Validation of a Crisis Standards of Care Model for Prioritization of Limited Resources During the Coronavirus Disease 2019 Crisis in an Urban, Safety-Net, Academic Medical Center*

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OBJECTIVES: The coronavirus disease 2019 pandemic has overwhelmed healthcare resources even in wealthy nations, necessitating rationing of limited resources without previously established crisis standards of care protocols. In Massachusetts, triage guidelines were designed based on acute illness and chronic life-limiting conditions. In this study, we sought to retrospectively validate this protocol to cohorts of critically ill patients from our hospital.

DESIGN: We applied our hospital-adopted guidelines, which defined severe and major chronic conditions as those associated with a greater than 50% likelihood of 1- and 5-year mortality, respectively, to a critically ill patient population. We investigated mortality for the same intervals.

SETTING: An urban safety-net hospital ICU.

PATIENTS: All adults hospitalized during April of 2015 and April 2019 identified through a clinical database search.

INTERVENTIONS: None.

MEASUREMENTS AND MAIN RESULTS: Of 365 admitted patients, 15.89% had one or more defined chronic life-limiting conditions. These patients had higher 1-year (46.55% vs 13.68%; $p < 0.01$) and 5-year (50.00% vs 17.22%; $p < 0.01$) mortality rates than those without underlying conditions. Irrespective of classification of disease severity, patients with metastatic cancer, congestive heart failure, end-stage renal disease, and neurodegenerative disease had greater than 50% 1-year mortality, whereas patients with chronic lung disease and cirrhosis had less than 50% 1-year mortality. Observed 1- and 5-year mortality for cirrhosis, heart failure, and metastatic cancer were more variable when subdivided into severe and major categories.

CONCLUSIONS: Patients with major and severe chronic medical conditions overall had 46.55% and 50.00% mortality at 1 and 5 years, respectively. However, mortality varied between conditions. Our findings appear to support a crisis standards protocol which focuses on acute illness severity and only considers underlying conditions carrying a greater than 50% predicted likelihood of 1-year mortality. Modifications to the chronic lung disease, congestive heart failure, and cirrhosis criteria should be refined if they are to be included in future models.

KEY WORDS: coronavirus disease 2019; crisis standards of care; healthcare equity; healthcare ethics; healthcare resources allocation; pandemic

***See also p. 1828.**

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BACKGROUND

The coronavirus disease 2019 (COVID-19) pandemic has disproportionately impacted the United States, which represents 4.28% of the world's population, yet 23.93% of the total COVID-19 cases with over 500,000 fatalities as of March 26, 2021 (1). Despite being a high-income economy, the United States has faced a crisis with widespread reports of insufficient personal protective equipment for front-line medical workers and shortages of ICU beds. The early months of the pandemic found many countries struggling to deliver care when faced with the stark reality of insufficient beds, staff, ventilators, and supplies. With shortages in mind, many states needed to develop triage algorithms quickly in order to determine priority scoring should a healthcare system be forced to enter into crisis standards of care (CSC). CSC refers to a state when healthcare systems are so overwhelmed by a catastrophic public health event that it is impossible to provide the standard level of care to all patients (2). At that juncture, prioritization would be made for patients who are most likely to survive the acute event, with some CSC frameworks also taking longer term survival into consideration. It is worth noting that as of May 2020 during the height of the first wave, only 29 of 50 states had any version of CSC guidelines (3).

On April 7, 2020, the Commonwealth of Massachusetts released their initial CSC guidelines, which incorporated key components of the University of Pittsburgh model policy (Pitt Model) (4). The Pitt Model prioritizes patients using acute illness severity with the Sequential Organ Failure Assessment (SOFA) score (5), as well as conditions prognosticating near-term survival. "Major" conditions (defined as > 50% chance of 5 yr mortality) were scored 2 points, and "severe" conditions (defined as > 50% chance of 1 yr mortality) were scored 4 points. The higher a patient's score, the lower their priority for receiving a scarce resource. However, the criteria for what classifies as poor prognostic factors for these conditions are not explicitly outlined in the Pitt model or the Massachusetts guidelines (**Table 1**). Hospitals were found in a unique situation of needing to clarify these conditions in order to determine resource prioritization. This issue extended to other states such as New Jersey and Pennsylvania, both which adopted similar CSC guidelines without specific scoring criteria for chronic conditions.

In April 2020, Boston Medical Center (BMC), a safety-net hospital caring for a primarily underserved and racial minority population, had the second highest total number of hospitalized patients in Massachusetts, and the highest percentage of COVID-19 patients per beds, peaking at greater than 70% of overall hospital capacity. At the peak of the initial COVID-19 surge between March 1 and May 18, 2020, 78.3% of the 1,186 patients hospitalized with COVID-19 at BMC were Black or Hispanic, 22.2% were homeless, and 24.1% were classified as critically ill (6). A committee of BMC physicians representing several specialties met to operationalize the state's guidance on resource allocation and to define major and severe comorbidities. The representatives reviewed available prognostication models for chronic illnesses and in several cases sought alignment with other regional hospitals regarding the scoring system. When considering the task of needing to save the most lives and life-years, the committee followed the established model of developing a point system based on major and severe underlying conditions and outlined criteria to fulfill those conditions (**Supplemental Table 1**, http://links.lww.com/CCM/G513). The criteria were determined by extrapolation from prognostic models for chronic disease outside of the critical illness setting as well as expert consensus. In this study, we assessed mortality of patients at 1 and 5 years in a sample of hospitalized critically ill patients under nonpandemic conditions. Specifically, we hypothesized that our sample of patients who scored for major and severe conditions (using our hospital-adopted criteria) would have greater than 50% mortality at 1 and 5 years, respectively.

METHODS

Ethics

The study protocol was approved by the Boston University Medical Campus Institutional Review Board, Approval Number H-40336.

Setting

BMC is a 514-bed urban academic medical center and the largest safety-net hospital in New England. Over 75% of visits are from underserved populations such as low income, homeless, and the elderly, who rely on government payors such as Medicaid, the Health Safety Net, and Medicare for insurance coverage (7). These patients tend to have complex medical and social histories, and approximately one-third of patient encounters are conducted in a language other than English.

TABLE 1.
Massachusetts Crisis Standards of Care Model and Underlying Conditions

Massachusetts Crisis Standards of Care Model (Based on Pitt Model) (1)					
		Point System			
Principle	**Specification**	**1**	**2**	**3**	**4**
Save lives	Prognosis for short-term survival (SOFA score)	SOFA score < 6	SOFA score 6–9	SOFA score 10–12	SOFA score > 12
Save life-years	Prognosis for long-term continued survival (medical assessment of underlying conditions that severely limit life expectancy)	–	Major underlying conditions that significantly limit near-term prognosis; death likely within 5 yr	–	Severely life-limiting conditions; death likely within 1 yr

Boston Medical Center's List of Underlying Conditions		
Underlying Condition	**Points**	**Criteria**
ESRD	2	ESRD ≥ 75 yr old
Cirrhosis	2	Decompensated cirrhosis and formal determination of "ineligible for transplant"
	4	Model for End-Stage Liver Disease ≥ 20 and formal determination of '"for transplant"
Oncology	2	Active cancer with expected survival < 5 yr[a]
	4	Active cancer with expected survival < 1 yr[a]
Heart failure	2	NYHA Class III with repeat hospitalizations (> 2 admissions in the preceding 12 mo)
		NYHA Class IV HF without one of the features below
	4	NYHA Class IV HF with at least one of the features below:
		Repeat hospitalizations (> 2 admissions in the preceding 12 mo)
		Frailty
		Cardiac cachexia (body mass index < 20 kg/m^2)
		Inability to tolerate beta blocker or ace-inhibitor
		Recurrent implantable cardioverter defibrillator shocks
Neurodegenerative conditions	2	Neurodegenerative conditions with expected survival < 5 yr[b]
	4	End-stage neurodegenerative conditions with expected survival < 1 yr[b]
Chronic lung disease	2	Chronic lung disease with expected survival < 5 yr[c]
	4	Chronic lung disease expected survival < 1 yr[c]

ESRD = end-stage renal disease, HF = heart failure, NYHA = New York Heart Association, SOFA = Sequential Organ Failure Assessment.
[a] 1 yr and 5 yr survival based on established criteria by cancer etiology.
[b] 1 yr and 5 yr survival based on established criteria by neurodegenerative condition etiology.
[c] 1 yr and 5 yr survival based on established criteria by chronic lung disease etiology.

Patient Identification

Adult (18 yr and older) patients were identified through BMC's electronic medical record system for the first 15 days of both April 2015 and April 2019. The study period was chosen to reflect the peak of new COVID cases in the state of Massachusetts (April 2020). All patients admitted to the medical, surgical, neurologic, or cardiac ICUs were included.

Data Collection and Variables

Variables collected included age, sex, race, length of stay, admission diagnosis, as well as date and cause of death when applicable. Triage scoring was performed via chart review by study physicians and verified by subspecialty physicians for complex scoring categories (e.g., neurodegenerative conditions, congestive heart failure [CHF], chronic lung disease [CLD]). Points were scored for chronic comorbid conditions at the time of ICU admission using the CSC point allocation framework (Table 1). These conditions included end-stage renal disease (ESRD) in patients older than 75 years, CHF, cirrhosis—ineligible for liver transplant—metastatic cancer, CLD, and neurodegenerative conditions (Supplemental Table 1, http://links.lww.com/CCM/G513). Any patient with ESRD on renal replacement therapy and greater than 75 years old scored 2 points. Patients with cirrhosis and concurrent laboratory values or clinical features suggestive of severe disease scored 2 points, and those with a Model for End-Stage Liver Disease (MELD) score greater than 20 scored 4 points. Patients with metastatic cancer scored 2 or 4 points, depending on the prognostication of cancer type as well as hospice eligibility. Patients with CHF scored 2 or 4 points depending on New York Heart Association class and concurrent clinical symptoms suggestive of decompensation. Patients with neurodegenerative conditions scored 2 points based on deteriorating cognitive impairment with extensive functional decline, and 4 points if such conditions were associated with complete functional dependence and signs of end-stage dementia. Criteria for those with CLD were most extensive and were subdivided based on type of condition, with criteria for each condition derived from prior literature and other clinical features suggestive of severe decompensation.

Data Analysis/Statistical Methods

Descriptive statistics of demographic and clinical variables were generated separately for patients with and without underlying conditions. Bivariate associations were calculated between these variables and whether or not the patient had an underlying condition. chi-square or Fisher Exact tests were used to compare categorical variables, and two-sample *t* tests were used to compare continuous variables. SAS 9.4 (SAS Institute Inc., Cary, NC) was used to perform all statistical analyses.

The date of admission and date of death were used to compute 1- and 5-year mortality. Patients who were admitted in 2019 were excluded from the 5-year mortality calculation. We defined any patients as lost to follow-up if they did not have 1- or 5-year follow-up encounters (depending on date of ICU admission). If a patient was lost to follow-up, they were classified as alive. For deceased patients with a missing year of death, the discharge date was used. Similarly, if a patient was discharged to hospice, they were classified as deceased with the date of death considered the date of hospital discharge when not otherwise available.

RESULTS

A total of 365 patients were identified as having an admission to an ICU during the study period. Elective admissions (such as ICU admitted for isolated post-operative monitoring) were excluded. Of these, 58 patients (16.45%) scored +2 (major) or +4 (severe) for at least one underlying medical condition outlined in the CSC point allocation framework. On average, patients with scored medical conditions were older than the group without (65.53 [14.46] vs 57.17 [17.46] yr; $p < 0.01$) but had similar sex distribution (46.55% vs 58.96% male; $p = 0.08$). There were no significant differences in the distribution of race or ICU length of stay between scored and unscored groups. Patients with scored conditions had a trend toward higher in-hospital mortality (13.79% vs 8.14%; $p = 0.17$) than those without these underlying conditions. Patients with scored conditions had higher 1-year (46.55% vs 13.68%; $p < 0.01$) and 5-year (50.00% vs 17.22%; $p < 0.01$) mortality rates (**Table 2**).

Of the 58 scored patients, eight received points for having ESRD on hemodialysis older than 75 years, seven for cirrhosis, 13 for metastatic cancer, eight for CHF, 19 for CLD, and seven for neurodegenerative conditions. The observed mortality at 1 year among all patients who scored for either +2 (major) or +4 (severe) in aggregate was 46.55% but differed among disease conditions: ESRD on HD (6/8; 75.00%), cirrhosis (3/7; 42.86%), metastatic cancer (8/13; 61.54%), CHF

TABLE 2.
Distribution of Demographics and Clinical Variables by Underlying Condition Status (Cumulative 2015 and 2019 Cohorts)

Demographics and Clinical Variables	Patients With Scorable Underlying Conditions, *n* = 58	Patients Without Scorable Underlying Conditions, *n* = 307	Test Statistic	Degrees of Freedom	p[a]
Age, mean (SD); (minimum–maximum)	65.53 (14.46); (31.00–88.00)	57.17 (17.46); (19.00–101.00)	–3.43	363	< 0.01
Male, *n* (%)	27 (46.55)	181 (58.96)	3.06	1	0.08
Race, *n* (%)			Fisher exact test		0.35
White	20 (42.55)	108 (43.37)			
Black	19 (40.43)	97 (38.96)			
Hispanic	6 (12.77)	30 (12.05)			
Asian	1 (2.13)	14 (5.62)			
American Indian/Native American	1 (2.13)	0 (0.00)			
Length of ICU stay			–0.23	109.77	0.82
Mean, d (SD)	5.47 (5.78)	5.26 (8.51)			
Scorable conditions					
End-stage renal disease on hemodialysis	8	NA			
Cirrhosis	7	NA			
Cancer	13	NA			
CHF	8	NA			
Chronic lung disease	19	NA			
Neurodegenerative	7	NA			
Mortality, *n* (%)					
Died during index hospitalization?	8 (13.79)	25 (8.14)	1.89	1	0.17
1 yr mortality	27/58 (46.55)	42/307 (13.68)	34.38	1	< 0.01
5 yr mortality	16/32 (50.00)	26/151 (17.22)	16.05	1	< 0.01

NA = not applicable.
[a]p calculated using χ^2 or Fisher Exact tests (for race) for categorical variables and two-sample t tests for continuous variables.

(5/8; 62.50%), CLD (2/19; 10.53%), and neurodegenerative conditions (4/7; 57.14%) (**Table 3**). When scored patients were subcategorized into +2 (major) and +4 (severe) conditions, all +4 scored categories met the greater than 50% observed mortality at one year except CHF (1/3; 33.33%) and CLD (2/15; 13.33%). For those in the +2 (major) category, all groups had greater than 50% observed mortality at 5 years except cirrhosis (0/1; 0.00%), metastatic cancer (2/6; 33.33%) and CLD (1/3; 33.33%) (**Table 4**).

DISCUSSION

To our knowledge, this is the first study of its kind to evaluate the applied CSC framework that considers underlying conditions. Doing so specifically within a

TABLE 3.
One- and Five-Year Mortality of Patients With Scored Conditions

Both 2015 and 2019 Cohorts (*n* = 365)	1 yr Mortality, *n* (%)	5 yr Mortality, *n* (%)
No underlying conditions	42/307 (13.68)	26/151 (17.22)
End-stage renal disease on hemodialysis	6/8 (75.00)	3/3 (100.00)
Cirrhosis	3/7 (42.86)	1/4 (25.00)
Cancer	8/13 (61.54)	6/10 (60.00)
Congestive heart failure	5/8 (62.50)	3/5 (60.00)
Chronic lung disease	2/19 (10.53)	3/12 (25.00)
Neurodegenerative	4/7 (57.14)	1/1 (100.00)
Scored on any condition (*n*)	27/58 (46.55)	16/32 (50.00)
Sum of scores		
0 points	42/307 (13.68)	26/151 (17.22)
2 points	13/29 (44.83)	8/15 (53.33)
4 points	13/25 (52.00)	7/14 (50.00)
6 points	1/3 (33.33)	1/2 (50.00)
8 points	0/1 (0.00)	0/1 (0.00)

hospitalized critically ill patient population with racial and socioeconomic diversity may provide additional support for the refinement of evidence-based resource allocation frameworks, especially during a pandemic that has disproportionately affected racial minorities.

In our population, we found that patients with +2 (major) and +4 (severe) medical conditions as defined by the BMC's scoring criteria in aggregate had 46.55% and 50.00% mortality at 1 and 5 years, respectively. However, mortality varied between conditions, with ESRD, metastatic cancer, CHF, and neurodegenerative disease criteria more consistently predicting greater than 50% mortality at 1 or 5 years than CLD or cirrhosis. Our scoring criteria for cirrhosis and CLD did not consistently identify patients with observed mortality greater than 50% at 5 years, emphasizing the importance of only including underlying conditions reliably associated with greater than 50% mortality at 1 year in CSC triage algorithms.

Only a minority of patients (15.89%) within our population scored for +2 (major) or +4 (severe) underlying conditions. For this reason, we opted to calculate mortalities both for +4 and +2 conditions in aggregate as well as separated out (with 1- and 5-yr mortalities for +4 and +2 scored conditions, respectively). The same scoring criteria were applied for data collection purposes by our hospital nurse administrators at the height of the COVID-19 pandemic (April to May 2020). At the time, 3,042 patients were reviewed, and only 338 (11.11%) scored for major or severe conditions. There are notable differences between the historical and COVID-era 2020 cohorts, as the 2020 cohort was almost exclusively hospitalized for COVID-19, whereas the historical cohort had variable illnesses. Nevertheless, the small percentage of scored patients likely reflects what would be encountered in prospective CSC scenarios and underscores the need to heavily consider acute survival metrics such as the SOFA score (which have demonstrated good association with short-term survival [8]) if crisis standards were to be implemented. It is worth noting that SOFA score criteria may need to be adjusted to reflect the context of critical illness in the COVID-19 era (9).

We noted significant variability in the complexity of scoring criteria. For example, ESRD required only two variables to fulfill the scoring benchmark, but CLD, cirrhosis, and neurodegenerative criteria were more

TABLE 4.
Separated One- and Five-Year Mortality of Patients With 4+ and 2+ Scored Conditions

2015 Cohort and 2019 Cohort Who Scored +4 on At Least One Condition (*n* = 32)	1 yr Mortality, *n* (%)
Scored 4 on any condition	14/29 (48.28)
+4 on ESRD on HD	NA
+4 on cirrhosis	2/3 (66.67)
+4 on cancer	6/6 (100.00)
+4 on CHF	1/3 (33.33)
+4 on chronic lung disease	2/15 (13.33)
+4 on neurodegenerative	3/3 (100.00)
2015 Cohort Who Scored 2 on At Least One Condition, Excluding Those Who Scored Greater Than 2 on Any Condition (*n* = 17)	**5 yr Mortality, *n* (%)**
Scored 2 any condition	8/15 (53.33)
+2 on ESRD on HD	3/3 (100.00)
+2 on cirrhosis	0/1 (0.00)
+2 on cancer	2/6 (33.33)
+2 on CHF	2/2 (100.00)
+2 on chronic lung disease	1/3 (33.33)
+2 on neurodegenerative	NA

CHF = congestive heart failure, ESRD = end-stage renal disease, HD = hemodialysis, NA = not applicable.

complex, labor intensive, and required subspecialist physician review. Future iterations of scoring criteria should seek to simplify data without significantly affecting their positive predictive value. Criteria simplification can allow scoring systems to be more easily and consistently applied across reviewers, whereas nuances in prognostication can be leveraged by specialists within CSC committees.

We suspect stringent adherence to CSC triage scoring will underreport the number of patients with chronic underlying conditions. In our study, several patients had documented histories of a chronic disease without supporting data, and therefore, we did not score them for the condition. This was often due to scarce outpatient records prior to admission. In addition, lack of specific information such as transplant eligibility, description of baseline cognitive function, outpatient laboratory values, or imaging criteria made it challenging to accurately score patients, especially for the pulmonary, cirrhosis, and neurodegenerative categories. We decided to keep include these patients in the unscored group rather than eliminating them from data analysis. Although this limited the reliability of ascertaining mortality among the specific conditions for our study, it reflects the real-life scenario that hospitals will likely face when using similar triage criteria prospectively. It also raises the possibility that patients who have received medical care and have more complete medical records with thorough documentation may be penalized by being scored for a life-limiting chronic medical condition, whereas others with the same conditions but no prior contact with our health system are not. This highlights the importance of electronic medical record intercompatibility for a more comprehensive understanding of admitted patients and their medical histories.

Most patients with a chronic lung condition had chronic obstructive pulmonary disease (COPD), with a small minority of patients suffering from other conditions such as interstitial lung disease, pulmonary arterial hypertension, or chronic bronchiectasis. Of those with COPD who did score, the vast majority did so on the basis of multiple hospitalizations. This criterion did not correlate well with mortality. Future studies can perhaps incorporate multiple hospitalizations as a supplemental rather than standalone criterion to help increase its predictive value. The pulmonary criteria that most strongly correlated with mortality included World Health Organization Class IV symptoms, hospice eligibility, and baseline blood gases suggestive of decompensation.

Chart reviewers often had limited available outpatient data to score patients with cirrhosis. For those patients, laboratory values were taken from their time of ICU admission, which may have overestimated the true severity of their underlying disease and consequently why greater than 50% mortality was not seen at 5 years. Increasing the MELD score requirement of the +4 scored population can potentially offset this limitation and strengthen the positive predictive value of the cirrhosis criteria. Furthermore, the committee made a conscious effort to include hepatic transplant ineligibility as a required scoring criterion. The rationale was that patients who are transplant eligible should not be adversely affected with a score, since if they were to survive, they could eventually receive life-prolonging treatment. However, only seven of the 31 patients with documented severe cirrhosis were also deemed transplant ineligible. Although lack of transplant eligibility evaluation may limit the application of this criterion, future scoring criteria might consider a "rapid evaluation" upon admission to identify major transplant exclusion criteria and guide decision-making for appropriate crisis scoring classification.

The neurodegenerative criteria used in our model met the greater than 50% predicted mortality benchmark at 1 and 5 years, but we found a small number of patients who met these criteria. The criteria were quite complex, requiring prior cognitive evaluations and key phrases documented in the chart (such as "bedbound," "multiple stage 3 or 4 ulcers," or "insufficient oral intake" with documented > 10% weight loss in 6 months or albumin < 2.5 g/dL which are commonly used as hospice criteria). It is essential to have objective criteria for predicting mortality in neurodegenerative conditions as many patients have a diagnosis of dementia, but this is not a uniformly life-limiting condition. Furthermore, subjective descriptors of patients may unintentionally reflect values about quality of life which should not be considered in CSC scoring criteria.

Although the cardiac criteria were relatively straightforward, subjective data such as "frailty" could not be consistently determined from chart reviews and should be removed in favor of more objective data. Similarly, the NYHC Class IV heart failure patients could score either +2 (major) or +4 (severe) depending upon the quality of documentation in our records or our ability to access outside records to determine recent hospitalization, tolerance of medications, and implantable cardioverter defibrillator shocks. This may explain the discrepancy seen between 1- and 5-year mortality being greater than 50%, but discordance between expected mortality in the subdivided +2 and +4 groups.

Our study had several limitations. Most notably, the small number of scored patients limited the ability to assess the predictive accuracy for any one condition. Assessment of mortality was another major limitation in this study due to the need to make assumptions regarding patient status as alive or deceased. Over a third of patients (130/365) were lost to follow-up and considered alive which, given their significant comorbidities, may have overestimated survival. To a lesser degree, we may have overestimated mortality for 53.33% of patients (8/15) discharged to hospice without confirmation of death and were assumed to be deceased. To add, patients with scored conditions were significantly older ($p < 0.01$), meaning that age could be a driver of mortality. Although it would have been ideal to adjust for potential confounding by age, the sample size of scored patients was too small. This could be better studied in a larger population. Finally, the cause of death was quite variable in 2015 and 2019 and did not reflect the almost uniform COVID-19 diagnosis that was encountered in April 2020 during the height of the pandemic, which affects the generalizability of our results. It is clear from emerging data that other risk factors outside of our current established comorbidities such as diabetes, obesity, and smoking are likely to affect both COVID-19 illness severity and survival (10–12). Future studies may benefit from incorporating these data into COVID-19 specific triage scoring criteria.

Overall, we believe that the experience of establishing CSC triage guidelines at our institution has taught us valuable lessons which may be generalizable to other healthcare systems facing the potential need to allocate limited resources. Notably, the majority of our population was comprised of racial minorities (Black and Hispanic). It is crucial to note that people of color are historically and presently disadvantaged by structural racism as well as unequal access to affordable healthcare, stable housing, education, and employment (13). No scoring criteria which includes chronic underlying medical conditions can rectify the fact that lifelong disparities in healthcare will bias a model toward penalizing minority patients (3). Given our marginalized patient population, special attention is needed to ensure that factors such as race, psychosocial issues, and socioeconomic status do not bias the risk calculation or negatively affect equitable resource allocation. These considerations have been reflected in the revised CSC issued by Massachusetts in October 2020 (14) (**Supplemental Table 2**, http://links.lww.com/CCM/G514). For example, the new guidelines safeguard against inadvertent race-based discrimination in SOFA scoring by limiting the number of points that can be added for elevated creatinine if a patient has chronic renal insufficiency at baseline, due to the disproportionately high prevalence of chronic kidney disease among Black Americans. Thus, we would also favor removing ESRD from the chronic conditions criteria despite its high predictive value for mortality in our study.

Our study supports the recent changes to the Massachusetts criteria (14) to eliminate the inclusion of major underlying conditions and use only acute illness severity and severe underlying conditions associated with greater than 50% mortality at 1 year in a scoring algorithm. The low number of patients scoring for chronic conditions appears to support counting severe underlying conditions as +2 rather than +4 to prioritize acute illness scoring. We believe this adjustment will more equitably score patients in our vulnerable populations as well as patients who have received the majority of their medical care within our network. Further research is needed to develop improved iterations of this CSC resource allocation triage model.

CONCLUSIONS

Our CSC triage algorithm proved useful in predicting greater than 50% 1- and 5-year mortality among our sample of scored patients with ESRD, metastatic cancer, CHF, and neurodegenerative disease in a sample of socioeconomically and racially diverse critically ill patients. However, mortality varied between conditions. The relatively low prevalence of major or severe underlying conditions in this critically ill population appears to support prioritizing acute survival as well as patients without underlying conditions carrying a greater than 50% predicted likelihood of 1-year mortality. Simplification and clarification of these criteria may improve the validity and utility of the scoring process in future iterations of CSC models.

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