The Ethics of Creating a Resource Allocation Strategy During the COVID-19 Pandemic

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Abbreviations:

COVID-19 – coronavirus disease 2019

ECMO – extracorporeal membrane oxygenation

ARDS – acute respiratory distress syndrome

ECPR – extracorporeal cardiopulmonary resuscitation

PPE – personal protective equipment

HIV - human immunodeficiency virus

SARS - severe acute respiratory syndrome

ICU – intensive care unit

NICU – newborn intensive care unit

PICU – pediatric intensive care unit

SOFA - Sequential Organ Failure System

PELOD - Pediatric Logistic Organ Dysfunction

SNAP - Score of Neonatal Acute Physiology

CRIB - Clinical Risk Index for Babies

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Naomi T. Laventhal, Ratna B. Basak, Mary Lynn Dell, Nanette Elster, Gina Geis, Robert C. Macauley, Mark R. Mercurio, Douglas J. Opel, David I. Shalowitz, Mindy B. Statter, and participated in the planning, literature review, and writing of this manuscript, and Douglas S. Diekema *critically reviewed the manuscript for important intellectual content.*

Drs. Laventhal, Basak, Geis, Opel, Statter and Macauley are members of the American Academy of Pediatrics Committee on Bioethics, to which Drs. Dell, Diekema, and Shalowitz are liaisons and Ms. Elster is consultant. Drs. Mercurio and Laventhal are members of the Executive Committee of the American Academy of Pediatrics Section on Bioethics. The opinions of the authors do not reflect AAP policy and do not necessarily represent the views of the AAP.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

***Abstract**:* The COVID-19 pandemic has affected nearly every aspect of medicine and raises numerous moral dilemmas for clinicians. Foremost of these quandaries is how to delineate and implement crisis standards of care and, specifically, to consider how healthcare resources should be distributed in times of shortage. We review basic principles of disaster planning and resource stewardship with ethical relevance for this and future public health crises, explore the role of illness severity scoring systems and their limitations and potential contribution to health disparities, and consider the role for exceptionally resource-intensive interventions. We also review the philosophical and practical underpinnings of crisis standards of care and describe historical approaches to scarce resource allocation in order to offer analysis and guidance for pediatric clinicians. Particular attention is given to the impact on children of this endeavor. Although few children have required hospitalization for symptomatic infection, children nonetheless have the potential to be profoundly affected by the strain on the healthcare system imposed by the pandemic and should be considered prospectively in resource allocation frameworks.

Introduction

The coronavirus disease 2019 (COVID-19), previously named 2019 novel coronavirus and abbreviated 2019-nCoV[1], pandemic raises weighty and urgent ethical questions affecting all patients and the clinicians who care for them. As bioethicists, we hope to provide support to our colleagues who care for children during this challenging pandemic. In particular, we will focus on the ethical issues related to resource allocation in times of shortage and offer analysis and guidance informed by new and historical literature.

During the COVID-19 pandemic, guidelines affecting the clinical care of adult and pediatric populations may overlap significantly. Likewise, many of the ethical principles relevant to resource allocation strategies and their implementation will be similar. However, ethical care of pediatric patients during a pandemic requires special consideration and is the focus of this report. Some important ethical considerations that primarily affect adult populations are not discussed in detail. We recognize that children receive healthcare not only from pediatricians, but from a diverse group of non-pediatrician physician and non-physician clinicians. Accordingly, we will refer to our intended audience as pediatric clinicians. Although this paper was written with specific attention to the immediate needs of clinicians during the COVID-19 pandemic, it is largely informed by previous work on scarce resource allocation

and crisis medicine; many of the guiding principles offered here are applicable to other pandemics and health crises.

COVID-19 and the shift in the orientation of clinical ethics

In the midst of a pandemic, real-time dashboards are needed to accurately report the number of cases and deaths, since these change by the minute. As of April 22, 2020, nearly 2.6 million cases are confirmed worldwide and nearly 178,000 deaths.[2] In the US, there are just over 825,000 cases and nearly 45,000 patients have died,[2] with most states still experiencing an exponential increase in cases and deaths. Because of limited testing, reliable data are not yet available on the number of children with confirmed COVID-19 infection, but children appear to be less susceptible to severe infection and deaths have been rare.[3,4] Severity of illness and case fatality have been linked to advanced age and preexisting comorbidities, but severe illness and death have occurred in younger, previously healthy adults. [3,5-7]

Social and clinical efforts to limit the prevalence and morbidity of COVID-19 include "social distancing" and hygiene campaigns as well as the restriction of non-essential healthcare encounters. Surgeries and other procedures judged to be non-urgent are being deferred, and patients may not be permitted to have visitors to support them through their medical care. These changes, among others, represent a fundamental shift in priority from maximizing the outcomes of individual patients to optimizing the welfare of the community. Unfortunately, the demands of the COVID-19 pandemic have already exceeded our ability to provide sufficient numbers of diagnostic tests and adequate personal protective equipment (PPE), and may still exceed the ability of some places to provide enough ventilators, intensive care unit (ICU) beds, and the healthcare professionals required to support the needs of patients. Participation in overt healthcare rationing is therefore likely for the first time in the lives of many clinicians. Consequently, institutions and clinical practices nationwide have needed to develop protocols to determine fair, systematic, and evidence-based methods for deciding who will receive healthcare

resources if demand for these resources exceeds available supply. This shift reflects an abrupt and urgent transition from a usual standard of care, in which a respect for patient autonomy is prioritized and benefit to each patient is maximized, to public health crisis standards of care, in which the common good is prioritized and benefit to the community is maximized.

Implementation of Crisis Standards of Care and Triage Across Institutions

Crisis standards of care are implemented when health care systems are so overwhelmed by a pervasive or catastrophic public health event that providing the normal, or standard, level of care to patients is impossible. Anticipating that demand for care will exceed available resources, contingency planning is essential prior to implementing crisis standards of care. Hospitals and local disaster planning committees should proactively explore and implement mechanisms to increase their ability to provide appropriate care to all patients through modifications in three essential areas: space, staff, and supplies. Key strategies to accomplish this include modular expansion of acute and critical care capacity in hospitals, pre-established tiered staffing models, transfer of patients to other facilities, shared ventilator and equipment protocols, and conserving, adapting, or substituting supplies.[8]

Local, state, and, regional consensus on crisis procedures and standards of care is desirable as it facilitates coordination of care across systems and conservation of needed resources in a way that is consistent and standardized. Several states do have publicly available triage guidelines:[9] in Michigan, for example, they serve as general guidance[10] and in Washington State, the call for uniformity in triage process is more prescriptive.[11] Once it becomes necessary to implement crisis standards of care, ideally these standards are adopted simultaneously across hospitals within a region or state. Simultaneous adoption of crisis standards of care facilitates the equitable distribution of available resources across institutions and health systems. The general principle should be that no hospital in a region or state should enter crisis standards of care until all hospitals in the region or state have reached that point. Ideally,

transfers of patients from hospitals at capacity to those with capacity should occur until no capacity exists in the area. This requires a regional or state-wide effort to monitor the availability of beds and scarce resources across the region and assist in the movement of patients or resources.

In the U.S., mechanisms and approaches for distribution of resources in times of shortage vary by state. Washington State offers one promising model. The Northwest Healthcare Response Network, in collaboration with the Washington State Department of Health, has implemented a Disaster Clinical Advisory Committee to develop clinically focused tools and planning for a disaster or pandemic related surge. This working group serves a monitoring and coordination function across the state during a surge response.[11] There has also been significant variation in the plans for resource conservation and distribution among different clinics and hospital systems. As a resource, organizational guidelines have been published in real time to advise clinical and organizational practice, informed by the experiences with COVID-19 in Asia and Europe. Institutions, however, are subject to different challenges with regard to the medical supply chain and variable state public health responses such as school closures and shelter-in-place ordinances.

Crisis standards of care may require that some scarce resources can only be made available to some patients, requiring triage. Triage judgments are best made by a triage team, comprised of a triage officer who leads the team along with other healthcare providers. The application of any allocation protocol requires careful attention to the potential for bias on the basis of factors not relevant to survival or need. The best way to minimize implicit bias is to develop a process in which a triage team is blinded to all but prognostic factors that speak to likelihood of benefit and degree of need.

While the triage assessment occurs, first responders and bedside clinicians should perform the immediate stabilization of any patient needing critical care. Importantly, the triage team's decision-making should occur independent of the primary clinician caring for the individual patient. While the clinician who has established a relationship with the patient might be the best person to inform the patient

or family of the triage team's decision, a member of the triage team ideally should be available to communicate how the decision was made.

Resource Stewardship and Constraints to Usual Clinical Care

Referral medical centers that provide highly specialized care, treat the sickest and most complex patients, and serve the needs of large geographic catchment areas will face unique ethical challenges. These issues are particularly salient for children, as their specific needs are less likely to be met in community hospitals given the concentration of pediatric specialists in academic centers. Moreover, children who require specialized treatment for other conditions have needs that are not expected to diminish in frequency due to the pandemic. For instance, infants will continue to be born prematurely or with congenital anomalies requiring prompt treatment. Children will still require care for complex chronic medical illnesses such as cystic fibrosis, sickle cell disease, cancer, and traumatic injuries.

As institutions and state governments de-prioritize elective procedures and non-urgent medical care, distribute disposable and durable equipment, allocate hospital beds, and deploy health professionals to care for sick adults, they should remain mindful of the usual needs of the regions they serve and recognize that there will be sick patients who do not have COVID-19 and need specialized care. These decisions may cause conflict between institutions' duty to care for patients and their responsibility to steward resources. Institutions may be forced to revisit their commitment to provide some services if the necessary resources are too debilitating for an already strained healthcare system or are simply not available. Neonatal and pediatric intensive care unit (ICU) beds, extracorporeal membrane oxygenation (ECMO) circuits, continuous renal replacement machines, blood products, or advanced ventilators all may need to be redistributed for the purpose of preserving the most lives.

Children should not be excluded from advanced care therapies without careful consideration of their unique needs and vulnerabilities. Good contingency planning can help mitigate the effects of resource

allocation and redistribution. In addition, illness severity scores should enable concurrent evaluation of COVID and non-COVID patients and support integrated rather than siloed resource allocation.[12]

General considerations for the allocation of scarce resources

Historically, several models for scarce resource allocation have been developed and iteratively debated. The response to the COVID-19 pandemic is largely informed by the philosophical underpinnings of different resource allocation frameworks. We review the fundamental ethical principles of scarce resource allocation and interpret them in the context of the COVID-19 pandemic. We also acknowledge that final institutional policies will likely vary based on the type and availability of the resource being allocated, institutional factors, and the local trajectory of COVID-19 cases.

There is broad agreement that frameworks for allocating scarce resources should focus on providing the greatest benefit to the greatest number of individuals while using the fewest resources. A fair system of allocation must be transparent and applied consistently. It is important to be mindful that socially vulnerable populations are most likely to suffer the greatest impact during public health emergencies,[13,14] and to consider how medical criteria incorporated into triage algorithms may perpetuate inequities. Unfortunately, real-time observation of racial and ethnic disparities in COVID-19 cases and deaths[15,16] have served as a sobering reminder that seemingly objective healthcare decisions and illness severity scoring systems may perpetuate inequities by overlooking social determinants of health [17,18]. As the magnitude of racial and ethnic disparities in COVID-19 outcomes becomes apparent,[19,20] the potential for illness severity scores to amplify, rather than mitigate, health disparities for historically disadvantaged groups (which are often more burdened by the very comorbidities that impart less favorable scores, such as hypertension and chronic kidney disease) has appropriately motivated closer scrutiny of triage algorithms.[21] All patients should be treated respectfully; race, ethnicity, disability, gender, sex, religion,

citizenship, social status and power, socio-economic status, ability to pay, past use of resources and other demographic factors should not be used in allocation decisions.

Although protocols may vary depending on resource, scarcity, and setting, several criteria should be considered in their development.[12,22-28] Preferably multiple criteria will be integrated into an allocation protocol since no single element incorporates every applicable moral consideration.[29] Allocations frameworks with particular relevance include (and summarized in Table 1):

***Likelihood of Benefit*:** Likelihood of benefit should be optimized in any allocation framework. Ideally, survival prognosis assessments should be as objective as possible, using existing, validated measures. Whether survival to hospital discharge or long-term survival (or both) should be used as the measure of benefit regarding intensive care intervention, such as ventilators (and the requisite ICU beds and clinician support) and blood products, is debatable. While it might be argued that long-term survival ultimately may lead to more objective benefit (in terms of optimizing life-years saved), a long-term survival framework carries the risk of discriminating against persons with shorter lifespans because of underlying disease, disability, or age. In the setting of COVID-19, benefit for patients has been largely defined as short-term survival, at least with regard to allocation of treatment modalities and hospital beds. However, this pandemic has also brought to light aspects of societal and public health benefit (other than survival) that need to be considered in the allocation of scarce resources that serve purposes other than the benefit of individual patients. For example, PPE stewardship and strategic diagnostic testing serve benefits such as maintaining a healthy workforce and limiting further transmission of infection.

***Greatest Need*:** Among patients with similar likelihood of benefit, those with the greatest need (defined as most likely to suffer harm without the resource) should get first priority. For example,

when two patients are both likely to benefit from ventilator support, the patient at greater risk of imminent respiratory failure should be prioritized.

***Amount of Resource Required*:** Arguably, if two people carry a similar prognosis, the one requiring the fewest resources should be prioritized. Because of the difficulty in predicting how much of a resource might be required by a patient (e.g., how long someone might remain on a ventilator), most frameworks have not included this criterion. However, in some circumstances prioritizing patients who have a generally predictable short-term need for a scarce resource (e.g., need for ventilation as a consequence of RSV bronchiolitis) may be appropriate. Additionally, this framework might advantage children regarding rationed medications that are dose-reduced for pediatric use.

***Persons carrying out vital functions*:** Arguably, the community benefits when persons carrying out vital functions during a disaster are prioritized with regard to PPE, vaccines, and treatment.[12,27] These roles usually include health care workers and first-responders, though the group may be expanded depending on the community's needs to include those working in grocery stores, food and mail delivery, and essential government service, for example. The argument for such prioritization includes the recognition that those individuals are essential to continue caring for others in the community during the crisis. In addition, prioritizing care for those individuals provides some degree of reciprocity for putting themselves in harm's way to assist others during the crisis. Furthermore, prioritization is an incentive for healthcare personnel to continue working even when the work is, or feels, unsafe. These compelling arguments are particularly powerful when the resource being allocated will prevent occupational harm (PPE, vaccines) or rapidly return an infected provider to service. In many triage algorithms, those who carry out vital

functions are prioritized only as a way of making decisions between people with similar likelihood of survival.

***Random Allocation*:** When all else is equal, randomization should be used to make decisions about ordering for priority. Random methods are generally considered to be more fair than prioritizing those who were first to arrive because the latter tends to benefit those with knowledge and resources to seek early assistance from healthcare institutions, which may contribute to inequities in access and outcome.

With attention to these frameworks, there are a few guiding principles when creating new resource allocation guidelines for COVID-19. First, short-term survival (survival to discharge) is a reasonable criterion by which to prioritize resource allocation. Second, first-come, first-served should not be used to determine who gets a scarce resource for patients with similar prognoses as this unfairly benefits patients who have better access to health care institutions. Third, considering giving prioritization of persons carrying out vital functions as a discriminator between patients of equivalent priority scores in a triage algorithm is justifiable.

Special Considerations for the Allocation of Scarce Resources in Pediatric Populations

The unique characteristics of children raise additional challenges that must be considered when balancing the needs of pediatric and adult populations. Many triage protocols are designed for adult patients for whom standardized clinical scoring methods are commonly utilized.[30-33] Although the vast majority of critically ill COVID-19 patients are adults, children may be placed into competition with adult patients for scarce resources, either because they have severe infection, or because of other conditions

requiring resource-intensive interventions. In addition, the surge in adult patients may overflow into emergency departments, inpatient wards, and intensive care units normally designated for infants and children.

Historically, age and life stage have been frequently invoked in resource allocation ethics.[12,22,34,35] It has been argued that some priority should be given to those in earlier life stages. The basis for this prioritization criterion is a "fair innings" argument that suggests that, all other things being equal (such as prognosis and need), those who have not experienced as many life stages as others should have the opportunity to do so.[36,37] This would prioritize children over adults and younger adults over older adults, at least within similar prognostic categories. Prioritization of younger patients can also be supported by the utilitarian argument that younger patients can derive more benefit from a life-saving intervention, by amortizing the return on that investment over more future years. Again, purely applied, this approach not only prioritizes children over adults, but infants over older children.

In recognition of increased mortality rates for older patients with COVID—6.4% in patients over sixty compared to 0.32% in those under sixty [38]—some countries have instituted age limits for intubation for COVID-19-related respiratory failure.[39] This, however, has prompted accusations of ageism. Regional guidelines in the U.S. that include even such non-specific considerations as "loss of reserves in energy, physical ability, cognition and general health"[11] have prompted lawsuits[40] appealing to federal health regulations which prohibit discrimination on the basis of age or disability.[41] The unreliable association between chronological and functional age has also raised concerns about arbitrary age cut-offs. Contrarily, community focus groups have endorsed consideration of age, if not as a primary determinant for allocation then as a discriminator between patients of equivalent priority scores.[32] Recognizing the need for standardization and transparency in prioritization protocols, the degree of priority given to children should be made explicit with an ethical justification provided. In principle, some prioritization of children over adults in situations of equivalent illness severity is morally justifiable, both on the basis of utility, by amortizing investment in medical resources over more life years, and by virtue of the "fair

innings argument". However, COVID-19 already disproportionately affects those who are older, mortality rates rise substantially with age, and older individuals are more likely to suffer from co-morbidities that impact likelihood of survival and illness severity scores. With a disease that already strongly favors younger age groups on the basis of likelihood of survival, further prioritizing younger age groups may be difficult to justify. Therefore, for COVID-19-specific resource allocation, we do not recommend explicit age-based prioritization; rather children, like members of the vital workforce, could be considered as an alternative to random allocation in rare situations of true clinical impasse.

A Framework for Balancing Obligations toward Children and Adults

An ideal measure for estimating survival likelihood across the age spectrum would be both objective and reliably accurate. The SOFA for adults[42] and the Pediatric Logistic Organ Dysfunction (PELOD, PELOD 2) scoring system for children[43,44], for instance, use physical findings and laboratory data to determine the short-term prognosis of patients[32] and appear frequently in institutional and state triage guidelines. Several other quantitative metrics have been developed to assist in making decisions about prognosis, including an age-adapted SOFA score[45] and the Pediatric Risk of Mortality III Score[46] for older children, and multiple iterations of Score of Neonatal Acute Physiology (SNAP) and Clinical Risk Index for Babies (CRIB) scores for neonates.[47] Many cite the parameters, ease of calculation and robustness of these scoring systems as evidence of their validity.[48] Whether any neonatal or pediatric illness severity score will prove to be a valid measure of prognosis in the setting of COVID-19 remains unclear; no available pediatric illness severity scoring system is validated in a public health crisis or as a triage tool.[25,33] Furthermore, the PELOD and PELOD-2 have not been validated in the Newborn Intensive Care Unit (NICU) population, a group commonly omitted from published frameworks. While these measures remain the best available scoring systems for prognosis, their shortcomings highlight the need for an updated, large-scale triage protocol developed from quantitative analyses of patient outcomes. Because numbers of children with severe COVID-19 illness are very small, and because, thus far, triage

algorithms for ventilator allocation have not been activated, whether some children with chronic illness and/or disability will be unfairly disadvantaged by existing prognostic scoring systems remains unknown;[49] however, such concerns are reasonable, and careful attention to disability bias remains essential to resource allocation protocols, for children as for adults.

Identifying a single, simple framework to allocate ventilators and other medical resources across populations of children and adults is complicated by heterogeneity in the organization of children's hospitals and management of resources. For example, a framework for a free-standing children's hospital to share its resources with an affiliated adult hospital will differ greatly from that adopted by a "children's hospital within a hospital" with potentially less restrictive boundaries between pediatric and adult patients. Management of ventilator fleets also may vary greatly. Some newborn intensive care units use dedicated neonatal ventilators which cannot be reallocated to adults; others use ventilators that function across the age spectrum and are part of a common fleet. These factors have the potential to alter how allocation protocols get applied to infants and children during a respiratory illness pandemic.

As discussed above, infants and children arguably should receive preference in situations of a tie in priority scores based on a fair-innings or life stages argument. Some may reject the entire premise of subjecting children to triage protocols based more on a moral intuition to protect children over adults rather than on ethical. Consider, however, a neonate or young child with a 10% chance of survival if given the needed resource. Should she be given preference over a 22-year-old woman who, with that resource, would have a 90% chance of survival? This seems counter-intuitive, even to a pediatric clinician, and would also be inconsistent with the goal of saving the most lives. A fair and feasible method must be found to allocate scarce resources among all patients across the age spectrum.

Should the resource allocation system explicitly confer an advantage for children? For instance, if one gives the same prioritization score to a child with a 60-70% chance of survival as an adult with a 70-80% chance, children are slightly favored. Giving the same prioritization score to a child with a 20% chance as an adult with a 50% chance clearly favors children even more. However, it should be

recognized that as systems increasingly favor patients with lower likelihood of survival, they deviate from the goal of saving the most lives (though perhaps not from saving the most life years). Anyone creating guidelines should do so with that understanding, as well as an understanding of the inherent limitations of using different prediction tools in the same protocol.

Neonates present yet another challenge. Scoring critically ill newborns is difficult because one tool is not applicable to all infants in this population. The National Institutes of Health Extremely Preterm Birth Outcomes Tool (NICHD-OT) could be used for those between 22 and 25 weeks' gestation, [50] but the likelihood of survival for this age group increases over the first days and weeks of life, making the tool less predictive over time; in fact, the tool was developed to inform obstetric and neonatal clinicians for prenatal counseling and decision-making, not to serve as a post-natal decision tool.[51] A number of neonatal illness severity scores, used primarily for clinical research purposes exist and consideration could be given to these as a parallel to SOFA and PELOD 2 scores; importantly, these scores have not been found to be of high clinical utility, and are not used in clinical practice.[52] To score newborns beyond the first few days, one might need to rely on clinical judgment regarding likelihood of survival, using input from subspecialists and outcomes data for a given pathological condition, but this strategy is prone to bias and provider variation. Co-morbidities that influence neonatal survival could be used to adjust a prediction tool score, as they do for adults in other tools. However, once a system relies on clinical assessment of likelihood of survival rather than specific clinical and laboratory data, the additional use of co-morbidities to adjust the score carries the risk of "double-counting" the effect of the co-morbidity on the assigned score.

Allocation of ECMO during COVID-19

WHO interim guidelines for the management of COVID-19 related acute respiratory distress syndrome (ARDS) recommend administering veno-venous ECMO to eligible patients in specialized centers with sufficient case volumes to ensure clinical expertise. In general, ECMO can be a viable rescue strategy for some patients,[53] but the potential benefit and duration of ECMO support for patients with COVID-19 will require systematic, prospective investigation.

In addition, ethical challenges will affect decision making when offering ECMO therapy in a pandemic. The American Pediatric Surgical Association (APSA) guidelines for ECMO candidacy for COVID-19 positive neonatal and pediatric patients, controlled cardiac or respiratory cannulation uses standard ECMO inclusion criteria.[54] Extra-corporeal cardiopulmonary resuscitation (ECPR, the implantation of veno-arterial extracorporeal membrane oxygenation in a patient after sudden and unexpected pulseless condition attributable to cessation of cardiac mechanical activity)[55] in COVID-19 positive pediatric patients is discouraged especially for those with other comorbidities, septic shock, or evidence of multisystem organ failure.[54] It has been suggested that the immunological status of patients should be incorporated when assessing ECMO candidacy since reportedly, during ECMO, IL-6 concentrations were consistently elevated and inversely correlated with survival in adults and children.[56] For patients under investigation (PUI) for COVID-19 (i.e., patients who are awaiting COVID-19 test results or whose test results were inconclusive), standard ECMO candidacy guidelines apply for respiratory, cardiac, and ECPR. ECMO cannulation for both COVID-19 positive and PUI patients requires careful attention to correct donning of PPE.

ECMO is a finite resource that requires investment of specialized equipment, highly and specifically trained health professionals, and large volumes of blood products. Use of ECMO during a pandemic, regardless of indication, thus warrants additional consideration when hospital resources are strained or limited.[57] These considerations may also be applied to other resource-intensive interventions for the sickest patients, such as continuous renal replacement therapy. We do not recommend uniform prohibition of ECMO or similar interventions during a public health crisis as a preemptive strategy to

preserve resources. Considering cannulation for ECMO for infants and children who stand to benefit from it (in terms of survival or preservation of function) is appropriate, but application of resource allocation policies by a triage officer may be necessary in times of scarcity.

Code Status for Children with Severe COVID-19 Infection

Code status for adults with severe COVID-19 infection has become controversial in the U.S., based in part on the high mortality observed among the sickest patients, the risk of viral transmission during resuscitation, and the use of PPE for an entire code team of providers.[58,59] Transparent and consistent approaches to code status for inpatients with COVID-19 infection are an essential component of institutional scarce resource allocation guidelines. Some have advocated for unilateral do-not-attempt resuscitation (DNAR) orders for all patients admitted to hospitals with COVID-19 infection (or at least for those who are severely ill).[59] It is reasonable to consider prioritizing pediatric clinician safety and PPE stewardship when a high-risk intervention has a low likelihood of success. Any justification for unilateral code status decision-making should be made explicit in hospital policies, and medical futility should not be conflated with the unique circumstances of this pandemic. If appropriate PPE is available, neither risks to the code team nor desire to conserve PPE are adequate justification for unilateral DNAR without first considering whether resuscitation is likely to successfully resuscitate the patient. However, well established principles and processes exist for consideration of CPR and other extraordinary measures at the end of life and are often codified in policies regarding non-beneficial treatment.[60] Such policies can be applied in the context of this pandemic but may require modifications based on available resources. Members of the code team should never be expected to forgo appropriate donning of PPE before initiating the resuscitation. Families should be informed that resuscitation efforts might be delayed for clinical providers to don appropriate protective gear.

Although children seem less likely to become critically ill, consideration of code status for those who do also requires explicit justification. The evidence that informs decisions for adult patients is likely not applicable to children, and children with COVID-19 might have a higher likelihood of recovery after a resuscitation effort than adults with similar illness severity. While DNAR status may be appropriate for critically ill children with COVID-19 with progressive hypoxemia, we do not recommend a preemptive strategy of unilateral DNAR orders for all children with severe infection.

Conclusion:

In this paper, we have explored several considerations in the development of an allocation protocol for distributing scarce resources during COVID-19. Protocols must consider how to allocate resources across the age spectrum and should integrate multiple criteria to capture all medically and morally relevant values. Transparency and inclusivity in development of allocation protocols is critical to ensure inequities are not exacerbated or perpetuated. The unique needs of children must be included in planning prospectively in order to prepare to meet their needs.

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Table 1: Summary of Resource Allocation Frameworks with Specific COVID-19-Related Considerations

	Overview	Limitations/ Pitfalls	Special COVID considerations
Likelihood of Benefit	Generally determined by survival estimates – allocate resources to those likeliest to survive	Debate about whether short term survival or-long term survival is the better metric; long-term survival introduces potential for age/disability-related bias Benefit can also be defined in terms of other metrics of population health	PPE conservation and reduction of risk of transmission to health care works could also be considered as benefits. Empirical data to inform COVID survival estimates largely lacking
Greatest Need	Allocate resources to those with most urgent/acute need	Difficult to determine objectively in real time May disproportionally allocate to patients with highest likelihood of mortality	Resource allocation algorithms likely assume alternative treatments have already been considered for less ill patients
Amount of Resource Required	Consider the absolute number of patients that can be helped, and maximize opportunities to help more patients	For weight-based resources (e.g. many pharmacologic treatments), may be biased towards younger, smaller patients unfairly	Could be considered with regard to anticipated duration of mechanical ventilation, and requires consideration of differences between COVID illness and other reasons for respiratory failure.
Persons carrying out vital functions	Considers healthcare workers and other first responders for priority in resource allocation	May not consider other essential workers who assume risk of infection in other settings. Potential to amplify existing societal inequities Potential threat to public trust in healthcare system	Potential multiplier effect to promote population health, but providers sick enough to require such resources may be less likely to return to workforce quickly Potential incentive for vital workforce retention
Random Allocation	Maximize fairness by forgoing all value or temporal triage weighting; distinct from first come first served	Difficult to operationalize if patients do not present simultaneously Risks investment of resources on patients unlikely to derive tangible benefit when used as the only method of resource allocation— not recommended as a first line method of resource allocation	Sequential (rather than simultaneous) presentation for care presents practical difficulties.

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