



Who to escalate during a pandemic? A retrospective observational study about decision-making during the COVID-19 pandemic in the UK

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ABSTRACT

Background Optimal decision-making regarding who to admit to critical care in pandemic situations remains unclear. We compared age, Clinical Frailty Score (CFS), 4C Mortality Score and hospital mortality in two separate COVID-19 surges based on the escalation decision made by the treating physician.

Methods A retrospective analysis of all referrals to critical care during the first COVID-19 surge (cohort 1, March/April 2020) and a late surge (cohort 2, October/November 2021) was undertaken. Patients with confirmed or high clinical suspicion of COVID-19 infection were included. A senior critical care physician assessed all patients regarding their suitability for potential intensive care unit admission. Demographics, CFS, 4C Mortality Score and hospital mortality were compared depending on the escalation decision made by the attending physician.

Results 203 patients were included in the study, 139 in cohort 1 and 64 in cohort 2. There were no significant differences in age, CFS and 4C scores between the two cohorts. Patients deemed suitable for escalation by clinicians were significantly younger with significantly lower CFS and 4C scores compared with patients who were not deemed to benefit from escalation. This pattern was observed in both cohorts. Mortality in patients not deemed suitable for escalation was 61.8% in cohort 1 and 47.4% in cohort 2 ($p < 0.001$).

Conclusions Decisions who to escalate to critical care in settings with limited resources pose moral distress on clinicians. 4C score, age and CFS did not change significantly between the two surges but differed significantly between patients deemed suitable for escalation and those deemed unsuitable by clinicians. Risk prediction tools may be useful in a pandemic to supplement clinical decision-making, even though escalation thresholds require adjustments to reflect changes in risk profile and outcomes between different pandemic surges.

INTRODUCTION

COVID-19 is an infectious disease caused by SARS-CoV-2.¹ On 11 March 2020, WHO declared COVID-19 a global pandemic.² Since then, surges in patients with COVID-19 presenting to hospital with severe respiratory failure have placed significant pressure on critical care resources across Europe.³ At times, the demand for invasive ventilation as a key critical care therapy for respiratory failure had exceeded availability. This pressure was particularly

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The COVID-19 pandemic placed considerable pressure on critical care resources. Systematic reviews have validated the use of clinical scoring systems including the Clinical Frailty Score and 4C score to predict prognosis and the potential benefit of critical care interventions for patients hospitalised with COVID-19 infection. Minimal research has explored whether these scores are consistent with clinical decision-making to identify patients who are likely to survive when maximal treatment is offered.

WHAT THIS STUDY ADDS

⇒ Retrospective application of validated risk factors and scores differed in patients deemed suitable for escalation compared with those patients who were not deemed suitable by the attending clinician. Patients who were deemed unsuitable for intensive care admission had significantly worse outcomes than those who were deemed suitable for escalation. The percentage of patients suitable for escalation and the differences between outcomes and scores depending on escalation status remained similar when comparing two separate pandemic surges. However, variation between clinical assessment and score prediction persisted, suggesting that a combination of scores and clinical assessment may support treatment escalation planning.

acute in the UK, which has a relatively low number of critical care beds per unit population, compared with the rest of Europe.⁴ Guidance issued from the National Institute for Health and Care Excellence (NICE) at the start of the first UK surge highlighted the need 'to make the best use of NHS resources'.⁵ Although guidance has changed over the course of the pandemic,⁶ surges in COVID-19 have presented a unique opportunity to investigate how escalation decisions with regard to admission to critical care were made. Despite the guidance available, no gold standard exists how decisions regarding suitability for escalation should be made and which adjustments need to be made as the pandemic progresses.

Early in the pandemic it became evident that age is independently associated with mortality

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Future pandemics have potential to create significant pressure on critical care resources. Under this pressure, the tendency to suggest risk prediction models to determine escalation decisions is likely to reoccur. Even under pandemic pressures with limited resources and time constraints, clinicians discriminated patients who were less likely to benefit from intensive care admission from those who may benefit, as confirmed by retrospectively calculated risk assessment scores. As outcome risks change over the course of a pandemic, clinical decision-making and risk assessment scores may require repeat review and adjustment. This retrospective analysis of escalation decision-making demonstrating alignment between clinical decisions and formal risk factors and outcome predictors may alleviate the moral distress perceived by healthcare professionals involved in these decisions.

in patients hospitalised with COVID-19 infection.⁷ Frailty increases with age and multimorbidity, and has been used to guide decision-making about the appropriateness of critical care. In March 2020, at the start of the pandemic, NICE recommended that all adults should be assessed for frailty on admission to hospital using the Rockwood Clinical Frailty Score (CFS) as a standardised tool.⁵ At the time of the first pandemic surge in March 2020, NICE guidance suggested a CFS of 5 as a cut-off to predict poor outcomes in patients aged >65 years with COVID-19.⁵ Nonetheless, this tool was not supposed to be used in isolation, with the guidance stating that the CFS should form part of a 'holistic assessment'.

In the course of the pandemic more specific risk prediction tools have been developed to predict outcomes of COVID-19. The 4C Mortality Score,⁸ which includes age, sex, number of comorbidities, RR, oxygen saturation at room air, GCS and serum concentrations of urea and C-reactive protein as prognostic markers, has been validated externally and shows high potential for use in clinical routine.^{9,10} Clearly, there is an abundance of research investigating the value of clinical scoring systems to predict prognosis and the potential benefit of critical care intervention for patients hospitalised with COVID-19. However, minimal research has explored the process employed to identify patients with COVID-19 who are appropriate for critical care admission and if decision-making tools such as the 4C Mortality Score or the CFS could support decision-making.

Despite general acceptance of the use of triaging in a pandemic, clinicians perceive the decision-making process as morally distressing and ethically challenging.¹¹ The concern to not make the best possible decision for patients requires regular review of the decision-making process to adapt the priorities and policies of triage for different phases of the pandemic. There remains a lack of evidence if outcome scores and risk factors could provide additional support for decision-making or merely confirm clinical decisions.¹²

In this retrospective study we analyse differences and overlaps in clinical decision-making compared with outcome prediction based on score results. We describe the clinical outcome and risk profile of patients with COVID-19 deemed suitable for escalation to critical care versus those who were not thought to benefit from escalation to critical care. We also assessed if age, CFS and 4C score were associated with physician decision-making and

whether these scores are suitable tools to supplement clinical escalation decisions in a pandemic situation.

METHODS**Setting**

A retrospective analysis of all referrals to Critical Care based at the Royal Site of Liverpool University Hospitals NHS Foundation Trust (Liverpool, UK) during the first pandemic surge between 28 March 2020 and 5 May 2020 was undertaken. We repeated data collection between 10 October 2021 and 21 November 2021 to compare patient characteristics over time and to explore potential changes in the profile of patients triaged. This second time period was chosen because it represents the last surge of Delta variant which is associated with comparable disease severity to the Alpha variant surge.¹³ During the pandemic surges, all patients who were hospitalised with acute symptoms of COVID-19 and required oxygen supplementation were referred to critical care. Following a review by a senior critical care physician, patients were subsequently allocated to two levels of escalation in case of clinical deterioration: ward-level care as the ceiling of treatment or escalation to invasive positive pressure ventilation including intubation combined with admission to critical care. Ward-level ceiling of treatment included provision of non-invasive respiratory support consisting of non-invasive ventilation in patients with pre-existing chronic obstructive pulmonary disease and continuous positive airway pressure where deemed suitable. Do not attempt cardiopulmonary resuscitation (DNACPR) discussions were led by the parent teams or by critical care physicians. All final escalation decisions were made by one or more critical care consultants.

Participants

For this analysis, we only included patients with a positive SARS-CoV-2 PCR test using a nasal swab, throat swab or tracheal aspirate and patients considered to have a high clinical suspicion of COVID-19. High clinical suspicion was defined according to WHO criteria by the attending physician.¹⁴ A unique identifier was allocated to each referral and repeat referrals of the same patient were excluded.

Data collection was performed by research-trained medical doctors (SB, SF, BJ, AT) in a standardised format and included age and gender of the patient, date of referral, patient location prior to the referral, whether a DNACPR order was issued, CFS and hospital mortality. The CFS was verified from case notes or, when not documented, retrospectively allocated during data collection, with a score between 1 and 9 given to the patient dependent on their clinical status at the time of referral. Where not routinely documented, the 4C Mortality Score, which had been validated in a large UK cohort, was calculated retrospectively by the investigators.¹⁵ The investigators had full access to all clinical case notes including patient outcomes.

For each cohort, we determined the proportion of referrals that were deemed suitable for escalation of care and those whose ceiling of treatment was ward care, the proportion of patients escalated and proportion that survived to hospital discharge or died in hospital. The proportion of males versus females deemed suitable for escalation and actually escalated was also compared between the two time periods. We also assessed characteristics of survivors and non-survivors within these groups, including the CFS calculated by the clinical staff at the time of referral and the retrospectively calculated 4C tool. Repeat referrals were not included in the analysis. Non-parametric tests (Mann-Whitney U test) were used to compare groups and χ^2 test was performed

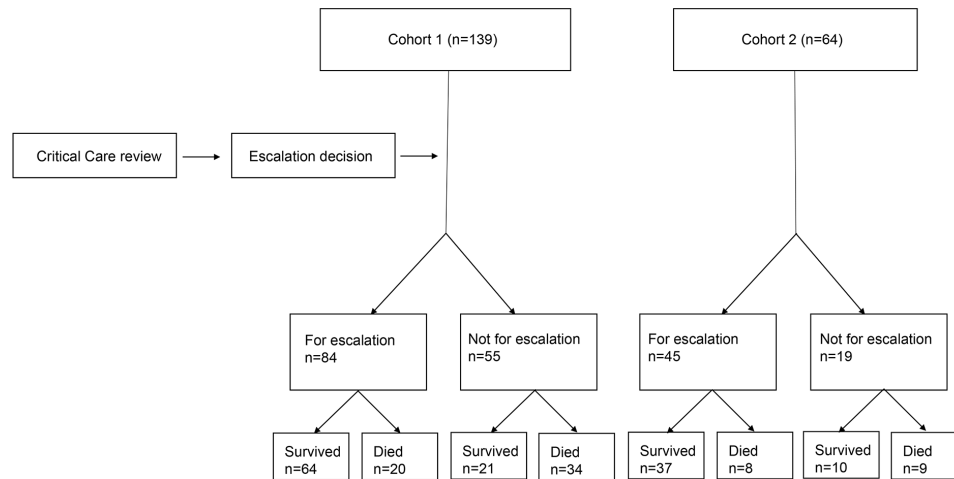


Figure 1 Flow chart of referrals to critical care during the study period for cohort 1 (27 March 2020 to 7 May 2020) and cohort 2 (10 October 2021 to 21 November 2021).

to investigate differences in distribution. $P < 0.05$ was considered significant. All statistical analyses were performed using IBM SPSS Statistics V.27.

Patient and public involvement

Patients or the public were not involved in the design, conduct, reporting or dissemination plans of our research.

Ethical review and Health Research Authority approval

This work forms part of the ‘Developing COVID-19 triaging and prognostication tools using conventional statistical analyses and Machine Learning (ML)’ project which received a favourable opinion after review (Reference No 20/EE/0226). During the COVID-19 pandemic, the Secretary of State for Health and Social Care provided a basis to process confidential patient information without consent for COVID-19 public health, surveillance and research purposes. All data were collected under this law.

RESULTS

A total of 203 patients who were referred to the critical care team regarding suitability for escalation to higher level of care were included in the analysis. One hundred and thirty-nine referrals were received during the first surge period (27 March 2020 to 7 May 2020) and fulfilled the inclusion criteria. Sixty-four patients were referred during the period from 10 October 2021 until 21 November 2021 (figure 1). In cohort 1, one patient was excluded as the patient was hospitalised in a different trust. A complete data set was generated by retrospectively calculating missing scores. Demographic data were extracted from electronic case notes with no data missing.

The survival rate in cohort 1 (61.2%) was lower but not significantly different from cohort 2 (73.4%, $p = 0.113$). A significantly higher proportion (28/64 patients, 43.8%) was admitted to intensive care unit (ICU) in cohort 2 compared with cohort 1 (39/139 patients, 28.1%, $p = 0.025$). Survival rates of patients admitted to ICU were 56.4% in cohort 1 and 71.4% in cohort 2 ($p = 0.054$).

In cohort 1, less than a third of patients (30.2%) were female (table 1); in cohort 2, the proportion of females was significantly higher (45.3%, $p = 0.014$). Among those who actually required ICU admission, the proportion of females increased significantly between cohort 1 and cohort 2 (12.8% vs 64.3%, $p < 0.001$).

The proportion of patients deemed suitable for escalation was comparable between the two cohorts (cohort 1: 60.4% (84/139 patients), cohort 2: 70.3% (45/64 patients), $p = 0.21$, table 1).

Overall comparison between cohort 1 and cohort 2 revealed no significant difference in age, 4C score and CFS between the two cohorts (table 1), indicating a similar patient population was admitted to hospital.

Outcomes according to escalation status

Among the 55 patients (39.6%) in cohort 1 deemed suitable for ward-level care only, none were admitted to critical care, and 52 (94.5%) had a DNACPR order in place. In cohort 2, 19 patients were deemed suitable for ward-level care only (table 1), and 18 (94.7%) had a DNACPR order in place. None of these patients were escalated to critical care. 61.8% of patients not deemed suitable for escalation by the treating physician died in cohort 1 compared with 47.4% in cohort 2 ($p < 0.001$). Thus, a significant proportion of patients who were not deemed suitable for escalation survived (figure 2).

Table 1 Gender, survival, escalation status and ICU admission rates in cohorts 1 and 2

	Cohort 1 (n=139)	Cohort 2 (n=64)	P value
Female, n (%)	42 (30.2)	29 (45.3)	0.014
Median age in years (Q1; Q3)	58 (51; 67)	58 (39; 70.5)	0.96
Median CFS (Q1; Q3)	3 (2; 4)	3 (2; 4)	0.785
Median 4C score (Q1; Q3)	9 (6; 12)	9 (6; 12.75)	0.871
Patients suitable for escalation (%)	84 (60.4)	45 (70.3)	0.21
DNACPR order issued (%)	74 (53.3)	23 (35.9)	0.025
ICU admission, n (%)	39 (28.1)	28 (43.8)	0.025
Death, n (%)	54 (38.8)	17 (26.6)	0.113
Deaths in patients unsuitable for escalation (%)	34/55 (61.8)	9/19 (47.4)	<0.001

Comparison between cohort 1 and cohort 2. Median and first and third quartiles (Q1; Q3) are shown for numerical data; absolute numbers and percentages are shown for categorical variables. Mann-Whitney U test was used for numerical data, χ^2 test was used for categorical variables. P values < 0.05 are highlighted in bold. CFS, Clinical Frailty Score; DNACPR, do not attempt cardiopulmonary resuscitation; ICU, intensive care unit.

Figure 2:

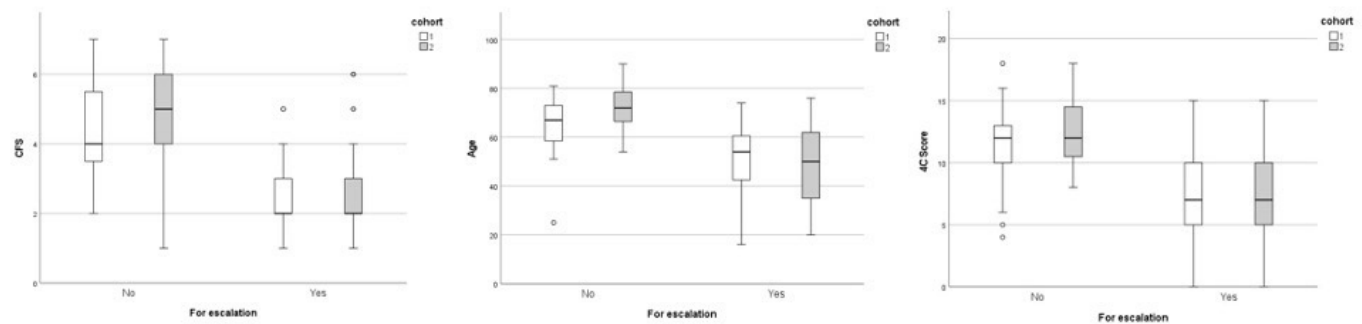


Figure 2 Age, Clinical Frailty Score (CFS) and 4C score for patients referred to critical care depending on their escalation status.

Age, CFS and 4C Mortality Score depending on escalation status

In both cohorts, age, CFS and 4C scores were significantly different between patients deemed suitable for escalation and those not suitable for escalation. Patients who were deemed not suitable for escalation by clinicians were older and had higher CFS and 4C scores (figure 2). Specifically, in cohort 1, the median CFS in patients deemed suitable for escalation was 2 (IQR 1) compared with the median of 4 (IQR 3) in those not suitable for escalation ($p < 0.001$). The 4C score was higher in patients not suitable for escalation (median 12, IQR 3) compared with those who were assessed as suitable (median 7, IQR 5, $p < 0.001$) (figure 2). Patients deemed suitable for escalation were significantly younger (median 54 years, IQR 19) than patients assessed as not suitable for escalation (median 67 years, IQR 15) (figure 2). In cohort 2, similar differences were observed: patients deemed suitable for escalation had a significantly lower CFS, were younger and had lower 4C scores.

Age, CFS and 4C score in patients deemed suitable for escalation: comparison between survivors and non-survivors

In cohort 1, CFS between survivors and non-survivors was not significantly different ($p = 0.91$). However, the 4C score differed significantly between survivors and non-survivors ($p = 0.003$). Survivors were significantly younger ($p = 0.02$). This age difference was also observed in cohort 2 ($p = 0.01$). In cohort 2, 4C score was significantly higher in patients who died compared with those who survived ($p = 0.01$). There was no difference in CFS when comparing survivors and non-survivors in cohort 2 ($p = 0.61$) (figure 3).

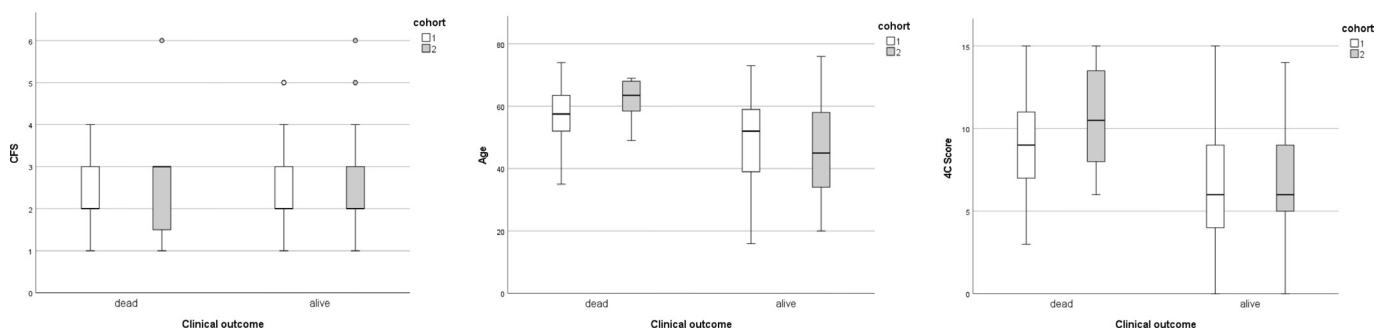


Figure 3 Comparison of survivors and non-survivors for patients who were deemed suitable for escalation. Boxplots of Clinical Frailty Score (CFS), age and 4C score are displayed.

Age, CFS and 4C score in patients deemed unsuitable for escalation: comparison between survivors and non-survivors

There was no significant difference in CFS between survivors and non-survivors in patients who were deemed unsuitable for escalation. Patients who died were significantly older in cohort 1 ($p = 0.027$) and had higher 4C scores ($p = 0.052$). These differences were not seen in cohort 2. Among patients who had been deemed unsuitable for escalation, survivors had significantly higher 4C scores and were older in cohort 2 compared with cohort 1 (figure 4). Similarly, patients who were deemed unsuitable for escalation and died had higher CFS in cohort 2 compared with cohort 1 (figure 4). These results indicate that as the pandemic progressed, older patients and more severely ill patients survived the disease more frequently even though they were not offered a higher level of care.

DISCUSSION

During the first 2 years of the pandemic, a significant proportion of patients admitted to hospital required admission to intensive care or high dependency units.¹⁶ This has placed an extraordinary burden on critical care services, and clinicians have been faced with complex ethical decisions when determining the patients to whom allocation of intensive care and ventilatory support is most appropriate. The necessity to determine which patients are suitable for escalation under pandemic pressures has caused considerable moral distress among healthcare professionals¹⁷ alongside concerns how valid the decision-making process and the tools used by healthcare professionals are in comparison to outcome prediction based on quantifiable risk factors and prediction tools.

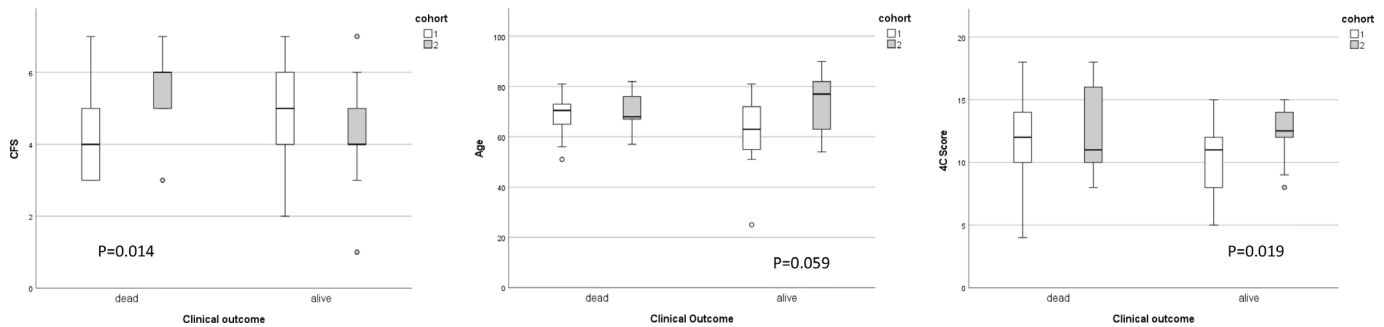


Figure 4 Comparison of survivors and non-survivors for patients who were deemed not suitable for escalation. Boxplots of Clinical Frailty Score (CFS), age and 4C score are displayed for each cohort. Patients who died had significantly higher CFS in cohort 2 than in cohort 1, while survivors had significantly higher 4C scores in cohort 2 compared with cohort 1.

In this retrospective study investigating escalation decision-making during the COVID-19 pandemic prior to the availability of validated tools, we explored the escalation decision-making by senior intensivists compared with established risk factors and disease severity tools. We describe the clinical outcome and risk profile of patients with COVID-19 deemed suitable for escalation to critical care versus those who were not thought to benefit from escalation to critical care. We also assessed if age, CFS and 4C score were aligned with physician decision-making and whether these scores are suitable tools to supplement clinical escalation decisions in a pandemic situation. We could establish four major findings: (1) Patients deemed suitable for escalation by senior intensivists were younger, were less frail and had lower 4C scores than patients deemed unsuitable for ICU admission. (2) Age and 4C scores were higher in patients who were deemed suitable for escalation but died. (3) Over the course of the pandemic, survival rates increased in patients deemed suitable for escalation despite higher disease severity. (4) The vast majority of patients not deemed suitable for escalation are issued with a DNACPR order.

Clinical escalation decisions align with age, CFS and 4C score

In this study, patients who were deemed suitable for escalation were younger and had lower frailty and disease severity scores than patients expected to not benefit from critical care admission, suggesting that a significant alignment exists between clinical assessment, described risk factors such as age and CFS as well as 4C score as a formal outcome prediction score. Age is an established determinant of short-term and long-term outcomes from critical illness and is associated with frailty.^{18–20} Age is also the predominant factor in the 4C score for patients over 70 years with regard to score points assigned.¹⁵ The 4C score was developed on data from over 35 000 patients and has been internally and externally validated in several large data sets.^{21 22} Risk prediction models offer potential advantages over physician predictions of outcomes. However, their application to individual patients or even at a unit population level was inferior to judgement by an experienced clinician in a non-pandemic patient cohort.¹⁸ In our study, there was a good alignment of established risk factors and disease severity scores with clinical decision-making. This suggests that clinicians might take age and frailty into consideration during their clinical assessment. Even if a full-risk prediction score such as the 4C score is not available or calculated at the bedside, clinicians might integrate components of such scores into their decision-making process.

Patients who were deemed suitable for escalation but died were older and had higher 4C scores

Advanced age has been identified as a major risk factor for adverse outcome of COVID-19 in large patient cohorts worldwide.²³ The results from our study confirm that age is also a major risk factor for mortality in those patients for whom the attending clinicians' decision supported escalation to ICU. Age forms a component of the 4C score which has been used to predict outcome and ICU admission.^{9 10 15} Our observation that patients who were deemed suitable for escalation but died had higher 4C scores than those who did not further supports the prognostic value of the 4C deterioration score in this selected cohort of patients.

Survival rates in patients deemed unsuitable for escalation increased during later phases of the pandemic despite higher disease severity

We observed that in the later stage of the pandemic, disease severity and age were higher in patients who survived the disease even when they were not offered critical care. This suggests that age and disease severity as decision criteria need to be adjusted during a pandemic, as the immune status of the population changes, for example, due to natural immunity or vaccination. The development of better therapies for the disease may also have influenced mortality in elderly and more severely ill patients.²⁴ These results suggest that physicians' decision-making strategies should be reviewed and, where necessary, adjusted to take into account changes in mortality.

DNACPR orders and escalation status

Treatment escalation decisions have historically been different from DNACPR orders.²⁵ It has been suggested that both processes can be combined by putting cardiopulmonary resuscitation decisions in the context of overall goals of care, that is, what treatments or outcomes a patient expects, accepts and wants.²⁶ Our results demonstrate that DNACPR decisions were closely linked to escalation status during the first pandemic wave, but also later in the pandemic, with nearly 95% of patients who were deemed unsuitable for critical care admission receiving DNACPR orders during or immediately after review by critical care specialists.

Limitations

Our study has several limitations. We present results from a single-centre observational cohort study. Decision-making may have been influenced by the culture and beliefs established within the critical care consultant team.²⁷ Hence, transferability into

different cultural settings is not feasible without confirmation in larger multicentre studies. Differences in healthcare systems, availability of critical care beds and pandemic preparedness represent further factors that may influence decision-making.²⁸

Interpretation of results and evolution of guidance on escalation decisions

Our results highlight the need to review and adjust decision-making during a pandemic in line with changing pressure on the healthcare system, development of new treatment options and consequently improved survival rates even in severe disease. General principles of escalation decisions include assessment by a physician with critical care experience,²⁹ taking into account comorbidities, severity of disease, frailty and age to assign care pathways that are likely to provide benefit to the individual patient.³⁰ Neither age or frailty nor more advanced risk scores can, when used in isolation, fully reflect the individual situation, including the benefits and burdens of treatment, patient preferences, prognostic factors, comorbidities and severity of the acute disease. The shift to an individualised approach to escalation planning is reflected in the evolution of NICE guidance. At the start of the pandemic, NICE suggested a CFS of less than 5 as a means for identifying patients with COVID-19 infection who would likely benefit from critical care organ support.⁵ This guidance has since been updated,⁶ and any numerical cut-offs to distinguish between patients who are likely and not likely to benefit from critical care have been omitted. An ‘individualized assessment of frailty’ is now recommended to inform discussions on treatment expectations for patients hospitalised with COVID-19.

Nevertheless, decision support tools and mortality scores can provide additional information when decision-making is difficult or fraught with uncertainties. In our hospital, all escalation decisions were made by at least two senior clinicians with extensive critical care experience. When a second opinion is not available, the importance of clearly defined scores and risk factors for swift decision-making increases. Although not investigated in our study, it is likely that clinicians take into account the individual components and risk factors without formalising them in scores.³⁰ During the COVID-19 pandemic the need for rapid decisions to provide respiratory support early after hospital admission has introduced time constraints and moral distress into clinical decision-making.³⁰ This retrospective review, taking into account age, CFS and 4C scores, may provide reassurance and support clinicians to reflect on decision-making.

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