Original Article

# Characteristics and outcome of tertiary care critically ill COVID-19 patients with multiple comorbidities admitted to the intensive care unit

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**Abstract:**

**PURPOSE:** We conducted this study to evaluate the characteristics and outcomes exclusively in high-risk coronavirus disease 2019 (COVID-19) tertiary care patients with multiple comorbidities, as very few have reported outcomes in this specific cohort.

**METHODS:** All patients, with two or more risk factors for COVID-19 and Charlson Comorbidity Index (CCI) of >2, who were admitted to intensive care unit (ICU) between March and December 2020 were included. Their characteristics, ICU course, and outcomes as well as differences between nonsurvivors and survivors were evaluated. The primary outcome was all-cause 28-day mortality.

**RESULTS:** Out of 1152 COVID-19 patients, 101 met the inclusion criteria. The patients had an average of 4 or more comorbidities with a very high CCI of 5. The 28-day all-cause mortality was 23% and inhospital mortality was 32%. Among all risk factors, only age > 70 years, male gender, and chronic kidney disease were significant determinants of mortality ($P < 0.03$). Admission $PaO_2/FiO_2$ ratio and elevated inflammatory markers were same among survivors and nonsurvivors ($P > 0.66$). The mean time from presentation to ICU admission (59 vs. 38 h), APACHE II score (20.5 vs. 17), ICU length of stay (25 vs. 12 days), and hospital length of stay (28 vs. 20 days) were all higher in nonsurvivors as compared to survivors, respectively ($P < 0.03$). Fifty-four percent of the patients were intubated and had higher 28-day (40%) and inhospital (55%) mortality.

**CONCLUSION:** Tertiary care patients with multiple comorbidities have higher mortality than what is reported for mixed populations. Further studies are needed to determine realistic mortality benchmarks for these patients.

**Keywords:**

COVID-19, high risk, intensive care unit, mortality, multiple comorbidities, outcome

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), progresses to critical illness among 5% of symptomatic patients.[1] These critical patients on average comprise 21% of all the hospitalized adults inflicted with the virus.[2] Since the start of the pandemic, the mortality rates in these critically ill patients have dropped from as high as 60% to an average of around 20%–30%.[3,4] The exact reasons for the improved survival remain unclear. However, one can speculate that better understanding of the disease, growing experience in supportive and ventilatory management, better resource utilization, and adoption of COVID-19-specific treatments such as steroids and interleukin-6 receptor blockers could have contributed to this improved survival.[5,6] The issue is that

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the huge improvement in survival rates is driven predominantly by good outcomes in patients with none or a single comorbidity, as patients with multiple comorbidities form a smaller proportion of the general population.[3,4,7]

Most of the studies have reported on the outcomes in mixed groups of COVID-19 patients with none to a few underlying comorbidities.[8,9] From these larger cohorts, investigators have tried to derive the risk factors associated with critical illness and admission to the intensive care unit (ICU).[2,7,10] Advanced age is one of the commonly reported predictors of poor survival in COVID-19, with a 10-year increase in age associated with a 58% additional risk of death among general populations.[11] Patients with comorbidities, however, are also found to have high mortality rates in COVID-19, as much as 12 times than those without any underlying medical conditions.[12] When age and comorbidities are evaluated together, the estimated relative risk of death from an increase of one comorbidity equals roughly to that of an additional decade of age.[13] This risk increases with the increasing number of comorbidities. In a report of 355 patients who died from COVID-19 in Italy, the average number of preexisting comorbidities was 2.7, and only 3 patients had no underlying condition.[14] However, that study did not elaborate on the survival of patients with similar number of comorbidities who were infected with COVID-19 and its patients were mainly above 80 years of age, something unique to their population.

Hence, even though the mortality rates for COVID-19 seem to have dropped overall, mortality risk still remains high for patients with underlying medical problems. Not all comorbidities have the same impact, and if patients have many of these comorbidities simultaneously, how does one determine which combination of these risk factors would be more detrimental? Are there any risks specific to these comorbid patients that dominate over the other risk factors and determine chances of survival? Are there any other parameters that need to be looked at while dealing with these comorbid COVID-19 patients? In order to answer these questions, more studies are needed to exclusively focus on these high-risk cohorts not only to better stratify these comorbidities but also to evaluate their impact on patient's course of illness and eventual survival. The answers would not only help establish appropriate triaging systems and devising early management plans for these patients but also in their prognostication. We conducted this study solely focusing on these high-risk comorbid patients with COVID-19 and evaluated their characteristics and outcome, as well as any differences between survivors and nonsurvivors.

## Methods

This was a retrospective study and ethical approval was obtained from the institutional review board of the hospital.

### Study location

The study was conducted at King Faisal Specialist Hospital & Research Center, Jeddah. It is a tertiary care hospital with a 26-bed medical ICU. The hospital is accredited by Joint Commission International and Nurses Magnet Recognition Programs. In addition to taking care of the tertiary care medical, surgical, cardiovascular, and oncological problems, the hospital runs active solid organ and bone marrow transplant programs as well. During the study period, ratios of physician, nurse, and respiratory therapist to patient were on average 1:9, 1:1, and 1:5, respectively. This ratio is the usual standard of care in our ICU and was not specific to COVID-19.

### Hospital's patient population

The hospital caters to the needs of tertiary care patients accepted through a referral system. Once accepted, these "eligible" patients are then followed in the hospital until they are discharged back to referring facility, discharged home, or succumb to their illness. If these eligible patients contracted COVID-19, they were evaluated and managed within the hospital.

### Definitions

Established risk factors for COVID-19: These have been identified by the United States Centers for Disease Control and Prevention and include cancer, chronic kidney disease, chronic obstructive pulmonary disease (COPD), immunocompromised state from solid organ transplant, obesity (body mass index $\geq 30$ kg/m$^2$), serious cardiovascular disease (including heart failure, coronary artery disease, and cardiomyopathies), Type 2 diabetes mellitus, Down syndrome, and sickle cell disease.[10] Smoking status was not used as a risk factor in our study.

Possible risk factors for COVID-19: These include lung diseases (excluding COPD), immunocompromised state, cerebrovascular disease, liver disease, hypertension, overweight, Type 1 diabetes mellitus, and neurological conditions.[10]

High-risk patients: In our cohort, we defined "high risk" as patients with 2 or more established or possible risk factors for COVID-19. In addition, score on the Charlson Comorbidity Index (CCI) in these patients had to be 2 or higher, denoting high baseline burden of disease.[13]

### Subjects

The COVID-19 outbreak in our region started in March of 2020. All critically ill high-risk adult patients, as defined

above, who were admitted to the ICU due to COVID-19 pneumonia between March 2020 and December 2020 were included in the study. Any patients who did not meet the minimum criteria of "high risk" and those who were transferred to other hospitals and lost to follow-up were excluded.

### Treatments used for COVID-19

When the World Health Organization declared COVID-19 a pandemic in March 2020, a collaborative meeting was held between the infectious disease and ICU team of the hospital. In the absence of concrete evidence, an "ongoing" flexible treatment plan was agreed upon taking into consideration the available resources and any emerging evidence. This was modified as new evidence became available. Dexamethasone was added to the regimen after the results of the RECOVERY trial were publicized in June of 2020. Tocilizumab and convalescent plasma were used, either as part of clinical trial or on compassionate basis, for select patients starting May of 2020. However, their timing of administration was left to the discretion of the treating team. Favipiravir and remdesivir were used based on availability.

### Outcome measures

The primary outcome was 28-day all-cause mortality. The secondary outcomes included inhospital mortality, mortality in intubated patients, ICU length of stay, and hospital length of stay. We also evaluated if there were any differences between the survivors and nonsurvivors in their characteristics and outcomes.

### Data collection

Subject demographics, underlying comorbidities, symptoms, characteristics on presentation to hospital and on 1$^{st}$ day of ICU admission, laboratory values, parameters and therapies during ICU stay, and outcome measures were recorded. Descriptive statistics were used to organize the collected data. Data were expressed as mean and standard deviation for continuous variables and number and percentage for categorical variables. Differences between survivors and nonsurvivors were explored using *t*-test for continuous variables and Fisher's exact test for categorical variables, as appropriate. All statistical tests were two-tailed with significance set at $P < 0.05$.

## Results

Totally 1152 patients were diagnosed with COVID-19 in our hospital from start of the surge in March 2020 till end of December 2020. Out of these, 105 patients met the inclusion criteria of critically ill high-risk patients with multiple comorbidities admitted to ICU for COVID-19 pneumonia. Four patients were excluded from analysis as they were lost to follow-up after being transferred to other hospitals and 101 were included in the final analysis. The patients in our cohort were middle aged, obese, and had an average of 4 or more comorbidities with a remarkably high CCI of 5. The details of their demographics are described in Table 1. The nonsurvivors, however, were predominantly male, relatively older, and with higher proportion of chronic kidney disease with or without dependence on hemodialysis ($P < 0.03$). The patients mostly had severe disease at presentation and were hypoxic and half got admitted to the ICU same day of presentation [Table 2]. Patients on admission to ICU were even more hypoxic with mean $PaO_2/FiO_2$ ratio of 122 and had elevated inflammatory markers. The admission to ICU occurred late (59 vs. 38 h) and APACHE II score was higher (20.5 vs. 17) in nonsurvivors as compared to survivors, respectively ($P < 0.03$) [Table 3]. Fifty-four percent of the patients were eventually intubated and required mechanical ventilation, while the rest were managed with supplemental oxygen. High-flow oxygen was used predominantly in the later patients whenever logistically feasible. Majority of the nonsurvivors when compared to survivors required intubation and mechanical ventilation, had prolonged time to intubation from admission, and had higher requirements of vasopressor agents, paralytics, and new initiation of renal replacement therapy [Table 4]. Two-third of all the patients received steroids and tocilizumab as per treating physician discretion. The 28-day all-cause mortality was 23% and inhospital mortality was 32%, with mean ICU and hospital length of stay of 16 and 23 days, respectively. The incidence of complications and end-organ damage was higher in nonsurvivors as compared to survivors, and ICU and hospital length of stay was also significantly longer in nonsurvivors vs. survivors, P < 03. [Table 5]. Mortality was much higher in patients requiring invasive mechanical ventilation, with 40% 28-day and 55% inhospital mortality.

## Discussion

Mortality in ICU is dependent on multiple factors including patients' age, comorbidities, type of illness, and its severity. This holds true for patients who become critically ill with COVID-19. In a pandemic which has caused devastation across the globe and stretched medical resources to the limits, physicians are faced with a daily struggle of prioritizing care to those with the gravest risk of deterioration. Outcome studies help guide physicians not only in identifying these high-risk patients but also in prognostication.

Most of the studies on the outcomes of critically ill COVID-19 patients so far have reported on general cohorts of patients. The patients included in these reports were usually considered high risk if they had any of the established risk factors and anywhere from

**Table 1: Patient demographics**

| Characteristic | Value | | | |
|---|---|---|---|---|
| | Combined (*n*=101), *n* (%) | Survivors (*n*=69), *n* (%) | Nonsurvivors (*n*=32), *n* (%) | *P* |
| Age (years), mean (SD)* | 62 (15.9) | 59 (15.1) | 70 (12.6) | <0.001 |
| Gender | | | | |
| Male | 59 (58) | 33 (51) | 23 (72) | 0.03 |
| Female | 42 (42) | 36 (49) | 9 (28) | |
| BMI (kg/m$^2$), mean (SD) | 31.9 (7.5) | 31.8 (8.1) | 32.5 (6.7) | 0.67 |
| Number of comorbidities, mean (SD)* | 4.5 (1.7) | 4 (1.7) | 5 (1.4) | 0.08 |
| Charlson Comorbidity Index, mean (SD)* | 5 (1.6) | 5 (1.6) | 5 (1.5) | 0.14 |
| Most common established risk factors for COVID-19 | | | | |
| Cardiovascular disorders | 58 (57) | 39 (57) | 19 (59) | 0.83 |
| Diabetes mellitus Type 2 | 54 (53) | 35 (51) | 19 (59) | 0.52 |
| Obesity (BMI 30–39.9>40 kg/m$^2$) | 48 (48) | 32 (46) | 16 (50) | 0.83 |
| Severe obesity (BMI>40 kg/m$^2$) | 14 (14) | 9 (13) | 5 (16) | 0.76 |
| Hemodialysis dependent | 30 (30) | 15 (22) | 14 (44) | 0.03 |
| Chronic kidney disease | 17 (17) | 7 (10) | 10 (31) | 0.02 |
| Cancer | 17 (17) | 10 (15) | 7 (22) | 0.39 |
| Solid organ transplant | 12 (12) | 7 (10) | 5 (16) | 0.51 |
| Most common possible risk factors for COVID-19 | | | | |
| Hypertension | 71 (70) | 46 (67) | 25 (78) | 0.34 |
| Diabetes mellitus Type 1 | 10 (10) | 7 (10) | 3 (9) | 0.99 |
| Other immunocompromised | 12 (12) | 7 (10) | 5 (16) | 0.51 |

*Mean values rounded to nearest 0.5 decimal. BMI=Body mass index, SD=Standard deviation, COVID-19=Coronavirus disease 2019

**Table 2: Characteristics on presentation to hospital**

| Characteristic | Value | | | |
|---|---|---|---|---|
| | Combined (*n*=101), *n* (%) | Survivors (*n*=69), *n* (%) | Nonsurvivors (*n*=32), *n* (%) | *P* |
| Main presenting complaints | | | | |
| Fever | 75 (74) | 53 (77) | 22 (69) | 0.46 |
| Cough | 57 (56) | 42 (61) | 15 (47) | 0.20 |
| Shortness of breath | 53 (52) | 34 (49) | 19 (59) | 0.39 |
| Malaise/body aches | 29 (29) | 20 (29) | 9 (28) | 0.98 |
| Gastrointestinal symptoms | 24 (24) | 15 (22) | 9 (28) | 0.61 |
| Symptom duration before admission (days), mean (SD)* | 4.5 (3.4) | 4.5 (3.2) | 5 (4.1) | 0.50 |
| Moderate disease at presentation | 18 (18) | 12 (17) | 6 (19) | 0.97 |
| Severe disease at presentation | 83 (82) | 57 (83) | 26 (81) | |
| Oxygen saturation on presentation (%), mean (SD)* | 84 (8.1) | 84 (8.6) | 84 (7.6) | 0.99 |
| Highest oxygen delivery mode within 6 h of presentation | | | | |
| Room air | 18 (18) | 12 (17) | 6 (19) | 0.97 |
| Up to 6 l nasal cannula | 33 (33) | 23 (33) | 10 (31) | 0.98 |
| Facemask | 17 (17) | 13 (19) | 4 (13) | 0.57 |
| NRM/high-flow oxygen | 24 (24) | 15 (22) | 9 (28) | 0.61 |
| Intubation | 9 (9) | 6 (9) | 3 (9) | 0.98 |
| $PaO_2/FiO_2$ ratio at presentation† | | | | |
| ≥150 | 39 (47) | 28 (47) | 11 (46) | 0.66 |
| <150 | 44 (53) | 31 (53) | 13 (54) | |
| Admitted to intensive care unit same day of admission | 48 (48) | 34 (50) | 14 (44) | 0.67 |

*Mean values rounded to nearest 0.5 decimal, †(*n*=83). NRM=Nonrebreather mask, SD=Standard deviation

30% to 80% of patients in these cohorts were without any underlying comorbidity.[2,3,7-9,14-17] We wanted to see the characteristics and outcomes in critically ill patients with multiple underlying comorbidities on COVID-19 outcome, as not all comorbidities confer the same risk.[18] The mean of four comorbidities and the CCI of 5 in our study is the highest in any reported cohort of critically ill COVID-19 patients so far and reflects the adverse odds stacked against them from the onset.[3] The average age in our study was 62 years, and majority were male. They had severe disease at presentation, in line with some other published studies, but were more obese

**Table 3: Characteristics on day 1 of intensive care unit admission**

| Characteristic | Value | | | |
|---|---|---|---|---|
| | Combined (*n*=101), *n* (%) | Survivors (*n*=69), *n* (%) | Nonsurvivors (*n*=32), *n* (%) | *P* |
| Duration from presentation to ICU transfer (h), mean (SD)* | 45 (47) | 38 (41) | 59 (49) | 0.03 |
| APACHE II score, mean (SD)* | 18 (6.7) | 17 (5.9) | 20.5 (6.8) | 0.01 |
| Lactic acid, mean (SD) | 2.1 (2.9)† | 2 (2.3)‡ | 2.1 (1.4)§ | 0.82 |
| Respiratory rate (per min), mean (SD)* | 32 (8.5) | 32 (8.4) | 32 (7.7) | 0.86 |
| Mode of oxygen delivery | | | | |
| Nasal cannula/facemask | 17 (17) | 15 (22) | 6 (19) | 0.79 |
| NRM/partial NRM | 19 (19) | 7 (10) | 12 (38) | 0.002 |
| High-flow oxygen | 42 (42) | 23 (33) | 13 (41) | 0.82 |
| Noninvasive ventilation | 4 (4) | 3 (4) | 1 (3) | 0.99 |
| Intubation | 19 (19) | 14 (20) | 7 (22) | 0.98 |
| PaO2/FiO2 ratio, mean (SD)* | 122 (65)† | 131 (73)‡ | 107 (47)§ | 0.09 |
| Inflammatory markers | n=94 | n=64 | n=30 | |
| C-reactive protein (mg/L), mean (SD)* | 135 (102) | 136 (104) | 127 (95) | 0.67 |
| Ferritin (μg/L), mean (SD)* | 1189 (1246) | 1133 (1045) | 1255 (1612) | 0.64 |
| D-dimer (mg/L FEU), mean (SD) | 1.96 (2.74) | 1.94 (2.83) | 2.06 (2.64) | 0.84 |

*Mean values rounded to nearest 0.5 decimal, †(*n*=86), ‡(*n*=57), §(*n*=29). NRM=Nonrebreather mask, SD=Standard deviation, ICU=Intensive care unit, APACHE II= Acute physiology and chronic health evaluation II score

**Table 4: Characteristics during intensive care unit stay**

| Characteristic | Value | | | |
|---|---|---|---|---|
| | Combined (*n*=101), *n* (%) | Survivors (*n*=69), *n* (%) | Nonsurvivors (*n*=32), *n* (%) | *P* |
| Patients intubated | 55 (54) | 25 (36) | 30 (94) | <0.001 |
| Duration from presentation to intubation (days), mean (SD)* | 3 (2.3) | 2 (2.8) | 7 (6.3) | 0.001 |
| Number of days on invasive mechanical ventilation (*n*=55), days, mean (SD)* | 17 (14.5) | 15 (12.6) | 18 (14.2) | 0.17 |
| Patients received high-flow oxygen | 53 (52) | 37 (54) | 16 (50) | 0.83 |
| Patients received proning | 42 (42) | 30 (43) | 12 (38) | 0.66 |
| Patients received neuromuscular blockers | 27 (27) | 9 (13) | 18 (56) | <0.001 |
| Patients received higher dose thromboprophylaxis | 49 (49) | 32 (46) | 17 (53) | 0.66 |
| Patients received therapeutic anticoagulation | 45 (45) | 29 (42) | 16 (50) | 0.52 |
| COVID-19 medications used | | | | |
| Steroids | 82 (81) | 57 (83) | 25 (78) | 0.59 |
| Tocilizumab | 65 (64) | 41 (59) | 24 (75) | 0.18 |
| Steroids plus tocilizumab | 58 (57) | 35 (51) | 23 (72) | 0.053 |
| Convalescent plasma | 43 (43) | 29 (42) | 14 (44) | 0.99 |
| Favipiravir | 45 (45) | 28 (41) | 17 (53) | 0.28 |
| Remdesivir | 9 (9) | 7 (10) | 4 (13) | 0.73 |
| New renal replacement therapy | 18 (18) | 4 (6) | 14 (44) | <0.001 |
| Patients received vasopressor agents | 40 (40) | 10 (15) | 30 (94) | <0.001 |

*Mean values rounded to nearest 0.5 decimal. Rows represent *n* (%) unless otherwise specified. SD=Standard deviation, COVID-19=Coronavirus disease 2019

than most published reports.[3,15,16] When looking at the baseline characteristics, the most striking risk factors associated with mortality in our patients were age 70 or above, male gender, and preexisting chronic kidney disease, with or without the need for dialysis. These risk factors are few of the long list of factors that have been mentioned in association with worse outcome for COVID-19 patients.[2,10] However, in our patients who had numerous risk factors with a huge comorbidity burden, these were the strongest influencers of outcome. Other risk factors did not show any predilection toward adverse outcome when stacked against each other, and this may help physicians identify the riskiest patients among those with multiple comorbidities. These results are different from populations with minimal or few comorbidities, where impact of these risks is evaluated against normal healthy individuals.[17,19]

The patients presented to the hospital after an average of 5 days from symptom onset which is earlier than 7 days reported for healthier COVID-19 patients.[20] This is expected as patients with comorbidities tend to deteriorate faster when compared to healthy patients.[21] Time to transfer to ICU and intubation occurred late in

**Table 5: Outcome measures**

| Outcome | Result | | | |
|---|---|---|---|---|
| | Combined (*n*=101), *n* (%) | Survivors (*n*=69), *n* (%) | Nonsurvivors (*n*=32), *n* (%) | *P* |
| 28 days all-cause mortality | 23 (23) | | N/A | |
| Inhospital mortality | 32 (32) | | | |
| Mortality in subset of intubated patients (*n*=55) | | | | |
| 28 days all-cause mortality | 22 (40) | | | |
| Inhospital all-cause mortality | 30 (55) | | | |
| Mortality directly due to COVID-19 or its complications | N/A | | 22 (69) | N/A |
| ICU length of stay, days, mean (SD)* | 16 (16.8) | 12 (15) | 25 (18.4) | <0.001 |
| Hospital length of stay, days, mean (SD)* | 23 (21.3) | 20 (18.4) | 28 (19.2) | 0.035 |
| Complications | | | | |
| Acute kidney injury | 32 (32) | 12 (17) | 20 (63) | <0.001 |
| Septic/cardiogenic shock | 27 (27) | 11 (16) | 23 (72) | |
| Bleeding | 14 (14) | 4 (6) | 12 (38) | |
| Disseminated intravascular coagulation | 10 (10) | 0 | 10 (31) | |
| Barotrauma | 6 (6) | 0 | 6 (19) | |

*Mean values rounded to nearest 0.5 decimal. SD=Standard deviation, N/A=Not applicable, COVID-19=Coronavirus disease 2019, ICU=Intensive care unit

nonsurvivors than survivors. Delay in ICU transfer and intubation can have adverse outcome on patients.[22] We can only contemplate that the delay could have been due to combination of several factors including patients' sudden deterioration from position of relative stability, overall moribund status, lack of ICU bed availability, or other logistical reasons. Nonetheless, it proved to be significant difference between the nonsurvivors and survivors and raises the importance of close monitoring and early ICU intervention in these patients.

Inflammatory markers have been postulated as predictors of poor outcome in some reports.[23] In our study, these were elevated but were similar in survivors and nonsurvivors. This reaffirms the recently published data highlighting the relatively weak predictive value of these inflammatory markers in elderly moribund populations like ours.[24] Only one-third of the survivors in our study were intubated as compared to nonsurvivors who almost all ended up requiring invasive mechanical ventilation for prolonged periods. Initiation of new renal replacement therapy also occurred more frequently in them. Both these factors are detrimental to the outcome.[2] Two-third of the patients received steroids, antivirals, and tocilizumab, however, we did not find any difference in their impact. This is probably because the administration of the medicines was not protocolized, and timing was not controlled.

The 28-day mortality and the inhospital mortality of our patients were 23% and 32%, respectively, while for patients on mechanical ventilation, it was 40% and 55%. The latter figures of intubated patients are higher than the cumulative 28% and 43% mortality, as reported in a meta-analysis of 28 studies.[2] These numbers are also worse than the expected mortality based on APACHE II scores and signify the deleterious impact of the SARS-CoV2 in patients with multiple comorbidities. Our findings call for further studies in these comorbid patients to determine realistic mortality benchmarks for tertiary care patients.

Our study has a few limitations. It is a retrospective analysis, and findings can only point toward association and not causation. It is a single-center experience of single ethnic population, and results may vary in other places and populations. Our outcomes are specific for tertiary care comorbid populations and not for healthier cohorts. Administration timing and usage of COVID-19-specific medications changed with changing evidence and could have some effect on the outcome. Our ICU had a physician-, nurse-, and respiratory therapist-to-patient ratio that is difficult to replicate in many ICUs, and outcome could be worse among ICU stretched to their limits due to patient load.

## Conclusion

Characteristics among nonsurvivors and survivors differ in high-risk COVID-19 patients with multiple comorbidities than what is reported for mixed populations. High-risk patients with multiple comorbidities have higher 28-day and inhospital mortality than generally described so far. Age 70 and above, male gender, chronic kidney disease, and invasive mechanical ventilation are the main predictors of adverse outcome in patients with multiple comorbidities. Early identification of these patients and aggressive treatment before onset of pneumonia and respiratory failure is the key to prevent death in these patients. Further studies are needed to determine realistic mortality benchmarks for these tertiary care patients.

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## Conflicts of interest

There are no conflicts of interest.

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