

Admission triage tool for adult intensive care unit admission in Hong Kong during the COVID-19 outbreak

Gavin M Joynt *, Anne KH Leung, CM Ho, Dominic So, HP Shum, FL Chow, Alwin WT Yeung, KL Lee, Gloria KY Tang, WW Yan; for the Triage Working Group of the Co-ordinating Committee (Intensive Care)

ABSTRACT

Intensive care is expensive, and the numbers of intensive care unit (ICU) beds and trained specialist medical staff able to provide services in Hong Kong are limited. The most recent increase in coronavirus disease 2019 (COVID-19) infections over July to August 2020 resulted in more than 100 new cases per day for a prolonged period. The increased numbers of critically ill patients requiring ICU admission posed a capacity challenge to ICUs across the territory, and it may be reasonably anticipated that should a substantially larger outbreak occur, ICU services will be overwhelmed. Therefore, a transparent and fair prioritisation process for decisions regarding patient ICU admission is urgently required. This triage tool is built on the foundation of the existing guidelines and framework for admission, discharge, and triage that inform routine clinical practice in Hospital Authority ICUs, with the aim of achieving the greatest benefit for the greatest number of patients from the available ICU resources. This COVID-19 Crisis Triage Tool is expected to provide structured guidance to frontline doctors on how to make triage decisions should ICU resources become overwhelmed by patients requiring ICU care, particularly during the current COVID-19 pandemic. The triage tool takes the form of a detailed decision aid algorithm based on a combination of established prognostic scores, and it should increase objectivity and transparency in triage decision making and enhance decision-making consistency between doctors within and

across ICUs in Hong Kong. However, it remains an aid rather than a complete substitute for the carefully considered judgement of an experienced intensive care clinician.

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¹ GM Joynt *, MBCh, FHKAM (Anaesthesiology)

² AKH Leung, MB, ChB, FHKAM (Anaesthesiology)

³ CM Ho, MB, ChB, FHKAM (Medicine)

⁴ D So, MB, BS, FHKAM (Anaesthesiology)

⁵ HP Shum, MB, BS, MD

⁶ FL Chow, MB, BS, FHKAM (Medicine)

⁷ AWT Yeung, MB, BS, FHKAM (Medicine)

⁸ KL Lee, MB, ChB, FHKAM (Medicine)

⁹ GKY Tang, MB, BS, FHKAM (Medicine)

⁵ WW Yan, MB, BS, FHKAM (Medicine)

¹ Department of Anaesthesia and Intensive Care, The Chinese University of Hong Kong, Hong Kong

² Department of Intensive Care, Queen Elizabeth Hospital, Hong Kong

³ Department of Intensive Care, Tuen Mun Hospital, Hong Kong

⁴ Department of Intensive Care, Princess Margaret Hospital, Hong Kong

⁵ Department of Intensive Care, Pamela Youde Nethersole Eastern Hospital, Hong Kong

⁶ Department of Intensive Care, Caritas Medical Centre, Hong Kong

⁷ Department of Medicine and Geriatrics, Ruttonjee & Tang Shiu Kin Hospitals, Hong Kong

⁸ Department of Intensive Care, United Christian Hospital, Hong Kong

⁹ Department of Adult Intensive Care, Queen Mary Hospital, Hong Kong

* Corresponding author: gavinmjoynt@cuhk.edu.hk

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Introduction

The most recent wave of coronavirus disease 2019 (COVID-19) infections in July to August 2020 resulted in more than 100 new cases per day in Hong Kong for a prolonged period. The stress experienced by individual intensive care units (ICUs) in Hong Kong was demonstrated by the need for an unusually large number of patient transfers between units to maximise the available ICU capacity, despite the implementation of surge strategies. Admission decisions to ICUs resulting from the added pressure for ICU beds, as well as social dimensions that were

triggered by the COVID-19 outbreak, resulted in an urgent requirement for contingencies to inform admission triage practices in the face of overwhelming ICU demand. Professional bodies have recommended that triage protocols (clinical decision support systems), rather than clinical judgement alone, be used in triage whenever possible,¹ and that such protocols be available to assist frontline doctors.^{1,2} Such protocols should be locally relevant and prepared in advance of the need for implementation.

This document is built on the existing

香港COVID-19爆發期間的深切治療部住院 分流工具

Gavin M Joynt、梁結雄、何俊明、蘇栩頌、沈海平、
鄒富來、楊維德、李家龍、鄧佳欣、殷榮華；統籌委員會
分流工作小組（深切治療）

在香港，深切治療部可提供的病床和受訓醫護人員數目有限。2020年7月至8月期間，2019冠狀病毒病（COVID-19）曾持續每天新增超過100宗個案。危重患者入住深切治療部的需求增加，對本地醫療系統構成挑戰，預期發生更大規模的爆發時，深切治療服務將不勝負荷。因此，一個透明和公平的分流是有迫切需要的。這個分流工具建基於現時的住院、出院和分流指南及框架上，指南和框架為醫院管理局深切治療部的常規臨床實踐提供參考，使深切治療部的資源能為最多患者帶來最大利益。COVID-19危機分流工具預計可為前線醫生提供有序指引，在深切治療部資源不堪重負時（尤其於當前COVID-19大流行期間），對需要深切治療部護理的患者作適當的分流決策。分流工具採用預後評分，增加分流決策的客觀性和透明度，有助本地院內和跨院深切治療部醫生決策的一致性。然而，這個分流工具只能擔當輔助角色，並不能取代深切治療部醫生的臨床判斷。

Admission, Discharge, and Triage Guidelines that inform routine clinical practice in Hospital Authority ICUs. The purpose of this COVID-19 Crisis Triage Tool is to provide structured guidance to frontline clinicians to assist with triage decision making should ICU resources become overwhelmed by patients requiring ICU care in Hong Kong.

Background

The Admission, Discharge, and Triage Guidelines for Adult Intensive Care Services for use in day-to-day ICU operations in Hong Kong were recently updated in an internal operations circular in 2018. A brief summary of this guideline follows. Hong Kong ICUs provide a high standard of intensive care by international benchmarks.³ However, because of the expensive nature of intensive care resources, there are a limited number of ICU beds available in Hong Kong. Hong Kong has approximately 7.1 critical care beds per 100 000 population, a low number compared with other high-income regions in Asia (Singapore: 11.4/100 000, Taiwan: 29/100 000), North America (Canada: 12/100 000, United States: 20/100 000), and Europe (Germany: 25/100 000, Belgium: 20/100 000).^{4,5} Therefore, ICU beds in Hong Kong are generally reserved for patients with reversible medical conditions who have reasonable prospects of substantial recovery, and triage (prioritisation) decisions are routinely necessary.^{6,7} The existing admission and triage guidelines are designed to help optimise the use of ICU services to achieve the largest

possible benefit for the most patients within available resources, a modified utilitarian ethical approach that is recommended by ICU professional bodies internationally.⁸⁻¹⁰ Briefly, patients who require ICU care are referred to the ICU team for admission screening. All ICU admission triage decisions are supervised by a senior, experienced ICU doctor and implemented according to individual unit policy. In principle, all triage decisions should be based on the patient's medical condition and the benefits likely to be derived from ICU admission (in comparison with a lower level of care). Non-medical factors such as gender, race, religion, education level, and social status should not be considered when making triage decisions. The existing broad-based framework that guides individual unit policy (Fig 1) was used to inform the relevant components of the new COVID-19 Crisis Triage Tool.

Maximising existing intensive care unit capabilities in response to a surge of COVID-19 cases

Prioritisation for ICU admission in the form of admission triage can only be justified once all efforts to maximise available resources have been exhausted. The Hospital Authority's existing infectious disease contingency plan dictates that the number of available ICU beds be increased and is based on certain key principles: first, that the standard of intensive care should be maintained at a standard similar to that usually provided by Hospital Authority ICUs, and second, that infection control procedures that provide a high level of protection against staff cross-infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) should be maintained. Maintaining these standards requires the provision of appropriately trained staff in adequate numbers. Failure to adhere to these principles may have devastating consequences, as occurred during the SARS outbreak in 2003.¹¹ The requirement to maintain these standards necessarily results in a relatively limited surge capacity¹² that may be incapable of meeting all the demands of a large COVID-19 transmission surge in the community. Thus, the overall increase (68 beds) in ICU airborne infection isolation room beds from Stage I (48 beds) to Stage III (116 beds) will likely be insufficient.

The Hong Kong Government has plans to construct a number of temporary community hospitals for a potentially large surge. However, this initiative does not include a provision for ICU beds, and independent preparations will be required to maximise ICU capacity. In the event that individual hospitals need to increase ICU capacity beyond that specified by the existing Contingency Plan Stage III provisions, a number of key principles should be adopted (Table 1).

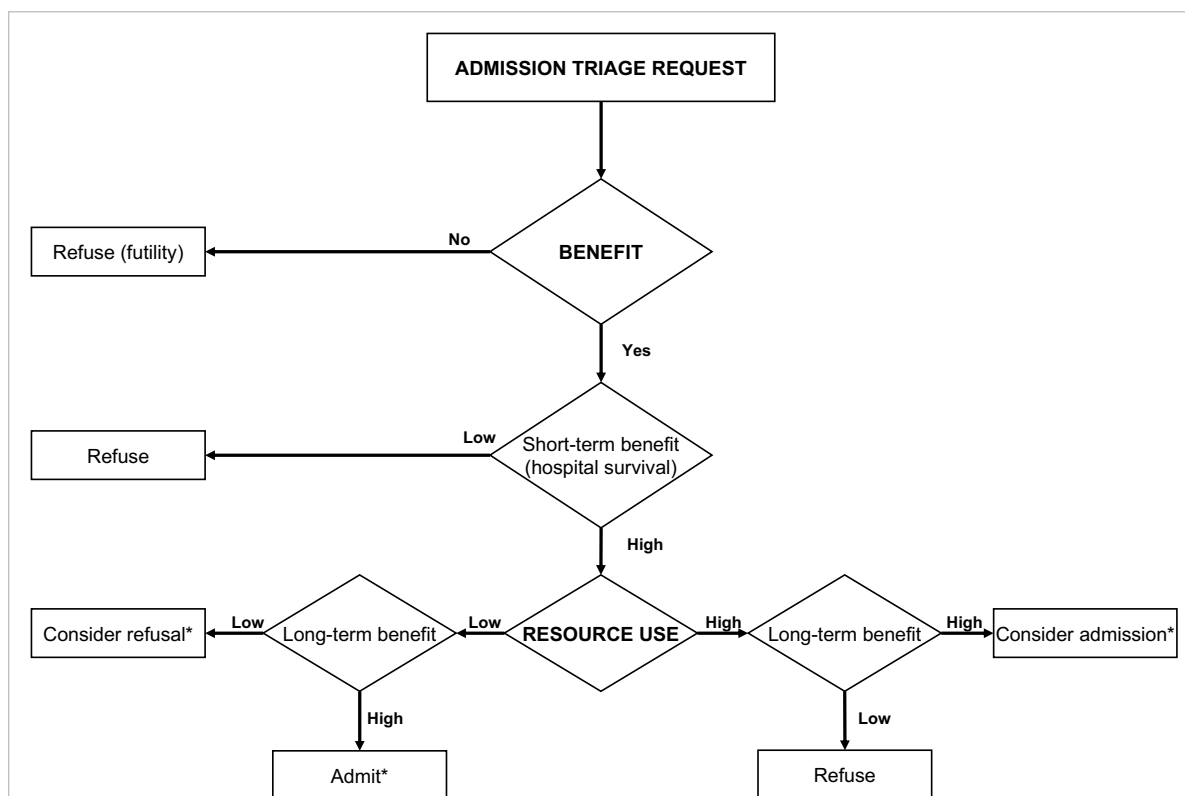


FIG 1. Triage prioritisation is a complex clinical decision made when ICU beds are limited. Current objective scoring systems are unable to predict which patients will derive benefit from ICU admission. Nevertheless, a structured decision-making process is important to maximise transparency and improve consistency in decision making. A clinical estimation of likely benefits (comparing the outcomes of ICU admission vs the outcomes expected if the patient remained in a ward/other location) is necessary, so that patients who will benefit most from ICU admission can be given priority. This is best done by an ICU doctor who is aware of current resource pressures and is likely to be the most experienced staff member at estimating prognosis and the likely beneficial effects of ICU care. This conceptual algorithm outlines a process for making an individual triage decision. However, each decision is made on the basis of an agreed-upon triage threshold for the particular setting (ie, stricter thresholds are thus required during substantial surges in COVID-19 infections). Long-term benefits may include an assessment of expected quality of life, if appropriate.¹⁰ Before any final decision regarding ICU admission, if admission is considered potentially appropriate, patient autonomy should be respected, and therefore, the patient's preference regarding desire for admission should be explored

Abbreviations: COVID-19 = coronavirus disease 2019; ICU = intensive care unit

* Goals of care discussion: patient/surrogate accepts or declines (autonomy)

TABLE 1. Principles to be adopted for ICU bed provision and triage beyond the Stage III Contingency Plan (Crisis stage)

1. The increase in ICU bed number cannot be solely dependent upon demand for admission or mechanical ventilation but should be determined by the reasonable limits of trained staff and safe facilities.
2. Patient and staff safety should be prioritised and appropriate protection from disease transmission ensured. Thus, the availability of appropriate AIIR facilities for ICU patients will be a key requirement for expansion beyond those available ICU facilities during contingency plan stage III activation.
3. The threshold ratios of ICU specialty staff to non-ICU specialty staff (deployed in from other specialties) and staff to patients should be regularly reviewed and meet current standards set by the HA.
4. The usual triage principles as outlined in the accompanying documents should be adopted during this phase. However, higher thresholds for admission will be required based on prediction of mortality, and such thresholds will be determined by ICU bed availability and the magnitude of the increased demand.
5. Although good communication between specialties caring for individual patients is of great importance, decisions made by the ICU COS/Director shall be final. The hospital ethics committee should provide advice for difficult cases and unresolvable conflicts.
6. The threshold for initiating organ support, especially resource-intensive means of support such as ECMO, should be aligned across HA ICUs and be regularly reviewed with regard to the surge situation.
7. Reliable communication channels and coordination should be maintained on an intra-departmental basis within ICUs and between the ICU, the hospital, and the HA Head Office.

Abbreviations: AIIR = airborne infection isolation rooms; COS = Chief of Service; ECMO = extracorporeal membrane oxygenation; HA = Hospital Authority; ICU = intensive care unit

Methods

Despite some previous attempts, no single objective, evidence-based triage tool in the form of a score or combination of scores has been shown to effectively determine appropriate ICU admission priority.¹³⁻¹⁵ Development of a guidance tool was thus initiated using an iterative process in which possible combinations of predictive scoring components were progressively evaluated for face validity by experienced intensive care specialists. The local development of this triage tool to accompany the Admission, Discharge, and Triage Guidelines for Hong Kong (outlined above) was led by 10 senior ICU clinical specialists who are currently practising in ICUs in Hong Kong. The participants included at least one representative of each of Hong Kong’s hospital cluster regions. Additionally, each participant routinely performs triage as a consequence of chronic ICU bed resource limitations. An initial meeting was held online, at which all key issues were discussed, and a draft document of the consensus view prepared by one author (GMJ). After circulation, several disagreements were documented. These were resolved by online voting, with a majority vote used to resolve persistent disagreement. Three rounds of online voting resulted in a finalised and universally supported document. A decision was made to respect and use the principles laid down in the pre-existing triage framework but to provide further detailed clinical guidance to frontline ICU doctors in Hong Kong regarding COVID-19. The starting point was to adapt and modify a recently published COVID-19 triage prioritisation tool developed by an international expert group.¹⁴ This tool took the form of a decision-making algorithm based on established ICU prognostic scoring systems that could inform bedside decision making in the event that ICU bed capacity becomes overwhelmed by patients with COVID-19. Therefore, the specific aim of the triage tool is to provide explicit and uniform guidance to

all frontline doctors charged with the responsibility of triaging ICU admissions. This guidance should improve the objectivity and consistency of triage decision making across Hong Kong. The triage tool was designed to be easily understood, rapidly implemented, and of high utility. A list of the major considerations addressed to achieve this goal is provided in Table 2.

Results

The first inclusion and exclusion criteria chosen for the triage tool (Fig 2) were those that, when answered, would rapidly finalise the decision without the need to proceed further, and thus prevent excessive use of valuable medical team time. Therefore, we created clear clinical exclusion criteria. Patients who are too ill to gain substantial incremental benefits from ICU care and those who refuse ICU admission on the basis of the perceived benefits and burdens of ICU care are excluded.

The explicit exclusion criteria are the same ones generally used in Hong Kong ICUs under normal circumstances. We chose general rather than specific diagnoses, as has been proposed previously, as specific diagnoses require the construction of long (but not exhaustive) lists.

The inclusion criteria are also directly comparable with the major inclusion criteria for ICU admission during ‘normal’ conditions: they reflect the need to admit patients who require ICU care to derive a survival benefit. Thus, patients who are ‘too well’ (ie, they can be reasonably treated in the ward) are excluded.

When a patient meets the inclusion criteria and does not meet any exclusion criteria, they become a potential ICU admission, and further priority is determined. Patients are subsequently chosen for admission based on their priority rank, ranging from 1—high priority to 3—low priority. A prioritisation score was developed by including variables that

TABLE 2. Key considerations in the development of the triage tool

1. Provision of support for immediate and rapid decision making that is needed at the bedside during an overwhelming pandemic and that will enhance consistency of decision making across different units
2. Provision of a triage tool that is simple and easy to understand and use
3. Provision of a tool that is flexible and adaptable to local practice, resource availability, and the changing severity of the outbreak
4. Provision of a tool that adheres to the existing ethical and functional principles of the Admission, Discharge, and Triage Guidelines
5. Individual triage decisions should ultimately be made or supervised by a senior ICU doctor based on the guidance provided by the triage prioritisation tool.
6. Patients with and without COVID-19 should be considered for priority on an equal basis.
7. The principles of triage implementation during the COVID-19 surge, and the contents of the triage tool, should be communicated to all relevant stakeholders, and if necessary, changes should be made on the basis of relevant feedback.

Abbreviations: COVID-19 = coronavirus disease 2019; ICU = intensive care unit

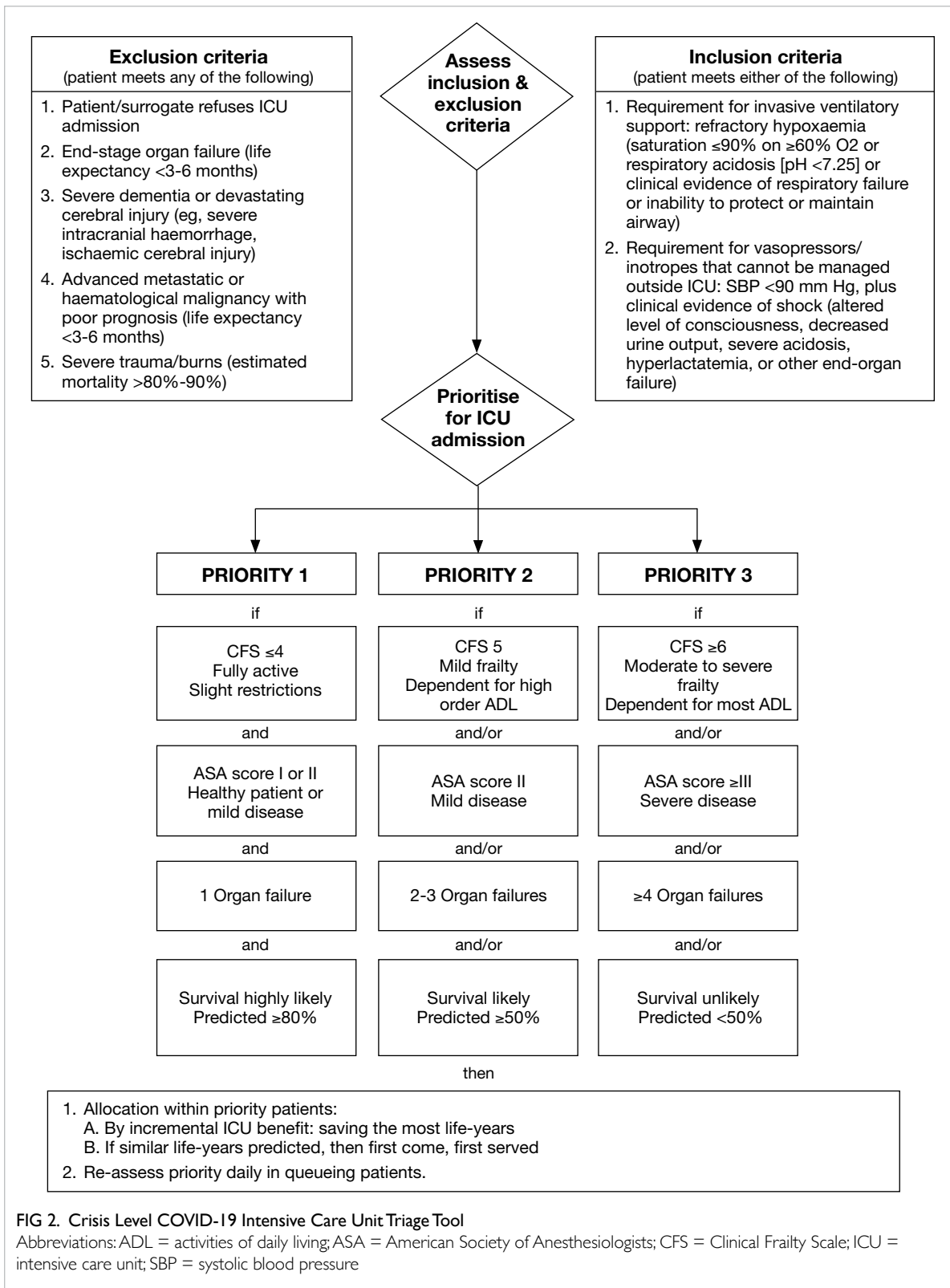
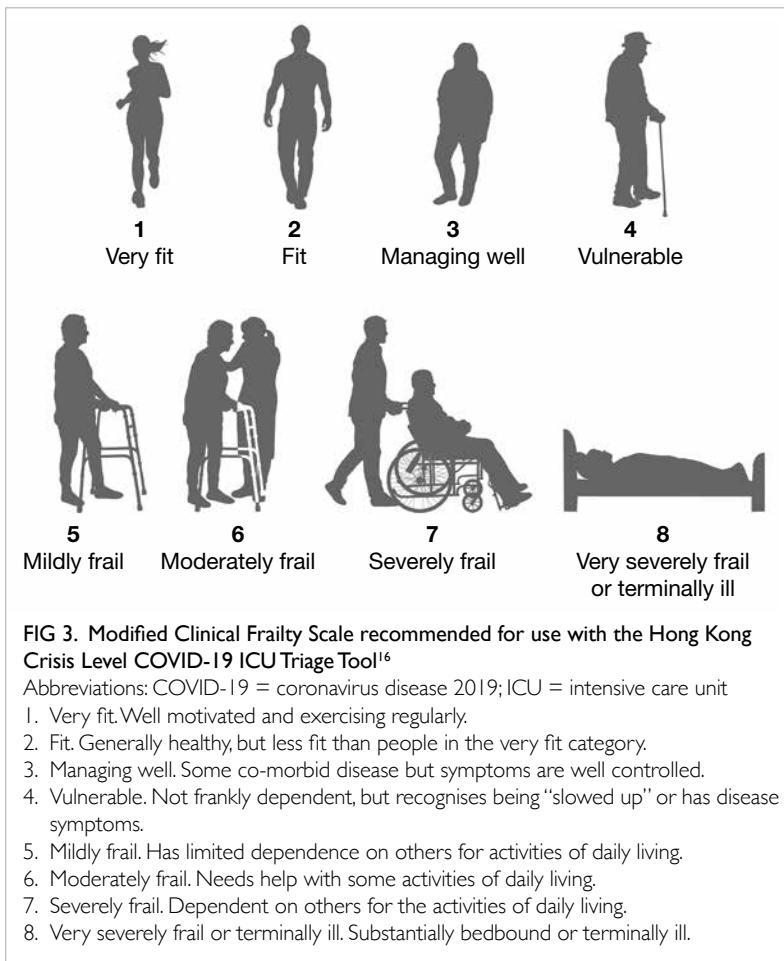


FIG 2. Crisis Level COVID-19 Intensive Care Unit Triage Tool

Abbreviations: ADL = activities of daily living; ASA = American Society of Anesthesiologists; CFS = Clinical Frailty Scale; ICU = intensive care unit; SBP = systolic blood pressure

predict short–medium-term mortality (3-6 months) in the first instance and are the most compatible with the principle of ‘quick and clear’ decision making. The clinical frailty scale (CFS) [Fig 3],¹⁶ a modified American Society of Anesthesiologists (ASA) score¹⁷ to assess co-morbidity (Table 3), and last, the clinical assessment of the number of current organ system failures (OSF), that has previously been well established as an indicator to assist the prediction of mortality.



Outcome prognostication by the senior supervising ICU doctor is largely dependent on knowledge of the factors associated with poor outcomes and clinical experience. Although key relevant factors are captured by the tool, because COVID-19 is a new condition, we provide a table summarising mortality risk factors in patients with COVID-19 who are admitted to ICU to further

aid prognostication (Table 4).¹⁸⁻²⁰ The data were adapted from countries with ICU practices that are considered generally similar to those in Hong Kong.

Finally, it has been previously recommended that time-limited trials may be adopted at the time of admission.²¹ A time-limited trial establishes an agreement between the healthcare team and the patient/surrogate to apply necessary intensive care treatment for a pre-determined period of time. The ICU team keeps the family informed of patient progress, and when the pre-agreed time limit is reached, life support therapies are either continued if the patient has responded positively or withdrawn if therapy is failing. Setting an appropriate time period for the trial requires great care,²² and in the setting of COVID-19, care should be taken to allow sufficient time for the patient to respond to therapy. The median number of days of mechanical ventilation and the length of stay have been reported for patients with COVID-19 (10 days, and 9 to 12 days respectively), whose ICU stays are longer than those of patients with other viral pneumonias.^{18,19}

The existing triage framework has been circulated for comment and feedback from relevant clinical specialty leadership groups in the Hospital Authority. Further, the current accompanying tool has been reviewed by the ad-hoc Hospital Authority Clinical Ethics Committee Core Group and finalised after incorporating relevant suggestions for change. After implementation, the triage working group will review the need for adjustment and updating of the guidelines according to local circumstances.

Discussion

The conceptual algorithm recommended herein broadly follows the existing recommended framework for individual triage decisions in that the inclusion criteria are based on a low likelihood of survival without ICU care (5%-10% or less), if met. Priorities for admission can then be allocated

TABLE 3. Modified American Society of Anesthesiologists score for use with the Hong Kong Crisis Level COVID-19 Intensive Care Unit Triage Tool¹⁷

Class	Description	Example
I	The patient is previously healthy and fit	Normal effort tolerance for age
II	The patient has mild systemic controlled disease	No substantive functional limitations: well-controlled diabetes mellitus or hypertension, mild lung disease, effort tolerance \geq 1-2 flights of stairs
III	The patient has severe but not incapacitating systemic disease	Substantive functional limitations: poorly controlled diabetes mellitus or hypertension, COPD, moderate reduction of ejection fraction, effort tolerance <1-2 flights of stairs, ESRD, history of MI, CVA, TIA, or CAD
IV	The patient has incapacitating systemic disease	Severe functional limitations: ongoing cardiac ischaemia or severe valve dysfunction, severe reduction of ejection fraction or effort tolerance restricted to short distances on level ground
V	Moribund and not expected to survive 24 hours	Massive trauma or burn injury, severe intracranial bleed with mass effect, extensive ischaemic bowel, significant cardiac pathology with severe reduction of ejection fraction, or multiple organ/system failure

Abbreviations: CAD = coronary artery disease; COPD = chronic obstructive pulmonary disease; COVID-19 = coronavirus disease 2019; CVA = cerebrovascular accident; ESRD = end-stage renal disease; MI = myocardial infarction; TIA = transient ischaemic attack

TABLE 4. Factors associated with increased mortality in critically ill patients admitted to ICU and reported estimates of risk¹⁸⁻²⁰

Variable	Category (description)	Multivariable	
		HR (95% CI)	OR (95% CI)
Age in years	10-Year increments	1.75 (1.60-1.92)	-
Sex	Male vs female	1.57 (1.31-1.88)	-
Hypercholesterolaemia	Present vs not present	1.25 (1.02-1.52)	-
Type 2 diabetes	Present vs not present	1.18 (1.01-1.39)	-
COPD	Present vs not present	1.68 (1.28-2.19)	-
COPD or ILD	Present vs not present	2.94 (1.48-5.84)	-
FiO ₂ at admission	10% Increments	1.14 (1.10-1.19)	-
Coronary artery disease	Present vs not present	-	1.47 (1.07-2.02)
Active cancer	Present vs not present	-	2.15 (1.35-3.43)
Coagulopathy	SOFA score component ≥2 vs <2	-	1.64 (1.00-2.69)
Liver dysfunction	SOFA score component ≥2 vs <2	-	2.61 (1.30-5.25)
Renal dysfunction	SOFA score component 1-4 vs 0	-	1.56-2.43 (1.20-4.05)
Chronic kidney disease	Present vs not present	1.76 (1.08-2.86)	-
BMI ≥40	Present vs not present	-	1.51 (1.01-2.25)

Abbreviations: 95% CI = 95% confidence interval; BMI = body mass index; COPD = chronic obstructive pulmonary disease; HR = hazard ratio; ICU = intensive care unit; ILD = interstitial lung disease; OR = odds ratio; SOFA = Sequential Organ Failure Assessment

on the basis of agreed-upon criterion thresholds for survival, as established in the accompanying triage tool and adjusted for Hong Kong’s circumstances at a specific time. Thus, an incremental benefit of at least 40% to 45% would be required to meet the criteria for priority level 3, but one of at least 70% to 75% would be required to meet the criteria for priority level 1. Admission would depend on available resources after safe maximisation of surge capacity and the number of patients queuing for admission (eg, stricter incremental benefit thresholds may be required during the peak of the pandemic, and less strict thresholds may be implemented at the beginning and towards the end). The use of predicted incremental benefit for decision making has been previously endorsed by expert consensus groups when triage is required, both under outbreak and non-outbreak conditions.^{1,2,14}

The CFS, which has nine variables, was chosen as the appropriate general health performance metric, as it meets local practice requirements: familiarity, ease of use, and having been validated as a predictor of short- and medium-term ICU outcomes.²³⁻²⁶ The well-established ASA score was chosen for modification to guide assessment of co-morbidities, as its descriptions are clear, concise, and logically presented (ASA 2019).¹⁷ Further, the relationship between increasing OSF scores and higher mortality is well established.^{27,28} A simple bedside clinical assessment of organ failure to decide the number of OSF is recommended, rather than attempting to determine the SOFA (Sequential Organ Failure Assessment) score, which requires additional

calculations from clinical variables, assessment of missing variables, and then further prioritisation.^{29,30} We suggest using a clinical judgement for assessing end-stage organ failure of the noted organs (eg, brain, heart, lungs). However, individual units may choose to use the SOFA score if its calculation is considered achievable under local circumstances.

After deliberating at length, the group concluded that the indicative mortalities of the three chosen variables for determining the priority scores (general well-being [CFS], co-morbidities [ASA], and number of OSF) are such that in combination they are likely to correspond to the subjective predicted outcomes and survival percentages noted at the bottom of the notation for each priority score. The noted predicted survival percentages were calibrated with the recommendations of previous consensus expert groups, one who decided to define ‘a minimal acceptable incremental ICU benefit’ in a resource-limited setting as a 15% to 25% difference in mortality,¹⁰ and the second who adjusted this difference to be substantially larger (50%) to account for the increased pressure anticipated in an outbreak setting.¹⁴ The use of the tool to guide the clinical estimation of likely benefits (outcome of ICU admission compared with outcome expected if the patient remained on the ward/other care area) is necessary for prioritisation of patients who will benefit most from ICU treatment. Nevertheless, because individual patients may have overriding characteristics not captured by the individual or combined scores, the final decision regarding likely incremental benefit and subsequent prioritisation

should be made by the senior supervising triage doctor.

If there is more than one patient judged to be within the same priority group, and there is anticipated queuing for the remaining available beds, further prioritisation by incremental ICU benefit, such as saving the most life-years (evaluating mortality from both acute and chronic disorders) should be considered. If a tie for ICU admission candidates remains after these progressive steps, we recommend that admission be determined by the first-come, first-served principle.

Because of the complexity of the decision-making process and the multiple factors that require careful consideration, final decisions are best made by an experienced ICU doctor. However, should uncontrollable circumstances dictate that decisions need be made by a more junior colleague, the tool can still provide assistance to guide and enhance consistent and justifiable decision making. To prepare for this possibility, preparatory education should be provided to more junior colleagues regarding triage decision making to facilitate appropriate interpretation of this tool.

This tool specifically addresses the triage of patients for ICU admission. However, when available ICU resources are overwhelmed, enhanced levels of care within the ward or available high care areas should be used for the treatment of cases denied ICU admission. This could optimise patient outcomes within the constraints of available alternatives. In this regard, both invasive and non-invasive mechanical ventilation is routine practice in the wards and high-care areas of many hospitals in Hong Kong. This fact can potentially be harnessed for the treatment of COVID-19 cases. Patients denied ICU admission on the basis of triage should be preferentially considered for diversion to such resources. Hospital-level coordination and close liaison between hospital facilities management and those who manage ICU resources is required to facilitate the appropriate use of all potentially available resources.³¹ Although this tool is designed specifically to guide ICU admission triage decisions, other users may consider using the priority assigned by the ICU triage officer to a refused case to allocate the patient to an appropriate next level of care.

Many bedside operational factors are part of the triage process but are not specifically embedded in this crisis tool. Nevertheless, they are substantially addressed in the current Admission, Discharge, and Triage Guidelines, of which the COVID-19 Crisis Triage Tool is an extension. These include the need for clear, empathic communication with patients and surrogates and the implementation of the appropriate best care plan, including palliation of symptoms when appropriate, to patients refused ICU admission. Clear and transparent communication

with referring medical teams, mechanisms for audit and oversight, and channels for feedback and reassessment are also required.

Important limitations must be acknowledged. The current guideline is based on the consensus of experienced Hong Kong clinicians with a history of performing bedside triage and not high-level, published medical evidence. Although the prognostic systems chosen have been well demonstrated to align with survival prognosis and functional outcomes, prognostic uncertainty in intensive care cannot be overcome by a single scoring system. All prognostic scoring systems, including the CFS,³² have limitations, and for this reason, the simultaneous use of multiple scoring methods, as used in this tool, has been recommended.¹⁵

Conclusion

The referral of a patient for ICU care triggers a complex triage (prioritisation) decision that must be made when ICU beds are limited. It is expected that this triage tool, in the form of a detailed decision aid algorithm, should increase objectivity and transparency in triage decision making and help to enhance consistency between doctors both within and across ICUs in Hong Kong. However, this tool is an aid rather than a complete substitute for the carefully considered judgement of an experienced intensive care clinician.

Author contributions

Concept or design: All authors.

Acquisition of data: All authors.

Analysis or interpretation of data: All authors.

Drafting of the manuscript: GM Joynt.

Critical revision of the manuscript for important intellectual content: All authors.

All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

All authors have disclosed no conflicts of interest.

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