ORIGINAL ARTICLE

# Direct Medical Cost Analysis of Indian COVID-19 Patients Requiring Critical Care Admission

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## Abstract

**Introduction:** Intensive care unit (ICU) admission is required for approximately 25% of patients affected with coronavirus disease-19 (COVID-19) and imposes a high economic burden on patients in resource-limited settings.

**Method:** We conducted a retrospective direct medical care cost analysis of COVID-19 patients requiring ICU admission after obtaining the Institutional Ethics Committee approval. Data were obtained from the records of patients admitted to the COVID-19 ICU of a tertiary care trust teaching hospital from June 2020 to December 2020. Direct costs were analyzed and correlated with various demographic variables and clinical outcomes.

**Results:** A total of 176 patients were included (males—76%). The median direct medical cost for a median stay of 13 days was INR 202248.5 ($ 2742.91). Hospital drugs and disposables accounted for 20% of the total cost followed by bed charges (19%), equipment charges (17%), biosafety protective gear (15.5%), pathological and radiological tests (15%), clinical management (7.6%), and biomedical waste management (1.6%). Government schemes accounted for 79% of medical claims followed by directly paying patients (12.5%) and private insurance (8.5%). The cost was significantly higher in patients with diabetes mellitus and sepsis and in those requiring mechanical ventilation (MV) ($p < 0.05$). Shorter lead time to hospital admission and lesser length of hospital stay were associated with significant lower direct cost.

**Conclusion:** Direct medical care cost is substantial for COVID-19 patients requiring ICU admission. This cost is significantly associated with increased ICU and hospital stay, longer lead time to admission, diabetes mellitus, sepsis, and those who need high-flow nasal cannula (HFNC), noninvasive ventilation (NIV), and MV.

**Keywords:** Cost, COVID-19, Intensive care unit.

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## Highlights

This unique study highlights the substantial economic burden faced by COVID-19 ICU patients in a tertiary care trust teaching hospital. High costs were associated with increased ICU and hospital stay, longer lead time to admission, diabetes mellitus, sepsis, and those who need HFNC, NIV, and MV.

## Introduction

As of June 2, 2021, India has reported 2,83,06,883 active coronavirus disease-19 (COVID-19) cases second only to the USA. The number of deaths in India is 3,35,114.[1] They attest to the suffering of patients, and the immense workload and stress the healthcare system have experienced. A subgroup analysis of a recent meta-analysis evaluating the rate of intensive care unit (ICU) admissions in coronavirus disease reveals that one in four patients affected with COVID-19 require admission to ICU.[2] Intensive care is expensive, and the cost of providing ICU care in COVID-19 varies widely across the geographical areas. The cost for the ICU treatment of COVID-19 in South Africa per patient is $ 7316, whereas the mean cost for the treatment is $ 16,652 in China, and $ 95,546 for non-ventilated ICU patients and $ 3,01,133 for ventilated ICU patients in the USA.[3–5]

In India, intensive care is one of the primary drivers of hospital cost accounting for 20 to 30% of a hospital's budget.[6] The penetration of health insurance is only 15% in rural and 20% in urban areas of India.[7] The National Health Accounts report suggests that out-of-pocket expenditure constitutes about 68% of total healthcare expenses.[8] Intensive care in India is primarily provided by the private sector, and costs are mostly borne through out-of-pocket expenditure by individuals. The COVID-19 pandemic is likely to have increased the economic burden on patients requiring ICU admission. There is a paucity of data from India regarding the cost of direct medical care for hospitalized COVID-19 patients.

We looked at the direct medical costs of patients with COVID-19 requiring intensive care and compared the findings with various demographic variables and clinical outcomes.

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**Conflict of interest:** None

## Materials and Method

### Study Area

The study was conducted in a tertiary care trust teaching hospital. The hospital was empaneled as a dedicated COVID health center by the state healthcare authorities with designated 350 hospital beds, including 75 ICU beds. The study received ethical approval from the Institutional Ethics Committee.

### Data Collection and Extraction

Data were extracted from the medical and billing records of patients admitted to the COVID-19 ICU from June 2020 to December 2020. The data included patients who were either directly admitted to the COVID-19 ICU or those who were later shifted to the ICU following worsening hypoxia or other complications. We excluded patients transferred from other hospitals, those seeking discharge against medical advice, and patients referred to another hospital after ICU admission on relatives' request.

The "lead time" was considered as the time between the onset of symptoms and admission to the hospital. The time at which the first symptom of COVID-19 was experienced by the patient was termed as "symptom onset." Symptoms included, but were not limited to fever, cough, weakness, diarrhea, and breathlessness.

Data extracted included age, gender, comorbidities, date of onset of illness, date of positive reverse transcriptase-polymerization chain reaction (RT-PCR) or rapid antigen test (RAT) COVID report, date of hospitalization, length of hospital stay, and length of ICU stay; and the World Health Organization (WHO) ordinal scale for clinical improvement severity grading (0–8)[9] was recorded. The severity of COVID-19 illness at admission was defined as per the Indian Council of Medical Research (ICMR) classification.[10]

### Direct Medical Cost

The hospital billing was done according to these eight categories:

- **Bed Charges:** Includes bed charges of the general ward, ICU, private rooms, and deluxe rooms.
- **Nursing Charges:** Includes nursing charges of the general ward, ICU, private rooms, and deluxe rooms.
- **Pathology Charges:** All laboratory tests (hematology, pathology, microbiology, and biochemistry), COVID RT-PCR, and RATs.
- **Radiological Charges:** X-rays, computed tomography scans, 2D Echo, and magnetic resonance imaging.
- **Procedure Charges:** Intubation, Foley's catheterization, catheterization, tracheotomy, and coronary angioplasty.
- **Hospital Drugs and Treatment:** Includes the cost of all the drugs and disposable items consumed by the patient during hospitalization.
- **Equipment Charges:** Ventilators, high-flow nasal cannula (HFNC), noninvasive ventilator (NIV), monitors, mechanical ventilation (MV), oxygen charges, syringe pumps, infusion pumps, air mattresses, and defibrillators.
- **In-patient Department (IPD) charges:** Consultation charges, biosafety protection costs including personal protective equipment (PPE), biomedical waste, administrative, and registration charges. The cost associated with flu isolation package, diet charges, respiratory, and physiotherapy was clubbed under miscellaneous for the ease of the analysis.

The costs charged to the patients in INR were converted to US dollars ($) at the exchange rate of 1$ = 73.735 INR as of May 7, 2021.

### Statistical Analysis

The data were checked for normality using the Skewness and Kurtosis test. The normally distributed data were presented using mean with standard deviation and non-normally distributed data using median with interquartile range (IQR). Normally distributed data were compared using the Student's *t*-test. Non-normally distributed data were compared using the Mann–Whitney *U* test. Categorical data are presented in terms of variables and percentages. For the ease of statistical interpretation, the median value was used as a cutoff for comparing the cost of hospitalization for patients in terms of length of hospital stay, ICU stay, and lead time between symptom onset to hospital or ICU admission. *p*-values <0.05 were considered statistically significant. All statistical tests were performed using Microsoft Excel 2010.

## Results

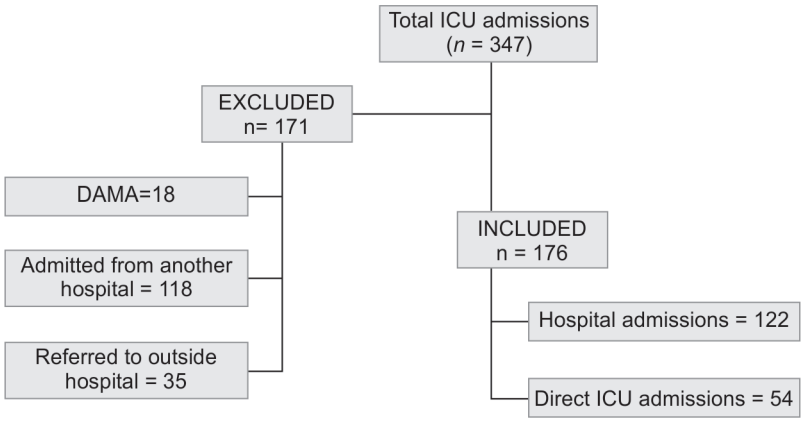
### Study Population

A total of 347 patients were admitted to ICU during the study period. Out of the total, 171 patients were excluded as they did not meet the inclusion criteria (Flowchart 1).

### Demographic Characteristics of the Study Population (Table 1)

Of the 176 patients, 76% were males, and no difference in age was noted between the genders. Seventy-two percent of the study population had at least one comorbidity, of which hypertension was the commonest (*n* = 89, 50.56%). Type 2 diabetes mellitus, ischemic

**Flowchart 1:** Study population



heart disease, chronic kidney disease, hypothyroidism, chronic obstructive pulmonary disease, and asthma were present in 45.45, 9.09, 3.94, 3.94, 2.84, and 1.70% of patients, respectively. Insurance schemes accounted for 154 (87.5%) patients, of which 139 (78.97%) individuals availed the government health schemes [Mahatma Jyotirao Phule Jan Arogya Yojana: MJPJAY ($n$ = 121), Maharashtra Police Kutumb Arogya Yojana: MJPKAY ($n$ = 17), and Central Government Health Scheme: CGHS ($n$ = 1)] and 17 (8.52%) patients had private insurance. Only 22 (12.5%) patients were self-paying.

## Clinical Outcomes of the Study Population (Table 2)

The median time for the patients to test COVID-19 positive from symptom onset was 3 days (IQR: 2–5 days). The median hospital stay was 13 days (IQR: 9–19 days), of which ICU stay was 9 days. The median time for patients to get admitted to ICU from the day of hospitalization was 2 days (IQR: 0–5 days). A total of 167 patients required ICU admission (94.9%) due to worsening hypoxia, while 9 patients (5.1%) were shifted to ICU in view of developing complications such as ischemic infarct ($n$ = 1), hemorrhage ($n$ = 1), uncontrolled diabetic ketoacidosis ($n$ = 2), portal hypertension ($n$ = 1), hematemesis ($n$ = 1), uncontrolled sepsis ($n$ = 2), and seizure ($n$ = 1). Forty-seven patients (27%) developed septic shock and required higher antibiotics. Of the 47 patients who developed sepsis, 8 patients died. This number of deaths was significantly higher among patients who developed sepsis than patients who did not develop sepsis ($p$ = 0.01). A total of 110 patients required the intervention of either HFNC or NIV or both, whereas 71% of the patients involved in the study were intubated and required invasive MV. Of the 176 patients, 58 patients were discharged after recovery.

## Disease Severity according to WHO Grading (Table 3)

Of the study population, 119 (67.61%) patients did not require oxygen support at hospital admission (grade 3), whereas 57 (32.39%) patients had oxygen requirement at admission (grades 4 and 5). The patients who did not require any oxygen support were admitted because they had existing comorbidities, older age, or could not be home isolated. Eighty-three patients were intubated at or immediately before ICU admission. Of the 58 patients discharged, only one patient required oxygen support at home.

**Table 1:** Demographical characteristics of the study population

| *Parameters* | *Values N = 176* |
|---|---|
| Gender | |
| Male, *n* (%) | *n* = 134 (76.14) |
| Age (mean ± SD) | 58.30 ± 13.34 |
| **Insurance status** | |
| Self-paying, *n* (%) | 22 (12.5) |
| Private insurance, *n* (%) | 15 (8.52) |
| MPKAY, *n* (%) | 17 (9.6) |
| MJPJAY, *n* (%) | 121 (68.75) |
| CGHS, *n* (%) | 1 (0.56) |
| **Comorbidities** | |
| None, *n* (%) | 50 (28.40) |
| 1 comorbidity, *n* (%) | 53 (30.11) |
| 2 comorbidities, *n* (%) | 49 (27.84) |
| 3 or more comorbidities, *n* (%) | 24 (13.63) |

*N*, total population; *n*, part of total population; SD, standard deviation; MPKAY, Maharashtra Police Kutumb Arogya Yojana; MJPJAY, Mahatma Jyotirao Phule Jan Arogya Yojana; CGHS, Central Government Health Scheme

**Table 2:** Clinical characteristics of the study population

| *Parameters* | *Values* |
|---|---|
| **Lead time in reaching hospital from onset of symptoms (days)** | |
| Median (IQR) | 4 (2–5) |
| **Duration between onset of symptoms to ICU admission (days)** | |
| Median (IQR) | 6 (4–9) |
| Duration of hospital stay (days) | |
| Median (IQR) | 13 (9–19) |
| Duration of ICU stay (days) | |
| Median (IQR) | 9 (5–13) |
| **Worsening hypoxia leading to ICU admission, *n* (%)** | 167 (94.9) |
| **Other complications leading to ICU admission, *n* (%)** | 9 (5.1) |
| **Patients developing sepsis during ICU stay, *n* (%)** | 47 (27) |
| **Interventions during hospitalization** | |
| No oxygen requirement, *n* (%) | 7 (3.97) |
| Nasal prongs/Face mask, *n* (%) | 143 (81.25) |
| NRBM, *n* (%) | 49 (27.84) |
| HFNC, *n* (%) | 88 (50) |
| NIV, *n* (%) | 22 (12.5) |
| MV, *n* (%) | 124 (70.45) |
| **Outcome at the end of hospitalization** | |
| Alive, *n* (%) | 58 (32.95) |
| Death, *n* (%) | 118 (67.04) |

IQR, interquartile range; ICU, intensive care unit; NRBM, non-rebreather reservoir bag mask; HFNC, high-flow nasal cannula; NIV, noninvasive ventilation

**Table 3:** Study population as per WHO severity grading

| *WHO grading* | *At hospital admission n (%)* | *At ICU admission n (%)* | *At the end of hospital/ICU stay n (%)* |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 56 (31.81) |
| 2 | 0 | 0 | 1 (0.56) |
| 3 | 119 (67.61) | 7 (3.97) | 0 |
| 4 | 50 (28.40) | 15 (8.52) | 1 (0.56) |
| 5 | 7 (3.9) | 31 (17.61) | 0 |
| 6 | 0 | 83 (47.15) | 0 |
| 7 | 0 | 42 (23.86) | 0 |
| 8 | 0 | 0 | 118 (67.04) |

*n*, part of total population; WHO, World Health Organization; ICU, intensive care unit

## Cost

Table 4 represents the overall healthcare cost associated with hospital and ICU admission. In the present study, a COVID-19 patient who required ICU admission had to bear a median cost of INR 2,02,249 ($ 2742.91). The mean cost of hospitalization was INR: 2,35,367 ($ 3192.06). However, since the data for cost were not normally distributed, we looked at the median values. For patients who availed government schemes, the median hospitalization cost was INR 2,17,380 (IQR: 1,38,969–3,22,034) [$ 2948.12 (IQR: $ 1884.70–$ 4367.45)]. The median difference in the amount of the final bill and the amount reimbursed through government schemes was INR 59,560 (IQR: 340–1,34,425) [$ 807.75 (IQR: $ 4.61–$ 1823.08)]. The median cost/patient/day stay in hospital was INR 16496.21 (IQR: 12498.99–20499.98) [$ 223.72 (IQR: $ 169.51–$ 278.02)].

According to the classification of costs as per hospital policy, IPD charges contributed to the maximum of the total cost. Within IPD costs, the major contributory factor was the biosafety protection cost (60.47%) followed by physician consultation (20.14%), miscellaneous charges (7.47%), biomedical waste management (6.35%), and administration charges (5.57%). Miscellaneous charges include administration charges, diet consultation charges, zipper bag charges, and indoor registration book-keeping charges.

If one were to consider the top 7 contributors to cost, hospital drugs and disposables contributed the maximum followed bed charges, equipment, biosafety gear, lab investigations and radiology, clinical management, and biomedical waste management charges (Fig. 1).

## Impact of Demographic Characteristics and Clinical Outcomes on Cost

Table 5 compares the healthcare cost with various demographic and clinical factors. Of the various demographic characteristics and comorbidities, only diabetes mellitus significantly contributed to cost ($p$ <0.05). Patients who developed septic shock also had a significantly higher cost of treatment ($p$ <0.05). A median delay of ≥4 days in lead time to hospitalization and ≥6 days in ICU admission from symptom onset resulted in a significantly higher cost of hospitalization. The total hospital expenses for patients with hospital or ICU stay more than the median duration were an additional INR 1,65,000/– ($ 2237.74). The median cost of treatment for patients who required respiratory therapy including HFNC, NIV, and MV [INR: 2,14,560 (IQR: 1,30,535–3,14,647) or $ 2909.87 (IQR: $ 1770.32–$ 4267.26)] was significantly greater than those patients who required only oxygen therapy with nasal prongs, simple face masks, or non-rebreather reservoir bag mask (NRBM) [INR: 1,35,530 (IQR: 69,760–1,66,590) or $ 1838.06 (IQR: $ 946.09–$ 2259.30)] ($p$ = 0.003). Patients requiring invasive MV had significantly higher direct median cost [INR 222148.5 (IQR: 134817.5–3,24,960) or $ 3012.79 (IQR: $ 1828.40–$ 4407.13)] as compared to patients who did not require invasive MV [INR 157668.5 (IQR: 1,12,973–238351.75) or $ 2138.31 (IQR: $ 1532.14–$ 3232.54)] ($p$ = 0.003). Of the 124 patients who received invasive MV, 106 died (85%) while only 12 (23%) of 52 patients who did not receive invasive MV succumbed to COVID-19. Median ICU stay for patients requiring MV was 9 days (IQR: 5–15), and for those not requiring MV it was 5 days (IQR 5–10); $p$ = 0.017. The median direct medical care expenses for patients were similar irrespective of mortality [alive: INR–221241.5 (1,35,825–320246.75) or $ 3000.49 (IQR: $ 1842.06–$ 4343.21); death: INR 1,97,755 (1,16,427–3,03,294) or $ 2681.96 (IQR: $ 1578.99–$ 4113.29)]. The length of stay was significantly more ($p$ <0.0001) for patients who survived [median hospital stay—18 days (IQR 12–23)] than those who succumbed to COVID-19 [median hospital stay—12 days (IQR 7–16)].

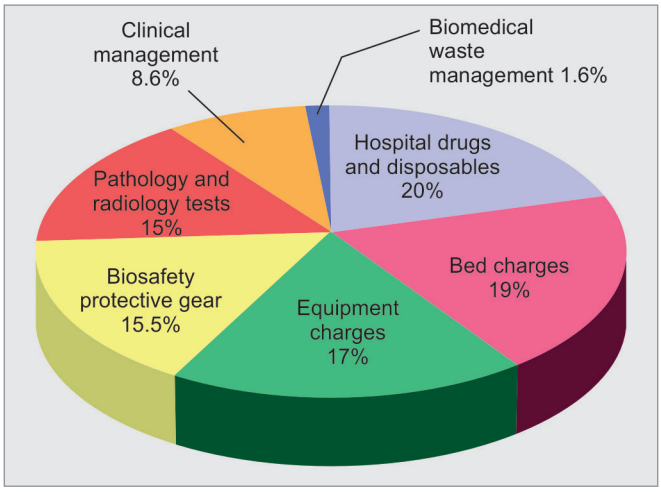



**Fig. 1:** Top 7 contributors of total direct medical care cost. Clinical management includes the physician and nursing consultation, and procedures; biosafety protective gear includes PPE and other protective equipment; and equipment charges include oxygen therapy. Remaining 2.4% of the total includes the combination of documentation and other administrative charges

**Table 4:** Classification of direct medical care cost as per hospital policy

| *Parameters (N = 176)* | *Percentage of total hospitalization cost* | *Cost–INR (Rs.) Median (IQR)* | *Cost–Dollar ($) Median (IQR)* |
|---|---|---|---|
| IPD charges | 26% | 51,500 (32,575–80,050) | 698.44 (441.78–1085.64) |
| Hospital drugs and material | 20% | 33,900 (15,701–57093.5) | 459.75 (212.93–774.30) |
| Bed charges | 19% | 35,000 (18687.5–52,125) | 474.67 (253.44–706.92) |
| Equipment charges | 17% | 29,400 (14,975–51912.5) | 398.72 (203.09–704.04) |
| Pathology charges | 12% | 26,390 (15,325–34,075) | 357.90 (207.83–462.12) |
| Radiological diagnostic tests | 3% | 3,200 (1,600–5,375) | 43.39 (21.69–72.89) |
| Nursing charges | 2% | 5,500 (2,100–7,580) | 74.59 (28.48–102.80) |
| Surgery procedure charges ($n$ = 124) | 1% | 2,250 (1139.75–4,050) | 30.51 (15.45–54.92) |
| Total hospital bill | — | 2,02,248.5 (127667.25–308293.75) | 2742.91 (1731.43–4181.10) |
| Difference amount[#] ($n$ = 114) | — | 94,900 (39.30–1,79,420) | 1287.04 (0.53–2433.30) |

*N*, total population; *n*, part of total population; IQR, interquartile range; INR, Indian rupee; IPD, in-patient department. [#]the difference of amount between maximum package provided by government scheme and actual direct medical cost incurred

**Table 5:** Comparison of costs with demographic and clinical variables

| Sl. No. | Parameters | Cost (INR) | Cost (dollar) | p value |
|---|---|---|---|---|
| 1. | **Age** | | | |
| | Young adults (age <55 years), median (IQR) | 1,76,140 (1,24,200–3,45,920) | 2388.82 (1684.41–4691.39) | 0.82 |
| | Older adults (age >55 years), median (IQR) | 2,08,615 (1,37,058–302203.5) | 2829.25 (1858.79–4098.50) | |
| 2. | **Comorbidities** | | | |
| A. | Without comorbidities, median (IQR) | 188277.5 (107018.25–296892.75) | 2553.43 (1451.39–4026.48) | 0.21 |
| | With comorbidities, median (IQR) | 207190.5 (1,36,415–314437.5) | 2809.93 (1850.07–4264.42) | |
| B. | Without diabetes mellitus | | | |
| | ($n = 96$), median (IQR) | 1,74,545 (1,10,418–282867.75) | 2367.19 (1497.49–3836.27) | <0.01* |
| | With diabetes mellitus, median (IQR) | 2,31,325 (155451.75–3,25,022) | 3137.24 (2108.24–4407.97) | |
| 3. | **Sepsis** | | | |
| | Without sepsis, median (IQR) | 194871.5 (114106.3–298483.8) | 2642.86 (1547.51–4048.06) | 0.04* |
| | With sepsis, median (IQR) | 2,26,960 (1,55,065–325111.25) | 3078.04 (2103.00–4409.18) | |
| 4. | **Lead time in reaching hospital from onset of symptoms** | | | |
| | Less than 4 days, median (IQR) | 1,87,470 (96,700–3,02,553) | 2542.48 (1311.45–4103.24) | 0.04* |
| | 4 or more than 4 days, median (IQR) | 2,14,560 (1,43,114–3,13,794) | 2909.87 (1940.92–4255.69) | |
| 5. | **Duration between onset of symptoms to ICU admission** | | | |
| | Less than 6 days, median (IQR) | 1,65,795 (77097.5–269615.75) | 2248.52 (1045.60–3656.55) | <0.01* |
| | 6 or more than 6 days, median (IQR) | 2,23,920 (1,53,740–3,33,639) | 3036.82 (2085.03–4524.83) | |
| 6. | **Length of ICU stay** | | | |
| | Less than 9 days, median (IQR) | 1,29,990 (74369.25–170379.75) | 1762.93 (1008.60–2310.70) | <0.01* |
| | Equal to or more than 9 days, median (IQR) | 295105.5 (217142.5–381452.5) | 4002.24 (2944.90–5173.28) | |
| 7. | **Length of hospital stay** | | | |
| | Less than 13 days, median (IQR) | 127444.5 (71842.75–170379.75) | 1728.41 (974.33–2310.70) | <0.01* |
| | Equal to or more than 13 days, median (IQR) | 296755.5 (208711.25–3,79,340) | 4024.62 (2830.55–5144.63) | |

IQR, interquartile range; ICU, intensive care unit; *n*, part of total population; INR, Indian rupee; *p* value calculated using Mann–Whitney *U* test. *$p$ statistically significant

## Discussion

We undertook this study to analyze the direct medical cost of COVID-19 patients requiring ICU admission as this imposes a heavy burden not only on patients and families but also on hospitals attempting to provide care to these extremely sick patients.

Our findings indicate that the mean direct hospitalization cost per COVID-19 patient who requires ICU admission is $ 3192.06 (INR: 2,35,367). While this is comparable to the costs for COVID-19 patients requiring ICU admission from Turkey ($ 2924) and Iran ($ 3755), it is substantially less than the costs from South Africa ($ 7316) and estimated costs from Saudi Arabia ($ 21,178).[3,11–13] The highest costs for such patients are reported from the USA and ranged from $ 95,546 for non-ventilated patients to $ 301.331 for ventilated patients.[5] The lower cost in our study may be explained by the substantially lower cost of drugs, equipment, and disposables, lower salaries to healthcare personal, and lower standard of living.

We found that the median direct hospitalization cost was significantly higher in patients with diabetes mellitus, sepsis, and the need for HFNC, NIV, and MV. Bain et al. found that poor glycemic control was associated with higher risk of ICU admission as well as an increased length of hospital stay.[14] A recent ICMR study by Vijay et al. found that secondary bacterial and fungal infections in COVID-19 patients significantly increased morbidity and mortality.[15] A significantly higher number of deaths were recorded in patients who developed sepsis in the present study. In a meta-analysis by Arefian et al., it was found that the median of the mean hospital-wide cost of treating per patient with sepsis was $ 32,421 (IQR $ 20,745–$ 40,835).[16] In the present study, there was a significant difference ($p = 0.04$) in the median cost of treating ICU patients with sepsis $ 3078.04 (IQR $ 2103.00–$ 4409.18) versus those without sepsis. The overall difference in the cost of treating sepsis may be because the meta-analysis included studies from higher-income countries. Similar to the observations made by Rae et al., the findings of our study show that patients on MV had significantly higher cost due to longer ICU stay.[17]

The median direct hospitalization cost also correlated significantly with the length of ICU and hospital stay. These findings are consistent with the available literature on COVID-19 patients, which states that the relatively high cost is a function of the length of hospital and ICU stay.[3–5]

Longer lead time to admission significantly correlated with increased cost ($p = 0.04$). This may be because patients presenting late take longer to recover, thus entailing increased cost.

We found that the maximum cost was incurred by hospital drugs and disposables, bed charges, equipment charges, biosafety protective gear (PPE), and pathological and radiological tests in COVID-19 management. These costs can be reduced by governmental control on hospital drugs, disposables, and PPEs.

We found a deficit between the actual costs incurred and the amount obtained through reimbursement by government schemes and through private insurance and self-paying patients. These differences were higher in the government schemes. The various government schemes, such as MJPJAY, cover the medical care expenses of up to 1.5 lakh rupees per family per year and were made available for COVID-19 as well.[18] The COVID-specific ICU package provided in government schemes for ventilated patients is INR 50,000/$ 678.10 (for 10 days stay) and INR 65,000/$ 881.53 (for 14 days) and for patients not requiring ventilation it is INR 20,000/$ 271.24 (for 10 days stay).[18] For patients having acute respiratory distress syndrome and disseminated intravascular coagulation who

require MV, the package available is INR 85,000/$ 1153.6.[18] The difference in amount between the maximum package provided by the government scheme and the actual median direct medical cost per patient availing government scheme was INR 59,560/–($ 807.75). This deficit can be addressed by increasing the insurance amount for COVID-19 patients requiring ICU admission in various government schemes.

The strength of our study is that we obtained the data from the actual medical and billing records of our hospital during the first peak of the pandemic. There are some limitations of the study. Due to the retrospective nature of the study, we could not obtain the indirect medical costs that could substantially increase the economic burden on patients and hospitals alike. These indirect costs include the costs associated with loss of productivity, absenteeism, and mortality.[19] Expenditure prior to hospital admission was not accounted for, due to the unavailability of this data from hospital records. Our data are not generalizable as our center is a "not for profit" public charitable trust teaching hospital. These costs are likely to be significantly higher in corporate hospitals. However, there are no studies identifying the cost of ICU treatment for COVID-19 patients in private hospitals from India; thus, a comparative cost analysis was not possible.

## Conclusion

ICU admission of COVID-19 patients imposes a substantial direct medical cost. This cost is associated with increased ICU and hospital stay, longer lead time to admission. It is higher in patients with diabetes mellitus, sepsis, and those who need HFNC, NIV, and MV. The increased cost due to drugs, disposables, and PPEs may be mitigated by government control on prices. The government healthcare expenditure as a percentage of gross domestic product needs to increase substantially to improve the delivery of tertiary care to patients and reduce their economic burden. Further studies are required to explore the impact of indirect medical care costs associated with COVID-19.

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