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Pediatrics and Neonatology 63 (2022) 5–12

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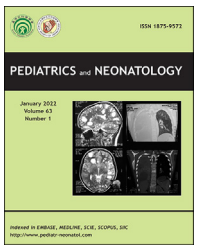

Review Article

Pandemic planning: Developing a triage framework for Neonatal Intensive Care Unit

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Received Mar 2, 2021; received in revised form Jun 3, 2021; accepted Jun 22, 2021
Available online 2 August 2021

Key Words
Neonatal Intensive Care Unit;
neonates;
pandemic;
resource allocation;
triage

Although the Covid-19 pandemic has not had a direct impact on neonates so far, it has raised concerns about resource distribution and showed that planning is required before the next crisis or pandemic. Resource allocation must consider unique Neonatal Intensive Care Unit (NICU) attributes, including physical space and equipment that may not be transferable to older populations, unique skills of NICU staff, inherent uncertainty in prognosis both antenatally and postnatally, possible biases against neonates, and the future pandemic disease's possible impact on neonates. We identified the need for a validated Neonatal Severity of Illness Prognostic Score to guide triage decisions. Based on this score, triage decisions are the responsibility of an informed triage team not involved in direct patient care. Support for the distress experienced by parents and staff is needed. This paper presents essential considerations in developing a practical framework for resources and triage in the NICU before, during and after a pandemic.

Abbreviations: NICU, Neonatal Intensive Care Units; ICU, Intensive Care Unit; WH, withhold; WD, withdraw; LST, life-sustaining therapies; Neo-SIPS, Neonatal Severity of Illness Prognostic Score.

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https://doi.org/10.1016/j.pedneo.2021.06.014

1. Introduction

There is an ebb and flow, but fairly constant workload in the Neonatal Intensive Care Unit (NICU). Although the COVID-19 pandemic has not yet seen severe disease in infants and children,[1–6] it has brought the issue of pandemic planning to the fore, particularly as novel COVID-19 variants emerge, with more rapid spread and some evidence that they are more marked in children, highlighting the importance of pandemic planning for all patient populations.[7] Reports from New York and Italy identifying tragic resource allocation decisions, especially ventilators, raised concerns in NICUs that triage decisions would potentially be biased against neonates.[8]

Though the current COVID-19 pandemic disease has not yet directly impacted NICUs, we argue that anticipatory triage planning is necessary for thoughtful resource allocation in case the needs of patients outstrip available resources, including physical space, equipment and workforce. Now, part way through this pandemic, leaders may be held accountable for last-minute planning and the lack of well-considered triage guidelines.[9]

Although frameworks for resource allocation have been described for adult settings, the NICU is a unique environment, which requires specific plans. This article reviews the paradigm shift in the decision-making process during pandemic planning and provides key considerations in developing a practical framework for resource allocation to be used to develop local guidelines. This framework may also inform triage processes in NICUs when they are over-capacity and life-and-death decisions are being considered about whether to withhold (WH) or withdraw (WD) life-sustaining therapies (LST).

2. Conventional life-and-death decision-making in the NICU

The practice of medicine is generally based on the principle of autonomy, where patients/families make informed health care decisions. This ethical approach is situated within the individual clinical encounter and is rooted in the relationship between the treating team and the patient/family. In the context of neonatal life-and-death decision-making, parent—provider relationships are most effective when they involve mutual trust, respect for parental decision-making authority, shared responsibility, and respectful and open communication. Life-and-death decisions are typically made using a shared decision-making model.[10] Once medical recommendations have been made, because health care professionals' values and beliefs may differ from those of parents, they must aim to ensure that parental beliefs, values, and preferences guide final decision-making.[11] Shared norms for decision-making are thought to include, at the minimum, considerations of what is in the best interest of the newborn.

To determine 'best interest,' survival and quality of life, both short- and long-term considerations, are relevant. A value-ordering of neonatal outcomes describes the 'worst' end of the spectrum being survival with intolerable deficits, followed by death, then by survival with tolerable or no deficits.[12] Nonetheless, outcomes are often uncertain and quality of life judgments of parents and NICU care teams may vary.[13] In medicine, there is a drive for new technology to save lives, but also a moral imperative to use this technology wisely. In the presence of uncertainty and where estimation of survival and longer-term complications drive decision-making, the ultimate decision is placed squarely with informed, capable parents.[14]

3. Considerations on life-and-death decisions during a pandemic

Resource allocation and triage frameworks have been described in adult medicine, to aid in making equitable decisions during a pandemic, when a shift toward a population-based health care ethic is anticipated.[15,16] A fundamental principle of public health ethics is to use means that are least restrictive to individual liberty to accomplish the public health goal: to maximize lives or life-years.[15,16] This paradigm shift from autonomy-based/individualized decision making to utilitarian/distributive justice, aims to provide the greatest good for the greatest number, while ensuring decisions are fair across the entire population, not only for the most affected subgroups.[15,17,18]

Current resource allocation frameworks focus on adult ICU physical space and ventilator shortages. These describe three stages of response to resource scarcity: a temporary increase of resources and sharing strategies; additional deviations from usual medical practice to accommodate patient needs; and, when hospitals are past capacity and/or transport between hospitals is not possible, implementation of a triage process.

Specific to triage, it has been suggested that local or regional triage decision teams be created that do not include the treating physician, whose primary responsibility is a duty to care. This separation is intended to enhance objectivity, avoid conflicts, protect the fiduciary and therapeutic patient/care team relationships, and minimize moral distress. The triage team would include members with expertise in critical care as well as in resource allocation and ethics. To maintain trust and cohesion, transparency in the reasons supporting decisions is essential and biases toward particular groups of patients, especially the most vulnerable ones, must be avoided.

In adult triage frameworks, all patients eligible for intensive care during ordinary circumstances remain eligible during a pandemic. There are no exclusion criteria based on age, assessments of quality of life, or judgments about a person's 'worth' based on the presence or absence of disability or other factors. Pandemic and non-pandemic medical conditions are weighed equally, and all patients receive an individualized assessment based on a validated tool to measure acute physiology and predict in-hospital mortality. An 'objective' priority score is initially based on chance of survival; then on lifecycle, with priority to younger patients; and, finally, on random chance or lottery, if the priority score is not sufficient. The priority score in relation to the outcome threshold identified for triage is used to guide decisions about which patients receive LST.[15] These decisions need regular reassessments considering

resource availability, change of severity of illness score, and any new information about the natural course of their underlying or pandemic disease.

4. Impact of a pandemic on the NICU

Although to date COVID-19 has had minimal direct impact on neonates, insidious consequences have included delayed prenatal visits, limitations on parental visitation, staffing constraints and plans to use NICU space for older infants. The next pandemic may have more direct effects, with increases in rates of prematurity, congenital anomalies or overall severity of illness. To avoid erroneous decisions, triage conversations must be based on well-considered unbiased guidelines.

Forward-thinking pandemic planning must address the unique attributes of the NICU's physical space, equipment and health professional resources. Ventilators, intravenous and feeding pumps, and physical footprints may not be easily transferable to pediatric or adult populations. In addition, the highly specialized NICU staff is not readily redeployed[19] and staff from other areas may not have the skills to care for NICU patients.

Parents may find it difficult to appreciate the paradigm shift during a pandemic, and the range of therapeutic options may be limited or broadened, potentially day-to-day, as the pressure on resources changes. Parents may not understand why responses may vary regionally and by proportion depending on situational needs. In Canada, our pluralistic yet secular society respects and embraces the multicultural basis of its citizenry, and some faith traditions will not accept withdrawal of LST. However, in a pandemic, limited resources may mandate triage, with inevitable life-and-death decision-making.

5. Triage in the NICU

Fairness would dictate a guiding principle in NICU similar to adult frameworks: that all patients eligible for intensive care during ordinary circumstances remain eligible during a pandemic. After chance of survival, triage in adults prioritizes younger patients. Incorporating life-years into the equation, neonates uniformly outperform adults.[20—22] NICU care is largely cost-effective in life-years and quality adjusted life-years, in that the sickest of infants die early, and those that leave the NICU survive for a long time.[23] However, scarcity may result in scrutiny of resuscitation thresholds based on available resources and anticipated outcomes. Introducing new thresholds for WH LST requires *a priori* reflection.

Medical uncertainty is inherent in neonatology and makes clinicians skeptical about their abilities to predict future outcome and survival.[24] In addition, when dealing with resource allocation, biases such as gestational ageism[25,26] or against newborns at high risk for neurodevelopment disabilities[24] are not uncommon and may surface during pandemic planning. Attention to bias must also include the social determinants of health that influence infant mortality,[27] the same risk factors related to socioeconomic position, occupation, race/ethnicity, indigeneity and homelessness that play an important role in pandemic times.[28]

Ideally, the tool informing triage decisions should be consistent across patient populations. A measure of probability of survival to hospital discharge has been suggested in adult and pediatric ICUs.[29,30] There is no up-to-date validated tool to estimate the chance of survival from NICUs in order to make triage decisions.[31] The Score for Neonatal Acute Physiology with Perinatal Extension-II (SNAPPE-II)[32] published 20 years ago, is limited by the availability of clinical data and has never been validated. The Clinical Risk Index for Babies (CRIB), $<$32 weeks,[33] National Institute of Child Health and Human Development (NICHD) calculator for $<$ 26 weeks,[34] and Neonatal Intervention Score (NIS) for $<$ 28 weeks[35] among others, have been suggested for preemies but are not applicable to the entire NICU population. A better alternative would be to develop a validated priority score — a Neonatal Severity of Illness Prognostic Score (Neo-SIPS) — predicting probability of survival to hospital discharge for all NICU patients, prior to the next pandemic. The development of such a tool is crucial as neonatology and obstetrics have essentially no elective volumes to decrease, and a decrease in census is not anticipated to accommodate a pandemic workload.

A Neo-SIPS tool should be highly predictive, simple to use, and applicable to all neonates requiring intensive care (including those with prematurity, congenital syndromes, or critical injury/multi-organ involvement). Conditions such as extreme prematurity with severe complications (e.g. large Grade IV intraventricular hemorrhage) or life-threatening congenital abnormalities prone to prejudice[25] raise questions about the utility and fairness of using life-saving medical equipment and human resources. Although burden of illness, quality of life, and impact on infants and families are all considered in shared decision-making, in pandemic times governed by distributive justice principles, a Neo-SIPS tool for triage should be solely focused on probability of survival to discharge, in order to be equitable across all populations.

Activation of NICU triage should follow regional/provincial authorities' direction. Timing and implementation of triage decisions include consideration of epidemiological data, physical space, equipment, and available personnel. These distinctions call for either a specific NICU triage team or a hospital-based triage team fully conversant in neonatology. Transparency in this process is crucial, with frequent updates across regional hospitals and to the public. Although it may lead to some distress, clear communication with parents, antenatally, and after admission to the NICU, of the critical nature of scarce resources and triage policies may help prepare parents.

The triage process must include counseling families regarding prognoses and, with parents' agreement, an initial trial of LST for those eligible, for a specified period of time, to allow for objective and thorough clinical evaluation. Subsequent reassessments of response to LST need to be planned in advance, based on the best available outcome data. Developing robust tools will aid in decision-making and mitigate moral distress experienced

Table 1 Framework of NICU triage PHASE 1. Prior to Pandemic.

Develop tool to be used for Neonatal Severity of Illness Prognostic Score (Neo-SIPS)

- Base tool on metrics (survival to discharge) that are consistent across populations: adults, paediatrics, and neonates
- Use Neo-SIPS consistently across all neonates irrespective of their disease or diagnosis
- Include patients with pandemic and non-pandemic illnesses: based on survival to discharge (local data, literature, expert opinion)
- Safeguard against conscious and unconscious biases (e.g. gestational ageism, neurodevelopmental impairment, race, ethnicity, social vulnerability)
- Review Neo-SIPS every 5 years to reaffirm validity of the tool

Assess physical spaces, staff, and equipment (NICU Leadership adaptive strategies)

- Identify minimum equipment, physical space, and staff required to provide NICU care safely
- Determine which equipment can be shared with paediatric/adult populations without compromising care (e.g. some ventilators may not readily be used for children or adults)
- Establish rules for temporary increased patient/nurse ratio assignment (e.g. from 2:1 to 3:1 or 4:1)
- Identify solutions to increase resource capacity (e.g. portable equipment for temporary negative pressure room, basic or older ventilation technologies, adapting physical space for providing intensive care)

Create and update documents about process for neonatal triage

- Establish criteria for triage activation, when unable to provide LST for all patients requiring intensive care; i.e. exceeding all adaptive strategies / capacity of resources / alternative to standard medical practices
- Develop algorithm for triage regarding WH initiation of LST with obstetric colleagues (prepare parent, staff and public to face triage situation if activated)
- Develop algorithm for triage regarding WD LST with representation from the entire neonatal interprofessional team (include ethicists and management)
- Inform parents and HCPs about potential need and process of triage

by health care providers. The limitations associated with an imperfect NICU triage framework require an accessible and efficient appeal process for parents. It is necessary to inform parents that appealing a decision during a pandemic is different from appeals in non-pandemic times, when parents can apply to the courts for adjudication of health care decisions. Appeal would be limited to the evaluation of the assessment score or whether the triage process was followed.

As of yet, the legal ramifications of pandemic planning in Canada have not been adjudicated. WH/WD LST against parental decision-making authority may be different during a pandemic than during non-pandemic times.[36] In developing triage guidelines, it is essential that liability risks be clarified to protect and reassure health care providers,[37] in particular when a state of emergency is declared, the declaration of which may vary among jurisdictions in the country.

6. Moral distress of NICU staff

Moral distress is experienced when the perceived ethically correct action is different from what the health care provider is tasked with doing, due to extraneous policies, procedures or decision-making.[38] Moral distress as a consequence of life-and-death decision-making is not new to NICU staff and has been experienced across professions. It is often related to identification of patients for whom WH/WD LST is offered; pain and suffering caused by ineffective therapies; challenges of shared decision-making related to roles and responsibilities; burdens of guilt; and, conflict on inter-professional teams.[39] In decision-making for WD LST, nurses have highlighted the suffering of the newborn whereas physicians stressed the uncertainty in treatment outcomes as significant sources of moral distress.[40] The ethics literature does not draw a distinction between WH/WD LST, but withdrawing is shown to be more

Table 2 Framework for NICU triage PHASE II. During pandemic.

PHASE IIA: PLANNING FOR TRIAGE

Triage team

- Chief of Staff / Department Chairs / Hospital CEO to select team early in the pandemic, before triage activation by regional / provincial authorities
- Include health care professional(s) with experience in critical care, resource allocation, and ethics; who are not directly caring for the patients being evaluated.
- Include a physician up to date with clinical neonatology and available for consultation

Transparency

- Distribute NICU triage framework within the region/province
- Educate all NICU HCPs about the NICU triage framework and its implications with scenarios (e.g. adaptive measures exhausted and no available ventilator)
- Inform parents antenatally and after NICU admission of the critical nature of scarce resources and the triage policy developed for pandemics
- Highlight that once triage is activated final WH/WD LST decisions rest with the triage team
- Clarify appeal process: evaluation of the Neo-SIPS score

PHASE IIB: ACTIVATION OF TRIAGE

Triage directives from regional/provincial level

- Activation of level of triage based on surge response and absolute system capacity
- Ongoing (i.e. twice daily) re-evaluation / reaffirmation of continued triage based on resource capacity

NICU triage process

- See Figure 1

NICU triage audit

- Document In real-time:
  - *Neo-SIPS initial scores and reassessments*
  - *Decisions of the triage team*
  - *Appeals, decisions, and actions taken*

Support parents and HCPs

- **For parents**
  - *A - Communication: inform parents of current visitation policy, adapt technology (e.g. tablets for video- or audio-conferencing)*
  - *B - Pandemic support (e.g. social worker, psychologist, spiritual care, peer support), especially when there is a decision to WH/WD LST*
- **For HCPs,** beyond general pandemic support, before, during, and after a triage event
  - *A - Identify available local resources (e.g. pandemic policies, wellness support)*
  - *B - Debrief when time permits as close as possible to the event*
- Ongoing audit of support resources available / used and additional resources required

stressful.[41] In pandemic times, this practical 'non-equivalence' may be compounded by different perceptions of duty to care for already ventilated patients and perceptions of acts/omissions.[24]

Although triage decisions regarding WH or WD LST must be made by the triage team, the NICU bedside team may experience moral distress as 'evaluators' and 'reporters' of severity of illness, and as providers of end-of-life care. This proximate action may cause distress and challenge the moral climate of the unit. Therefore, institutions will need a pandemic-specific approach to moral distress associated with illness scoring, triage decisions, and caring for families and newborns at the end of life.

7. Framework for resource allocation and pandemic triage in NICU

This paper presents key considerations to inform the development of NICU specific guidelines for local resource allocation/triage of LST. The framework is aligned with the different phases of the pandemic cycle: before (Table 1), during (Table 2, Fig. 1), and after (Table 3) and is guided by the following ethical principles:

- Utility: producing the greatest good.
- Distributive justice: fairness, that equals ought to be treated equitably, avoiding unfair discrimination.

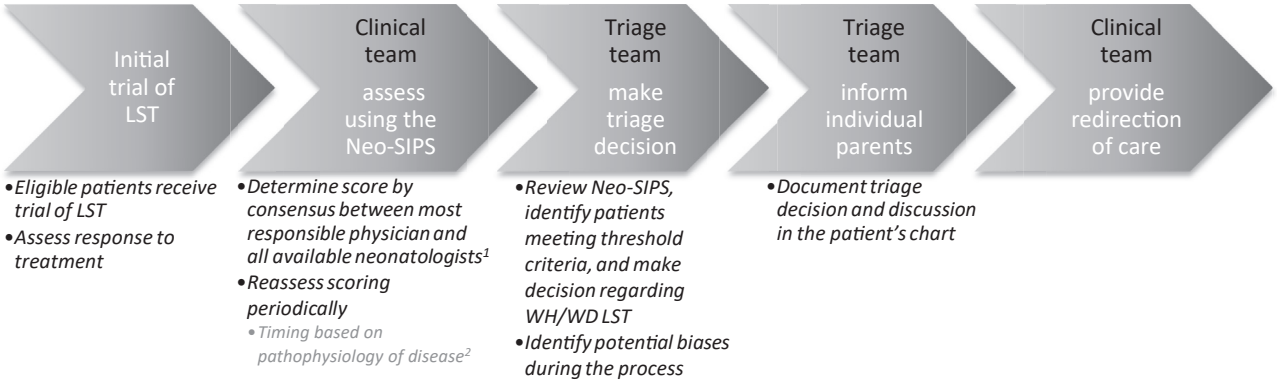

Figure 1 NICU Triage Process. LST, Life sustaining treatment. Neo-SIPS, Neonatal severity of illness prognosis score. WH/WD, Withholding/Withdrawing. [1] Score by consensus to improve consistency of scoring and share responsibility of the decision. [2]Example: a ventilated infant with RDS treated with surfactant expected to improve rapidly may call for a different timing for reassessment compared to an infant with severe BPD who is ventilator dependent.

Table 3 Framework for NICU triage PHASE III: Post-Pandemic.

Review of triage process and decisions
•Ensure all reviews are privileged and confidential, for quality assurance purposes (protected by regional/provincial legislation)
•**At local NICU level (NICU interprofessional team)**
•*A - Review patients who were triaged to assess process for severity of illness scoring, decisions, and appeals to ensure that there were no conscious or unconscious biases in the process*
•*B - Monitor distress of parents (social work, spiritual care, peer support, ethics)*
•*C - Monitor moral distress of HCPs (e.g. debriefs, wellness huddles, management to review sick leave and staff turnover)*
•**At a regional/provincial level (External review)**
•*A - Review triage process, all decisions, appeals, and outcomes related to triage*
•*B - Report back to local NICUs*
Required research *before* the next pandemic / wave
•Develop the Neo-SIPS tool and correlate with outcomes
•Evaluate utility of Neo-SIPS: for application both to WH and WD LST
•Solicit input from parents regarding information sharing during pandemic (e.g. whether parents want to know about triage in advance or only once triage is activated)
•Solicit feedback from HCPs regarding lessons learned (e.g. policy changes, communication, and available supports)

- Efficiency: duty to steward resources needed to produce the greatest good or optimize population health.
- Duty to care: fiduciary responsibility to provide standard of care for patients.
- Liberty: imposing the least burden on self-determination.
- Transparency: openness, communication, and accountability.

These recommendations are for health care and NICU leadership to guide response to a pandemic and to support NICU teams. We acknowledge there are gaps and uncertainties in the data to inform triage decisions. Considerations prior to the next pandemic are included in Table 3.

8. Conclusion

Medical care for all in need within a region may not be possible during a pandemic. In the event of scarce medical resources, a transparent and fair triage framework for decisions about LST must be available in order to save the most lives. When the health care needs of a region overwhelm medical capacity, a decision will likely be made to embark upon triage, which will engender a great deal of moral distress for families and health care teams. The unique attributes of the NICU need to be acknowledged in a pandemic triage framework. Developing guidelines for triage and data to support the guidelines is best accomplished before the pandemic. The degree of moral distress may be mitigated by an ethically robust and transparent framework, clear communication of the process employed, and support for families and health care providers. Future research needs to define a validated, robust and fair neonatal severity of illness score and its utility for identifying outcomes. In addition, pandemic planning will benefit from investigation of perspectives of parents as well as the doctors, nurses, respiratory therapists and others on the NICU health care team.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

Acknowledgements

We would like to thank Dr Michael Van Manen and Dr Sandesh Shivananda for reviewing the manuscript and their insightful comments.

The authors thank Joan Ramsay medical editor, CHEO Research Institute, for editing the manuscript.

References

1. Dong Y, Mo X, Hu Y, Qi X, Jiang F, Jiang Z, et al. Epidemiology of COVID-19 among children in China. *Pediatrics* 2020;**145**: e20200702.
2. Gordon M, Kagalwala T, Rezk K, Rawlingson C, Ahmed MI, Guleri A. Rapid systematic review of neonatal COVID-19 including a case of presumed vertical transmission. *BMJ Paediatr Open* 2020;**4**:e000718.
3. Duran P, Berman S, Niermeyer S, Jaenisch T, Forster T, Gomez Ponce de Leon R, et al. COVID-19 and newborn health: systematic review. *Rev Panam Salud Publica* 2020;**44**:e54.
4. Zimmermann P, Curtis N. COVID-19 in children, pregnancy and neonates: a review of epidemiologic and clinical features. *Pediatr Infect Dis J* 2020;**39**:469—77.
5. Raba AA, Abobaker A, Elgenaidi IS, Daoud A. Novel coronavirus infection (COVID-19) in children younger than one year: a systematic review of symptoms, management and outcomes. *Acta Paediatr* 2020;**109**:1948—55.
6. Hoang A, Chorath K, Moreira A, Evans M, Burmeister-Morton F, Burmeister F, et al. COVID-19 in 7780 pediatric patients: a systematic review. *EClinicalMedicine* 2020;**24**:100433.
7. Davies NG, Abbott S, Barnard RC, Jarvis CI, Kucharski AJ, Munday JD, et al. Estimated transmissibility and impact of SARS-CoV-2 lineage B.1.1.7 in England. *Science* 2021;**372**: eabg3055.
8. Haward MF, Janvier A, Moore GP, Laventhal N, Fry JT, Lantos J. Should extremely premature babies get ventilators during the COVID-19 crisis? *Am J Bioeth* 2020;**20**:37—43.
9. Giuffrida A. Relatives of Italian Covid victims to file lawsuit against leading politicians. *Guard Int Ed* 2020. Available at https://www.theguardian.com/world/2020/dec/22/relatives-of-italian-covid-victims-to-file-lawsuit-against-leading-politicians?CMP=share_btn_link. Accessed December 23, 2020.
10. Charles C, Gafni A, Whelan T. Decision-making in the physician-patient encounter: revisiting the shared treatment decision-making model. *Soc Sci Med* 1999;**49**:651—61.
11. Kon AA. The shared decision-making continuum. *JAMA* 2010; **304**:903—4.
12. Kipnis K. Harm and uncertainty in newborn intensive care. *Theor Med Bioeth* 2007;**28**:393—412.
13. Saigal S, Stoskopf B, Boyle M, Paneth N, Pinelli J, Streiner D, et al. Comparison of current health, functional limitations, and health care use of young adults who were born with extremely low birth weight and normal birth weight. *Pediatrics* 2007;**119**:e562—73.
14. Coughlin KW. Medical decision-making in paediatrics: infancy to adolescence. *Paediatr Child Health* 2018;**23**:138—46.
15. White DB, Lo B. A framework for rationing ventilators and critical care beds during the COVID-19 pandemic. *JAMA* 2020; **323**:1773—4.
16. Scheunemann LP, White DB. The ethics and reality of rationing in medicine. *Chest* 2011;**140**:1625—32.
17. Emanuel EJ, Persad G, Upshur R, Thome B, Parker M, Glickman A, et al. Fair allocation of scarce medical resources in the time of covid-19. *N Engl J Med* 2020;**382**:2049—55.
18. Laventhal N, Basak R, Dell ML, Diekema D, Elster N, Geis G, et al. The ethics of creating a resource allocation strategy during the COVID-19 pandemic. *Pediatrics* 2020 Jul;**146**: e20201243.
19. Philips K, Uong A, Buckenmyer T, Cabana MD, Hsu D, Katyal C, et al. Rapid implementation of an adult coronavirus disease 2019 Unit in a children's hospital. *J Pediatr* 2020;**222**:22—7.
20. Meadow W. Epidemiology, economics, and ethics in the NICU: reflections from 30 Years of neonatology practice. *J Pediatr Gastroenterol Nutr* 2007;**45**(Suppl 3):S215—7.
21. Buchh B, Graham N, Harris B, Sims S, Corpuz M, Lantos J, et al. Neonatology has always been a bargain — even when we weren't very good at it! *Acta Paediatr* 2007;**96**:659—63.
22. Caughey AB, Burchfield DJ. Costs and cost-effectiveness of periviable care. *Semin Perinatol* 2014;**38**:56—62.
23. Meadow W, Lagatta J, Andrews B, Lantos J. The mathematics of morality for neonatal resuscitation. *Clin Perinatol* 2012;**39**: 941—56.
24. Wilkinson DJ. A life worth giving? The threshold for permissible withdrawal of life support from disabled newborn infants. *Am J Bioeth* 2011;**11**:20—32.
25. Janvier A, Leblanc I, Barrington KJ. Nobody likes premies: the relative value of patients' lives. *J Perinatol* 2008;**28**:821—6.
26. Wilkinson DJC. Gestational ageism. *Arch Pediatr Adolesc Med* 2012;**166**:567—72.
27. Reno R, Hyder A. The evidence base for social determinants of health as risk factors for infant mortality: a systematic scoping review. *J Health Care Poor Underserved* 2018;**29**:1188—208.
28. Public Health Ontario. *COVID-19 — what we know so far about… Social determinants of health*. 2020. p. 13. Available at https://www.publichealthontario.ca/-/media/documents/ncov/covid-wwksf/2020/05/what-we-know-social-determinants-health.pdf?la=en. Accessed July 8, 2020.
29. Jones AE, Trzeciak S, Kline JA. The Sequential Organ Failure Assessment score for predicting outcome in patients with severe sepsis and evidence of hypoperfusion at the time of emergency department presentation. *Crit Care Med* 2009;**37**: 1649—54.
30. Leteurtre S, Duhamel A, Salleron J, Grandbastien B, Lacroix J, Leclerc F. PELOD-2: an update of the PEdiatric logistic organ dysfunction score. *Crit Care Med* 2013;**41**:1761—73.
31. Garg B, Sharma D, Farahbakhsh N. Assessment of sickness severity of illness in neonates: review of various neonatal illness scoring systems. *J Matern Fetal Neonatal Med* 2018;**31**:1373—80.
32. Richardson DK, Corcoran JD, Escobar GJ, Lee SK. SNAP-II and SNAPPE-II: simplified newborn illness severity and mortality risk scores. *J Pediatr* 2001;**138**:92—100.
33. Parry G, Tucker J, Tarnow-Mordi W. Crib II: an update of the clinical risk index for babies score. *Lancet* 2003;**361**:1789—91.
34. Rysavy MA, Horbar JD, Bell EF, Li L, Greenberg LT, Tyson JE, et al. Assessment of an updated neonatal research network extremely preterm birth outcome model in the Vermont oxford network. *JAMA Pediatr* 2020;**174**:e196294.
35. Prentice TM, Janvier A, Gillam L, Donath S, Davis PG. Providing clarity around ethical discussion: development of a neonatal intervention score. *Acta Paediatr* 2019;**108**:1453—9.
36. CMPA COVID-19 Hub. *Advice, support, and medical-legal information*. 2020. Available at https://www.cmpa-acpm.ca/en/covid19. Accessed July 8, 2020.
37. Downie J. Coronavirus triage protocols: hard choices over ventilator shortages shouldh't put doctors at legal risk. *Dal News* 2020 Apr 14. Available at https://www.dal.ca/news/2020/04/14/coronavirus-triage-protocols-hard-choices-over-ventilator-short.html. Accessed July 8, 2020.
38. Thorne S, Konikoff L, Brown H, Albersheim S. Navigating the dangerous terrain of moral distress: understanding response patterns in the NICU. *Qual Health Res* 2018;**28**:683—701.
39. Williams C. *Practical virtues: an evidence-based ethical framework for approaching end-of-life care in the neonatal intensive*

care unit. ProQuest Diss Theses. University of Toronto; 2015. Available at https://tspace.library.utoronto.ca/handle/1807/69052. Accessed July 8, 2020.

40. van Zuuren FJ, van Manen E. Moral dilemmas in neonatology as experienced by health care practitioners: a qualitative approach. *Med Health Care Philos* 2006;**9**:339—47.

41. Messner H, Gentili L. Reconciling ethical and legal aspects in neonatal intensive care. *J Matern Neonatal Med* 2011; **24**(Suppl 1):126—8.