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Highlights

- Survival analysis of 131 patients with SARS-COV-2 in Somalia conducted
- Interventions to improve outcomes in low-resource and fragile setting examined
- Risk factors for deaths include ≥ 60, CVD and use of non-invasive ventilation
- Patients receiving oxygen only were more likely to survive than those ventilated
- Optimizing critical care for COVID-19 in fragile states need policy discourse
Survival analysis of all critically ill patients with COVID-19 admitted to the main hospital in Mogadishu, Somalia, 30 March–12 June 2020: what interventions are proving effective in fragile states?

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ABSTRACT

OBJECTIVES

To determine risk factors for death in patients with coronavirus disease-19 (COVID-19) admitted to the main hospital in Somalia and identify interventions contributing to improved clinical outcome in a low-resource and fragile setting.

METHODS

We conducted a survival analysis of all COVID-19 patients admitted to the main hospital in Somalia from 30 March–12 June 2020.

RESULTS

Of the 131 patients admitted to the hospital for COVID-19, 52 (40%) died and 79 (60%) survived. The main factors associated with the risk of in-hospital death were age ≥ 60 years (survival probability on day 21 in patients < 60 years was 0.789 (95% confidence interval (CI): 0.658–0.874) versus 0.339 (95% CI: 0.205–0.478) in patients ≥ 60 years); cardiovascular disease (survival probability 0.478 (95% CI: 0.332–0.610) in patients with cardiovascular disease versus 0.719 (95% CI: 0.601–0.807) in patients without cardiovascular disease) and non-invasive ventilation on admission (patients who were not ventilated but received oxygen only were significantly more likely to survive than those who were ventilated, P< 0.001).

CONCLUSION

Considering the risk factors (advanced age, presence of cardiovascular disease and use of non-invasive ventilation) is critical when managing severe COVID-19 patients especially in low-resource settings where availability of skilled health workers for critical care units is limited. Our findings also highlight the importance of use of medical oxygen for severely ill patients and on
the critical aspect of deciding whether to ventilate critical patients with SARS-COV-2 infection in such settings in order to improve the clinical outcome.

**Background**

On 16 March 2020, the Federal Ministry of Health and Human Services of Somalia reported the country’s first laboratory-confirmed case of COVID-19 in a Somali student arriving from China (WHO, 2020). Since then and until 31 October 2021, the country has officially reported 22,369 laboratory-confirmed cases of COVID-19, including 1238 associated deaths. Among the reported laboratory-confirmed COVID-19 cases, around 16% were admitted to isolation centers designated by the government (FMOH & WHO 2021). Owing to lack of consistent data, it is not clear how many of these admitted patients required critical care support. One study showed that between 23 April and 28 June 2020, of the 443 patients with confirmed SARS-COV-2 admitted in the largest tertiary level hospital in the capital city of country, only 48 patients (10.8%) with severe symptoms were admitted to the intensive care unit (Mohamud et al., preprint).

Like many other African countries, Somalia has not reported a very high number of cases and deaths. Given the fragility of the health care system in Somalia, it was anticipated that the system would be overwhelmed. The outbreak occurred at a time when the country had no intensive care beds, no ventilators and no central supply of medical oxygen in the public sector. Ranked 193 out of 195 countries on the Global Health Security Index (Aitken, 2020; Index Project Team, 2021), Somalia’s health system, considered the second most fragile in the world (World Bank, 2021), has been debilitated by decades of civil war, insecurity and disease outbreaks, as well as natural disasters such as droughts and floods leading to a deterioration in health outcomes. The universal health coverage index of Somalia, as a measure of effective health services coverage and its contribution to improved health outcome of all its people is the lowest in the world – 25
The current health workforce density in Somalia (0.34 health care workers per 1000 population) is substantially lower than the density needed for universal health coverage (UHC) – 4.45 health care workers per 1000 population by 2030 (WHO, 2015; WHO, 2016). At the time the epidemic hit the country, there were only 15 intensive care unit beds (all in the private sector) for a population of more than 15 million. Broadly, the country’s health system suffers from underperformance, fragmented and poor-quality service delivery, limited and unequal access and inequitable distribution of health workforce. The country’s disease surveillance system to detect, monitor and facilitate a rapid response to any outbreak is rudimentary and dysfunctional.

To date, most of the laboratory-confirmed cases of COVID-19 in Somalia did not require hospitalization as over 80% were either asymptomatic or had mild symptoms (FMOH & WHO 2021) Between 30 March and 12 June 2020 (our study period), the country has reported 2922 COVID-19 laboratory-confirmed cases in Mogadishu, of which only 93 died and only 131 with severe illness were admitted to the main hospital of the country in Mogadishu.

Although data are available from developed and high-income and middle-income countries on the clinical characteristics of COVID-19, and the outcome and risk factors for clinical outcome (Bhatraju et al., 2020; Bialek et al., 2020; Salinas-Escudero et al., 2020; Thai et al., 2020; Yang et al., 2020), few studies investigating the links between interventions and clinical outcome have been published from less developed countries making our contribution to the literature out of the ordinary and remarkable as it comes from such a low-resource setting as Somalia.

Documenting the length of hospitalization and survival of patients with COVID-19 and the risk factors associated with death in low-resource settings could provide a better understanding of the impact of the disease and the usefulness of medical interventions as well as hospital capacity to
cope with the surge in COVID-19 patients in such settings. This information can also guide policy responses on the use of low-cost, high-impact interventions in such setting to save lives and manage a surge in cases.

The main aim of this study was to assess the clinical characteristics of patients with COVID-19 admitted to the main public sector hospital in Somalia, estimate the length of hospital stay and identify the risk factors for death in these patients. The study also assessed what interventions might help to improve clinical outcomes in patients with severe COVID-19 in low-resource and fragile settings.

Methods

Study design and patients

The current study took place in De Martino Hospital, the principal COVID-19 quarantine hospital in Mogadishu, Somalia, the country’s capital city, during the early period of the pandemic, from 30 March 2020 to 12 June 2020. We included a cohort of all 131 patients who were admitted with a laboratory-confirmed SARS-COV-2 infection in this hospital from 30 March to 12 June 2020. These dates represent the date of hospital admission and the date when the entire cohort of 131 patients included in this study were either discharged alive or died. The SARS-COV-2 infection was diagnosed based on positive reverse transcription-polymerase chain

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1 Regarding admission criteria for hospitalization of patients with COVID-19 in Somalia, and according to the national standard operating procedure for case management of COVID-19 published by the Federal Ministry of Health of Somalia, patients who fall into the high-risk category as per the WHO’s classification such as over 60 years of age, heavy smoker, having chronic medical conditions (diabetes, hypertension, chronic kidney disease) and immune deficiency should be admitted to any of the isolation centers designated by the government. Regarding intensive care unit admission criteria for COVID-19, a patient must meet one or more of the following criteria: a. Acute and potentially reversible organ dysfunction poorly responding to initial resuscitation b. Severe respiratory failure or intubated (SpO2 /FiO2 ratio < 200) c. Refractory circulatory shock (SBP < 90 mmHg, Lactate > 4) d. More than single organ failure Please refer to the National Standard Operating Procedures (SOP): Case Management COVID-19 handbook for further information. [https://www.humanitarianresponse.info/ru/operations/somalia/document/somalia-final-sop-case-management-covid-19-v1-26042020](https://www.humanitarianresponse.info/ru/operations/somalia/document/somalia-final-sop-case-management-covid-19-v1-26042020), (accessed 1 November 2021).
reaction results. Extracted information from all clinical records of COVID-19 patients admitted to De Martino Hospital.

**Data extraction and outcomes**

We extracted information from clinical records of all these 131 patients. The patients’ information extracted included: patient’s place of residence, age, sex, date of admission, date of onset of symptoms, reported signs and symptoms (fever, shortness of breath, muscular pain, chest pain, abdominal pain, joint pain, general weakness, diarrhea, cough, nausea or vomiting, sore throat, headache, runny nose, irritability and confusion), clinical characteristics (temperature, pharyngeal exudate, coma, abnormal lung X-ray, conjunctival infection, dyspnea or tachypnea, seizure and abnormal lung auscultation), comorbidities as reported by the patients (cardiovascular disease including hypertension, immunodeficiency including HIV, diabetes, renal disease and chronic lung disease), clinical interventions (delivery a ratio of the partial pressure of arterial oxygen over the fraction of inspired oxygen (PaO$_2$/FiO$_2$ ratio), ventilation support through a facemask under positive pressure without the need for endotracheal intubation, non-invasive ventilation, antibiotics, inotropes and vasopressors), and final outcome and date (survived or died). It must be noted that inotropes and/or vasopressors were only used when needed (e.g., in the case of septic shock).

We transcribed individual patient data into an Excel spreadsheet (Microsoft Corporation Redmond, WA, United States), and both the care providers and the information officers independently verified the data from the patient medical records for completeness and accuracy. The primary outcome was survival status and time to outcome from date of hospitalization (in days).
**Statistical analysis**

Quantitative data presented as mean and standard deviation (95% CI) and/or median and interquartile range (IQR). We dichotomized age into < 60 years and ≥ 60 years.

We report the distribution of cases and deaths by sex and age group, and the distribution of symptoms, clinical characteristics, comorbidities and type of treatment by sex and age group.

Kaplan–Meier curves were performed to estimate survival probabilities and the log-rank test was conducted to assess the significance of differences in survival curves between groups. The outcome of survival probabilities was reported at days 7, 14 and 21 after admission with 95% CI. As the final disposition of all patients was reported up to the last day of discharge or death (i.e., day 21), these chosen points of analysis (7, 14 and 21 days) was selected for this study.

We extended the survival analysis using the Cox proportional hazard model to estimate the likelihood of death and simultaneously assess the effect of several risk factors on survival, adjusting for confounding or effect modification. We also examined the assumption of proportionality. Age, diabetes and cardiovascular diseases were used as variables in the Cox proportional hazard model.

We used Stata Software, version 16.0 (StataCorp LLC, College Station, TX) for data quality assessment and analysis. A p-value < 0.05 was considered statistically significant.

**Results**

**Epidemiological characteristics**

We followed all 131 patients with COVID-19 admitted to the hospital until the end of their stay. The first admission was on 30 March 2020 and the last was on 12 June 2020. The length of hospital stay ranged between 1 day and 35 days with a median length of 5.5 days, interquartile range (IQR) 9.0 days.
Around two-thirds (68%) of the patients were males versus almost one-third (32%) females. The mean age was 58.5 (SD: 16.1) years and the median was 60.0 (IQR: 18.0) years for males and 56.9 (SD: 17.1) years and median 55.0 (IQR: 27) years for females. The total number of patients enrolled in this study are shown in Table 1. Patient data are stratified into age and sex groups. Of the 131 patients, 52 (40%) died and 79 (60%) survived (Table 1).

Clinical characteristics and comorbidities

The clinical features, comorbidities and the interventions data given, by age group and sex of patients enrolled in this study were given in Table 2. Most of the patients reported fever, shortness of breath and cough; a few had abdominal pain, diarrhea or a runny nose. Muscular and joint pain, general weakness and headache increased with age for both sexes. None of the patients has presented with either pharyngeal exudate, coma, conjunctival infection or seizures. However, 95% of patients had abnormal lung findings on X-ray and 95% abnormal lung auscultation. Around 91% of patients have presented dyspnea and/or tachypnea. Overall, males showed more acute clinical characteristics than females, but interestingly the frequency of the symptoms often increased with age in female patients (Table 2).

The main comorbidities observed in the included patients were cardiovascular disease (40%) and diabetes (40%). Cardiovascular disease was reported mainly by patients aged 40 years or older. Diabetes was more prevalent among females (48%) compared to males (36%). Only two male patients had immunodeficiency.

None of the female patients was pregnant or reported end of pregnancy in the 6 weeks before hospitalization.
All the patients were given antibiotics according to the national protocol adopted by the country. Oxygen therapy was given to 91% of the observed patients and the use of oxygen increased with patient age. Inotropes and vasopressors were given to 21% of patients, all of whom were 40 years or older. The criteria for an adult to receive oxygen therapy is that they present with acute respiratory distress syndrome with the following oxygen impairment level: $200 \text{ mmHg} < \text{PaO}_2/\text{FiO}_2 \leq 300 \text{ mmHg}$ (with positive end-expiratory pressure or continuous positive airway pressure $\geq 5 \text{ cmH}_2\text{O}$, or non-ventilated) (FMOH 2020).

*Treatment outcome by epidemiological characteristics, comorbidities*

Table 3 shows the survival probabilities with 95% CI at days 7, 14 and 21 after admission, by age group, sex, presence of cardiovascular disease and diabetes, and treatment with inotropes and vasopressors.

Table 3 shows that patients 60 years and older were significantly more likely to die than patients younger than 60 years ($P < 0.003$), and the risk of death was significantly different between the two age groups at days 7, 14 and 21 (Figure 1). The probability of surviving on day 21 in patients younger than 60 years was 0.789 (95% CI: 0.658–0.874) compared with 0.339 (95% CI: 0.205–0.478) in patients 60 years and older. The probability of death was very similar for males and females; $P = 0.049$ (Figure 1a).

Patients without cardiovascular disease were significantly more likely to survive than those with cardiovascular disease ($P = 0.0134$) (Figure 2). About half of the patients with cardiovascular
disease survived the first week of hospitalization (survival probability = 0.478, 95% CI: 0.332–0.610) compared with three-quarters of patients without cardiovascular disease (survival probability = 0.719, 95% CI: 0.601–0.807). However, the survival probabilities of patients without cardiovascular disease decreased by the third week and reached 0.558 (95% CI: 0.379–0.704) compared with 0.425 (95% CI: 0.265–0.576) Table 3. A similar pattern was seen in patients with diabetes, although the difference was smaller (Figure 2).

Of 29 patients given inotropes or vasopressors, 25 (86%) died in the first week of admission. The survival probability of those who did not receive this intervention was significantly higher at day 7 (survival probability = 0.769, 95% CI: 0.670–0.842), at day 14 (survival probability = 0.728, 95% CI: 0.614–0.813) and at day 21 (survival probability = 0.655, 95% CI: 0.508–0.768) after admission compared with those who received the intervention (Table 3). Overall, patients not given inotropes or vasopressors were significantly more likely to survive than those given them (P < 0.001) (Figure 3).

Out of 131 patients, 12 were not given oxygen as their condition was considered mild and they all survived. We categorized the remaining 119 patients who were given oxygen on admission into three categories – not given non-invasive ventilation, delayed non-invasive ventilation and non-invasive ventilation given on admission – and calculated their survival probabilities (Figure 4 and Table 4). Those who were not ventilated or whose ventilation was delayed had a higher probability of survival than those who were ventilated on admission. Those who were ventilated on admission had a 22% probability of survival on day 3 compared to those who were
not ventilated at all with a survival probability of 83%. None of the patients ventilated on admission survived after day 4 (Table 4).

All patients who received delayed non-invasive ventilation as a response to worsening symptoms did not survive beyond day 16. Overall, patients who were not ventilated had a significantly better probability of survival than those who were ventilated on admission \( (P < 0.001) \) (Figure 4).

The likelihood of death for females and males by ventilation status was estimated using a Cox proportional hazard model, adjusting for age and two comorbidities. Table 5 shows the adjusted hazard ratios. The likelihood of death in female patients who were ventilated on admission (hazard ratio = 33.79, 95% CI: 4.09–279.07) was higher than in males who were ventilated on admission (hazard ratio = 8.65, 95% CI: 3.93–19.06).

**Discussion**

We included the largest cohort of patients in our analysis with the aim of identifying risk factors for in-hospital deaths and identify what interventions had higher probability of improved clinical outcome in fragile and vulnerable health system settings. In our analysis, we included all the 131 patients who were hospitalized in the main public sector hospital of Somalia with laboratory-confirmed SARS-COV-2 infection during the first three months of COVID-19 pandemic in the country from 30 March to 12 June 2020. In our analysis, we only included this cohort of 131 patients as there was no patient admitted in this hospital with laboratory-confirmed SARS-COV-2 infection after 12 June 2020 and all the patients included in our cohort were either discharged
alive or died within this period of 30 March to 12 June 2020. We assessed the demographic and clinical characteristics, outcomes, and risk factors for death among this cohort of 131 patients. Before the COVID-19 outbreak, the main hospital in Somalia, where the study took place, had no intensive care beds and was not designed to care for severely ill patients. When COVID-19 began in the country, the government refurbished the De Martino Hospital and fitted it with 20 intensive care beds. The decision was made to transfer all severely ill patients diagnosed with COVID-19 to this hospital. In this paper, we present, also, the findings of a survival analysis where we have assessed what interventions, given in accordance with national treatment guideline of Somalia for SARS-COV-2 infection to this cohort of 131 patients in this hospital, have improved the probability of survival.

To our knowledge, this is the first evidence from a fragile and vulnerable health setting on risk factors for in-hospital deaths and what interventions have proven successful in an environment with limited resources and capacities. Our study sample had a higher number of deaths. Of the 133 cohort of patients, 60% recovered and were discharged and the remaining 40% died in the hospital during the study period of 30 March to 12 June 2020.

The median length of hospital stay for our study sample was 5.5 days (IQR: 9 days) with a range of 1–35 days and a mean of 7.7 days (SD: 6.9). In a similar study in Vietnam, the median length of hospital stay was 21 (range: 16–34) days (Thai et al., 2020), while in the United States of America and the United Kingdom, the length of stay was shorter with an average of 7–8 days only (Bhatraju et al., 2020; Bialek et al., 2020; Docherty et al., 2020).

Two-thirds of patients were male (69%) with a mean age of 58.5 years versus 56.9 years for females. These findings are consistent with other studies in Vietnam (Thai et al., 2020) and China (Yang et al., 2020) which suggest a gender difference in hospitalized patients with
COVID-19. The signs and symptoms by age group and sex in our study do not differ from those reported in studies outside of Africa (Bhatraju et al., 2020; Bialek et al., 2020; Docherty et al., 2020; Salinas-Escudero et al., 2020; Thai et al., 2020; Wu and McGoogan, 2020; Wu et al., 2020); however, there are no comparable data from African settings, especially in sub-Saharan African countries.

The main comorbidities found in the 131 patients with COVID-19 in our study are similar to the findings of other studies done in Africa (Dalal et al., 2011). Although, we are limited by the lack of population-based data on the prevalence of diabetes and cardiovascular diseases in males and females in Somalia. Also, the proportion of female COVID-19 patients with diabetes in our study (48%) was higher than males (36%) and this is consistent with a study from Somaliland (Ahmed et al., 2019). This study found that the prevalence of diabetes was higher in females than males, and cardiovascular disease was higher among males, and in both sexes, the risk factors for diseases increased with age (Ahmed et al., 2019). These findings are also consistent with another study that examined the burden of noncommunicable diseases in sub-Saharan Africa (Dalal et al., 2011) and another study which examined comorbidities in a sample of patients hospitalized with COVID-19 in New York City and surrounding areas (Richardson et al., 2020).

Our survival analysis and estimation of the hazard ratio of death show that being over 60 years old and having cardiovascular disease as a co-morbidity significantly increased the likelihood of death due to COVID-19. However, patient’s sex did not increase the likelihood of death. In a study in China, men were more than twice as likely to die from COVID-19 than women, which differs from our study and age > 50 years increased the risk of death from COVID-19, which concurs with our study (Meng et al., 2020). The use of vasopressors and inotropes did not reduce the risk of death, as patients who received such treatment have very low probability of survival.
and the adjusted hazard ratio of death is 6.24 (95%CI: 3.55,10.99) compared to those who were not given the treatment (calculation not shown). Another study from China reported similar low survival rates among patients who received treatments such as the use of vasoconstrictive agents and oxygen therapy as these measures were administered on patients with a higher severity of disease (Yang et al., 2020).

Similar to another study from Italy (Grasselli et al., 2020), we also found that the use of non-invasive ventilation was an indicator of severe disease and increased the risk of death. An important finding of our study is the comparative benefit in the clinical outcome of providing the patients with non-invasive ventilation and the use of medical oxygen. The survival probability of patients who were given medical oxygen only was higher (75%) at day 7, and consistently remained at over 70% even at day 14 after admission, than in patients treated with both oxygen and non-invasive ventilation (10%), the risk of death for patients given non-invasive ventilation with medical oxygen was 5.43 times higher than in patients given only oxygen (calculation not shown). The lack of clinical benefit from the use of ventilation has also been reported in other settings (Bhatraju et al., 2020; Zareifopoulos et al., 2020). In addition, sophisticated hospital equipment, like ventilators, are often operated by health care workers with little training on such specialized equipment, as has been the case in Somalia’s COVID-19 crisis where short supply of equipment and trained staff has been a concern. Using hastily supplied ventilators with limited training can lead to improper use, discomfort and even death in patients (Branson, 2018; Kohbodi et al., 2020; Zareifopoulos et al., 2020).

As the COVID-19 pandemic spread throughout the world, there was concern that the infection would have a substantial impact on African countries because they were unprepared to deal with such a crisis (El-Sadr and Justman, 2020; Nkengasong and Mankoula, 2020). While this is true,
the level of preparedness was judged by the number and availability of intensive care beds and ventilators per millions of people’s use. However, our experience has shown that ventilators, although useful for patients suffering from severe symptoms, are not a feasible treatment in countries where skilled and trained staff, such as specialized nurses and intensivists to manage intensive care units and ventilators, are not available, as was the case in the hospital where this study was conducted. Although, the causal link between the level of skills and training of Somali health care workers and the relatively high number of deaths observed among the admitted cohort of 133 patients with SARS-COV-2 infection could not be established, it may be probable that relative lack of experience of healthcare workers on the use of ventilators and managing high-dependency critical care unit contributed to this high mortality (40%) among the admitted patients.

As reported in most sub-Saharan African countries (Mangipudi et al., 2020), medical oxygen in secondary and tertiary health care settings is not always available even though it is well established that this therapy is fundamental for the treatment of acutely ill patients, especially for pneumonia, which is a leading cause of death in elderly people and children under 5 years. Its usefulness in the treatment of patients with COVID-19 is further evidence of the urgent need to ensure that medical oxygen is always available in these settings. However, for myriad reasons, one of them being a lack of data regarding the availability of medical oxygen, supplying and delivering oxygen in sub-Saharan African countries has not been a priority despite that it is recognized as a fundamental hospital component.

Our study has a number of limitations and the result of this study should be interpreted in light of these limitations. First, the study includes a small cohort who were admitted in one public sector hospital in Somalia during the first three months of the pandemic. The dataset does not include
all clinical variables related to the evolution of COVID-19, and data were collected manually, retrospectively, although the data were checked by two people to minimize error. Nonetheless, human error and many other missing pieces of information (such as obesity, smoking habits, etc.), should be taken into consideration while analyzing and interpreting the data. Therefore, the results may not be generalized for rest of the country or other population groups, or may not be representative for the whole outbreak trajectory in the country. Second, our data includes information on deaths from laboratory-confirmed cases and do not include other patients who could not be tested. This may lead to underestimation of our findings (of the benefit of oxygen over non-invasive ventilation) and limit their generalizability. Third, the absence of important data on oxygen saturation levels and respiratory rates upon admission and upon discharge or death represent another limitation of this study. All these limiting factors may confound the observation to be inferred from the study findings.

Despite these limitations, our study contributes to an understanding of the risk factors for in-hospital death from COVID-19 in Somalia. Risk factors for in-hospital death from COVID-19 have not been studied or published from sub-Saharan countries before. In addition, the study has used findings from survival analyses to assess what interventions can have a higher probability of improved clinical outcome of patients with severe COVID-19 illness in resource poor settings by early use of medical oxygen.

**Conclusion**

Considering the risk factors mentioned in this study – advanced age, presence of cardiovascular disease and use of non-invasive ventilation – is critical when dealing with severe COVID-19
patients in an environment where trained and skilled health workforce to manage patients in high dependency units are limited and critical care services are rudimentary. This study confirms the importance of high levels of hospital emergency preparedness including decision-making in managing critical care. Our findings highlight the importance of the critical aspect of deciding whether to ventilate critical patients in a low-resource setting when advanced levels of critical care are not available and instead optimize the use of available healthcare resources in these settings, such as the use of medical oxygen to improve the probability of survival. Thus, the study results have important policy implications by highlighting the value of available, accessible and affordable low-cost interventions in a fragile and resource-poor setting to inform case management for severe acute respiratory diseases. The scaling up of availability of medical oxygen in such a setting will also promote improved access to care for childhood pneumonia and other respiratory diseases and result in improved outcome in terms of lives saved and deaths averted since the lower respiratory infections are the third leading cause of death and second leading cause of disability-adjusted life years for both sexes in Somalia (GBD 2019 Universal Health Coverage Collaborators).

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Ethical approval
Not applicable. The use of this surveillance dataset for outbreak analysis did not need ethical approval.

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Figure 1: Kaplan–Meier survival estimates by age and sex

Age group

Sex

Log-rank=12.95, P-value=0.0003

Log-rank=0.46, P-value=0.4970

Figure 1: Kaplan–Meier survival estimates by age and sex
Figure 2: Kaplan–Meier survival estimates by comorbidity

Cardiovascular disease (CVD) including hypertension

Diabetes

Log-rank=6.11, P-value=0.0134

Log-rank=3.85, P-value=0.0497

Figure 2: Kaplan–Meier survival estimates by comorbidity
Figure 3: Kaplan–Meier survival estimates by use of inotropes and vasopressors.
Figure 4: Kaplan–Meier survival estimates by ventilation use

Log-rank = 78.79, P-value < 0.001

Days of hospitalization

Survival probability

- Not ventilated
- Ventilation delayed
- Ventilated on admission

Figure 4: Kaplan–Meier survival estimates by ventilation use
| Age group (years) | Males n (%) | Females n (%) |
|------------------|-------------|---------------|
|                  | Total No. of patients | No. died | Total No. of patients | No. died |
| Mean (SD)        | 58.5 (16.1) |            | 56.9 (17.1) |            |
| Median (IQR)     | 60.0 (18.0) |            | 55.0 (27)   |            |
| 10–19            | 2            | 0           | 0            | 0           |
| 20–29            | 3            | 0           | 4            | 2           |
| 30–39            | 9            | 0           | 6            | 0           |
| 40–49            | 5            | 2           | 4            | 0           |
| 50–59            | 15           | 4           | 11           | 4           |
| 60–69            | 32           | 19          | 9            | 4           |
| 70–79            | 17           | 8           | 3            | 1           |
| 80+              | 6            | 5           | 5            | 3           |
| Total            | 89 (68%)     | 38 (73%)    | 42 (32%)     | 14(27%)     |
Table 2. Distribution of the patients (number of cases) according to disease characteristics and treatment, by sex and age group, Somalia, 2020

| Variable                        | Females (no.) | Males (no.) | Females (no.) | Males (no.) |
|---------------------------------|---------------|-------------|---------------|-------------|
|                                 | Age (years)   |             | Age (years)   |             |
|                                 | < 40          | 40–59       | ≥ 60          | < 40        | 40–59       | ≥ 60 |
| Symptoms and signs              |               |             |               |             |
| Fever                           | 9             | 13          | 17            | 13          | 19          | 54   |
| Shortness of breath             | 8             | 15          | 16            | 14          | 20          | 52   |
| Muscular pain                   | 1             | 1           | 6             | 1           | 2           | 11   |
| Chest pain                      | 3             | 4           | 9             | 4           | 11          | 21   |
| Abdominal pain                  | 2             | 2           | 2             | 0           | 1           | 5    |
| Joint pain                      | 1             | 1           | 9             | 2           | 3           | 18   |
| General weakness                | 3             | 4           | 10            | 3           | 6           | 24   |
| Diarrhea                        | 1             | 1           | 1             | 0           | 2           | 5    |
| Cough                           | 9             | 15          | 16            | 14          | 19          | 52   |
| Nausea/vomiting                 | 2             | 3           | 0             | 0           | 1           | 6    |
| Sore throat                     | 4             | 6           | 8             | 5           | 9           | 26   |
| Headache                        | 4             | 5           | 12            | 7           | 12          | 30   |
| Runny nose                      | 0             | 0           | 0             | 0           | 0           | 4    |
| Irritability confusion          | 2             | 1           | 6             | 1           | 6           | 15   |
| Clinical characteristics        |               |             |               |             |
| Abnormal lung X-ray findings    | 7             | 13          | 17            | 14          | 20          | 54   |
| Dyspnea tachypnea               | 8             | 14          | 17            | 14          | 19          | 47   |
| Abnormal lung auscultation      | 7             | 14          | 17            | 14          | 20          | 52   |
| Comorbidities                   |               |             |               |             |
| Cardiovascular disease          | 0             | 6           | 8             | 0           | 10          | 29   |
| Immunodeficiency, including HIV | 0             | 0           | 0             | 1           | 0           | 1    |
| Diabetes                        | 1             | 9           | 10            | 2           | 9           | 21   |
| Renal disease                   | 1             | 1           | 1             | 0           | 1           | 2    |
| Chronic lung disease            | 1             | 1           | 2             | 0           | 1           | 10   |
| Treatment                       |               |             |               |             |
| Oxygen therapy                  | 7             | 14          | 17            | 11          | 17          | 53   |
| Non-invasive ventilation        | 1             | 1           | 5             | 0           | 3           | 20   |
| Inotropes and vasopressors      | 0             | 1           | 3             | 0           | 4           | 20   |
| Antibiotics                     | 10            | 15          | 17            | 14          | 20          | 55   |
| Total                           | **10**        | **15**      | **17**        | **14**      | **20**      | **55** |
Table 3. Survival probability according to patient characteristics and treatment on day 7, 14 and 21 after admission to hospital, Somalia, 2020

| Variable                        | At day 7 Survival probability (95% CI) | At day 14 Survival probability (95% CI) | At day 21 Survival probability (95% CI) |
|---------------------------------|----------------------------------------|-----------------------------------------|-----------------------------------------|
| **Age group (years)**           |                                        |                                         |                                         |
| < 60                            | 0.789 (0.658–0.874)                    | 0.789 (0.658–0.874)                    | 0.789 (0.658–0.874)                    |
| ≥ 60                            | 0.489 (0.365–0.602)                    | 0.440 (0.312–0.561)                    | 0.339 (0.205–0.478)                    |
| **Sex**                         |                                        |                                         |                                         |
| Female                          | 0.669 (0.497–0.794)                    | 0.669 (0.497–0.794)                    | 0.535 (0.254–0.752)                    |
| Male                            | 0.600 (0.487–0.696)                    | 0.557 (0.436–0.662)                    | 0.488 (0.348–0.613)                    |
| **Cardiovascular disease**      |                                        |                                         |                                         |
| No                              | 0.719 (0.601–0.807)                    | 0.697 (0.574–0.790)                    | 0.558 (0.379–0.704)                    |
| Yes                             | 0.478 (0.332–0.610)                    | 0.425 (0.265–0.576)                    | 0.425 (0.265–0.576)                    |
| **Diabetes**                    |                                        |                                         |                                         |
| No                              | 0.704 (0.585–0.795)                    | 0.684 (0.561–0.779)                    | 0.547 (0.372–0.693)                    |
| Yes                             | 0.499 (0.353–0.629)                    | 0.449 (0.290–0.596)                    | 0.449 (0.290–0.596)                    |
| **Inotropes or vasopressors**   |                                        |                                         |                                         |
| No                              | 0.769 (0.670–0.842)                    | 0.728 (0.614–0.813)                    | 0.655 (0.508–0.768)                    |
| Yes                             | 0.107 (0.027–0.251)                    | 0.107 (0.027–0.251)                    | 0.000 (0.000–0.000)                    |

CI: confidence interval.
Table 4. Survival probability according to length of time after admission, by administration of non-invasive ventilation, Somalia, 2020

| Length of time after admission (days) | No ventilation | Delayed non-invasive ventilation | Non-invasive ventilation on admission |
|--------------------------------------|----------------|----------------------------------|--------------------------------------|
|                                      | Survival probability (95% CI) | Survival probability (95% CI)    | Survival probability (95% CI)        |
| 1                                    | 0.966 (0.899–0.989)       | 1.000 (1.000–1.000)            | 0.739 (0.509–0.873)                 |
| 2                                    | 0.910 (0.827–0.954)       | 1.000 (1.000–1.000)            | 0.304 (0.135–0.493)                 |
| 3                                    | 0.828 (0.731–0.893)       | 1.000 (1.000–1.000)            | 0.217 (0.079–0.399)                 |
| 4                                    | 0.778 (0.675–0.853)       | 1.000 (1.000–1.000)            | 0.087 (0.015–0.242)                 |
| 5                                    | 0.753 (0.647–0.832)       | 0.714 (0.258–0.920)            |                                      |
| 7                                    | 0.753 (0.647–0.832)       | 0.571 (0.172–0.837)            |                                      |
| 9                                    | 0.737 (0.627–0.819)       | 0.571 (0.172–0.837)            |                                      |
| 14                                   | 0.737 (0.627–0.819)       | 0.429 (0.098–0.734)            |                                      |
| 15                                   | 0.737 (0.627–0.819)       | 0.214 (0.012–0.586)            |                                      |
| 16                                   | 0.698 (0.564–0.798)       | 0.214 (0.012–0.586)            |                                      |
| 21                                   | 0.698 (0.564–0.798)       |                                  |                                      |

CI: confidence interval.
Table 5. Adjusted hazard ratios for death in hospitalized patients with COVID-19, by sex, Somalia, 2020

| Variable                        | Adjusted hazard ratios (95% CI) |
|---------------------------------|---------------------------------|
|                                 | Females                        | Males                          |
| **Age (years)**                 |                                 |                                |
| < 60                            | 1.00                            | 1.00                            |
| ≥ 60                            | 1.08 (0.34–3.40)                | 1.84 (0.74–4.57)               |
| **Cardiovascular disease**      |                                 |                                |
| No                              | 1.00                            | 1.00                            |
| Yes                             | 0.72 (0.16–3.28)                | 1.67 (0.86–3.26)               |
| **Diabetes**                    |                                 |                                |
| No                              | 1.00                            | 1.00                            |
| Yes                             | 2.14 (0.65–7.08)                | 1.33 (0.69–2.56)               |
| **Non-invasive ventilation**    |                                 |                                |
| No                              | 1.00                            | 1.00                            |
| Delayed                         | 2.20 (0.42–11.40)               | 2.26 (0.71–7.18)               |
| On admission                    | 33.79 (4.09–279.07)             | 8.65 (3.93–19.06)              |