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Managing intensive care admissions when there are not enough beds during the COVID-19 pandemic: a systematic review

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ABSTRACT

The surge in cases of severe COVID-19 has resulted in clinicians triaging intensive care unit (ICU) admissions in places where demand has exceeded capacity. In order to assist difficult triage decisions, clinicians require clear guidelines on how to prioritise patients. Existing guidelines show significant variability in their development, interpretation, implementation and an urgent need for a robust synthesis of published guidance. To understand how to manage which patients are admitted to ICU, and receive mechanical ventilatory support, during periods of high demand during the COVID-19 pandemic, a systematic review was performed. Databases of indexed literature (Medline, Embase, Web of Science, and Global Health) and grey literature (Google.com and MedRxiv), published from 1 January until 2 April 2020, were searched. Search terms included synonyms of COVID-19, ICU, ventilation, and triage. Only formal written guidelines were included. There were no exclusion criteria based on geographical location or publication language. Quality appraisal of the guidelines was performed using the Appraisal of Guidelines for Research and Evaluation Instrument II (AGREE II) and the Appraisal of Guidelines for Research and Evaluation Instrument Recommendation EXcellence (AGREE REX) appraisal tools, and key themes related to triage were extracted using narrative synthesis. Of 1902 unique records identified, nine relevant guidelines were included. Six guidelines were national or transnational level guidance (UK, Switzerland, Belgium, Australia and New Zealand, Italy, and Sri Lanka), with one state level (Kansas, USA), one international (Extracorporeal Life Support Organization) and one specific to military hospitals (Department of Defense, USA). The guidelines covered several broad themes: use of ethical frameworks, criteria for ICU admission and discharge, adaptation of criteria as demand changes, equality across health conditions and healthcare systems, decision-making processes, communication of decisions, and guideline development processes. We have synthesised the current guidelines and identified the different approaches taken globally to manage the triage of intensive care resources during the COVID-19 pandemic. There is limited consensus on how to allocate the finite resource of ICU beds and ventilators, and a lack of high-quality evidence and guidelines on resource allocation during the pandemic. We have developed a set of factors to consider when developing guidelines for managing intensive care admissions, and outlined implications for clinical leads and local implementation.

INTRODUCTION

The growing number of COVID-19 cases has resulted in many countries experiencing unprecedented and sustained high levels of demand for limited intensive care unit (ICU) capacity.[1] In China and Italy, around 5% and 9%, respectively, of confirmed cases developed critical disease requiring treatment in ICUs.[2 3] In some countries, there have been reports of doctors triaging admissions to ICU and ventilators where demand has exceeded capacity.[1 4] These decisions place a significant psychological burden on clinicians who are having to decide who does not receive potentially life-saving treatment.[5] To support clinicians facing these decisions under challenging circumstances, clear guidelines on how to triage patients are necessary.[5]

While there are existing guidelines to manage limited ventilatory support capacity in a pandemic or public health emergency, published prior to the COVID-19 pandemic,[6] many countries have developed specific guidelines and triage criteria for COVID-19, reflecting the unique challenges of managing emerging respiratory disease.[7] There is significant variability in the development, interpretation, and implementation of these guidelines, which may contribute to difficulties for clinicians. There is an urgent need for a robust synthesis of published guidance to inform future guidance and revised iterations of existing guidance. Despite the initial peak of the pandemic passing in some countries, the need for suitable guidance will continue in preparation for subsequent peaks. Rises in intensive care admissions have been met in some places by significantly reducing (effectively rationing) routine care and other demands for intensive care admissions (eg, trauma). This is unlikely to be sustainable which may create renewed pressure to triage intensive care admissions.

We conducted a systematic review and synthesis of guidelines to provide acute insights into the guidance on which patients are treated in ICU and receive ventilation during periods of high demand for ICU capacity during the COVID-19 pandemic. Robust synthesis of existing guidance will inform

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the future development of guidelines and provide consistent high-quality direction to the front-line workforce.

METHODS

We undertook a time-sensitive systematic review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[8] The review protocol was registered on PROSPERO (CRD42020179447).

Inclusion criteria

We included formal written guidelines in any language published by a recognised body (eg, government or government agency, professional body, hospital) that provided advice on how to select patients who should be admitted to, or discharged from, intensive care during periods of high demand during the COVID-19 pandemic (regardless of whether it applied to patients with COVID-19 or to those with other health conditions). We used a broad definition of intensive care locations and management (including ICU, critical care unit, intensive therapy unit, ventilation and extracorporeal membrane oxygenation (ECMO)).

We excluded opinion pieces, guidance concerning triage not related to ICU admission (eg, triage for general hospital care) and guidelines relating to general public health emergencies (unless they were clearly specified as being appropriate for use in the COVID-19 pandemic).

Database searches

We searched databases of published literature (Medline, Embase, Web of Science and Global Health) on 27 March 2020. We also undertook a search of grey literature, hand searching the first 100 items to identify the most relevant material from a series of searches on Google.com, on 31 March 2020, and a search of MedRxiv on 2 April 2020.

A search strategy was developed in Medline using Medical Subject Headings and free text terms, tested against a sample of relevant papers and adapted for other databases. The detailed search strategies and search terms are described in online supplemental appendix 1.

We sought to include guidelines specific to SARS-CoV-2 and COVID-19, and included documents published on or after 1 January 2020, consistent with the disease first being reported to the WHO Country Office in China on 31 December 2019.[9]

Screening

Search results were merged using EndNote X9 (Clarivate Analytics) and deduplicated. We independently double screened titles and abstracts using Covidence systematic review software (Veritas Health Innovation) according to prespecified inclusion/exclusion criteria by four authors (CSBT, OTM, SVG, JLYA). Full-text articles, for potential inclusion, were retrieved and independently double screened for eligibility by four authors (CSBT, OTM, SVG, JLYA). The final list of studies to be included was agreed by five authors (CSBT, OTM, SVG, JLYA, MTM). In cases of uncertainty, the citation would be included in the next round of more detailed screening and conflicts were resolved by five authors (CSBT, OTM, SVG, JLYA, MTM).

Data extraction

Independent double-data extraction was performed by four authors (CSBT, OTM, SVG, MTM) using a shared Google data collection form developed according to the Cochrane Handbook.[10] Data were extracted by a single author and verified by a second different author. The final data extraction was discussed and agreed among four authors (CSBT, OTM, SVG, MTM).

We extracted the following: guideline title, official body, authors, date of publication and jurisdiction, criteria used or proposed for resource allocation, ethical framework identified, any other ethical issues discussed, features of the decision-making process, evidence used to inform guideline development and other information on methodological quality.

Data synthesis

In the interest of informing ongoing operations and due to the heterogeneity of results suggested by scoping searches, we undertook a narrative synthesis and qualitative appraisal with four main elements: developing a theory, developing a preliminary synthesis, exploring relationships in the data and assessing robustness of the synthesis.[11] These elements were applied iteratively. Themes in the narrative synthesis were identified, discussed and agreed among four authors (CSBT, OTM, SVG, MTM).

Quality appraisal

The guidelines were appraised using the Appraisal of Guidelines for Research and Evaluation Instrument II(AGREE II)[12] and the Appraisal of Guidelines for Research and Evaluation Instrument Recommendation EXcellence (AGREE REX)[13] quality appraisal tools by two authors (CSBT, OTM). Independent appraiser scores were used to calculate domain scores for AGREE II. Consensus scores, achieved through discussion and agreement on a score value between both authors, were used to calculate domain scores for AGREE REX. AGREE II requires scoring by a minimum of two appraisers, whereas AGREE REX requires either a consensus score or five independent appraisers in order to be reliable. A score of 1 was used to indicate absence of information. Scoring was performed on guidelines as a whole, rather than to individual recommendations.

RESULTS

Our search strategy identified 1902 unique records, with 1813 excluded (based on title and abstract search), with 89 records remaining. After full-text review, we identified nine sets of unique guidelines (see figure 1). All nine guidelines were identified through the Google.com search with one[14] duplicate also identified in the database search. Of the guidelines, eight concerned ICU capacity or ventilator allocation and one[15] concerned ECMO allocation. Of the nine guidelines, six were national or transnational level guidance,[14 16–20] with one state level,[21] one international[15] and one specific to military hospitals.[22] Four of the guidelines were produced by government bodies,[16 20–22] and five by professional organisations.[14 15 17–19]

Narrative synthesis identified nine broad themes across the guidelines, numbered one to nine, which are reported in table 1. As ECMO is a special case, we report the findings for ECMO separately as a narrative summary. No guideline demonstrated complete coverage of all themes. Results specific to each theme are described below. The quality appraisals of the guidelines are summarised in supplemental tables 1 and 2 in online supplemental appendix 2.

Quality of guidelines

Overall, the guidelines scored more highly for their description of scope and purpose (median score 78, IQR 67–83) and clarity of presentation (58, 47–64). They scored poorly for rigour of development (9, 4–14), applicability (8, 4–10) and editorial

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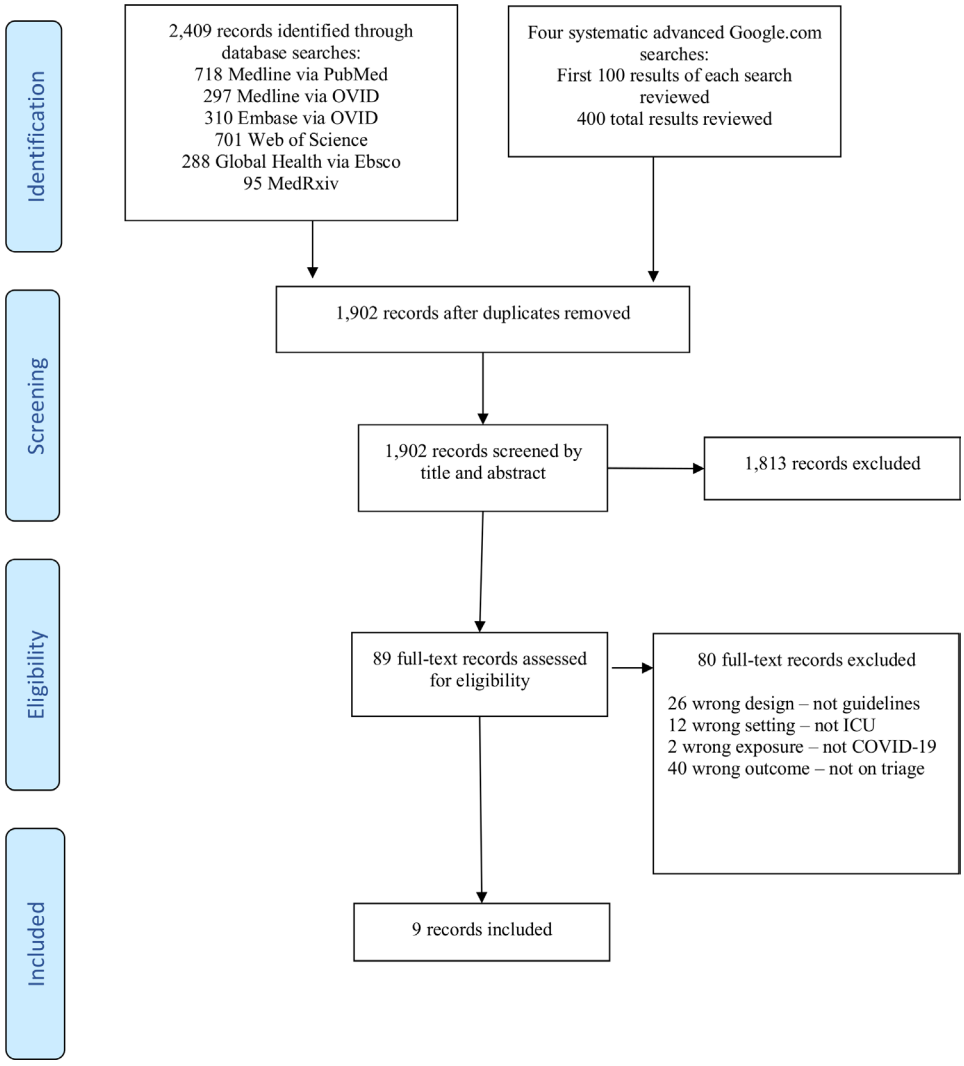

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.[41] ICU, intensive care unit.

independence (8, 8–8). All but one guideline scored 50% or less for clinical applicability (28, 28–39), values and preferences (25, 17–38) and ease of implementation (25, 25–33). The level of stakeholder involvement varied between the guidelines (33, 25–42). None of the guidelines scored highly across all domains and the range of scores across the domains varied markedly. The agreement between appraisers for AGREE II scoring varied between 65% and 83%.

Extracorporeal membrane oxygenation

Four guidelines make reference to the use of ECMO.[14 15 17 19] The Extracorporeal Life Support Organization (ELSO) guidance prioritises ECMO for younger patients with only minor comorbidities and healthcare workers.[15] The exclusion criteria include significant comorbidities and patients who have been mechanically ventilated for more than 7 days. They do not include renal failure. De-escalation is recommended when there has been no recovery in lung or cardiac function after approximately 21 days.[15] The ELSO guidance states that use of ECMO should be rare for patients with advanced age[15] and, similarly, the Belgian guidance suggests it should not be used for care home residents.[17] Recognising that it is resource intensive, the Swiss and Italian guidelines recommend starting ECMO only after careful consideration.[14 19]

Development of guidelines

Seven of the guidelines had been developed de novo, but two guidelines were adapted from existing pandemic or emergency guidelines.[14 21] Limited information was provided on the process for developing the guidelines, although there were exceptions. The UK guideline involved evidence review and rapid consultation.[16] The Swiss guideline was based on pandemic guidance, adapted by four experts, reviewed by an ethics committee and ratified by professional bodies for medicine and intensive care.[14] Based on the author list, most guidelines appeared to be written by a panel of experts.[14 17–19 21 22] None of the guidelines reported systematically reviewing evidence and limited reference tended to be made to empirical evidence that underlaid the guidance. However, there were exceptions, such as the Swiss guideline which referenced increasing age as being associated with a worsening prognosis when discussing the use of age as an admission criterion.[14]

Ethical frameworks and principles

Most guidelines highlighted the importance of ethical frameworks and distributive justice in making decisions around the allocation of limited resources. In all the guidelines the preferred justifying principle for allocating intensive care resources when

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Table 1 Summary of guidelines for allocating limited intensive care resources during the COVID-19 pandemic during periods of high demand for intensive care

Guideline	Area	1. Development of guidelines process	2. Ethical Framework	3. Criteria for admission	4. Criteria adapt as demand changes	5. Criteria for discharge	6. Equality across conditions	7. Equality across healthcare system	8. Decision-making processes and support	9. Communication of decision
Toolkit for COVID-19—Kansas Department for Health and Environment (28 February 2020)[21]	Kansas, USA	Based on guidance produced by expert panel (doctors, hospital managers, state officials) in 2013—few adaptations for COVID-19.	Not explicitly stated, but emphasises maximising lives saved. For patients of similar risk-benefit category, allocation should be at random or first come, first served.	Primarily medical survivability determined by clinical judgement or formal means (eg, SOFA score). Additional explicit exclusion criteria for severe conditions (eg, metastatic disease with poor prognosis, end-stage organ failure).	Yes. Hospitals should adapt based on resources.	Yes. Reassess every 48 hours, with step down if exclusion criteria are met.	Not discussed.	Yes. Patients using ventilators in chronic care facilities would not be subjected to acute care triage guidelines. Uniform policies are required to avoid inequalities.	Triage team (medically led and independent of treating doctor) will make decisions on resource allocation for individual patients, and its decision-making scrutinised by a 'review committee'.	Not discussed.
Clinical ethics recommendations for the allocation of intensive care treatments in exceptional resource-limited circumstances—Italian Society of Anaesthesia, Analgesia and Intensive Care (SIAARTI) (16 March 2020)[19]	Italy	Not stated. Written by panel of experts.	Maximise benefits for the greatest number of people. Discusses possible need of using first come, first served during resource saturation.	Age (with possible upper limit); comorbidities; functional status.	Yes. Criteria need to be flexible and locally adapted based on resource availability.	No explicit criteria, but de-escalation decisions should not be postponed.	Yes.	Partially—principles established but anticipate different thresholds locally based on local capacity and demand.	Decision-making responsibility is for doctors managing care—suggests second opinion for challenging cases. Recommends systems put in place to support healthcare workers to debrief.	Yes. Communicate decisions with patients and obtain their wishes.
The Australian and New Zealand Intensive Care Society COVID-19 Guidelines v1 (16 March 2020)[18]	Australia and New Zealand	Consensus-based guidelines drawing on previous experience and literature.	Not explicitly stated, but emphasises maximising lives saved.	Probable outcome of the patient's condition; burden of ICU treatment; comorbidities; likelihood of response to treatment.	Yes, described as 'a living document that will be continually revised'.	Not discussed.	Yes.	Yes. While similar criteria should apply across all jurisdictions, the ultimate decision-making is at discretion of senior intensive care medical staff.	Treating clinician responsible for decision-making. Shared decision-making with other clinicians.	Yes. Shared and transparent decision-making process with patients and relatives.
Ethical principles concerning proportionality of critical care during the COVID-19 pandemic: advice by the Belgian Society of Intensive Care Medicine (18 March 2020)[17]	Belgium	Not stated. Written by a panel of experts.	Not explicitly stated, but emphasises maximising lives saved.	Probable outcome of patient's condition; frailty in elderly patients (eg, Clinical Frailty Score); cognitive impairment in elderly patients; comorbidities (particularly severe or life-limiting conditions); age alone should not be used.	Not discussed.	Not discussed.	Yes.	Not explicitly discussed. Each hospital drafts their own ethical guideline.	Decision to deny or prioritise treatment made by two or three doctors in consultation. Psychological support offered to clinicians making triage decisions. Keep register of all triage decisions.	Yes. Open communication with patient and family.
Department of Defense COVID-19 practice management guide (23 March 2020)[22]	US military hospitals	Not stated. Written by a panel of experts.	Not discussed.	Each hospital should provide a specific plan regarding ICU admission/exclusion criteria. Age and comorbidities should be a factor for provision of (any form of) care for older patients.	Yes. Recommends having different criteria for different levels of capacity/need.	Not discussed.	Not discussed.	Yes. Each hospital should have their own criteria and implement based on their own resources.	Not discussed.	Providers should avoid discussing rationing of care at the bedside.

Continued

Table 1 Continued

Guideline	Area	1. Development of guidelines process	2. Ethical Framework	3. Criteria for admission	4. Criteria adapt as demand changes	5. Criteria for discharge	6. Equality across conditions	7. Equality across healthcare system	8. Decision-making processes and support	9. Communication of decision
COVID-19 pandemic: triage for intensive care treatment under resource scarcity—Swiss Academy of Medical Sciences (24 March 2020)[14]	Switzerland	Based on previous pandemic guidelines. Adapted by four experts, reviewed by ethics committee, ratified by professional bodies for medicine and intensive care.	Maximising lives saved is a decisive factor for purposes of triage. Acknowledges importance of equity and protecting healthcare professionals.	Patients who are most likely to survive to discharge. Specific exclusion criteria given, primarily related to severe life-limiting underlying conditions; when no ICU beds available, a broader set of conditions and any patient aged >85 years, regardless of underlying health.	Two sets of criteria for different bed availability: (A) capacity limited, (B) no beds available.	Yes. Reassess every 48 hours with specific clinical discontinuation criteria given.	Yes.	Yes. Uniform criteria across the country.	Decisions to be made by multidisciplinary team, which may include input from ethicists. Most senior clinician takes responsibility. Deviation from guidance possible but must be clearly stated why.	Not explicitly discussed but must be transparent.
COVID-19 rapid guideline: critical care in adults—National Institute for Health and Care Excellence (NICE) (27 March 2020)[16]	UK	Developed using existing national and international guidance, advice from specialists and a rapid guideline process.	Not stated.	Based on likelihood of recovery. Frailty (using Clinical Frailty Score or individualised assessment of frailty if score not appropriate); comorbidities; patient wishes.	Not discussed.	No explicit criteria but acknowledge need for regular review and stop when not achieving outcomes.	Yes.	Yes. Hospitals should discuss sharing of resources and transfer patients between units in other hospitals to ensure best use of critical care within the National Health Service.	Not explicit. Decision-making is by the critical care team.	Encourages open communication with patient and family and shared decision-making.
Provisional clinical practice guidelines on COVID-19 suspected and confirmed patients—Ministry of Health Sri Lanka (31 March 2020)[20]	Sri Lanka	Not stated. Written by a panel of experts.	Not stated. Appears to suggest prioritising saving lives.	Admission rather than triage criteria, which are: acute and potentially reversible organ dysfunction; adequate physiological reserve; and goals of ICU admission defined.	Not discussed.	Patients with poor physiological reserve or comorbidities are prioritised for step down to ensure ICU not overwhelmed.	No. Guidance specific to patients with COVID-19.	Not explicitly discussed, but guidance is national.	Decision made by senior member of intensive care team.	Not discussed.

ICU, intensive care unit; SOFA, Sequential Organ Failure Assessment.

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there is insufficient capacity was utility, with some guidelines showing a clear link between the stated ethical framework and the choice of triage criteria for allocating resources. The phrasing of this principle varied, for example, 'the greatest benefit to the greatest number of patients',[14 19 20] or the 'greatest life expectancy and chance of therapeutic success'[19] and 'prioritising patients who will benefit from ICU admission'.[20]

Other ethical considerations were also given priority, notably a form of egalitarianism (either random allocation[21] or first come, first served[19 21]), but were only recommended as a second-tier means to allocate resources among patients with equal clinical need or prognosis. However, the Swiss guidance specifically stated that, 'lotteries' and first come, first served principles should never be applied.[14] Some guidelines give weight to other ethical and legal considerations. For example, the Swiss guidance states that available resources should be allocated irrespective of age, sex, residence, nationality, religious affiliation, social or insurance status, or chronic disability, in keeping with Swiss law.[14]

Criteria for admission

A range of criteria were suggested to inform decisions about who should be admitted to ICU: likelihood of survival, assessment scores, comorbidities, and age. All the guidelines agreed that elements of these factors should be used in combination in decision-making. Often these factors were presented as criteria for doctors to consider without clear guidance on their relative importance nor on how they should be used in practice.[16–19 22] In contrast, some guidance was very proscriptive (ie, Switzerland,[14] Kansas[21] and Sri Lanka[20]).

Likelihood of survival

The likely outcome and survivability of ICU interventions are used as admission criteria in several guidelines.[16–18 20 21] The Belgian guidance states that the absence of chronic organ dysfunction, absence of comorbidities, and high quality of life or functional status prior to admission are likely to lead to better outcomes.[17] The Kansas[21] guideline recommends that short-term survival, either estimated by clinical judgement or objectively assessed with a scoring system, should be the primary means to allocate ICU beds.

Assessment scores

The Sequential Organ Failure Assessment (SOFA) scoring system for adults and the Paediatric Logistic Organ Dysfunction score for children are used in the Kansas[21] guideline. Score values are ascribed to prioritisation categories (low, intermediate, or high). The Belgian[17] and UK[16] guidelines also advocate the use of an assessment score, the Clinical Frailty Score, to formally assess frailty. However, they state that the score should be used 'as part of a holistic assessment'[16] and 'taken into account',[17] without providing details on how the score should be used in practice or the wider assessment in which the score should be used. For example, the UK guideline recommends that intensive care teams be involved in discussions about ICU admission for patients scoring less than 5 and also more than 5,[16] making it unclear how the score affects management.

Comorbidities

All guidelines suggest that admission criteria include comorbidities, and some detail specifically which comorbidities should restrict admission to ICU. The Swiss guideline[14] has two lists of severe comorbidities that exclude admission, one for when beds are available, and one for when no beds are available (see table 2). The Kansas[21] guideline also provides a similar list of comorbidities intended to exclude patients with a short life expectancy, irrespective of COVID-19 infection.

Age

The majority of guidelines state or imply that age on its own should not be used in triage criteria.[14 17 19 21 22] Three discuss the use of age but only when integrated with other clinical parameters.[14 17 19] In contrast, the Italian[19] guidelines suggest that an upper age limit for admission to ICU may need to be set, if resources become significantly limited. The Swiss[14] guideline, while recognising a legal duty to not discriminate on the basis of age, recommends an upper age limit of 85 years for ICU admissions if there are no ICU beds available, as survival for older people tends to be poor, and the stated aim is to maximise the number of lives saved. Kansas and Switzerland also both have upper age limits for people with comorbidities (eg, Switzerland,[14] 75 years for people with significant liver cirrhosis,

Table 2 List of comorbidities that restrict ICU admission from the Swiss Academy of Medical Sciences

Stage A: when beds are available exclusion criteria for ICU admission include any one of:	Stage B: when no beds are available exclusion criteria for ICU admission include any one of:
Severe and irreversible neurological conditions	Severe cerebral deficits after stroke
NYHA class IV heart failure	NYHA class III or IV heart failure
COPD GOLD grade 4 group D	COPD GOLD grade 4 group D or COPD groups A–D with either FEV_1<25% or cor pulmonale or home oxygen therapy (long-term oxygen therapy)
Liver cirrhosis with Child-Pugh score >8	Liver cirrhosis with refractory ascites or encephalopathy >stage I
Severe dementia	Moderate confirmed dementia
Malignant disease with <12 months' life expectancy	Severe burns (>40% of total body surface area affected) with inhalation injury
End-stage neurodegenerative diseases	Stage V chronic kidney disease (KDIGO)
Severe circulatory failure	Age >85 years
Cardiac arrests which are unwitnessed, recurrent or with no return of spontaneous circulation	Age >75 years and at least one criterion (liver cirrhosis, stage III chronic kidney disease (KDIGO), NYHA class >I heart failure, estimated survival <24 months)
Treatment resistant despite increased vasoactive therapy	
Estimated survival <12 months	

COPD, Chronic Obstructive Pulmonary Disease; FEV1, Forced expiratory volume in 1 second; GOLD, Global Initiative for Chronic Obstructive Lung Disease; ICU, intensive care unit; KDIGO, Kidney Disease Improving Global Outcomes; NYHA, New York Heart Association functional classification of heart failure.

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Box 1 Factors to consider when developing guidelines for managing intensive care admissions during the COVID-19 pandemic

Ethical principles
- Use an underlying ethical framework on which to build your guidelines. The most common framework used was maximising lives saved (the principle of utility).

Admission criteria
- Consider using specific ICU admission criteria when there are insufficient beds to meet demands.
- The most common admission criteria used were: likelihood of survival (eg, using SOFA or PELOD score), comorbidities, frailty (eg, using CFS score), age. These are often used in combination to aid clinical judgement.

Discharge criteria
- Consider using specific ICU discharge criteria and regularly review patient progress, for example, every 48 hours. This ensures ICU resources are available to those most likely to benefit.
- The most common discharge criteria used were: no improvement and/or deterioration in condition, for example, cardiac arrest during ICU stay or significant organ failure.
- Consider provision of appropriate care, including palliation, for those discharged from ICU.

Adaptability
- Ensure the guidelines are able to adapt to the changing demand and supply of ICU resources during the pandemic. For example, some admission criteria become more stringent as the number of ICU beds decreases.

Equality between COVID-19 and other health conditions
- Define if the guidelines apply to patients with COVID-19 and/or to patients with other health conditions requiring ICU admission. Most guidelines suggest that all patients should be subject to the same criteria.

Equality across healthcare systems
- Define the scope of the guidelines as local, for example, a hospital system, regional, or national.
- There should be equality in treatment, triage process, and access to care across a healthcare system. There should be fair allocation of resources irrespective of gender, ethnicity, nationality, religion, age, social status, or disability. Hospitals should consider facilitating the sharing of resources.

Responsible officer for decision-making
- Define who is responsible for the decisions made, that is, the triage team, admitting clinician, or most senior clinician. Healthcare systems should provide oversight for triage decisions.
- Consider the need for shared decision-making among treating clinicians or the use of multidisciplinary triage teams.
- Multidisciplinary triage teams should include ICU specialists, respiratory specialists, ethicists, medicolegal representatives, and those with triage training. Having both an intensivist and a non-intensivist clinician is beneficial as together they can estimate the probability of a good outcome with and without intensive care.
- Document decisions and consider providing an appeals process for when guidance is not followed.

Communication and transparency
- The decision-making process should be transparent to all healthcare professionals, patients, and families. ICU admission should be discussed with patients and families, outlining the risks and benefits, and obtaining patient wishes.
- Guidelines should be developed with public consultation, be widely disseminated and, preferably, be prepared in advance.

Technology
- Consider the use of wearable and smartphone devices. Telemedicine can be used for rapid and remote clinical assessment. Rapid access to prognostic information, expert opinion or data analytics on which to base assessments can improve decision-making and resource allocation.

CFS, Clinical Frailty Score; ICU, intensive care unit; PELOD, Paediatric Logistic Organ Dysfunction; SOFA, Sequential Organ Failure Assessment.

kidney disease, or heart failure; Kansas,[21] 60 years for major burn injuries).

Adaptation of criteria

The majority of guidelines acknowledge and agree on the need for adapting ICU admission and discharge criteria as the pandemic evolves and available resources change.[14 18 19 21 22] For example, the Swiss guideline states that criteria should become more stringent as capacity becomes more limited.[14] Similarly, some guidelines are expected to evolve or be revised over time.[16 18 21] For example, those from Australia and New Zealand describe the guideline as a 'living document' that will be revised frequently[18] and the UK guideline states that the document will be updated as 'knowledge base and expert experience develops'.[16]

Criteria for discharge

Most guidelines provide guidance or criteria for discharging patients from ICU and recognise the importance of considering, who is admitted and who is likely to be discharged from ICU, for the efficient use of resources.[14 16 19–21] The guidance varies in its levels of proscription. For example, in order for ICU admission to continue, the Swiss guidance requires that every 48 hours a patient show stabilisation or improvement of haemodynamics, oxygenation, ventilation, or underlying organ dysfunction.[14] This is to ensure that the patient is benefiting from intensive care. Furthermore, it provides criteria that would indicate continued admission would be of little or no benefit, for example, cardiac arrest during ICU stay or significant organ failure. In contrast, the UK guideline suggests a need for regular review, with a view to discharge, but provides no specific criteria for discharge.[16]

Trials of ICU care are discussed in the Sri Lankan and Italian guidelines and if patients are unable to show improvement, they recommend that their ICU care should be discontinued.[19 20] The Kansas guideline specifies that a patient's use of scarce life-saving resources should be reviewed by a triage team daily, and that they should continue to receive the resources unless or until they meet defined exclusion criteria.[21]

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Equality between COVID-19 and other health conditions

Five guidelines state that the same criteria should be applied to patients with COVID-19 and patients with other health conditions, during the pandemic.[14 16–19] Most guidelines describe the need to reduce elective procedures and non-urgent hospital care, in order to redirect resources to more urgent and COVID-19-related care, and facilitate increases in capacity.[14 17 18 20–22]

Equality across healthcare systems

Several guidelines state the importance of uniform policies and ICU admission criteria to avoid variations between facilities; across a health system or country.[14 18 21] Conversely, the US guideline for military hospitals specifies that each hospital should provide its own ICU admission criteria based on resources available.[22] The Belgian guidance also recommends that each hospital should have its own ethical guideline.[17] The Kansas guideline recommends that ventilated patients in chronic care facilities should not be subjected to acute care triage guidelines, unless such patients require transfer to an acute facility.[21]

Decision-making processes and support

Most guidelines agree that triage decisions should be made in consultation with colleagues. Two guidelines recommend that hospitals should have a multidisciplinary 'triage team', independent of the clinical team, that is responsible for making triage decisions.[14 21] Where decision-making is left to the treating clinician, it is recommended that they consult with other colleagues in order to share the decision-making process,[17–19] recognising the emotional burden of such decisions.[19] Several guidelines state that ICU clinicians are the primary decision makers with respect to the provision of ICU treatments,[14 16 18 20] and that the most senior should take overall responsibility.[14] It was recommended that all triage decisions should be fully documented.[14 16–19]

Communication of decisions

Guidelines highlight the importance of ensuring that the decision-making process is transparent and that families should be guided through the process.[14 16 18 19] The UK and Italian guidelines specify the significance of discussing ICU admission with patients, families and carers, outlining the risks and benefits.[16 19] Three guidelines discuss the crucial role of advance care directives and early discussions about escalation.[16 18 19]

DISCUSSION

Our narrative synthesis has identified several attributes that can inform the development of new, and refinement of existing, guidelines (box 1), along with implications for clinical leads and local implementation (box 2). These attributes are supported by previously published literature on the topic, which have been developed using more robust methodologies.[6 23 24]

While we recognise that the guidelines have had to be produced quickly in the context of a rapidly evolving pandemic, it is noticeable that the quality of the guidance was poor, particularly with respect to use of evidence (none incorporated a systematic review), stakeholder involvement, and applicability. All guidelines were developed in part by expert panels. The evidence they reviewed was poorly described and the method used for coming to a consensus was not stated. The guidelines have been produced by national professional bodies and are directing respective country responses to the pandemic. While it is understandable that guideline development processes would need to adapt, standard elements of good guideline practice should not be compromised (eg, defining expertise of those involved in guideline production).

Box 2 Implications for clinical leads and local implementation

- Clinical leads should be aware of the variable quality of current guidelines.
- Clinical leads should seek high-quality guidelines underpinned by robust processes of development and evidence.
- High-quality guidelines should: have clear aims, clearly define target users and patients, involve target users and patients in guideline development, be evidence based, provide specific and clear recommendations, be acceptable to patients and clinicians, be applicable in clinical practice, consider cost implications, and be devoid of bias.
- Given the lack of clarity of existing guidelines, clinical leads should consider developing local protocols (see box 1) to assist with triage decisions.
- Local protocols should be based on the best available evidence and should adapt as more evidence becomes available.

Ethics

Decisions about who is admitted to ICU, and who receives ventilation during periods of high demand, involve the application of moral and cultural values even when presented in terms of objective criteria or clinical judgement.[1 25 26] While much of the guidance appeared to suggest underlying ethical principles that underpinned the triage criteria, often those principles were not made explicit. Building criteria based on an explicitly stated ethical framework is more transparent, and helps to provide a rationale[1] for extraordinarily difficult decision-making. While it may be simpler to leave prioritisation to the discretion of clinicians, there is a risk that if the principles and criteria used are not transparent, public trust may be undermined.[26] Furthermore, decision-making may be inconsistent and subject to unconscious bias.[27]

Despite a range of possible ethical frameworks to guide decision-making, their consideration was relatively limited and we found a strong preference for a utilitarian approach,[28] as first described in 'The greatest happiness principle' by Jeremy Bentham in, '*Introduction to the Principles of Morals and Legislation*'.[29] Exceptionally, the Swiss guideline, which provides the most stringent criteria, also discusses the ethical frameworks in significantly more detail than other guidelines.[14]

The first come, first served principle has received criticism in the literature, with clear expression that it should not be used.[1 30 31] Interestingly, some of the guidelines discussing ethical issues refuted its use, but several supported its use if resources are completely exhausted or there is comparable medical urgency. Decision-making based on this principle has been contentious, as demonstrated by the Belgian guidance which recommended the first come, first served principle for comparable medical urgency in its original version, but later removed the recommendation.

Throughout the literature and in the guidelines there is constant reference to 'triage'.[25 26] This term was originally used to describe the prioritisation of treatment for wounded soldiers on the battlefield, in order to maximise the number of lives saved.[32] Other terminology that is commonly used in the guidance includes: prioritisation and allocation. The choice of

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terminology is contentious; with terms like 'rationing' provoking considerably more emotion than 'allocation'. The guidelines were generally devoid of the word 'rationing', which may signal the discomfort felt around such terminology.

Despite public trust and consent being at the core of medical decision-making, there has been little public consultation of the ethical principles that underlie the guidelines we have reviewed. We note that two prepandemic sets of guidelines, both from North America involving significant public consultation, favoured approaches that sought to maximise lives saved.[23 33] These consultations helped to endorse the ethical principles used within these guidelines. The wider literature suggests that the principle of utility is the most used ethical theory for triaging resources.[34 35] This is reflected in the guidelines reviewed. However, the literature also suggests that a single ethical theory is not sufficient for directing the triage of resources, which requires input from the public and professionals and is tailored to the public health emergency being faced.[34 35]

Similarities and differences between guidelines

The majority of guidelines highlighted the same themes and shared similar criteria for ICU admission. In particular, most guidelines concluded that a combination of admission criteria should be used, including the likelihood of survival and comorbidities, but that age on its own should not be used. The majority of guidelines also agreed on the need for discharge criteria, and adapting ICU admission and discharge criteria as the pandemic evolves. Most shared the need for criteria to be applied equally to patients with COVID-19 and patients with other health conditions, and for triage decisions to be made in consultation with colleagues.

While a primary set of criteria or themes was discernible, there was significant variation in how they were put into effect. In particular, the extent to which triage criteria were proscriptive. This may reflect the different cultural, legal, and political contexts that these guidelines span. Namely Europe, Asia, America, and Oceania. For example, a do not attempt resuscitation decision requires patient or surrogate approval in the USA, while in the UK the decision is made by the treating clinician after discussion with the patient or their nominated consultee.[36] This may have influenced the more proscriptive approach seen in Kansas[21] and elsewhere in North America.[23 33] At the time of writing, different countries are faced with different demands on their ICU resources. Such differences in demand may influence the guidelines, as they may become more stringent as demand increases.

Comparison with previous work

The criteria and themes that we identified are very similar to the recommended items to include in a triage protocol for critically ill patients in a pandemic or public health emergency as recommended by the American College of Chest Physicians Consensus Statement.[24] However, the Statement does not recommend use of SOFA score exclusion thresholds because the score's predictive ability varies across populations. In addition, the Statement includes guidelines for children, but few of the guidelines we reviewed discussed children, which may reflect the low incidence of critical COVID-19 illness in children.[37] Two pre-existing guidelines from North American states (New York[6] and Maryland[23]) on triaging during public health emergencies shared similar characteristics to the Kansas[21] and Swiss[14] guidelines. They used an explicit ethical principle (maximising lives saved), admission and discharge criteria (including the SOFA score), and triage committees.[6 23]

Strengths and limitations

We undertook a rigorous evaluation of existing and recently developed guidelines for triaging ICU admissions during the COVID-19 pandemic. Several guidelines implied that they would be modified as events unfold and other guidelines may be published in due course. While individual guideline content may evolve, the types of criteria and principles we have identified (boxes 1 and 2) will be less susceptible to change. By way of illustration, since undertaking this search, Azoulay[31] and colleagues recently discussed local guidance from the COVID-19 Paris region area. The themes considered support those identified in this review and highlight many of the factors in box 1.

The guidelines provide little information on the way in which they were developed and the evidence behind the recommendations. Consequently, we are not able to identify 'best practice'. Countries and jurisdictions have different ethical values and cultural norms, which are reflected in the guidance. Not all guidelines were explicit, which may in part reflect cultural differences and political sensitivities. Some guidance has been translated into English, which may have resulted in a loss of nuance or clarity. Where guidance was not explicit, we have stated this and indicated our consensus interpretation.

Future work

Future work should aim to understand and explain cultural differences, factors leading to divergence in guidelines, and assessment of the impact of the guidelines. For example, to what extent are the proposed criteria able to manage demand to keep it below ICU surge capacity? Future work should seek to understand how guidelines are being used in practice, and the extent to which they meet the needs of clinicians and managers. It is important to understand the extent to which prioritisation of ICU resources actually occurred, both for patients with COVID-19 and other health conditions, including variations within and between countries.

Implications for practice and policy

While many geographies have instituted substantial temporary increases in ICU capacity, prioritisation has still occurred. Until there is no longer significant spread of COVID-19, there will be an ongoing risk of increased ICU demand, so there is a need to prioritise and address these issues critically. The criteria we have identified and the synthesis of different global guidelines provide essential information for the revision of existing guidelines and the development of new guidelines. Future guidelines need to be evidence based and developed using robust methodologies.

The emotive nature of terminology around this topic, and lack of clarity within extant guidelines, suggests a difficultly in discussing these issues openly. Ethicists suggest that a transparent approach is preferable,[25 26] and further work is required, in terms of political and public engagement, to create an environment for clear and transparent guidelines and practice to support the complex decisions that need to be made in these pressurised circumstances. During the development of guidelines, it is critical to determine whether the guidance is accepted by clinicians involved in making the decisions on the front line, and also by the public and patients; including groups who might be disadvantaged by the guidance.

The guidelines suggest that equality across healthcare systems, demonstrated by the use of uniform policies, is important. A lack

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of consistency between hospitals in a similar location or providing similar services can result in unwarranted variation and poor outcomes. In addition, a lack of clear guidance across a healthcare system may lead to community clinicians making inconsistent hospital referrals based on assumptions about the likelihood of patients receiving ICU care. It is necessary to prevent such inequalities in practice. While the guidelines also suggest that non-urgent care be redirected to more urgent and COVID-19-related care, concerns have been raised over the impact this is having on the backlog of patients who are not receiving care or not accessing services as they normally would.[38 39] It is critical that all patients requiring care are able to access and receive care that is safe, effective, efficient, equitable, patient centred, and timely.[40]

CONCLUSION

While no clinician wants to make rapid and unguided ICU admission and ventilatory support allocation decisions, the COVID-19 pandemic has unfortunately placed some clinicians in this position. This work provides a synthesis of current guidelines, and identifies the different approaches taken globally, to manage these challenging situations. We have developed a set of factors to consider when developing guidelines to inform the creation or revision of guidelines for managing intensive care admissions during the pandemic. Clear evidence-based guidelines are essential to avoid inconsistency and bias in decision-making, reduce distress among clinicians having to make difficult decisions, and improve patient outcomes.

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