sichuan University, Sihui people's Hospital, Songzi people's Hospital, Suichuan County People's Hospital, Taizhou Second People's Hospital, Taizhou first people's Hospital, Taiyuan Fourth People's Hospital, Tanghe County People's Hospital, Tianjin Third Central Hospital, Tianjin Fifth Central Hospital, Tianjin First Central Hospital, Tianjin People's Hospital, Tianjin Xiqing hospital, Tianjin Medical University General Hospital , tianjin hospital, Tianquan Tianyuan hospital, Tieling Central Hospital, Tonghua people's Hospital, Tongbai County Central Hospital, Wanning people's Hospital, Weixin County People's Hospital, Weishan people's Hospital, Wenzhou Longwan District First People's Hospital, Wenzhou Yongjia hospital, Wenzhou Hospital of traditional Chinese Medicine, People's Hospital of Woyang County, Wuwei people's Hospital, Wuxi Fourth People's Hospital, Wuzhong people's Hospital, Wuhan Caidian District People's Hospital, People's Hospital of Wuhan University, Wuhan Pulmonary Hospital, Caidian District People's Hospital of Wuhan, Wuhan Sixth Hospital, Wuhan Dongxihu District People's Hospital, Wuhan commercial staff hospital, Wuhan Wuchang hospital, Wuhan hospital of traditional Chinese Medicine, Wuyang County People's Hospital, The First Affiliated Hospital of Xi'an Jiaotong University, Central Hospital of Xi'an Mining Bureau, Xiping County People's Hospital, Xishuangbanna mental health center, Xilingol League hospital, Xilinhot, Xianyang Qianxian people's Hospital, Xianyang Central Hospital, Xianyang Wugong County People's Hospital, Xiangtan Xiangtan County People's Hospital, Xinhuang people's Hospital, The seventh division hospital of Xinjiang production and Construction Corps, Xinyu people's Hospital, Xinyang Third People's Hospital, Xinyang Fifth People's Hospital, Suqian infectious disease control center, Affiliated Hospital of Xuzhou Medical University, Xuyong County People's Hospital, Haiyang people's Hospital of Yantai, Yantai Qishan hospital, Yan'an University Affiliated Hospital, Yancheng Dafeng people's Hospital, Yan Fen clinic, Yangzhou Third People's Hospital, Yangquan Third People's Hospital, Yangshuo people's Hospital, Yichang first people's Hospital, Yichang Central People's Hospital, People's Hospital of Zigui County, Yichang, Yimen people's Hospital, Yiyang Anhua people's Hospital, South County People's Hospital of Yiyang, People's Hospital of Datong Lake District, Yiyang City, Yinchuan first people's Hospital, Yingkou Third People's Hospital, Yingcheng people's Hospital, Yongfu people's Hospital, Yongjia people's Hospital, Yongtai County Hospital, Yuzhong first people's Hospital, Yulin Red Cross Hospital, People's Hospital of Jiangchuan District, Yuxi City, Yuxi people's Hospital, Yueyang Second People's Hospital, The third people's Hospital of Yunnan Province, Affiliated Hospital of Changchun Beihua University, Changjiang Shipping General Hospital, Changzhi Changzhi people's Hospital, Zhao'an County Hospital, The First Affiliated Hospital of Zhejiang University Medical College, Taizhou Hospital of Zhejiang Province, Zhenjiang first people's Hospital, Zhengzhou Central Hospital, Ningbo Huamei Hospital of Chinese Academy of Sciences, PLA Navy General Hospital, 985th Hospital of the joint service support force of the Chinese people's Liberation Army, 924th Hospital of the joint service support force of the Chinese people's Liberation Army, Aviation General Hospital of China Medical University, Xiangya Third Hospital of Central South University, Huiya hospital, the First Affiliated Hospital of Zhongshan University, Zhongwei people's Hospital, Zhongxiang people's

Hospital, Chongqing Liangjiang New Area first people's Hospital, Chongqing Bishan District People's Hospital, Fengdu County People's Hospital of Chongqing, Chongqing Fuling Central Hospital, Chongqing public health medical treatment center, Chongqing Liangping District People's Hospital, Chongqing Tongnan District People's Hospital, Chongqing Wanzhou District Shanghai hospital, Central Hospital of Wuling Town, Wanzhou District, Chongqing, Chongqing Xiushan people's Hospital, The Third Affiliated Hospital of Chongqing Medical University, The First Affiliated Hospital of Chongqing Medical University, Zhoukou Central Hospital, Zhuhai People's Hospital, Zibo Central Hospital, Zigong Rongxian people's Hospital, Zigong first people's Hospital, Zhuhai integrated traditional Chinese and Western Medicine Hospital, Tianhe District Center for Disease Control and Prevention, Shanwei people's Hospital, Shantou Chenghai District People's Hospital, The Second Affiliated Hospital of Shantou University Medical College, Shantou Chaonan Minsheng hospital, Luocun hospital, Nanhai District, Luhe County People's Hospital, The first naval hospital of the southern theater of the PLA, Jianghai work station of Jiangmen disease control and Prevention Center, Huizhou Third People's Hospital, Huadu District People's Hospital, The Third Affiliated Hospital of Guangzhou Medical University, Guangzhou Chest Hospital, Guangzhou Haizhu Center for Disease Control and Prevention, Guangning people's Hospital, Zhuhai Hospital of Guangdong Hospital of traditional Chinese Medicine, Guangdong hydropower hospital Co. Ltd, Guangdong Provincial People's Hospital, The second people's Hospital of Guangdong Province, Panyu District Central Hospital, Dongguan Dalang hospital, Chaozhou Central Hospital