ELECTRONIC SUPPLEMENTARY MATERIAL

Downar J *et al.*: A framework for critical care triage during a major surge in critical illness

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eAppendix A Justification for Choosing 12-month Mortality Risk

The Framework prioritizes patients based on *short term mortality risk* following the onset of critical illness and not on *survival duration*. Survival duration pertains to *how long* patients survive or do not survive their critical illness. This can be a useful measure to describe patient outcomes retrospectively; however, it is challenging in clinical practice to determine prospectively with certainty that an individual patient *will* survive their ICU stay or how long they *will* survive. By contrast, mortality risk pertains to *how likely* it is that patients will survive or die from their critical illness. For example, if a person with an advanced, incurable medical condition develops critical illness, we might not be able to say with certainty whether that person will survive their critical illness, or how long they would be likely to survive. But based on published evidence and expert opinion, we could say that if there were 100 patients in this situation, at least 80 of them (for example) would not be alive at a defined point in the short-term future following their critical illness (i.e., an 80% short-term mortality risk). In this framework, priority is given to those patients who are *more likely* to survive their critical illness over those *least likely* to survive their critical illness.

Short-Term Mortality Risk

A prioritization approach that focuses on short-term mortality risk was adopted for two reasons: i) there is less data about health outcomes upon which to base decisions beyond the short term; and ii) consideration of medium term or longer term health outcomes increases risk of discrimination against older persons or persons with pre-existing conditions, disabilities or life circumstances associated with a generally shorter lifespan (e.g., homelessness). There is variability, however, in how 'short-term' is defined. Some protocols define 'short-term' as 'survival to discharge,' others as 'survival typically ≤ 1 year;' most do not provide an explicit definition or use related terms such as 'near-term' or 'immediate-term' without specification. White and Lo recently revised their triage approach (adopted by much of the US) to address population health and justice concerns, and they defined near-term prognosis as 12 months.[1]

Further research is needed to develop more accurate, reliable and feasible tools to estimate mortality risk.

Why is mortality risk at 12 months used rather than a shorter or longer time parameter? Assessing mortality *risk* at 12 months is not the same thing as asking whether or not a specific patient will survive 12 months. Rather, it describes a patient's *likelihood* of survival at 12 months following critical illness based on clinical risk factors. Twelve months was chosen for the following reasons:

i. It is common in practice and in more recent epidemiological studies to focus on mortality risk at one year, so there is a stronger evidence base to support decisions using this metric.
ii. Survival to ICU discharge or hospital discharge, or 30-day survival is too short because they are unreliable measures of survival in practice—there are a number of patients who survive their critical illness but die within days of discharge from the ICU due to the advanced nature of their underlying illness (often following a consensual decision to withdraw and transfer the patient to a ward to receive palliative care). Flaaten and colleagues showed that the difference between ICU mortality and 30-day mortality was 11% among frail elderly patients[2]—a strong indication of why ICU discharge does not necessarily indicate the end of the illness, and it does not necessarily indicate a successful recovery. In addition, although the skills and technological capability of critical care services can sustain patients with very advanced critical illness for 30 days or more, many of these patients do not recover sufficiently to be discharged.[3]
iii. Survival curves following the onset of critical illness are very "steep" initially (indicating ongoing mortality related to the acute illness) but tend to flatten out (less mortality) by 6 months. This suggests that it is not appropriate to consider an acute event to be over until at least that point. Focusing on either 6 or 12 month mortality risk would likely result in the same individuals being prioritized in a triage scenario.[4] We have chosen 12 months due to the reason supplied in (i).

eAppendix B The Use of an Acute Illness Score in Critical Care Triage

An earlier triage protocol developed post SARS and H1N1 for Ontario included a prioritization system based on sequential organ failure assessment (SOFA) scoring,[5] and triage approaches used in other jurisdictions also include SOFA scores.[6]

We opted not to use an acute illness score (e.g., SOFA) for two reasons. First, a large retrospective study of the H1N1 pandemic found that those in the highest risk category according to SOFA score (typically >11) had only a 59% mortality rate; furthermore, for patients admitted with influenza, the mortality rate was even lower: only 31%.[7] SOFA scores that would identify a mortality risk of 80-90% would be found in fewer than 1% of patients at the time of referral, making this unhelpful for resource allocation purposes.[7] Second, high SOFA scores do not consistently identify mortality risk across different presenting complaints, e.g., mortality from poisoning (29%) is substantially lower than mortality from neurological presentations (67%),[7] which raises concerns about the accuracy of such an approach. We are still learning about how best to prognosticate for patients with COVID-19, but available data suggests that the admission SOFA scores for non-survivors are low, and thus unhelpful for distinguishing them from survivors.[8,9] A review of COVID-19 admissions from Arizona found that the discriminant accuracy of SOFA for predicting mortality was very poor (AUROC 0.59) and actually worse than age alone.[10] A more recent US study indicated that SOFA significantly overestimated mortality risk for Black patients compared with white patients, raising additional equity concerns with this approach.[11]

Combining SOFA or another acute illness scoring system with a system based on chronic, life-limiting conditions is another approach. Examples include frameworks published by White and Lo[6] and also by New York State.[12] Although we do not have published data on the outcomes of these approaches, a recent study applied them retrospectively to a large pre-COVID-19 cohort of critically ill patients in New York and found similar issues to those identified above.[13] The lowest priority group would account for only 4.3-8.9% of admissions, while 77-81% would be in

the highest priority group. Of those in the lowest priority group, hospital survival was 40-60%, whereas overall hospital survival was 77%, suggesting little separation of the survivors and non-survivors.

In a recent editorial, Dr. Michael Christian, the author of the first published triage allocation system to use the SOFA score,[5] reflected on these recent published studies and concluded that on the basis of the above considerations, it was "time to rethink the role of the [SOFA] score in triage protocols."[14]

eAppendix C Suggested Clinical Factors and Tools for Predicting Short-Term Mortality Risk in an Adult Population

The clinical tools in the Supplementary Table were developed for purposes including prognostication, but were not developed with the intent of informing resource allocation decisions. To our knowledge, no clinical tool has been validated for the specific purpose of critical care resource allocation in a pandemic. Consequently, unless and until valid tools are developed, clinicians must adapt the clinical tools available to them to the context of critical care triage. Otherwise, they must rely on clinical judgment alone, which increases the subjectivity of clinical assessment, introduces clinician bias and inconsistency, places greater cognitive and moral burden on clinicians making decisions in a crisis, and presents greater risk of violating human rights and exacerbating health and social inequities.

However, even clinical tools for which there is strong evidence supporting their accuracy (i.e., their ability to predict short-term mortality risk), reliability (i.e., multiple people using the tool on the same patient would obtain the same result), and feasibility (i.e., people are able to use the tool in the context of a pandemic) may still be concerning if they are unjustifiably discriminatory towards a specific group on prohibited human rights grounds. The use of the Clinical Frailty Scale, in particular, has been the subject of much scrutiny and criticism, particularly from some disability rights experts.

For future use, we recommend that a multidisciplinary consensus panel of experts in critical care and other relevant clinical disciplines be funded and convened for the purpose of further developing clinical assessment guidelines based on best available evidence accumulated during the pandemic and within the guiding ethical principles set out in this framework using a similar lens as described above. Such a panel should seek input from experts in ethics, human rights, law, and related disciplines, and engage the perspectives of those representing marginalized populations and others who may be disproportionately affected by critical care triage (e.g., persons with disabilities). The process by which such clinical assessment guidelines are

generated and finalized, including the process by which experts and other stakeholders are engaged, should be made transparent. Explicit justifications grounded in the principles and considerations outlined in this appendix and in the framework should be provided for the inclusion or exclusion of clinical factors or tools. We suggest that human rights tools and health equity impact assessment tools be applied to any tools considered for inclusion in such a guideline, as well as to the guideline itself.

eTable Suggested Clinical Factors and Tools

Clinical Factor	Level 1 Triage Scenario (Aiming to identify patients with >80% short-term mortality risk)	Level 2 Triage Scenario (Aiming to identify patients with >50% short-term mortality risk)	Level 3 Triage Scenario (Aiming to identify people with >30% short-term mortality risk)
A	Severe Trauma with predicted mortality >80% based on TRISS score	Severe Trauma with predicted mortality >50% based on TRISS score	Trauma with predicted mortality >30% based on TRISS score
B	Severe burns with any 2 of: Age >60, >40% total body surface area affected, inhalation injury	Same as Level 1	Same as Level 1
C	Cardiac arrest • Unwitnessed cardiac arrest or • Witnessed cardiac arrest with non-shockable rhythm or • Recurrent cardiac arrest	Same as Level 1	Cardiac arrest
D	Metastatic malignant disease with any of the following: • ECOG grade>=2 at baseline (2-4 weeks before admission) • Disease progressing or stable on treatment • Active treatment plan with >80% predicted mortality during or soon after critical illness • Unproven (experimental) treatment plan • Treatment plan that would only be started if the patient recovers from critical illness	Metastatic malignant disease with any of the following: • ECOG grade>=2 at baseline (2-4 weeks before admission) • Disease progressing or stable on treatment • Active treatment plan with >50% predicted mortality during or soon after critical illness • Unproven (experimental) treatment plan • Treatment plan that would only be started if the patient recovers from critical illness	Metastatic malignant disease
E	Severe and irreversible neurologic event with >80% risk of death based on: • For Intracerebral Hemorrhage a modified ICH score of **4-7** • For Subarachnoid Hemorrhage, a WFNS grade 5 (GCS 3-6) • For Traumatic Brain Injury, the IMPACT score • Acute ischemic stroke alone would not be excluded at this level	Severe and irreversible neurologic event with >50% risk of death based on: • For Intracerebral Hemorrhage a modified ICH score of **3-7** • For Subarachnoid Hemorrhage, a WFNS grade 3-5 (GCS 3-12 OR GCS 13-14 AND focal neurological deficits) • For Traumatic Brain Injury, the IMPACT score • For acute ischemic stroke, an NIHSS of **22-42.**	Irreversible neurologic event/condition with >30% risk of death on: • For Intracerebral Hemorrhage a modified ICH score of **2-7** • For Subarachnoid Hemorrhage, a WFNS grade 2-5 (GCS <15) • For Traumatic Brain Injury, the IMPACT score • For acute ischemic stroke, an NIHSS of **14-42.**
F	End-stage organ failure meeting the following criteria: *Heart* • Chronic End-stage Heart Failure with NYHA Class 4 symptoms, ineligible for advanced therapies (mechanical support, transplant) *Lung* • COPD - Use Clinical Frailty Score criterion (G) • Cystic Fibrosis with FEV_1 <20% predicted when measured at time of clinical stability • Pulmonary fibrosis with any of: ○ VC <60% or DLCO <40% predicted ○ Chronic supplemental O_2 >12h per day • Secondary pulmonary hypertension (RVSP >50 mmHg) • Rapid progression (>10% decline in FVC over 6m, or acute exacerbation in previous 12m) • For pulmonary hypertension, anyone with ESC/ERS high risk criteria or a REVEAL 2.0 score >=9 while on optimal therapy (see below) *Liver* • Chronic Liver Disease with failure of 2 or more organ systems (ACLF Grades 2-3) • MELD score >=25	End-stage organ failure meeting the following criteria: *Heart* • Chronic End-stage Heart Failure with NYHA Class 3 or 4 symptoms, ineligible for advanced therapies (mechanical support, transplant) PLUS any of: ○ High/increasing BNP ○ Cardiorenal syndrome ○ Recent discharge (<30d) or multiple admissions for CHF in past 6 months *Lung* • COPD - Use Clinical Frailty Score criterion (G) • Cystic Fibrosis with FEV_1 <20% predicted when measured at time of clinical stability • Pulmonary fibrosis with any of: ○ VC <60% or DLCO <40% predicted ○ Chronic supplemental O_2 >12h per day • Secondary pulmonary hypertension (RVSP >50 mmHg) • Rapid progression (>10% decline in FVC over 6m, or acute exacerbation in previous 12m)	End-stage organ failure as suggested by an unscheduled admission for an exacerbation or complication of their chronic illness in the past 12 months or previous organ transplant with evidence of chronic rejection or chronic organ dysfunction in the transplanted organ. Note that some admissions (e.g., catheter or access infections) may not suggest an elevated risk of mortality, and for some less common conditions unscheduled admissions may not suggest an elevated risk of mortality and specialist input should be sought.

Clinical Factor	**Level 1 Triage Scenario (Aiming to identify patients with >80% short-term mortality risk)**	**Level 2 Triage Scenario (Aiming to identify patients with >50% short-term mortality risk)**	**Level 3 Triage Scenario (Aiming to identify people with >30% short-term mortality risk)**
	Note that patients who meet these criteria may be eligible for ICU admission if they are currently on an organ donation waiting list and would be given highest priority if admitted to ICU (e.g., status 4/4F for liver transplantation). This does not include people who have been referred to a transplant service but have not yet been listed for a transplantation. This also would not apply if organ donation processes are halted due to triage conditions precluding organ procurement.	• For pulmonary hypertension, all of: ○ ESC/ERS intermediate risk criteria or a REVEAL 2.0 score >=7 while on optimal therapy (see below) ○ Age >=75 ○ Hospitalization for pulmonary hypertension in past 3 months OR a significant comorbidity (e.g. renal failure *Liver* • Chronic Liver Disease with failure of 1 or more organ systems (ACLF Grades 1-3) • MELD score >=15 Note that patients who meet these criteria may be eligible for ICU admission if they are currently on an organ donation waiting list and would be given highest priority if admitted to ICU (e.g., status 4/4F for liver transplantation). This does not include people who have been referred to a transplant service but have not yet been listed for a transplantation. This also would not apply if organ donation processes are halted due to triage conditions precluding organ procurement.	
G	Clinical Frailty Score of >=7 (on the 9-point tool) at baseline (2-4 weeks before admission) due to a **progressive** illness or generalized deterioration of health status. This factor does not include all people with clinical frailty. This factor is **not** relevant for non-progressive conditions, such as developmental disability, spinal cord injury, or traumatic brain injury, because these are not necessarily associated with a higher risk of death during or soon after an episode of critical illness.	Clinical Frailty Score of >=5 (on the 9-point tool) at baseline (2-4 weeks before admission) due to a **progressive** illness or generalized deterioration of health status. This factor does not include all people with clinical frailty. This factor is **not** relevant for non-progressive conditions, such as developmental disability, spinal cord injury, or traumatic brain injury, because these are not necessarily associated with a higher risk of death during or soon after an episode of critical illness.	Same as level 2.
H	Elective palliative surgery	Same as Level 1	Elective or emergency palliative surgery
I	Mechanical ventilation for >=14 days with a ProVent-14 score of 3-6.	Mechanical ventilation for >=14 days with a ProVent-14 score of 2-6.	Mechanical ventilation for >=14 days with a ProVent-14 score of 1-6.

The following provides further information on the tools described in the table:

TRISS Score Calculator
Access the tool on MDApp.

ECOG
Eastern Cooperative Oncology Group Performance Status

GRADE	ECOG PERFORMANCE STATUS
0	Fully active, able to carry on all pre-disease performance without restriction
1	Restricted in physically strenuous activity but ambulatory and able to carry out work of a light or sedentary nature, e.g., light house work, office work
2	Ambulatory and capable of all selfcare but unable to carry out any work activities; up and about more than 50% of waking hours
3	Capable of only limited selfcare; confined to bed or chair more than 50% of waking hours
4	Completely disabled; cannot carry on any selfcare; totally confined to bed or chair

Modified ICH Score:[15]
One point each for age >80, infratentorial origin, volume >30mL, intraventricular extension, use of oral anticoagulants, and Glasgow Coma Score (GCS) of 5-12. Two points for a GCS of 3-4. Scores of 4-7 suggest a 30-day mortality rate of >80%. Scores of 3-7 suggest a mortality rate of >60%.

The World Federation of Neurological Surgeons grading system:
A combination of Glasgow Coma Score (GCS) and the presence or absence of focal neurological deficits.[16] A WFNS grade 5 (GCS 3-6) is associated with a >90% probability of a poor outcome. Grades 3-4 (GCS 7-12 or GCS 13-14 AND focal neurological deficits) are associated with a >50% probability of a poor outcome. Grade 2 (GCS 14 with no neurological deficits) is associated with a ~30% probability of a poor outcome.

The IMPACT Score[17] predicts outcome at 6-months based on multiple demographic, clinical and radiographical factors using the calculator found at http://www.tbi-impact.org/?p=impact/calc

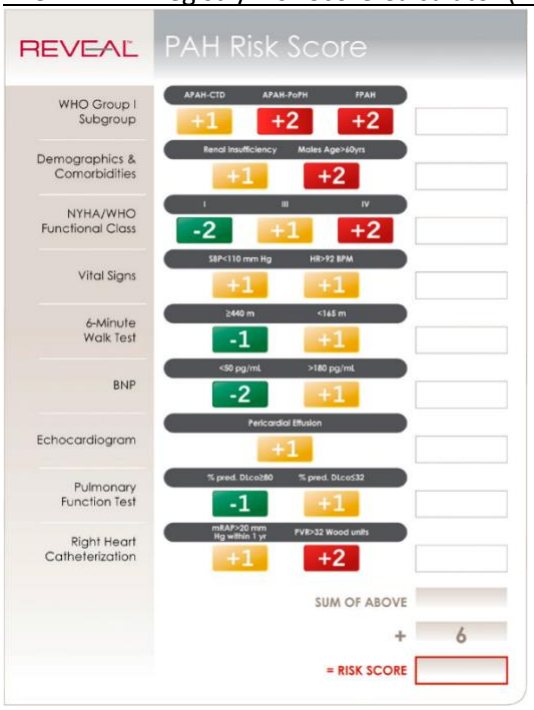
National Institute of Health Stroke Scale (NIHSS): score 0-7 is associated with a 30-day mortality of 4.2%; 8-13 with a 30d mortality of 13.9%; 14-21 with a 30d mortality of 31.6%; and 22-42 with a 30d mortality of 53.5%:[18]

ECS/ERS High Risk Criteria for pulmonary hypertension:[19]

- WHO Class 4 symptoms
- 6MWT <165m
- NT pro-BNP >1400 ng/L
- RA area >26 cm^2
- RAP >14 mmHg
- CI <2.0 L/min/m^2
- SvO_2 <60%

Registry to Evaluate Early and Long-Term Pulmonary Arterial Hypertension Disease Management (REVEAL) 2.0 Score[20]

The REVEAL Registry Risk Score Calculator (Benza et al. CHEST 2019; 156(2):323-337) can be found here.



ACLF grading system is based on the number of organ systems failing at the time of admission in a patient with chronic liver disease. Patients with more than 2 organ systems failing on presentation (ACLF Grades 2 and 3) have an >=80% risk of mortality at 6 months.[21] Those with ACLF Grade 1 have an approximately 50% mortality at 6 months; ACLF grade 1 is defined as having chronic liver failure plus ONE of the following three findings:

- Creatinine >177 umol/L (2.0 mg/dL)
- Creatinine >132 umol/L (1.5 mg/dL) AND Hepatic encephalopathy grade 3-4
- Creatinine >132 umol/L (1.5 mg/dL) OR Hepatic encephalopathy grade 1-2 AND ONE OF:
    - Bilirbin >200umol/L (12mg/dL)
    - INR >2.5
    - pressor support required
    - PaO2/FiO2 <200

Clinical Frailty Scale[22-24]

- Dalhousie University's discussion of the Clinical Frailty Scale tool
- Dalhousie University's guidance and training related to the Clinical Frailty Scale

ProVent Score- calculated at 14 days:
One point for each of Age >50, platelet count <150, requiring hemodialysis, and requiring vasopressors. An additional point is given for age >=65, for a maximum score of 5. Scores of 4-5 at 14 days suggest a mortality rate of ~90% at 1 year. Scores of 2-3 at 14 days suggest a mortality rate of 56-80% at 1 year.[25]

eAppendix D Levels of Triage versus Ordinal Ranking of Patients

The use of levels allows for a proportional application of triage, as explained above. It also addresses concerns about categorical exclusion criteria[6] by making it clear that no medical diagnosis automatically precludes critical care. Rather, the framework focuses on an individualized assessment of predicted short-term mortality risk using clinical factors captured in the tools provided. The use of levels also allows for a more feasible application of triage at the bedside when a person develops critical illness. We felt that an ordinal ranking system, in which each patient who is critically ill is assigned a rank compared to all other patients, would be difficult to implement because few if any prognostic tools have the degree of precision that an ordinal system would require. It would also be challenging to apply to a newly referred patient with critical illness; having to determine both their mortality risk *and* their ranking in relation to an existing (and possibly lengthy) list of other patients in a time-pressured situation before initiating critical care would likely lead to potential delays in treatment for those who might benefit. Maintaining the priority list would also require frequent and time-consuming reassessments by dedicated staff who would be in short supply.

Appeals would also be challenging in such a setting as clinicians would not only have to defend their assessment of STMR for a specific patient, but also defend their assessment of other patients given a higher priority (which is part of the justification for deprioritizing the patient). This process raises both privacy and feasibility concerns. Moreover, since patients and resources are shared regionally and provincially in our jurisdiction, the priority list would have to span multiple facilities, which would likely not be feasible. Assessing a newly referred patient and comparing their predicted short-term mortality risk to the current level of triage, while withdrawing life-sustaining measures in proportion to need, would be more feasible and achieve the same objectives of proportionality and avoiding categorical exclusions. We acknowledge that the mortality risk ranges that define our levels of triage have an element of inherent (and unavoidable) arbitrariness.

eAppendix E Elements of an Appeals Process

We identified the following elements to include or consider when developing an appeals process for critical care triage (adapted from White and Lo[6]):

- The appeals process should be clear and easy for a lay person to trigger and conduct.
- Patient advocates or a member of the patient's circle of care should be able to initiate an appeal on behalf of a patient with the patient or their SDM's consent.
- Physicians should explain the grounds for the critical care triage assessment decision that was made. They should also consider reassessing the patient at regular intervals.
- Appeals should immediately be brought to an Appeals Committee that is independent of the patient's care team.
- Appeals Committees should be established at a regional level to enhance consistency across hospitals, bridge capacity gaps (e.g., small versus large hospitals), and draw from a larger pool of relevant expertise and perspectives, including those with experience in arbitration and dispute resolution. Appeals Committees should include the perspectives of those with expertise in critical care, due process, and members of the community. Committees should include perspectives of equity-relevant populations, including Black and other racialized populations, Indigenous populations, and persons with disabilities. The process should proceed by telephone, virtually, or in person, and the outcome should be promptly communicated verbally and in writing to whomever brought the appeal.
- The appeals process must occur quickly enough that it does not create any delay in treatment or further harm the patient (in the case of initial triage decisions) or patients who are in the queue for scarce critical care resources currently being used by the patient who is the subject of the appeal (in the case of triage decisions involving the withdrawal of life-sustaining measures).
- The care team should err on the side of providing critical care until the appeals process is complete.

- The Critical Care Triage Appeals Committee should maintain an accurate data base and routinely review cases and evaluate whether the appeals process is consistent with effective, fair, and timely application of the allocation framework.

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