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Systematic Review

Clinical, Laboratory and Imaging Features of COVID-19: A systematic review and meta-analysis

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Running Head: Clinical Features of Coronavirus Disease 2019 – Systematic Review

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Abstract

Introduction: An epidemic of Coronavirus Disease 2019 (COVID-19) begun in December 2019 in China, causing a Public Health Emergency of International Concern. Among raised questions, clinical, laboratory, and imaging features have been partially characterized in some observational studies. No systematic reviews have been published on this matter.

Methods: We performed a systematic literature review with meta-analysis, using three databases to assess clinical, laboratory, imaging features, and outcomes of COVID-19 confirmed cases. Observational studies, and also case reports, were included, and analyzed separately. We performed a random-effects model meta-analysis to calculate the pooled prevalence and 95% confidence interval (95%CI).

Results: 660 articles were retrieved (1/1/2020-2/23/2020). After screening by abstract/title, 27 articles were selected for full-text assessment. Of them, 19 were finally included for qualitative and quantitative analyses. Additionally, 39 case report articles were included and analyzed separately. For 656 patients, fever (88.7%, 95%CI 84.5-92.9%), cough (57.6%, 40.8-74.4%) and dyspnea (45.6%, 10.9-80.4%) were the most prevalent manifestations. Among the patients, 20.3% (95%CI 10.0-30.6%) required intensive care unit (ICU), with 32.8% presenting acute respiratory distress syndrome (ARDS) (95%CI 13.7-51.8), 6.2% (95%CI 3.1-9.3) with shock and 13.9% (95%CI 6.2-21.5%) of hospitalized patients with fatal outcomes (case fatality rate, CFR).

Conclusion: COVID-19 brings a huge burden to healthcare facilities, especially in patients with comorbidities. ICU was required for approximately 20% of polymorbid, COVID-19 infected patients and this group was associated with a CFR of over 13%. As this virus spreads globally, countries need to urgently prepare human resources, infrastructure and facilities to treat severe COVID-19.

Keywords: Coronavirus Disease 2019; SARS-CoV-2; clinical features; laboratory; outcomes; epidemic.

Introduction

Rationale

The Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), is a newly emerging zoonotic agent appearing in December 2019 that caused the Coronavirus Disease 2019 (COVID-19) [1], formerly known as the 2019 novel Coronavirus (2019nCoV). This pathogen causes a syndrome leading in some cases to a critical care respiratory condition, requiring specialized management at intensive care units (ICU) in many of them [2-7]. The SARS-CoV-2, taxonomically, is currently part of the species of the SARS-related coronaviruses that belong to the subgenus *Sarbecovirus*. Together with the subgenuses *Embecovirus*, *Hibecovirus*, *Merbecovirus*, and *Nobecovirus*, that is part of the genus *Betacoronavirus* (order *Nidovirales*; suborder *Cornidovirineae*; family *Coronaviridae*; subfamily *Coronavirinae*) [8-14].

Other Betacoronaviruses before have caused epidemics over the last two decades in Asia, as is the case of SARS-CoV in 2002-2003 in China [10, 15, 16], and later with the Middle East Respiratory Syndrome (MERS-CoV) in 2012-2013 in Saudi Arabia [17-20]. As expected, several similarities and differences in the epidemiology, clinical features, and management of SARS, MERS, and COVID have been identified [3-5, 20-23]. These are enveloped positive-strand RNA viruses isolated from bats that share sequence homology with isolates from humans, suggesting them as natural hosts and reservoirs [9, 24-27]. Although the clinical picture of SARS, MERS, and COVID-19 seems to be similar, since early reports, differences were noted [4, 5, 21, 28]. Then, full clinical characterization of disease, as well as their laboratory and image findings, is required.

While, two months after the beginning of the COVID-19, is still a preliminary time frame, some studies and case reports have been already published in major international scientific and medical journals, from China and other countries with travel- and non-travel-related cases [7, 13, 29, 30]. Many of them alone started to answer clinical questions, including evolution and outcomes, as well as potential risk factors, and clinical, laboratory and image findings; however, a systematic review to consolidate what has been learned from each study or reported case is still required. Although systematic reviews and meta-analyses usually include randomized clinical trials (RCTs) and aim to provide a more precise estimate of the effect of a treatment or risk factor for disease, also have been extensively used, especially during the last decades, to synthesized observational studies [31-33]. In many situations, RCTs are not feasible or available, and only data from observational studies are accessible [33]. This is the case for the clinical, laboratory, and image features of COVID-19.

Objectives

- To summarize the clinical, laboratory, and image features of COVID-19 reported on currently available observational studies
- To examine the outcome of COVID-19 cases, including risk factors, the proportion of patients requiring ICU and those evolving to death.
- To assess the prevalence of comorbidities among COVID-19 confirmed cases.

Methods

Protocol and registration

This protocol follows the recommendations established by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [34], and it has been reported in the International Prospective Register of Systematic Reviews (PROSPERO) database (ID 170643).

Eligibility criteria

We included published peer-reviewed articles that reported cases with demographical, clinical, laboratory, and image features of real-time reverse transcriptase polymerase chain reaction (rRT-PCR) confirmed SARS-CoV-2 infection. For assessing clinical, laboratory and imaging characteristics eligible study designs were case-control, cohort studies, case reports, and case series. For assessing risk factors and outcomes only observational studies were included. Article language limit was not set, and we included publications from January 1, 2020 until the date the search was finished. Review articles, opinion articles and letters not presenting original data were excluded, as well as studies reporting cases with incomplete information.

Information sources and Search Strategy

We conducted a systematic review using Medline/PubMed, Scopus, and Web of Sciences. The search terms used were these: “Novel coronavirus,” “Novel coronavirus 2019”, “2019 nCoV”, “COVID-19”, “Wuhan coronavirus,” “Wuhan pneumonia,” and “SARS-CoV-2.” The searches were concluded by February 23, 2020, and four different researchers independently evaluated search results.

Study Selection

The results of the initial search strategy were first screened by title and abstract. The full texts of relevant articles were examined for inclusion and exclusion criteria (Figure 1). When an article reported duplicate information from the same patient, the information of both reports was combined in order to obtain complete data, but only counted as a single case. Observational studies that reported the proportion of symptoms, laboratory characteristics and risk factors were included for quantitative synthesis (meta-analysis). Case reports were not included for meta-analysis, as they do not have a denominator for any variables, but descriptive statistics were applied to them, to summarize their findings.

Data collection process and data items:

Data extraction forms including information on the type of publication, the publishing institution, country, year and date of publication, the number of reported cases, of cases at ICU, age, sex, comorbidities, clinical features (e.g., fever, cough),

laboratory findings (e.g., white blood cell counts [WBC], biochemistry), imaging (e.g., chest X-ray), complications (e.g., acute respiratory distress syndrome, ARDS), outcome (e.g., death) were filled independently by four investigators. A fifth researcher checked the article list and data extractions to ensure there were no duplicate articles or duplicate information of the same patient and also resolved discrepancies about study inclusion.

Assessment of methodological quality and risk of bias:

For quality assessment, we used the Quality Appraisal of Case Series Studies Checklist of the IHE and specifically the critical appraisal tool to assess the quality of cross-sectional studies (AXIS) [35, 36]. Publication bias was assessed using a funnel-plot. A random-effects model was used to calculate the pooled prevalence and 95%CI, given variable degrees of data heterogeneity, and given the inherent heterogeneity in any systematic review of studies from the published literature. Also, Egger's test was performed.

Statistical approach

Unit discordance for variables was resolved by converting all units to a standard measurement for that variable. Percentages and means ± standard deviation (SDs) were calculated to describe the distributions of categorical and continuous variables, respectively. Since individual patient information was not available for all patients, we report weighted means and SDs. The baseline data were analyzed using the Stata version 14.0, licensed for Universidad Tecnológica de Pereira.

The meta-analyses were performed using Stata, and the software OpenMeta[Analyst] [37] and Comprehensive Meta Analysis ve.3.3® licensed for Universidad Tecnológica de Pereira, Colombia. Pooled prevalences and their 95% confidence intervals (95% CIs) were used to summarize the weighted effect size for each study grouping variable using the binary random-effects model (the weighting took into consideration the sample sizes of the individual studies), except for median age, where a continuous random-effect model was applied (DerSimonian-Laird procedure) [38, 39].

Measures of heterogeneity, including Cochran's Q statistic, the I^2 index, and the tau-squared test, were estimated and reported. We performed subgroup analyses by age groups (adults or children). And meta-analyses for each of the variables of interest. Publication bias was assessed using a funnel-plot.

Results

Study Selection and Characteristics:

A total of 660 articles were retrieved using the search strategy, including 39 case reports. After screening by abstract and title, 64 articles were selected for full-text assessment. Of these, six were excluded due to lack of information on molecular

diagnosis, and 58 were finally included for final qualitative analysis, 19 of them for quantitative meta-analysis and 39 case reports for descriptive analysis (Figure 1). The main characteristics of the included studies are shown in Table 1.

Our review included 19 studies that were published between January 1, 2020, and February 21, 2020, most of them from China (18) and one from Australia (Table 1), including a total of 2,874 patients, ranging from a case series of 9 [40] to a cross-sectional study of 1,590 [41]. Although for March 9, 2020, there have been more than 111,000 cases reported, these have not been included and published in studies available in the literature. Most studies were cross-sectional (15), and four were case series (Tables 1-5). We analyzed 42 variables for the meta-analyses (Table 6). Publication bias was assessed with a funnel plot for the standard error by logit event, with no evidence of bias (Figure S1). Additionally, the Egger test (P=0.801) suggested that there was no notable evidence of publication bias.

Demographical characteristics and comorbidities:

The mean age of patients across 18 studies was 51.97 years old (95%CI 46.06-57.89), being male 55.9% (95%CI 51.6-60.1%). Patients presented in 36.8% comorbidities (95%CI 24.7-48.9%), being the highest hypertension (18.6%, 95%CI 8.1-29.0%), cardiovascular disease (14.4%, 95%CI 5.7-23.1%), and diabetes (11.9%, 95%CI 9.1-14.6%), among others (Table 6) (Figure S2).

Clinical manifestations and laboratory findings:

Regarding the clinical manifestations, fever (88.7%, 95%CI 84.5-92.9%), cough (57.6%, 40.8-74.4%) and dyspnea (45.6%, 10.9-80.4%) were the most prevalent clinical manifestations (Table 6). Fever frequency was significantly higher in adults compared to children (92.8%, 95%CI 89.4-96.2%; versus 43.9%, 95%CI 28.2-59.6%) (Figure S2).

Concerning laboratory findings, decreased albumin (75.8%, 95%CI 30.5-100.0%), high C-reactive protein (58.3%, 95%CI 21.8-94.7%), and high lactate dehydrogenase (LDH) (57.0%, 95%CI 38.0-76.0), lymphopenia (43.1%, 95%CI 18.9-67.3), and high erythrocyte sedimentation rate (ESR) (41.8%, 95%CI 0.0-92.8), were the most prevalent (Table 6) (Figure S2).

Imaging, Complications, and Outcomes:

At the chest X-rays, the pneumonia compromise was predominantly bilateral (72.9%, 95%CI58.6-87.1), being the image findings ground-glass opacity in 68.5% (95%CI 51.8-85.2) (Table 6) (Figure S2).

Among the patients, 20.3% (95%CI 10.0-30.6%) required ICU, with 32.8% presenting ARDS (95%CI 13.7-51.8), 13.0% acute cardiac injury (95%CI 4.1-21.9%), 7.9% acute kidney injury (95%CI 1.8-14.0%), 6.2% (95%CI 3.1-9.3%) with shock and with a fatal outcome in 13.9% (95%CI 6.2-21.5%) (Table 6). RNAemia (detection of viral RNA in blood) was reported 96.8% of the patients (95%CI 94.9-98.7%) (Table 6) (Figure S2), in addition to nasopharyngeal aspirates (NPA).

Case reports:

We found 39 case report articles (Table S1, summarizing 126 cases of COVID-19. The mean age was 47.9 y-old (SD 22.2), being male 69.01% of those with sex identified in the article (Table 7). From the total, 10.3% presented hypertension as comorbidity, followed by other conditions. The more common clinical features were fever (77.0%), cough (55.6%), and myalgia (31.0%), among others (Table 7). Regarding the laboratory findings, lymphopenia was the more frequent (23.8%), followed by high C-reactive protein (22.2%) and high aspartate transaminase (AST) (7.9%). At the chest X-ray, 46% presented ground-glass opacity, with a bilateral compromise in 39.7% of the patients. All the case reports had RNAaemia. For the complications, 7.1% presented ARDS, and 1.6% secondary infections, among others. Most of the case reports were hospitalized (74.6%), with a fatality rate of 15.9% (Table 7).

Discussion

Over the last two months, more than 119,000 cases of a new infectious disease have been confirmed in China and other countries in Asia, Europe, Africa, and the Americas [22, 23, 42-44]. The COVID-19 is an emerging condition that primarily threat the preparedness and biosecurity conditions of the countries in the world [45]. Preparedness at different levels, facing a new clinical disease, demands efforts in epidemiological, diagnostic, therapeutic, and preventive fields during a potential pandemic [46], which threat with spread to new territories (>110) and areas with the risk of epidemics.

Clinical, laboratory, image findings, as well as the factors associated with evolution and outcomes, are critical knowledge that should be carefully studied when a new infectious disease emerged, including multiple other factors. Recently, in this context of the COVID-19 outbreak, several questions have been raised, including what is the full spectrum of disease severity (which can range from asymptomatic, to symptomatic-but-mild, to severe, to requiring hospitalization, to fatal)? [47]. In this systematic review and random-effects meta-analysis, we tried to initially summarize clinical data on COVID-19 confirmed cases that were published over the first weeks of the outbreak, achieving to analyze more than 780 patients for major clinical manifestations, and close to a half of them for identifying significant laboratory findings. A random-effects meta-analysis model involves an assumption that the effects being estimated in the different studies are not identical, but follow some distribution. For random-effects analyses, the pooled estimate and 95%CIs refer to the center of the distribution of pooled prevalence but do not describe the width of the distribution. Often the pooled estimate and its 95%CI are quoted in isolation as an alternative estimate of the quantity evaluated in a fixed-effect meta-analysis, which is inappropriate. The 95%CI from a random-effects meta-analysis describes uncertainty in the location of the mean of systematically different prevalence in the different studies [38, 39].

As expected from initial observations in China [4, 5, 11], COVID-19 patients presented predominantly with fever and cough, which appears to be more frequent in adults than children, as well as dyspnea, and myalgia, among other clinical features. This was consistently found not only in the studies meta-analyzed but also in the case reports included in this systematic review. Fever frequency is similar in SARS and MERS, but the cough is higher in SARS and COVID-19 than MERS (<50%)

[28, 48, 49]. In SARS and MERS, diarrhea is reported in 20-25% of patients [50], here we found it in less than 7%, at the studies (Table 6) and case reports (Table 7). Curiously, at case reports, myalgia was the third most common reported symptom after fever and cough. Most patients required hospitalization, which can be explained due to the patient's previous comorbidities, observed in a third of the cases. Then, also requiring in a fifth of them, to be admitted to ICU for critical management. Unlike what happens in SARS, with the well-characterized two-stages clinical course of the disease, in COVID-19, still, this needs further definition [48]. A first week is also similar, coinciding with recent data of the viral load during this stage [51]. However, case-control studies and cohort studies are necessary to define the clinical evolution of disease better. A second stage, as occurs in SARS, is maybe also seen in COVID-19, with the lower respiratory tract bilateral compromise, observed in more than 72% of the patients across nine studies with more than 500 patients, also experiencing a dry cough, and dyspnea [5, 48, 52] and with images at chest X-rays of ground-glass opacity frequently observed, two-thirds of patients, which is also seen in SARS [53].

The laboratory abnormalities predominantly found included hypoalbuminemia, elevated inflammatory markers, such as C-reactive protein, LDH, and ESR, among others. Also, lymphopenia is consistently present in more than 40% of the patients across eight studies with more than 500 patients. Data from the 2002-2003 outbreak indicate that SARS may be associated with lymphopenia, leukopenia, and thrombocytopenia, elevated levels of LDH, alanine transaminase (ALT), AST, and creatine kinase [54, 55], but also, and not significantly seen, nor consistently reported, in COVID-19 studies and cases, with thrombocytopenia, mild hyponatremia, and hypokalemia. The frequency of lymphopenia found suggests that COVID-19 might act on lymphocytes, especially T lymphocytes, as does SARS-CoV, maybe including depletion of CD4 and CD8 cells [4]. Virus particles spread through the respiratory mucosa, initially using the ACE2 receptor at ciliated bronchial epithelial cells, and infect other cells, induce a cytokine storm in the body, generate a series of immune responses, and cause changes in peripheral white blood cells and immune cells such as lymphocytes [56, 57].

Patients complicated and died. A third of them presented ARDS, but also, albeit in a lower frequency, acute cardiac injury, acute kidney injury, and shock, eventually followed by multiple organ failure. Therefore, early identification and timely treatment of critical cases are of crucial importance [4]. They evolved in more than 13% to a fatal outcome in 7 studies summarizing 632 patients. In two studies in China (n=41, n=99), the case fatality rates were 15% [5] and 11% [4], respectively. Crude surveillance data [42], indicated that till March 9, 2020, from 111,363 reported cases, 3,892 patients have died (3.49%), with >89% of the deaths occurred in China (3,119). This is different from the found in this systematic review and may be explained by the fact that cases requiring medical attention in hospitals where patients were included the selected studies consulted with a more advanced stage of disease, they were hospitalized. Even, from the crude epidemiological data reported by the countries, some of them have reported a higher proportion of deaths, as is the case of Australia (3.75%), China (3.86%), Italy (4.96%), Argentina (8.33%), and Iraq (10.0%). Then this needs further reassessment. Nevertheless, after all, more studies are needed to answer what the risk factors for severe illness or death are? Moreover, how can we identify groups most likely to have poor outcomes so that we can focus on prevention and treatment efforts? [47].

After the development of this systematic review (SR), and even availability on a preprint server, online Feb. 25, 2020 (http://dx.doi.org/10.20944/preprints202002.0378.v1); a brief systematic review and meta-analysis, only addressing fever, cough, muscle soreness or fatigue, ARDS, abnormal chest CT, patients in critical condition and death of patients with COVID-19, was published (Feb. 28, 2020) [58]. This review was based on ten studies, using a random effect model, as we did.

Comparing their findings [58] with ours, they found fever in 89.8% (95%CI 81.8-94.5%) of patients, this SR found 88.7% (95%CI 84.5-92.9%), but we assessed differences, as mentioned above, between adults and children, and they not. For cough, based on the 95%CI, there were not significant differences too, between that SR and the current, 72.2% (95%CI 65.7-78.2%) versus 57.6% (95%CI 40.8-74.4%). For fatigue, also there is overlapping in the frequency between both studies, 42.5% (95%CI 21.3-65.2%) versus 29.4% (95%CI 19.8-39.0%). Sun et al did not assessed other clinical manifestations [58], we were able to do it for eight of them. Between both reviews is clear and consistent that more than 80% of the patients presented fever, more than a half cough, and more than a third fatigue. That SR did not assess any laboratory findings, but evaluated the frequency of patients presenting ADRS, 14.8% (95%CI 4.6-29.6%), which was also consistent with our study, 32.8% (95%CI 13.7-51.8%), although little higher, but with the 95%CI overlapping (not significant difference).

For patients admitted to critical care, there were also small differences. Sun et al found 18.1% (95%CI 12.7-24.3%), however, we identified that 20.3% required intensive critical care (95%CI 10.0-30.6%). The major difference between both studies was in the last variable assessed in that SR, deaths, they report 4.3% (95%CI 2.7-6.1%) and we 13.9% (95%CI 6.2-21.5%), being significantly lower compared with the current data. Finally, Sun et al only included studies, but not case reports, as we did, which provided additional consistent findings of the clinical, laboratory, imaging and evolution characteristics of patients with confirmed COVID-19.

Our results showed that there is still a need for more comprehensive clinical studies, including short and long -term follow-up cohort assessments. More studies related to outside, where there are more than 100 patients diagnosed with COVID-19, as is the case of South Korea, Italy, and Japan [59, 60], will be excellent opportunities also for this, in addition to the growing number of studies appearing from China. Even more, the situation with the cruise ship Diamond Princess, docked in Yokohama, Japan, with 3,711 passengers, approximately 20% of the infected, with 7 deaths, is also a valuable chance to characterize better the COVID-19. Clinical evidence synthesized in this review is mainly derived from China, although for case reports, ten of the thirty-two countries with confirmed cases [7, 12, 29, 30], have published some of them (Table 7). Further clinical data is crucial to elucidate the clinical spectrum of disease associated to this viral infection. In this regard, learning the clinical experience stemming from countries dealing with an increasing number of cases such as Italy, which only have reported genomic data of their two first cases [61], Singapore, Hong Kong, Nepal [7], Iran, and Malaysia in the form of case reports, case series, or large observational studies. Regardless, cross-sectional studies or case reports, the clinical findings were consistent between them but still limited to characterize further and define the risk factors for admission in ICU and fatal outcomes. However, data suggest that older age and comorbidities play a vital role in influencing severe disease and negative clinical outcomes. These data would be useful to guide patient risk groups management in the current epidemic,

especially in those countries not yet receiving cases, as occur in many countries in Latin America, which have confirmed COVID-19 cases in Brazil, Mexico, Ecuador, Argentina, Chile, Peru, Costa Rica, Dominican Republic, Paraguay, Colombia, Panama, and Bolivia, so far (March 10, 2020) [62]. In these and other resource-constrained settings, e.g. Africa, supplies chains, including those for drugs, would be even affected.

The results of this systematic review highlight the clinical, laboratory, and imaging findings that may assist clinicians anywhere in the globe in suspecting the possibility of COVID-19 infection in those with recent travel to areas with ongoing transmission or among contacts to a confirmed case. Early recognition of cases will allow clinicians to ensure adequate clinical monitoring, institution of supportive interventions, and preventing further transmission by implementing of infection control measures [29, 56, 63]. Finally, there is a need for prospective studies to further understand the epidemiology, pathogenesis, duration of viral shedding, and the clinical spectrum of disease associated to this emerging viral infection [29, 56, 63].

To effectively protect healthcare workers in the face of arrival and spreading of this emerging viral pathogen, understanding the natural history of the disease, its clinical spectrum of disease are of utmost importance not only for an appropriate clinical suspicion, diagnosis, management and mitigation of transmission of COVID-19.

Limitations

This review has several limitations. First, still few studies are available for inclusion. It would be better to include as many studies not only from China, once these have been published, to get a more comprehensive understanding of COVID19. Second, more detailed patient information, particularly regarding clinical outcomes, was unavailable in most studies at the time of analyses; however, the data in this review permit a first synthesis of the clinical and laboratory characteristics of COVID-19, although the need to be more detailed for image characterization. As we mentioned, also the differences between the crude fatality rate (<3.5%) and the found among hospitalized patients in the selected studies, that may be explained by the fact that cases requiring medical attention in hospitals where patients were included the selected studies consulted with a more advanced stage of disease, they were hospitalized.

Conclusions

Infection with COVID-19 is associated with significant morbidity especially in patients with chronical medical conditions. At least one fifth of cases require supportive care in medical intensive care units. Despite the implementation of optimal supportive interventions, case fatality rate among hospitalized patients is more than 10 percent. Similar to other viral respiratory pathogens, COVID-19 presents in the majority of cases with a rapidly progressive course of fever, cough and dyspnea. One important distinguishing factor from is leukopenia and the rapid progression to ARDS. Eliciting a history of recent travel to areas with ongoing outbreaks of this emerging pathogen or contact with a confirmed case of COVID-19,

should prompt clinicians to initiate isolation precautions and obtaining laboratory confirmation. Additional research is needed to elucidate viral and host factors in the pathogenesis of severe and fatal infections.

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Figure 1. Study selection and characteristics.

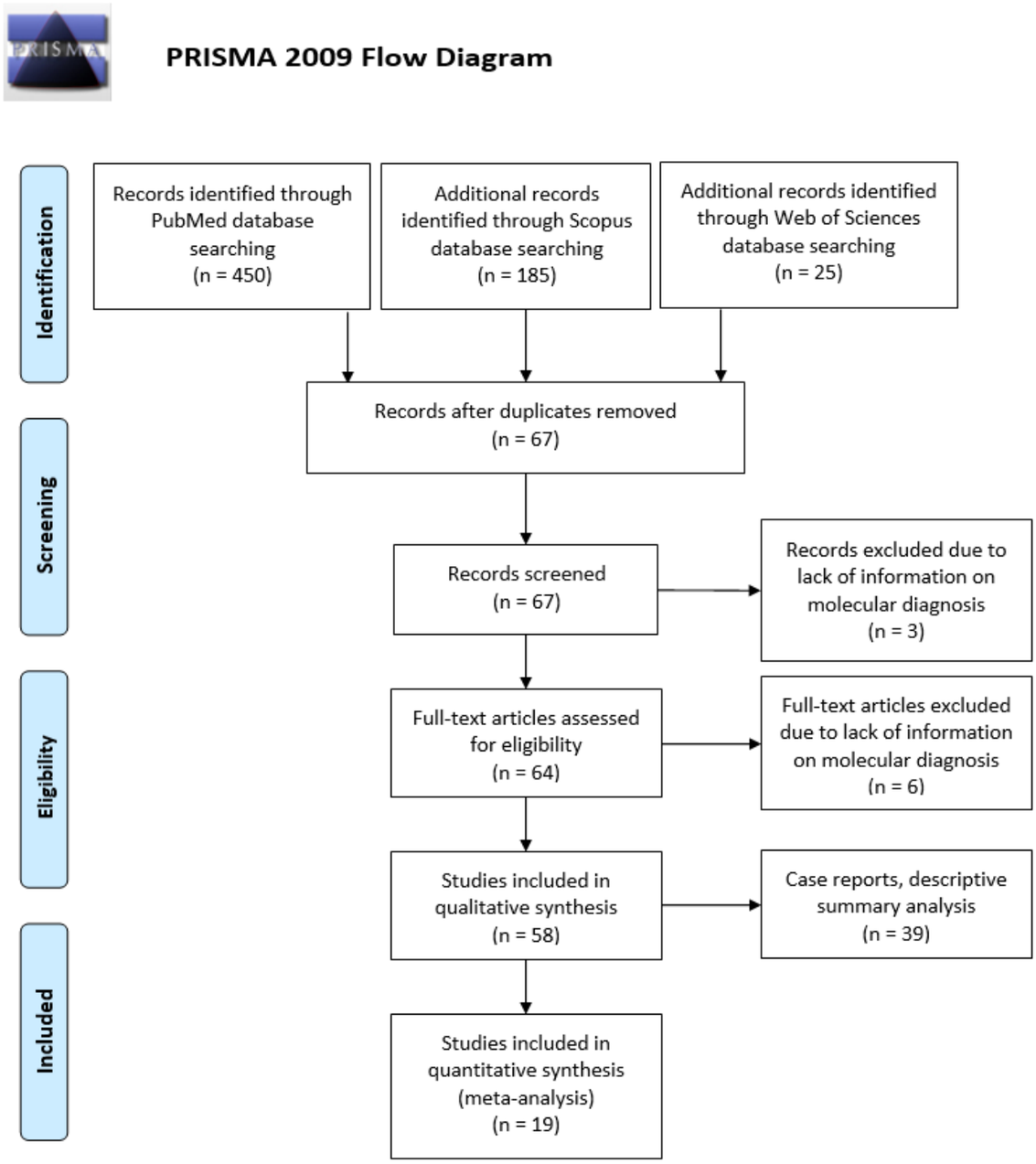

Table 1. Characteristics of the included studies on COVID-19, 2020. All patients confirmed by real-time RT-PCR.

Author	Journal	Date (MM/DD)	Country	Study type	N	Quality score*	Reference
WMCHHHPNCI	Comission Report	01/20	China	Cross-sectional	136	12	[64]
Chaolin et al.	Lancet	01/24	China	Cross-sectional	41	19	[5]
Li et al.	NEJM	01/29	China	Cross-sectional	425	19	[11]
Chen et al.	Lancet	01/30	China	Cross-sectional	99	19	[4]
Chung et al.	Radiology	02/04	China	Cross-sectional	21	12	[65]
Chen et al.	Chin J Tuberc Respir Dis	02/06	China	Cross-sectional	29	12	[66]
Wang et al.	JAMA	02/07	China	Cross-sectional	138	19	[67]
Kui et al.	Chin Med J	02/07	China	Cross-sectional	137	12	[68]
Chang et al.	JAMA	02/07	China	Cross-sectional	13	14	[69]
To et al.	Clin Infect Dis	02/12	China	Cross-sectional	12	14	[70]
COVID-19 team Australia	Team Report	02/12	Australia	Cross-sectional	15	12	[71]
Yueying et al.	Eur Radiol	02/13	China	Cross-sectional	63	14	[72]
Li et al.	Preprint Lancet	02/13	China	Case series	24	14	[73]
Feng et al.	Radiology	02/13	China	Case series	21	12	[74]
Liang et al.	Lancet Oncology	02/14	China	Cross-sectional	1590	17	[41]
Zhang et al.	Chin J Tuberc Respir Dis	02/15	China	Case series	9	12	[40]
Feng et al.	Chin J Pediatr	02/17	China	Case series	15	12	[75]
Wang et al.	Chin J Pediatr	02/17	China	Cross-sectional	34	12	[76]
Xiaobo et al.	Lancet Respir Med	02/21	China	Cross-sectional	52	17	[52]

WMCHHHPNCI, Wuhan Municipal Commission of Health and Health on Pneumonia of New Coronavirus Infection. MM/DD, Month, Day. *Quality score ranged, 0-20. Based on the Appraisal Tool for Cross-Sectional Studies, AXIS.[36]

Table 2. Demographical characteristics, ICU, and comorbidities of the study subjects.

							N (%)							
Author	**Date (MM/DD)**	**N**	**Mean Age (y-old)**	**Age Range**	**Sex (Male)**	**N at ICU**	**Comorbidities**	**Diabetes**	**Hypertension**	**Cardiovascular disease**	**Chronic obstructive pulmonary disease**	**Malignancies**	**Chronic liver disease**	**Reference**
WMCHHHPNCI	01/20	136	-	25-89	66	-	-	-	-	-	-	-	-	[64]
Chaolin et al.	01/24	41	49	41-58	30	13 (31.7)	13 (31.7)	8 (19.5)	6 (14.6)	6 (14.6)	1 (2.4)	1 (2.4)	1 (2.4)	[5]
Li et al.	01/29	425	56	26-82	240	-	-	-	-	-	-	-	-	[11]
Chen et al.	01/30	99	55.5	21-82	67	23 (23.2)	50 (50.5)	12 (12.1)	-	40 (40.4)	1 (1.0)	1 (1.0)	-	[4]
Chung et al.	02/04	21	51	29-77	13	-	-	-	-	-	-	-	-	[65]
Chen et al.	02/06	29	56	26-79	21	-	16 (55.2)	5 (17.2)	8 (27.6)	-	-	1 (3.4)	2 (6.9)	[66]
Wang et al.	02/07	138	56	42-68	75	36 (26.1)	64 (46.4)	14 (10.1)	43 (31.2)	20 (14.5)	4 (2.9)	10 (7.2)	4 (2.9)	[67]
Kui et al.	02/07	137	57	20-83	61	-	27 (19.7)	14 (10.2)	13 (9.5)	10 (7.3)	2 (1.5)	2 (1.5)	-	[68]
Chang et al.	02/07	13	34	34-48	10	-	-	-	-	-	-	-	-	[69]
To et al.	02/12	12	62.5	37-75	7	-	-	-	-	-	-	-	-	[70]
COVID-19 team Australia	02/12	15	43	8-66	9	1 (6.7)	-	-	-	-	-	-	-	[71]
Yueying et al.	02/13	63	-	15.2 - 44.9	33	-	-	-	-	-	-	-	-	[72]
Li et al.	02/13	24	43	12 - 84	8	-	-	-	-	-	-	-	-	[73]
Feng et al.	02/13	21	40.9	25-63	6	-	-	-	-	-	-	-	-	[74]
Liang et al.	02/14	1590	-	-	911	130 (8.2)	18 (1.1)	2 (0.1)	2 (0.1)	-	1 (0.06)	-	-	[41]
Zhang et al.	02/15	9	36	15-49	5	-	1 (11.1)	1 (11.1)	-	-	-	-	-	[40]
Feng et al.	02/17	15	-	4 - 14	5	-	-	-	-	-	-	-	-	[75]
Wang et al.	02/17	34	8	-	14	-	-	-	-	-	-	-	-	[76]
Xiaobo et al.	02/21	52	59.7	33.6-85.8	35	-	21 (40.4)	9 (17.3)	-	5 (9.6)	4 (7.7)	2 (3.8)	-	[52]

WMCHHHPNCI, Wuhan Municipal Commission of Health and Health on Pneumonia of New Coronavirus Infection. MM/DD, Month, Day. ICU, intensive care unit. y-old, years old. -, Not available, not reported.

Table 3. Clinical characteristics of the study subjects.

Author	Date (MM/DD)	N	N (%)									Reference
			Fever	Cough	Sore Throat	Myalgia or fatigue	Sputum production	Headache	Haemoptisis	Diarrhoea	Dyspnoea	
WMCHHHPNCI	01/20	136	136 (100.0)	136 (100.0)	-	-	-	-	-	-	136 (100.0)	[64]
Chaolin et al.	01/24	41	40 (97.6)	31 (75.6)	0 (0.0)	18 (43.9)	11 (26.8)	3 (7.3)	2 (4.9)	1 (2.4)	22 (53.7)	[5]
Li et al.	01/29	425	-	-	-	-	-	-	-	-	-	[11]
Chen et al.	01/30	99	82 (82.8)	81 (81.8)	5 (5.1)	11 (11.1)	-	8 (8.1)	-	2 (2.0)	31 (31.3)	[4]
Chung et al.	02/04	21	14 (66.7)	9 (42.9)	-	6 (28.6)	-	3 (14.3)	-	-	-	[65]
Chen et al.	02/06	29	28 (96.6)	21 (72.4)	-	12 (41.4)	21 (72.4)	2 (6.9)	-	4 (13.8)	17 (58.6)	[66]
Wang et al.	02/07	138	136 (98.6)	82 (59.4)	24 (17.4)	138 (100.0)	37 (26.8)	9 (6.5)	-	14 (10.1)	43 (31.2)	[67]
Kui et al.	02/07	137	112 (81.8)	66 (48.2)	-	44 (32.1)	6 (4.4)	13 (9.5)	7 (5.1)	11 (8.0)	26 (19.0)	[68]
Chang et al.	02/07	13	12 (92.3)	6 (46.2)	-	3 (23.1)	2 (15.4)	3 (23.1)	-	1 (7.7)	-	[69]
To et al.	02/12	12	-	-	-	-	-	-	-	-	-	[70]
COVID-19 team Australia	02/12	15	14 (93.3)	11 (73.3)	-	-	-	-	-	-	-	[71]
Yueying et al.	02/13	63	-	-	-	-	-	-	-	-	-	[72]
Li et al.	02/13	24	19 (79.2)	6 (25.0)	-	6 (25.0)	-	4 (16.7)	-	-	2 (8.3)	[73]
Feng et al.	02/13	21	18 (85.7)	12 (57.1)	4 (19.0)	11 (52.4)	6 (28.6)	-	-	-	-	[74]
Liang et al.	02/14	1590	-	-	-	-	-	-	-	-	-	[41]
Zhang et al.	02/15	9	8 (88.9)	5 (55.6)	4 (44.4)	4 (44.4)	-	-	-	-	-	[40]
Feng et al.	02/17	15	5 (33.3)	1 (6.7)	-	-	-	-	-	-	-	[75]
Wang et al.	02/17	34	17 (50.0)	13 (38.2)	-	-	-	-	-	-	-	[76]
Xiaobo et al.	02/21	52	51 (98.1)	40 (76.9)	-	6 (76.9)	-	3 (11.5)	-	-	33 (63.5)	[52]

WMCHHHPNCI, Wuhan Municipal Commission of Health and Health on Pneumonia of New Coronavirus Infection. MM/DD, Month, Day. -, Not available, not reported.

Table 4. Laboratory characteristics of the study subjects.

			N (%)														
Author	Date (MM/DD)	N	Leucocytosis	Leukopenia	Lymphopenia	High AST	High Creatinine	High Creatine kinase	High LDH	High Troponin I, >99th perc	Anemia	Decreased Albumin	High ALT	High Bilirubin	Erythrocyte sedimentation rate elevated	C-reactive protein, high	Serum ferritin	Reference
WMCHHHPNCI	01/20	136	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[64]
Chaolin et al.	01/24	41	12 (29.3)	10 (24.4)	26 (63.4)	15 (36.6)	4 (9.8)	13 (31.7)	29 (70.7)	5 (12.2)	-	-	-	-	-	-	-	[5]
Li et al.	01/29	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[11]
Chen et al.	01/30	99	24 (24.2)	9 (9.1)	35 (35.4)	35 (35.4)	3 (3.0)	13 (13.1)	75 (75.8)	-	50 (50.5)	97 (98.0)	28 (28.3)	18 (18.2)	84 (84.8)	63 (63.6)	62 (62.6)	[4]
Chung et al.	02/04	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[65]
Chen et al.	02/06	29	6 (20.7)	6 (20.7)	20 (69.0)	7 (24.1)	2 (6.9)	-	20 (69.0)	-	-	15 (51.7)	5 (17.2)	1 (3.4)	-	27 (93.1)	-	[66]
Wang et al.	02/07	138	0 (0.0)	0 (0.0)	97 (70.3)	-	-	-	55 (39.9)	-	-	-	-	-	-	-	-	[67]
Kui et al.	02/07	137	26 (19.0)	51 (37.2)	99 (72.3)	-	-	-	-	-	-	-	-	-	-	115 (83.9)	-	[68]
Chang et al.	02/07	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[69]
To et al.	02/12	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[70]
COVID-19 team Australia	02/12	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[71]
Yueying et al.	02/13	63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[72]
Li et al.	02/13	24	-	5 (20.8)	2 (8.3)	-	-	-	-	-	-	-	-	-	6 (25.0)	12 (50.0)	-	[73]
Feng et al.	02/13	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[74]
Liang et al.	02/14	1590	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[41]
Zhang et al.	02/15	9	1 (11.1)	-	2 (22.2)	-	-	-	-	-	-	-	-	-	-	5 (55.6)	-	[40]
Feng et al.	02/17	15	-	8 (53.3)	-	-	-	-	-	-	-	-	-	-	-	-	-	[75]
Wang et al.	02/17	34	5 (14.7)	1 (2.9)	1 (2.9)	-	-	-	10 (29.4)	-	-	-	-	-	5 (14.7)	1 (2.9)	-	[76]
Xiaobo et al.	02/21	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[52]

WMCHHHPNCI, Wuhan Municipal Commission of Health and Health on Pneumonia of New Coronavirus Infection. MM/DD, Month, Day. LDH, Lactate dehydrogenase. AST, Aspartate transaminase. ALT, Alanine transaminase. -, Not available, not reported.

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Table 5. Imaging and complications of the study subjects.

			N (%)												
			Imaging					Complications							
Author	Date (MM/DD)	N	Chest Ray Unilateral Pneumonia	Chest Ray Bilateral Pneumonia	Ground-glass opacity	Acute respiratory distress syndrome	RNAaemia	Acute cardiac injury	Acute kidney injury	Secondary infection	Shock	Hospitalization	Discharge	Death	Reference
WMCHHHPNCI	01/20	136	-	-	-	-	-	-	-	-	-	-	-	1 (0.7)	[64]
Chaolin et al.	01/24	41	-	40 (97.6)	40 (97.6)	12 (29.3)	6 (14.6)	5 (12.2)	3 (7.3)	4 (9.8)	3 (7.3)	7 (17.1)	28 (68.3)	6 (14.6)	[5]
Li et al.	01/29	425	-	-	-	-	425 (100.0)	-	-	-	-	-	-	-	[11]
Chen et al.	01/30	99	25 (25.3)	74 (74.7)	14 (14.1)	17 (17.2)	99 (100.0)	-	3 (3.0)	-	4 (4.0)	57 (57.6)	31 (31.3)	11 (11.1)	[4]
Chung et al.	02/04	21	2 (1.5)	16 (11.8)	18 (13.2)	-	21 (15.4)	-	-	-	-	21 (15.4)	-	-	[65]
Chen et al.	02/06	29	-	-	29 (100.0)	-	29 (100.0)	-	-	-	-	27 (93.1)	-	2 (6.9)	[66]
Wang et al.	02/07	138	0 (0.0)	138 (100.0)	138 (100.0)	27 (19.6)	138 (100.0)	10 (7.2)	5 (3.6)	-	12 (8.7)	138 (100.0)	47 (34.1)	6 (4.3)	[67]
Kui et al.	02/07	137	-	36 (26.3)	55 (40.1)	-	137 (100.0)	-	-	-	-	77 (56.6)	44 (32.4)	16 (11.8)	[68]
Chang et al.	02/07	13	1 (7.7)	-	6 (46.2)	-	13 (100.0)	-	-	-	-	12 (92.3)	1 (7.7)	-	[69]
To et al.	02/12	12	-	-	-	-	12 (100.0)	-	-	-	-	12 (100.0)	-	-	[70]
COVID-19 team Australia	02/12	15	-	-	-	-	15 (100.0)	-	-	-	-	11 (73.3)	-	-	[71]
Yueying et al.	02/13	63	-	38 (60.3)	14 (22.2)	-	63 (100.0)	-	-	-	-	-	-	-	[72]
Li et al.	02/13	24	-	-	-	-	24 (100.0)	-	-	-	-	-	-	-	[73]
Feng et al.	02/13	21	18 (85.7)	-	-	-	21 (100.0)	-	-	-	-	21 (100.0)	-	-	[74]
Liang et al.	02/14	1590	-	-	-	-		-	-	-	-	1590 (100.0)	-	-	[41]
Zhang et al.	02/15	9	2 (22.2)	5 (55.6)	7 (77.8)	-	9 (100.0)	-	-	-	-	9 (100.0)	-	-	[40]
Feng et al.	02/17	15	4 (26.7)	8 (53.3)	-	-	15 (100.0)	-	-	-	-	-	15 (100.0)	-	[75]
Wang et al.	02/17	34	-	34 (100.0)	34 (100.0)	-	34 (100.0)	-	-	-	-	34 (100.0)	34 (100.0)	-	[76]
Xiaobo et al.	02/21	52	-	-	-	35 (67.3)	-	12 (23.1)	15 (28.8)	2 (3.8)	-	52 (100.0)	-	32 (61.5)	[52]

WMCHHHPNCI, Wuhan Municipal Commission of Health and Health on Pneumonia of New Coronavirus Infection. MM/DD, Month, Day. ICU, intensive care unit. y-old, years old. AST, Aspartate transaminase. ALT, Alanine transaminase. -, Not available, not reported.

Table 6. Meta-analysis outcomes (random-effects model)*.

Variable	Number of Studies	Mean (y-old) / Prevalence (%)	95%CI	n	Q†	I^{2} ‡	t^{2} §	p
Age	18	51.97	46.06-57.89	2626	1193.28	98.56	145.687	**<0.001**
Male	22	55.9	51.6-60.1	2874	61.98	66.12	0.005	**<0.001**
ICU	6	20.3	10.0-30.6	1883	49.49	89.89	0.013	**<0.001**
Comorbidities	7	36.8	24.7-48.9	505	47.75	87.44	0.022	**<0.001**
Hypertension	5	18.6	8.1-29.0	363	23.989	83.33	0.011	**<0.001**
Cardiovascular disease	6	14.4	5.7-23.1	485	45.29	88.96	0.01	**<0.001**
Diabetes	8	11.9	9.1-14.6	523	4.065	0.00	0.00	0.772
Chronic obstructive pulmonary disease	6	1.8	0.6-3.0	485	4.413	0.00	0.00	0.492
Malignancies	6	2.5	0.7-4.2	496	7.59	34.16	0.00	0.180
Chronic liver disease	3	3.0	0.7-5.4	208	0.744	0.00	0.00	0.689
Clinical manifestations								
Fever	15	88.7	84.5-92.9	784	128.73	89.12	0.04	**<0.001**
Adult	13	92.8	89.4-96.2	735	68.25	82.42	0.002	**<0.001**
Children	2	43.9	28.2-59.6	49	1.25	20.2	0.003	0.263
Cough	15	57.6	40.8-74.4	784	657.76	97.87	0.102	**<0.001**
Adult	13	63.4	48.0-78.8	735	413.05	97.09	0.072	**<0.001**
Children	2	22.0	0.0-52.9	49	8.983	88.87	0.044	**0.003**
Dyspnea	8	45.6	10.9-80.4	656	1346.86	99.48	0.248	**<0.001**
Myalgia or fatigue	11	29.4	19.8-39.0	446	46.53	80.66	0.017	**<0.001**
Sputum production	6	28.5	10.8-46.3	379	94.94	94.73	0.044	**<0.001**
Sore throat	5	11.0	2.8-19.2	308	28.24	85.39	0.006	**<0.001**
Headache	9	8.0	5.7-10.2	554	5.048	0.00	0.00	0.752
Diarrhea	6	6.1	2.4-9.7	457	13.19	62.11	0.001	**0.022**
Laboratory findings								
Decreased Albumin	2	75.8	30.5-100.0	128	24.29	95.88	0.103	**<0.001**
High C-reactive protein	6	58.3	21.8-94.7	332	472.34	98.94	0.200	**<0.001**
High LDH	5	57.0	38.0-76.0	341	54.03	92.59	0.043	**<0.001**
Lymphopenia	8	43.1	18.9-67.3	511	349.18	97.99	0.117	**<0.001**
High Erythrocyte sedimentation rate	3	41.8	0.0-92.8	157	118.55	98.31	0.199	**<0.001**
High AST	3	33.3	26.3-40.4	169	1.7	0.00	0.00	0.427
High ALT	2	24.1	13.5-34.6	128	1.749	42.84	0.003	0.186
High Creatinine Kinase	2	21.3	3.2-39.4	140	5.36	81.36	0.014	**0.021**
Leukopenia	8	18.7	8.5-28.8	517	126.80	94.48	0.018	**<0.001**
Leukocytosis	7	16.8	5.5-28.0	487	87.47	93.14	0.019	**<0.001**
High Bilirubin	2	10.7	0.0-25.1	128	8.19	87.79	0.01	**0.004**
High Creatinine	3	4.5	1.0-8.0	169	2.23	10.17	0.00	0.328
Chest X-Ray Pneumonia Compromise								
Unilateral	7	25.0	5.2-44.8	316	165.31	96.37	0.065	**<0.001**
Bilateral	9	72.9	58.6-87.1	557	463.64	98.28	0.042	**<0.001**
Adult	7	70.7	50.4-91.0	508	451.59	98.67	0.070	**<0.001**
Children	2	77.7	33.5-100.0	49	12.04	91.69	0.094	**<0.001**
Image findings								
Ground-glass opacity	10	68.5	51.8-85.2	584	992.3	99.09	0.068	**<0.001**
Complications								
RNAemia	18	96.8	94.9-98.7	1096	241.19	92.95	0.001	**<0.001**
Adult	16	96.6	94.6-98.6	1047	240.59	93.77	0.001	**<0.001**
Children	2	98.3	94.7-100.0	49	0.125	0.00	0.00	0.723
Acute respiratory distress syndrome	4	32.8	13.7-51.8	330	49.49	93.93	0.035	**<0.001**
Acute cardiac injury	3	13.0	4.1-21.9	231	6.72	70.22	0.004	**0.035**
Acute kidney injury	4	7.9	1.8-14.0	330	16.5	81.85	0.003	**<0.001**
Shock	3	6.2	3.1-9.3	278	2.34	14.67	0.00	0.310
Secondary infections	2	5.6	0.3-10.9	93	1.22	18.16	0.00	0.269
Hospitalization	15	87.9	84.2-91.6	2211	390.76	96.42	0.004	**<0.001**
Outcome								
Discharged	7	52.9	23.9-81.8	477	548.77	98.91	0.15	**<0.001**
Death	7	13.9	6.2-21.5	632	107.17	91.4	0.009	**<0.001**

* 95% CI = 95% confidence interval; ICU, intensive care unit. y-old, years old. AST, Aspartate transaminase. ALT, Alanine transaminase.
† Cochran's Q statistic for heterogeneity.
‡ I^{2} index for the degree of heterogeneity.
§ Tau-squared measure of heterogeneity.

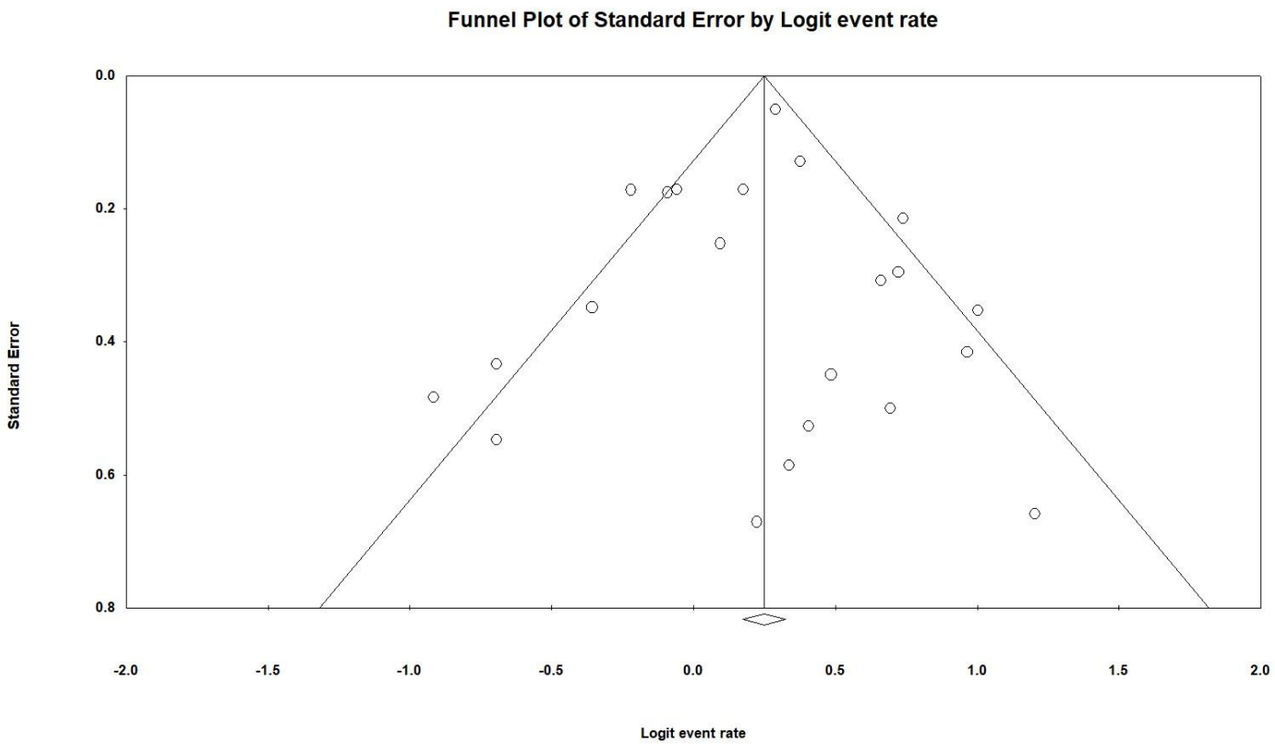
Table 7. Summary of the case report findings.*

Variables	N (126)	%	Variables	N (126)	%
Age (y-old) (mean, SD) (n=118)	47.9	22.2	*Images*		
Sex (Male/Female) (n=71)	49	69.01	Ground-glass opacity at chest X-ray	58	46.0
ICU (Yes)	11	8.7	Chest X-Ray Bilateral Pneumonia	50	39.7
Comorbidities			Chest X-Ray Unilateral Pneumonia	13	10.3
Hypertension	13	10.3	*Complications*		
Chronic liver disease	5	4.0	RNAaemia	126	100.0
Cardiovascular disease	3	2.4	Acute respiratory distress syndrome	9	7.1
Chronic obstructive pulmonary disease	2	1.6	Secondary infection	2	1.6
Malignancy or cancer	1	0.8	Acute kidney injury	1	0.8
Clinical features			Shock	1	0.8
Fever	97	77.0	Hospitalization	94	74.6
Cough	70	55.6	*Outcomes*		
Myalgia or fatigue	39	31.0	Discharge	48	38.1
Dyspnoea	27	21.4	Death	20	15.9
Sputum production	16	12.7			
Sore Throat	13	10.3	*Countries of the case report articles (39)*		
Diarrhoea	8	6.3	China	25	64.1
Headache	7	5.6	South Korea	4	10.3
Haemoptisis	1	0.8	Australia	1	2.6
Laboratory findings			Canada	1	2.6
Lymphopenia	30	23.8	France	1	2.6
High C-reactive protein	28	22.2	Germany	1	2.6
High AST	10	7.9	Japan	1	2.6
Leukopenia	9	7.1	Nepal	1	2.6
High ALT	9	7.1	Taiwan	1	2.6
High LDH	8	6.3	Thailand	1	2.6
High Erythrocyte sedimentation rate	6	4.8	United States of America	1	2.6
Leukocytosis	4	3.2	Vietnam	1	2.6
Anemia	4	3.2	*Countries of the cases reported (n=126)*		
Decreased Albumin	3	2.4	China	101	80.2
High Creatinine	2	1.6	South Korea	6	4.8
High Creatine kinase	2	1.6	Germany	5	4.0
High Bilirubin	1	0.8	France	3	2.4
			Australia	2	1.6
			Taiwan	2	1.6
			Vietnam	2	1.6
			Canada	1	0.8
			Japan	1	0.8
			Nepal	1	0.8
			Thailand	1	0.8
			United States of America	1	0.8

*The list of case reports is available at Table S1—supplemental materials.

Supplemental Materials.

Figure S1. Funnel-plot for the Standard Error by Logit Event rate to assess for publication bias.



 doi:10.20944/preprints202002.0378.v3

Figure S2. Pool prevalences forest plots of findings described in Table 2.

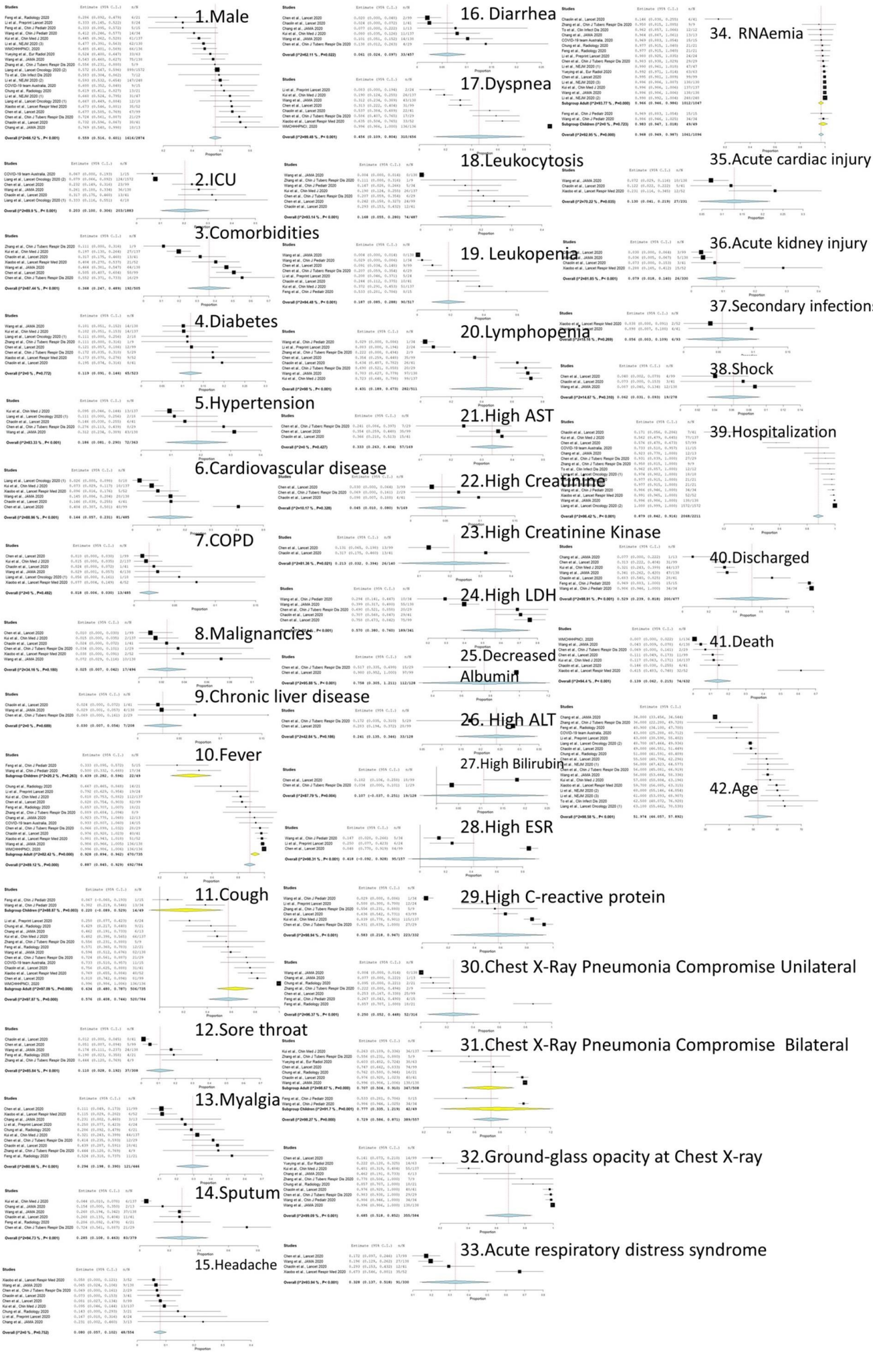


Table S1. Case reports included in the review.

Article title	List of authors	Journal name	Year	MM/DD	doi
Emergence of a novel coronavirus causing respiratory illness from Wuhan, China	Julian W. Tang , Paul A. Tambyah , David S.C. Hui	Journal of Infection	2020	02/06	doi.org/10.1016/j.jinf.2020.01.014
Public responses to the novel 2019 coronavirus (2019-nCoV) in Japan: mental health consequences and target populations	Jun Shigemura, Robert J. Ursano, Joshua C. Morganstein, Mie Kurosawa, David M. Benedek.	Psychiatry and Clinical Neurosciences	2020	02/09	doi.org/10.1111/pcn.12988
Clinical characteristics and therapeutic procedure for four cases with 2019 novel coronavirus pneumonia receiving combined Chinese and Western medicine treatment	Zhenwei Wang, Xiaorong Chen, Yunfei Lu, Feifei Chen, Wei Zhang.	BioScience Trends	2020	02/09	10.5582/bst.2020.01030
A Locally Transmitted Case of SARS-CoV-2 Infection in Taiwan	Ying-Chu Liu, Ching-Hui Liao, Chin-Fu Chang, Chu-Chung Chou, Yan-Ren Lin	The New England Journal of Medicine	2020	02/12	10.1056/NEJMc2001573
Journey of a Thai Taxi Driver and Novel Coronavirus	Wannarat A. Pongpirul, Krit Pongpirul, Anuttra C. Ratnarathon, Wisit Prasithsirikul,	The New England Journal of Medicine	2020	02/13	10.1056/NEJMc2001468
Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records	Huijun Chen, Juanjuan Guo, Chen Wang, Fan Luo, Xuechen Yu, Wei Zhang, Jiafu Li, Dongchi Zhao, Dan Xu, Qing Gong, Jing Liao, Huixia Yang, Wei Hou, Yuanzhen Zhang	The Lancet	2020	02/12	10.1016/S0140-6736(20)30360-3
Identification of a novel coronavirus causing severe pneumonia in human: a descriptive study.	Ren LL, Wang YM, Wu ZQ, Xiang ZC, Guo L, Xu T, Jiang YZ, Xiong Y, Li YJ, Li XW, Li H, Fan GH2, Gu XY, Xiao Y, Gao H, Xu JY, Yang F, Wang XM, Wu C, Chen L, Liu YW, Liu B, Yang J, Wang XR, Dong J, Li L, Huang CL, Zhao JP, Hu Y, Cheng ZS, Liu LL, Qian ZH, Qin C, Jin Q, Cao B, Wang JW.	Chinese Medical Journal	2020	02/11	10.1097/CM9.0000000000000722
Novel Coronavirus Infection in Hospitalized Infants Under 1 Year of Age in China	Min Wei, Jingping Yuan, MD, Yu Liu, Tao Fu, Xue Yu, Zhi-Jiang Zhang.	JAMA	2020	02/14	10.1001/jama.2020.2131
Case of the Index Patient Who Caused Tertiary Transmission of Coronavirus Disease 2019 in Korea: the Application of Lopinavir/Ritonavir for the Treatment of COVID-19 Pneumonia Monitored by Quantitative RT-PCR	Lim J, Jeon S, Shin HY, Kim MJ, Seong YM, Lee WJ, Choe KW, Kang YM, Lee B, Park SJ	Journal of Korean medical science	2020	02/17	10.3346/jkms.2020.35.e79
Novel Coronavirus Pneumonia Outbreak in 2019: Computed Tomographic Findings in Two Cases	Xiaoqi Lin, Zhenyu Gong, Zuke Xiao, Jingliang Xiong, Bing Fan, Jiaqi Liu	Korean journal of radiology	2020	02/11	10.3348/kjr.2020.0078
CT Imaging of the 2019 Novel Coronavirus (2019-nCoV) Pneumonia	Junqiang Lei, Junfeng Li, Xun Li, Xiaolong Qi.	Radiology - Radiological Society of North America	2020	01/31	doi.org/10.1148/radiol.2020200236
First imported case of 2019 novel coronavirus in Canada, presenting as mild pneumonia	William Kyle Silverstein, Lynfa Stroud, Graham Edward Cleghorn, Jerome Allen Leis	The Lancet	2020	02/13	10.1016/S0140-6736(20)30370-6
Imaging features of 2019 novel coronavirus pneumonia	Xi Xu, Chengcheng Yu, Lieguang Zhang, Liangping Luo, Jinxin Liu	European Journal of Nuclear Medicine and Molecular Imaging	2020	02/14	10.1007/s00259-020-04720-2
Importation and Human-to-Human Transmission of a Novel Coronavirus in Vietnam	Phan LT, Nguyen TV, Luong QC, Nguyen TV, Nguyen HT, Le HQ, Nguyen TT, Cao TM, Pham QD	The New England Journal of Medicine	2020	01/28	10.1056/NEJMc2001272
2019 Novel Coronavirus (2019-nCoV) Pneumonia	Peng Liu, Xian-zheng Tan.	Radiology - Radiological Society of North America	2020	02/04	doi.org/10.1148/radiol.2020200257
A new coronavirus associated with human respiratory disease in China	Fan Wu, Su Zhao, Bin Yu, Yan-Mei Chen, Wen Wang, Zhi-Gang Song, Yi Hu, Zhao-Wu Tao, Jun-Hua Tian, Yuan-Yuan Pei, Ming-Li Yuan, Yu-Ling Zhang, Fa-Hui Dai, Yi Liu, Qi-Min Wang, Jiao-Jiao Zheng, Lin Xu, Edward C. Holmes & Yong-Zhen Zhang	Nature	2020	02/03	doi.org/10.1038/s41586-020-2008-3
A pneumonia outbreak associated with a new coronavirus of probable bat origin	Peng Zhou, Xing-Lou Yang, Xian-Guang Wang, Ben Hu, Lei Zhang, Wei Zhang, Hao-Rui Si, Yan Zhu, Bei Li, Chao-Lin Huang, Hui-Dong Chen, Jing Chen, Yun Luo, Hua Guo, Ren-Di Jiang, Mei-Qin Liu, Ying Chen, Xu-Rui Shen, Xi Wang, Xiao-Shuang Zheng, Kai Zhao, Quan-Jiao Chen, Fei Deng, Lin-Lin Liu, Bing Yan, Fa-Xian Zhan, Yan-Yi Wang, Geng-Fu Xiao & Zheng-Li Shi.	Nature	2020	02/03	doi.org/10.1038/s41586-020-2012-7
A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster	Chan JF, Yuan S, Kok KH, To KK, Chu H, Yang J, Xing F, Liu J, Yip CC, Poon RW, Tsoi HW, Lo SK, Chan KH, Poon VK, Chan WM, Ip JD, Cai JP, Cheng VC, Chen H, Hui CK, Yuen KY.	The Lancet	2020	01/24	10.1016/S0140-6736(20)30154-9
First case of 2019 novel coronavirus infection in children in Shanghai	Cai JH, Wang XS, Ge YL, Xia AM, Chang HL, Tian H, Zhu YX, Wang QR, Zeng JS.	Chinese journal of pediatrics	2020	02/04	10.3760/cma.j.issn.0578-1310.2020.0002
A Novel Coronavirus from Patients with Pneumonia in China, 2019	Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, Zhao X, Huang B, Shi W, Lu R, Niu P, Zhan F, Ma X, Wang D, Xu W, Wu G, Gao GF, Tan W	The New England Journal of Medicine	2020	01/24	10.1056/NEJMoa2001017

Article title	List of authors	Journal name	Year	MM/DD	doi
Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China	Wang W, Tang J, Wei F	Journal of medical virology	2020	01/29	10.1002/jmv.25689
Transmission of 2019-nCoV Infection from an Asymptomatic Contact in Germany	Rothe C1, Schunk M, Sothmann P, Bretzel G, Froeschl G, Wallrauch C, Zimmer T, Thiel V, Janke C, Guggemos W, Seilmaier M, Drosten C, Vollmar P, Zwirglmaier K, Zange S, Wölfel R, Hoelscher M	The New England Journal of Medicine	2020	01/30	10.1056/NEJMc2001468
COVID-19, Australia: Epidemiology Report 2	COVID-19 National Incident Room Surveillance Team.	Communicable diseases intelligence - Australian Government Department of Health	2020	02/12	10.33321/cdi.2020.44.14
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