Clinical characteristics and health care cost among patients successfully treated for COVID-19 in Henan, China: A Descriptive Study

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Research

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Clinical characteristics and health care cost among patients successfully treated for COVID-19 in Henan, China: A Descriptive Study

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Abstract

Objective: To clarify the clinical and medical expense characteristics of COVID-19.

Methods: In this retrospective, single-center study, 55 cured cases with confirmed COVID-19 were analyzed for demographic, epidemiological, clinical, and radiological features and medical expense data.

Results: The average age of the 54 successfully treated patients with COVID-19 was 53.2 years old (SD 19.0), including 27 men and 27 women. Off this, 31 (57.4%) patients had chronic diseases. Patients commonly had clinical manifestations of fever (45 [83.3%] patients), cough (29[54.7%] patients), expectoration (28 [51.9%] patients), fatigue (24[44.4%] patients) and diarrhea (8[14.8%] patients) on admission. There was a 10-day interval from the onset of signs and symptoms to hospital admission. About 80% of them got recovery after a two-week treatment. The mean interval from the onset of signs and symptoms to hospital discharge was 20.5 (IQR 16-29) days. The median total medical expense of the treated patient, in general, was 2579.6 (IQR 1366.1-4837.6) U.S. dollars. Still, the median medical expense was 8904.1 (IQR 6660.1- 27143.8) U.S. dollars in patients with more than five comorbid illnesses during the treatment.

Conclusion: There is a 3-week interval from the onset of signs and symptoms to cure, and most hospitalized patients get recovery within two weeks. The total medical expense of cases with more than five comorbid conditions during the treatment is higher. Quite a few COVID-19 cases with other serious diseases are likely to account for most of the total medical expenses.

Research in context

Evidence before this study

We searched PubMed on May 13, 2020, for articles that describe the epidemiological, clinical, and health economic characteristics of COVID-19, using the search terms "COVID-19" or "2019 novel coronavirus (2019-nCoV)" with no language or time restrictions. Previously published research discussed the sources if SARS-CoV-2, epidemiological and clinical characteristics, mechanism, symptoms and diagnosis, prevention, and treatment strategies of COVID-19. The only report of the health care cost data of COVID-19 on China and the world was published on Apr 16, 2020, with analysis from the socio-economic perspective. To the best of our knowledge, no study has examined the hospital cost data of COVID-19.

Added value of this study

This study is, to our knowledge, the earliest study to date of COVID-19 infections, with 54 cured patients admitted into Henan Provincial People's Hospital and provides further information on the demographic, clinical, epidemiological, and health care cost of patients. It presents the latest status of COVID-19 treatment and control in China and is an extended investigation of the previous report, with more details on health services utilization.

Implications of all the available evidence

There is a 3-week interval from the onset of signs and symptoms to cure, and most hospitalized patients get recovery within two weeks. COVID-19 infection does not cost much to treat for most cases, with quite a few cases with more than five comorbid diseases during the treatment accounting for most of the expenses. Priority should be given on timely hospitalization, and active intervention for comorbid conditions to effectively lower the medical costs and prevent the spread of this coronavirus in China and worldwide.

Introduction

Since Dec 8, 2019, COVID-19 epidemic occurred in Wuhan, Hubei province, China.[1-4] In the past months, COVID-19 has resulted in more than 3.6 million confirmed cases, and 250 thousand died cases globally, exceeding the impacts of confirmed cases of SARS (8273 cases, 775 deaths) and MERS (2494 cases and 858 deaths). [5-7] COVID-19 infection has clinical symptoms of respiratory diseases resembling SARS, with fever, fatigue, dry cough as the primary manifestations. [8-11] Most of the patients were moderate to mild, with a good prognosis, and a few were in critical condition. [12,13]

Based on the current epidemiological evidence, the incubation period of COVID-19 is 1-14 days, mostly 3-7 days.[14-16] There is evidence of human-to-human transmission, and asymptomatic patients may also become the source of infection.[17,18] The main transmission routes are respiratory droplet transmission and contact transmission.[19] People of all ages are susceptible. [20,21] Children show better prognosis than the elderly and adults with chronic diseases have poor.[22]

At present, information regarding clinical characteristics and health care cost of patients successfully treated for COVID-19 is scarce. [23,24] In this study, we did a comprehensive exploration of the clinical and health economic features of 54 successfully treated patients with confirmed COVID-19 admitted to Henan Provincial People's Hospital, Zhengzhou, which cured all the patients with COVID-19 to be reported on.

Methods

Study design and participants

For this retrospective, single-center study, we recruited patients from Jan 23 to Feb 27, 2020, at Henan Provincial People's Hospital in Zhengzhou, China. Henan Provincial People's Hospital is a Regional Medical Center of central China with the Infectious Disease Department as its critical specialized department. As COVID-19 medical observation and hospitalization institution designated by the Chinese government, the hospital received all suspected patients with COVID-19 related symptoms (fever or respiratory symptoms) from the whole of Henan province and surrounding provinces without selectivity. All patients diagnosed as having COVID-19, according to World Health organization (WHO) interim

guidance was enrolled in this study.[25] All the data of included cases have been reported to provincial and national CDCs. No patients of this retrospective study were directly involved in the recruitment and design and identified through the anonymized database. The study was approved by the Henan Provincial People's Hospital Ethics Committee.

Procedures

The demographical, clinical, and health care cost data were obtained from the Hospital Information System of Henan Provincial People's Hospital. Clinical outcomes were followed up to the discharge date of the last patient (Mar 10, 2020). In terms of data missing from the records or clarification was needed, we obtained data by direct communication with healthcare providers of the Infectious Disease Department of Henan Provincial People's Hospital. There was no missing health economic data. All data were checked by three independent physicians (LM, LF, and CRR).

Outcomes

We described demographic characteristics (age, sex, marriage, etc.) and epidemiological characteristics (allergy drug, morbid chronic disease, exposure history, etc.); Clinical characteristics(signs and symptoms at admission, duration of Signs and symptoms at admission, comorbidities, etc.); Chest radiography and Computed Tomography (CT) findings; Treatment (Oxygen therapy, Mechanical ventilation, traditional Chinese medicine treatment, etc.) and outcome (cure rate); Health economic characteristics (total medical expenses and composition) and the correlations between total medical expense and comorbid chronic medical illness.

Statistical analysis

We presented continuous variables as mean (SD) and median (IQR), respectively, and categorical variables as count (%). We used linear regression to analyze the correlation between the total medical expense and comorbid chronic medical illnesses among the sampled patients. $P<0.05$ was considered statistically significant. Statistical analysis was performed using SPSS (Version 26.0).

Role of the funding source

The funder has no role in study design, analysis, and interpretation of the study findings.

Results

A total of 54 patients with COVID-19 were included in this study, and each of them come from different families. The mean age for all patients was 54.2 years old, ranging from 20 to 90 years old, and patients aged 50-59 were most numerous (31.5%). Half of the patients were male (50.0%). 23 (42.6%) patients lived in rural areas. Off these, 31(56.4%) patients had chronic diseases, and ten (18.5%) had more than one chronic disease. Five patients had a self-reported medical history of Penicillin or Piperacillin hypersensitivity (table 1).

On admission, the patients commonly experienced symptoms of fever (83.6%), cough (55.6%), expectoration (50.9%), fatigue 24 (44.4%), and diarrhea (14.5%) (table 2). The mean interval from the onset of signs and symptoms to hospital admission was 10 (5-25) days. More than a third of the patients were admitted within one week, but 9 (16.7%) had signs and symptoms for more than three weeks before seeking hospitalization services. Some patients presented with organ function damage, including 14 patients (25.5%) with acute respiratory injury, seven patients (12.7%) with ARDS, four patients (7.3%) with septic shock, and three patients (5.5%) with acute renal injury. According to chest X-ray and CT, 53 (98.2%) patients showed bilateral pneumonia, with only 14 (23.3%) patients showing unilateral pneumonia (table 2). It's worth noting that 38 (70.4%) patients showed multiple mottling and ground-glass opacity (table 2).

All patients were treated in isolation. All patients received antiviral treatment, and the duration of antiviral treatment was 5–14 days (median7.2 days [IQR 6–11]). Most patients (87.0%) were given antibiotic treatment (table 2); 46(85.2%) patients were given combination therapy. Only 1(1.9%) patient was given CRRT and ECMO therapy. Also, 49 (90.7%) patients were given proprietary Chinese medicine (including traditional Chinese medicine injection) recommended by the National Health Commission (table 2).

During the treatment, 43(78.2%) patients had at least one comorbid condition, 11 (20.4%) had more than five comorbid illnesses. By the end of Mar 10, 2020, all patients had been discharged. The mean interval

from the onset of signs and symptoms to hospital discharge was 20.5 (16-29) days. The median length of stay was 9.5 (6.8-12.3) days. About a quarter of the patients got discharged within one week, and patients receiving 1 to 2 weeks of hospitalization services were most numerous. The median total medical expense was 2579.6 ($ 1366.1-4837.6) U.S dollar, comprising drug expenses (37.5%), health services expenses (29.1%), test expenses (18.1%), and medical material expenses (15.3%). The medical costs varied greatly among different patients. The 54 patients cost $ 504663.2 U.S. dollars in total, with the top five highest expenses accounting for 70.2% ($354349.9 US dollars). The highest medical expense (US $212542.6) came from a patient using a combination of ECMO and CRRT therapies. The intervals between the onset of symptoms and the discharge were 38 days (Jan 24 to Mar 10, 2020). The second-highest expense was $ 51443.4 U.S. dollars, which was only less than a quarter of the highest cost.

Excluding the patient with the highest medical expense, the median medical cost was 8904.1 (IQR $ 6660.1- 27143.8) U.S dollars in patients with more than five comorbid conditions during the treatment, compared to the 2019.3 (IQR $1231.2-$3151.8) U.S. dollars in the rest of the patients(P<0.001, picture A). The higher medical expense was found in organ function damage cases (median, $6811.8 vs. $1964.1, P<0.001, picture B). For patients who used CRRT and ECMO in the treatment, the medical expenses were significantly higher than the rest cases (median, $8904.1 vs. $2163.6, P<0.001, picture C). The lowest cost was found in patients with a length of stay of less than one week ($1433.9 vs. $2908.2, P=0.008). No difference was identified for medical expenses among the rest patients with similar length of stay (picture D).

Discussion

This is an extended descriptive study on the clinical, epidemiological, and health care cost of 54 patients successfully treated patients with COVID-19, who were hospitalized in Henan Provincial People's Hospital. As a pandemic disease identified by WHO, COVID-19 is resulting in more death with an estimated case fatality rate ranging from 0.15% to 11%. [26-29] At data cut off for this study, no case of the 54 included patients infected by COVID-19 died. However, additional deaths might occur in subsequent

cases. As new reports of re-infections among previously treated COVID-19 cases come from some countries, including China, the health status of the discharged patients' needs continuous follow-up.

In the present study, we found that most patients were middle- and old-aged, with 1:1 male-female ratio. The mean age (53.2[SD 19.0])) is younger than data reported by Chen et al. and Zhang et al. [29, 30] 56.4% of the patients had at least one chronic illness on admission. During the treatment, 78.2% of them developed comorbid conditions, many of them progressed into organ dysfunction, including acute respiratory injury (ARDS), septic shock, and acute renal injury. Therefore, early identification and timely treatment of critical cases are crucial for preventing disease and multiorgan failure. Although fever (83.6%), cough (55.6%), expectoration (50.9%), fatigue (44.4%) and diarrhea (14.5%) were the most common symptoms in the 54 patients, the prevalence of symptoms in this cohort was significantly lower than previously reported data.[21, 31] This might be one of the reasons why all 54 patients were cured, it is known that fever severity correlates with disease severity and risk of developing ARDS.[32] These individuals where many were asymptomatic carriers or that the disease may represent a cohort of mild infection. They also were caught early and treated. It's important to note that there was a 10-day interval from the onset of signs and symptoms to hospital admission. These asymptomatic or mild patients may cause more infections during the interval. Considering the human-to-human transmission characteristics and the unknown transmission rate of COVID-19, it is necessary to reduce the population's mobility during the pandemic.

In terms of treatment, minimizing treatment duration and comorbidities are critical for patient management. Most hospitalized patients were given treatments according to the COVID-19 protocol recommended by Chinese National Health Commission (version 1 was published on Jan 23, 2020, the latest version 7 was released on Mar 4, 2020), including oxygen therapy, antibiotics, antivirals, Glucocorticoids, and traditional Chinese medicine. Considering that old age and comorbidities might be associated with low immunity and increased mortality, many of them were given a combination of antibiotics and intravenous immunoglobulin to prevent infection and strengthen their immune system. For patients with ARDS, steroids (methylprednisolone 1–2 mg/kg per day) were used for as short a duration

of treatment as possible. In general, the treatments were effective, with all patients cured, and about 80% of them got recovery within the two-weeks treatment duration.

According to our data, COVID-19 is not very expensive to treat (Median 2579.6 [IQR 1366.1-4837.6]), compared to the average cost of tertiary hospitalization of China in 2018 (US $1885.7) [33] and Henan Provincial People's Hospital in 2019($2971.5). During treatment, if individuals developed more than five comorbid diseases in patients, their total medical expenses are likely to increase significantly. Further, although the sequelae of COVID-19 are not entirely clear, patients with more than five comorbidities during the treatment are likely to have higher long-term health expenditure. Although CRRT combined with ECMO is useful in treating severe patients, the therapy is greatly costly.[34, 35] Timely intervention in patients and the prevention of progression to other comorbidities is crucial to reduce high medical costs.

This study has several limitations. First, only 54 successfully treated patients with confirmed COVID-19 were included; suspected but undiagnosed cases were ruled out in the analyses. It would be better to include as many treated patients as possible in Zhengzhou, in other cities in China, and even in other countries to get a more comprehensive understanding of COVID-19 from a health economic perspective. Further, the true economic burden may not have been assessed since only four or only 7.4% of the patients were intubated in this cohort, whereas in the Wuhan, China cohort was close to 43%.[32, 36] Future studies should examine the burden of COVID-19, particularly regarding health-adjusted life years, disability-adjusted life years, health-related quality of life, and potential years of life loss.

Declarations

Ethics approval and consent to participate

All enrolled patients gave written informed consent before the clinical treatment in Henan Provincial People's Hospital. The ethics committee of Henan Provincial People's Hospital ruled that no formal ethics approval was required in this particular case.

Consent for publication

All authors have approved the final manuscript and consented for the publication.

Availability of data and material

The anonymized dataset of this article is available through the email of the corresponding author.

Competing interests

The authors declare that there is no conflict of interest.

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Authors' contributions

YD M, MZ L, F L and HY Z collected the epidemiological and clinical data and processed statistical data. YD M, JQ G and ZJ C drafted the manuscript. S B, S H, U B, J W and RR C revised the final manuscript. LY W and M L are responsible for summarizing all data related to clinical features. YD M, JQ G and HY Z are responsible for summarizing all health services utilization data.

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Table 1: **Demographic information and Epidemiological characteristics of 55 successfully treated patients admitted to Henan Provincial People's Hospital (Jan 23– Mar 10, 2020) with COVID-19**

	Patients (n=54)
Age, years	
Mean (SD)	53.2(19.0)
Range	20-90
≤29	9(16.7%)
30-39	6(11.1%)
40-49	5(9.3%)
50-59	17(31.5%)
60-69	6(11.1%)
70-79	6(11.1%)
≥80	5(9.3%)
SEX	
Female	27(50.0%)
Male	27(50.0%)
Place of residence	
Rural	23(42.6%)
Urban	31(57.4%)
Health insurance	
Social health insurance	37(68.5%)
Commercial medical insurance	12(22.2%)
No health insurance	5(9.3%)
Allergy Drug	
None	49(81.6%)
Penicillin	4(6.7%)
Piperacillin	1(1.7%)
Chronic illness	
Any	31(57.4%)
0 disease	23(42.6%)
1 disease	21(38.8%)
2 diseases	5(9.3%)
3 diseases	3(5.6%)
4 diseases	2(3.7%)

Note: Data are n (%); COVID-19= Corona Virus Disease 2019. SD=standard deviation. Three medical staffs were diagnosed with COVID-19, but none of them was the staff of Henan Provincial People's Hospital.

Table 2: **Clinical characteristics, treatment and outcome of patients with COVID-19**

	Patients (n=54)
Signs and symptoms at admission	
Fever	45(83.3%)
Cough	29(54.7%)
Expectoration	28(51.9%)
Fatigue	24(44.4%)
Diarrhoea	8(14.8%)
Onset of symptoms to hospital admission, Day	
Median (IQR)	10.0 (5-20)
≤7	19(35.2%)
8-14	16(29.6%)
14-20	10(18.5%)
≥21	9(16.7%)
Chest X-ray and CT findings	
Unilateral pneumonia	14(23.3%)
Bilateral pneumonia	53(98.1%)
Multiple mottling and ground-glass opacity	38(70.4%)
Treatment	
Oxygen therapy	41(74.5%)
Mechanical ventilation	
Non-invasive (ie, face mask)	11(20.4%)
Invasive	4(7.4%)
CRRT	8(14.8%)
ECMO	2(3.7%)
Antibiotic treatment	47(87.0%)
Antifungal treatment	7(13.0%)
Antiviral treatment	54(100.0%)
Glucocorticoids	37(68.5%)
Intravenous immunoglobulin therapy	9(16.7%)
Traditional Chinese medicine treatment	49(90.7%)
Comorbid illness during the treatment	
Any	43(78.2%)
0 disease	12(22.2%)
1 disease	13(24.1%)
2 diseases	7(13.0%)
3 diseases	6(11.1%)
4 diseases	5(9.3%)
≥5 diseases	11(20.4%)
Organ function damage	
Acute respiratory injury	13(24.1%)
ARDS	7(13.0%)
Septic shock	4(7.4%)
Acute renal injury	3(5.6%)
Clinical outcome	
Remained in hospital	0(100.0%)
Discharged	54(100.0%)
Died	0(100.0%)
Length of stay, Day	
Median (IQR)	9.5 (6.8-12.3)
≤7	14(25.9%)
8-13	29(53.7%)
14-20	7(13.0%)

≥21	4(7.4%)
Onset of symptoms to Discharge (Day)	
Median (IQR)	20.5(16-29)
≤13	7(13.0%)
14-20	20(37.0%)
≥21	27(50.0%)

Note: IQR=interquartile range. ARDS=acute respiratory distress syndrome. ECMO=extracorporeal membrane oxygenation. CRRT=continuous renal replacement therapy. COVID-19= Corona Virus Disease 2019.

Table 3: **Medical expense characteristics of successfully treated patients with COVID-19**

	Patients (n=54)
Medical expense ($)-median (IQR)	
Total medical expense	2579.6(1366.1-4837.6, 100%)
Drug expense	705.5(386.0-705.5, 37.5%)
Health services expense	647.4(407.0-1256.5, 29.1%)
Test expense	932.6(576.4-932.6, 18.1%)
Medical material expense	76.2(38.5-177.9, 15.3%)
Distribution of total medical expense	
Top 1 case	212542.6(42.1%)
Top 5 cases	354349.8(70.2%)
Top 15 cases	424716.1(84.2%)
Top 25 cases	459592.7(91.1%)
Top 35 cases	482164.8(95.5%)
Top 45 cases	496109.4(98.3%)
All 54 cases e throat	504663.2(100.0%)

Note: Data are n (%), n/N (%), and median (IQR). COVID-19= Corona Virus Disease 2019. The exchange rate between RMB and US dollar is 1 to 7.095.

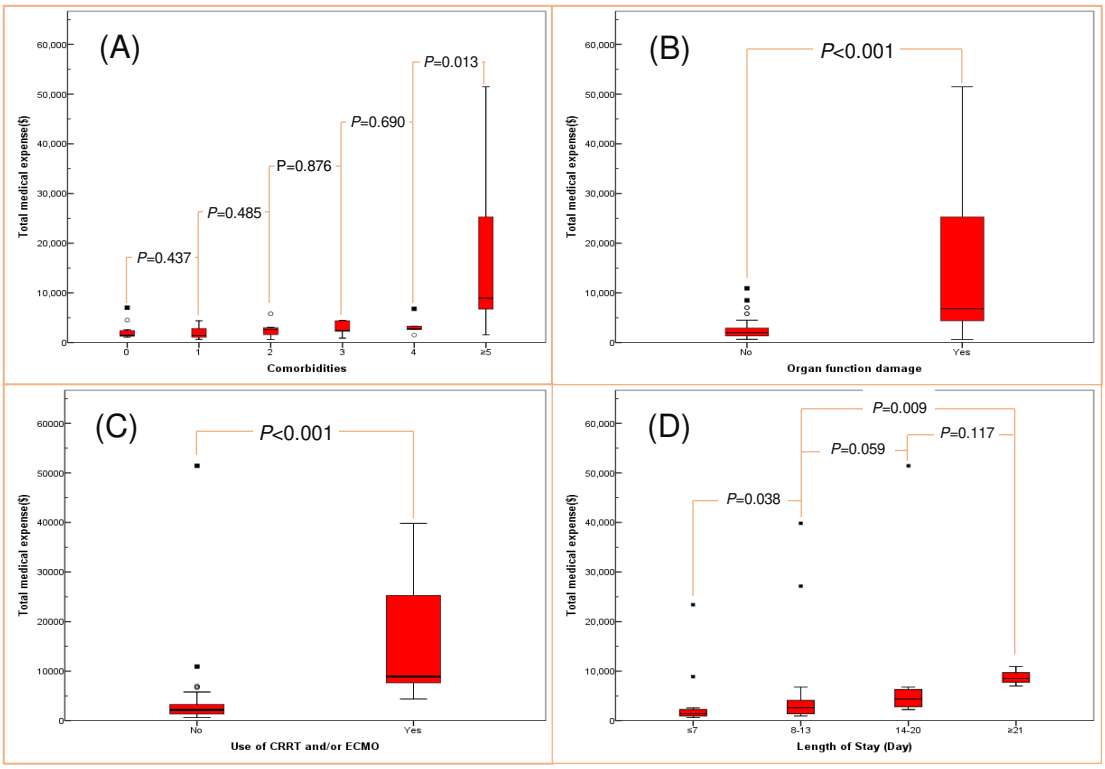

Figure: Comparisons of total medical expenses between/among different groups of 53 successfully treated patients with COVID-19.

Figure A-D did not contain the medical expense of the patient with the highest medical expenses ($212542.6, accounting for 42.1% of the total medical expenses of the 54 patients).

Figures

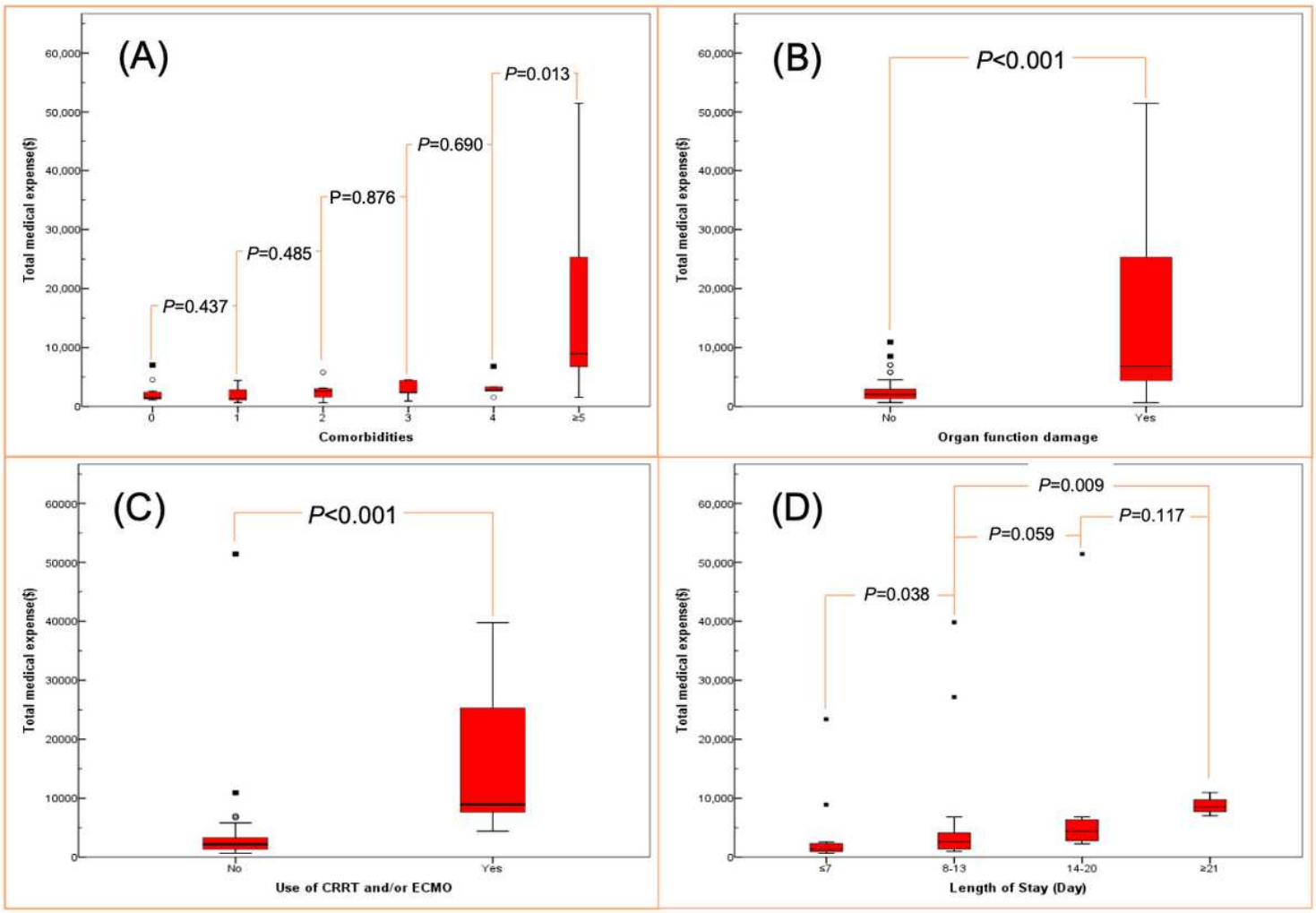

Figure 1

Comparisons of total medical expenses between/among different groups of 53 successfully treated patients with COVID-19. Figure A-D did not contain the medical expense of the patient with the highest medical expenses ($212542.6, accounting for 42.1% of the total medical expenses of the 54 patients).