

Healthcare Costs Associated with Severe vs Moderate and Mild COVID-19 – A US Payer Perspective

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Introduction

- In the United States, Coronavirus Disease 2019 (COVID-19) has impacted more than 82 million individuals as of April 1st, 2022.¹ COVID-19 healthcare costs, from the perspective of the American payers are not well understood.
- A unique characteristic of COVID-19 is its heterogenous presentation: people infected with SARS-CoV-2 develop a wide range of symptoms from asymptomatic to deadly, and therefore healthcare costs and utilization vary greatly.²

Objective

- Evaluate disease-specific and all-cause costs associated with all treatments provided during the duration of COVID-19, from the perspective of the US commercial payer, based on patient severity.

Methods

- Database: IBM® MarketScan® Commercial and Medicare Supplemental databases
- Patients with COVID-19 (first date = index) from April 1, 2020 to June 30, 2021 onwards were stratified by severity (mild, moderate and severe/critical (SC)), based on the Janssen Phase 3 ENSEMBLE Clinical Trial definition of severity.³ The algorithms used to define mild, moderate and severe based on the trial definition and diagnoses of COVID-19 signs and symptoms (CSS) are shown in [Table 1](#).
- Duration of disease was defined as follows: from 5 days before positive test to last related visit/prescription, with a maximum gap of 35 days between visits/prescriptions.
- Variables included demographics, comorbidities (Elixhauser index (EI) and all 31 Elixhauser disease domains), and all CSS during index disease, as well as treatments received during the inpatient care.
- Healthcare utilization and Payments: All healthcare payments for care in the in- or outpatient settings were analyzed for the entire duration of disease as defined above. Payments for visits or admissions with a CSS diagnosis were defined as “disease-specific” payments so that two different total payments could be analyzed: an “all-cause” payment, including all care encountered during the duration of the disease, and a “disease-specific” payment, including only care with CSS diagnoses.
- Statistical Analyses: Descriptive statistics were reported for all study variables. Payments were analyzed using generalized linear models (GLM) with gamma distribution and log links.

Results

- A total of 383,883 patients with a COVID-19 diagnosis or a positive COVID-19 test result, including 160,326 mild, 189,240 moderate, and 34,317 severe/critical (SC) cases, were analyzed, as shown in [Table 2](#) below.

Table 2: Baseline demographic characteristics of patients with COVID-19 stratified by severity of disease

Patient Characteristic	Severity of Disease at Index		
	Mild	Moderate	Severe/Critical
N	160,326	189,240	34,317
Age - Mean (standard deviation (SD))	37.71 (17.1)	42.70 (16.5)	55.58 (14.9)
Gender: Female – n (%)	88,257 (55.0)	107,260 (56.7)	15,234 (44.4)
Payer: Medicare Supplemental – n (%)*	4,106 (2.6)	9,027 (4.8)	6,812 (19.9)
Elixhauser Comorbidity Score – Mean (SD)	0.68 (1.15)	1.04 (1.49)	2.16 (2.35)
Elixhauser Score Category			
0	100,972 (63.0)	97,347 (51.4)	10,506 (30.6)
1 or 2	47,196 (29.4)	65,356 (34.5)	12,034 (35.1)
3 or 4	9,935 (6.2)	20,019 (10.6)	6,979 (20.3)
5 or more	2,223 (1.4)	6,518 (3.4)	4,798 (14.0)
Estimated Duration of Disease (Days) – mean (SD)	18.8 (15.3)	27.9 (30.8)	60.7 (67.0)

*All non-Medicare patients had commercial insurance

- As expected, age and comorbidities increased with disease severity, proportion of males also increased with increased severity, as expected from other studies that evaluated risk factors for severe disease.⁴
- The proportion of patients with an Elixhauser of 5 or above also increased, from 1.4% in the mild cases to 14.0% in the SC cases. Largest increase was observed between moderate and SC cases.
- Mild patients experienced COVID-19 for an average 19 days vs. 61 days for SC patients.
- [Table 3](#) shows adjusted disease-specific and all-cause healthcare costs for Commercial and Medicare patients.

Table 1: Algorithm used to define mild, moderate and severe patients based on CSS, and healthcare utilization (for ICU/Ventilator/ECMO use)

SEVERITY	Definition (Janssen Ensemble Phase 3 Clinical Trial) ³	Identification using Database Variable - including diagnoses for CSS, admissions (inpatient/ICU) and treatments (ventilator/ECMO)
Mild	One of the following symptoms: fever (≥38.0°C or ≥100.4°F), sore throat, malaise (loss of appetite, generally unwell, fatigue, physical weakness), headache, muscle pain (myalgia), gastrointestinal symptoms, cough, chest congestion, runny nose, wheezing, skin rash, eye irritation or discharge, chills, new or changing olfactory or taste disorders, red or bruised looking feet or toes, or shaking chills or rigors.	At least 1 of: Chills, cough, chest congestion, fever, eye irritation or discharge, headache, GS, malaise, myalgia, OTD, runny nose, skin rash, sore throat, wheezing - and: Do not qualify as moderate or severe
Moderate	Any 1 of the following new or worsening signs or symptoms: Respiratory rate ≥20 breaths/minute, abnormal saturation of oxygen (SpO2) but still >93% on room air at sea level, clinical or radiologic evidence of pneumonia, radiologic evidence of deep vein thrombosis (DVT), shortness of breath or difficulty breathing Any 2 of the following new or worsening signs or symptoms: Fever (≥38.0°C or ≥100.4°F), heart rate ≥90 beats/minute, shaking chills or rigors, sore throat, cough, malaise as evidenced by 1 or more of the following: - Loss of appetite - Generally unwell - Fatigue - Physical weakness, headache, muscle pain (myalgia), Gastrointestinal symptoms (diarrhea, vomiting, nausea, abdominal pain), new or changing olfactory or taste disorders, red or bruised looking feet or toes	At least 1 of: DVT, pneumonia, shortness of breath (may be coded as outpatient-only ARF/ARDS), tachypnea, hypoxemia, or: At least 2 of: Chills or rigors, cough, fever, gastrointestinal symptoms, headache, malaise, myalgia, new or changing olfactory or taste disorders, skin rash, sore throat, tachycardia - and: Do not qualify as severe/critical
Severe / Critical	Clinical signs at rest indicative of severe systemic illness (respiratory rate ≥30 breaths/minute, heart rate ≥125 beats/minute, oxygen saturation (SpO2) ≤93% on room air at sea level, or partial pressure of oxygen/fraction of inspired oxygen (PaO2/FiO2)- Respiratory failure (defined as needing high-flow oxygen, non-invasive ventilation, mechanical ventilation, or extracorporeal membrane oxygenation [ECMO]) - Evidence of shock (defined as systolic blood pressure (defined as systolic blood pressure < 90 mm Hg, diastolic blood pressure < 60 mm Hg, or requiring vasopressors) - Significant acute renal, hepatic, or neurological dysfunction - Admission to the ICU - Death	Severe systemic illness characterized by inpatient admission with at least 1 of: hypoxemia, hepatic failure, neurological dysfunction, renal failure, shock, tachypnea, tachycardia, respiratory failure/distress or mechanical ventilation or ECMO or ICU admission (death not identifiable in database)

References:

- <https://www.worldometers.info/coronavirus/country/us/>
- Rodebaugh *et al.* Open Forum Infect Dis. 2021 Mar 1; 8(3):ofab090.
- <https://www.jnj.com/coronavirus/covid-19-phase-3-study-clinical-protocol> accessed April 20, 2022.
- Sepulchre E *et al.* Acta Clin. Belg. 2022 Apr; 77(2):261-267

Table 3. Adjusted average costs of symptomatic patients with COVID-19 stratified by severity of disease

Mean (95%CI)	Commercial	Medicare Supplemental
Disease Specific Costs		
Severity = Mild	\$427 (95%CI: \$419-\$435)	\$573 (95%CI: \$513-\$634)
Severity = Moderate	\$1,787 (95%CI: \$1,756-\$1,817)	\$2,096 (95%CI: \$1,950-\$2,242)
Severity = SC	\$27,335 (95%CI: \$26,140-\$28,530)	\$13,080 (95%CI: \$12,032-\$14,127)
Disease Specific Incremental Costs		
From mild to moderate	\$1,359 (95%CI: \$1,328-\$1,390)	\$1,523 (95%CI: \$1,366-\$1,679)
From mild to SC	\$26,908 (95%CI: \$25,712-\$28,103)	\$12,506 (95%CI: \$11,456-\$13,556)
All-Cause Costs		
Severity = Mild	\$1,040 (95%CI: \$1,018-\$1,061)	\$2,209 (95%CI: \$2,070-\$2,349)
Severity = Moderate	\$3,607 (95%CI: \$3,542-\$3,673)	\$7,011 (95%CI: \$6,713-\$7,309)
Severity = SC	\$47,121 (95%CI: \$44,999-\$49,242)	\$35,404 (95%CI: \$33,721-\$37,088)
All-Cause Incremental Costs		
From mild to moderate	\$2,568 (95%CI: \$2,501-\$2,634)	\$4,801 (95%CI: \$4,481-\$5,121)
From mild to SC	\$46,081 (95%CI: \$43,959-\$48,203)	\$33,195 (95%CI: \$31,507-\$34,883)

*SC: Severe/Critical

Abbreviations:

COVID-19: Coronavirus disease 2019
CSS: COVID-19 signs and symptoms
ECMO: Extracorporeal membrane oxygenation
GLM: Generalized linear model
ICU: Intensive Care Unit
SC: Severe/Critical
SD: Standard deviation

Key Findings

- Patients within the US claims databases were characterized as mild, moderate and severe/critical, using diagnoses of COVID-19 signs and symptoms.
 - Increase in age, comorbidity and duration of disease was observed with increased disease severity, as expected from prior research.
- The cost of care for mild patients was low, with disease-specific costs averaging < \$1K.
- All-cause cost of care of severe/critical patients, however, averaged nearly \$50K for commercial payers and \$35K for Medicare. As expected, Medicare costs are much lower than costs for commercial payers.

Conclusions

- Payer costs for treatment of COVID-19 increase significantly with disease severity.
- On average:
 - The disease-specific costs for treatment of severe/critical COVID-19 were 8-10X higher than those required for treatment of moderate disease.
 - The all-cause costs for treatment of severe/critical COVID-19 were 5-10X higher than those required for treatment of moderate disease.