Pediatric Acute Respiratory Distress Syndrome: Consensus Recommendations From the Pediatric Acute Lung Injury Consensus Conference

The Pediatric Acute Lung Injury Consensus Conference Group

Objective: To describe the final recommendations of the Pediatric Acute Lung Injury Consensus Conference.

Design: Consensus conference of experts in pediatric acute lung injury.

Setting: Not applicable.

Subjects: PICU patients with evidence of acute lung injury or acute respiratory distress syndrome.

Interventions: None.

Methods: A panel of 27 experts met over the course of 2 years to develop a taxonomy to define pediatric acute respiratory distress syndrome and to make recommendations regarding treatment and research priorities. When published, data were lacking a modified Delphi approach emphasizing strong professional agreement was used.

Measurements and Main Results: A panel of 27 experts met over the course of 2 years to develop a taxonomy to define pediatric acute respiratory distress syndrome and to make recommendations regarding treatment and research priorities. When published data were lacking a modified Delphi approach emphasizing strong professional agreement was used. The Pediatric Acute Lung Injury Consensus Conference experts developed and voted on a total of 151 recommendations addressing the following topics related to pediatric acute respiratory distress syndrome: 1) Definition, prevalence, and epidemiology; 2) Pathophysiology, comorbidities, and severity; 3) Ventilatory support; 4) Pulmonary-specific ancillary treatment; 5) Nonpulmonary treatment; 6) Monitoring; 7) Noninvasive support and ventilation; 8) Extracorporeal support; and 9) Morbidity and long-term outcomes. There were 132 recommendations with strong agreement and 19 recommendations with weak agreement. Once restated, the final iteration of the recommendations had none with equipoise or disagreement.

Conclusions: The Consensus Conference developed pediatric-specific definitions for acute respiratory distress syndrome and recommendations regarding treatment and future research priorities. These are intended to promote optimization and consistency of care for children with pediatric acute respiratory distress syndrome and identify areas of uncertainty requiring further investigation. (*Pediatr Crit Care Med* 2015; XX:00–00)

Key Words: acute lung injury; acute respiratory distress syndrome; consensus development conference; guidelines; pediatrics

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Since the first description of the "acute respiratory distress syndrome" (ARDS) by Ashbaugh et al (1) in 1967, pediatric intensivists have recognized that ARDS in children is different from ARDS in adults. In the absence of identification of these differences, however, children have been characterized

as having acute lung injury (ALI) and ARDS based on the adult definitions originating from the 1994 American-European Consensus Conference (AECC) (2). Seventeen years later, a second consensus conference was convened with the intent of improving the feasibility, reliability, and validity of the ALI/ARDS definitions. As with the previous AECC, however, this was conducted without specific consideration of children. The new Berlin definitions (3) included several significant changes: 1) the ALI category was eliminated and replaced with a gradation of ARDS severity (mild, moderate, and severe) based on the degree of oxygenation disturbance; 2) a minimum of 5 cm H_2O of positive end-expiratory pressure (PEEP) was required; and 3) the determination of cardiac failure was rendered more subjective in view of the decreased utilization of pulmonary artery catheters.

Both the AECC and Berlin ARDS definitions were focused on adult lung injury and have limitations when applied to children. For example, a major shortcoming is the necessity of invasive measurement of arterial oxygen. Pulse oximetry is increasingly obviating the use of arterial blood gas measurement in pediatrics, and consequently, definitions requiring direct measurement of Pa_{O_2} may underestimate ARDS prevalence in children. This may result in the selection of children with more severe hypoxemia and/or cardiovascular compromise. A second limitation is the use of the Pa_{O_2}/F_{IO_2} (P/F) ratio. In addition to requiring measurement of Pa_{O_2}, this ratio is greatly influenced by ventilator pressures (4–7). Although the Berlin definition requires a minimum PEEP of 5 cm H_2O, other ventilator manipulations and the practice patterns around PEEP management can also alter this ratio. Consequently, differences in clinical practice may influence the diagnosis, particularly in the PICU where there is greater variability in ventilator management relative to adult ICUs (8, 9). This has led some pediatric practitioners to adopt the oxygenation index (OI) ($[F_{IO_2} \times$ mean airway pressure (Paw) $\times 100]/Pa_{O_2}$) and oxygen saturation index (OSI) ($[F_{IO_2} \times Paw \times 100]/Sp_{O_2}$) to assess hypoxemia in children (10, 11). Finally, differences in risk factors, etiologies, pathophysiology, and outcomes between adults and children were not considered in either the AECC or Berlin definitions.

These concerns prompted the organization of the Pediatric Acute Lung Injury Consensus Conference (PALICC) (12). The concept originated with the Pediatric Acute Lung Injury and Sepsis Investigators (PALISI) Network but was subsequently supported by the Australian and New Zealand Intensive Care Society, Canadian Critical Care Trials Group, World Federation of Pediatric Intensive and Critical Care Societies, European Society for Pediatric and Neonatal Intensive Care, and French Group for Pediatric Intensive Care and Emergency Medicine. The goals of the conference were 1) to develop a taxonomy to define pediatric ARDS (PARDS), specifically predisposing factors, etiology, and pathophysiology; 2) to offer recommendations regarding therapeutic support of the patient with PARDS; and 3) to identify priorities for future research in PARDS, including defining short- and long-term outcomes of interest. We also hoped to foster collaborative relationships for future international research in PARDS.

METHODS

Three members of the organizing committee met in March 2012 to define the methodology, to select the subtopics for study, and to identify the experts in the field. Experts were invited based on their record of publications in PARDS in the past 5 years and their participation in clinical research studies in pediatric critical care. The final list of 27 experts, representing 21 academic institutions and eight countries, constituted the PALICC expert group (**Appendix 1**). Of note, only one expert declined to participate due to personal reasons; two experts initially agreed to participate but were subsequently unable for personal reasons.

The first PALICC meeting took place in Chicago, IL, on October 2, 2012, in conjunction with the fall meeting of the PALISI Network. At this meeting, we discussed and agreed upon conference subtopics, the project timeline, and the consensus methodology (**Fig. 1**). Experts were also assigned to each of the nine subtopics. The modified Delphi approach previously employed by the French Society of Pediatric Intensive Care (13) was chosen as the methodology to achieve consensus. This approach was necessary because of the limited data and low level of available evidence, as well as the high variability in clinical practice in PARDS. A detailed description of this methodology is available in the supplement published in *Pediatric Critical Care Medicine* (14).

Between the first and second meeting, each group of experts undertook a comprehensive, standardized literature review. Upon completion, each group drafted their recommendations along with detailed arguments to support them. The second meeting occurred in Montreal, QC, Canada, on April 18–19, 2013. At this 2-day meeting, the recommendations were discussed and the wording of each agreed upon by the majority of experts. Possible omissions for any of the nine topics were also discussed. After the second meeting, recommendations with their respective arguments (long texts) were distributed to each expert for electronic scoring by the Research ANd Development/University of California Los Angeles (RAND/UCLA) appropriateness method (15). Experts with a disclosed conflict of interest were excluded from voting on areas where any real or perceived conflict was identified. After the initial scoring, all recommendations were consolidated by the organizing committee.

Agreement was determined by voting using the RAND/UCLA scale (scores range from 1 to 9), with each expert having an equal vote but with the highest and lowest scores discarded after each vote. "Strong" agreement required that all experts rank the recommendation 7 or higher. "Weak" agreement meant that at least one more expert ranked the recommendation below 7, but the median vote was at least 7. Those with strong agreement were considered complete, and those with weak agreement were revised based on comments by the experts. These revised recommendations were then distributed for a second round of electronic voting. After this voting, some reworded recommendations obtained a strong agreement. For the remaining recommendations with a weak agreement after the second round, the percentage of experts who rated 7 or above was calculated and is reported after each weak recommendation. With this method

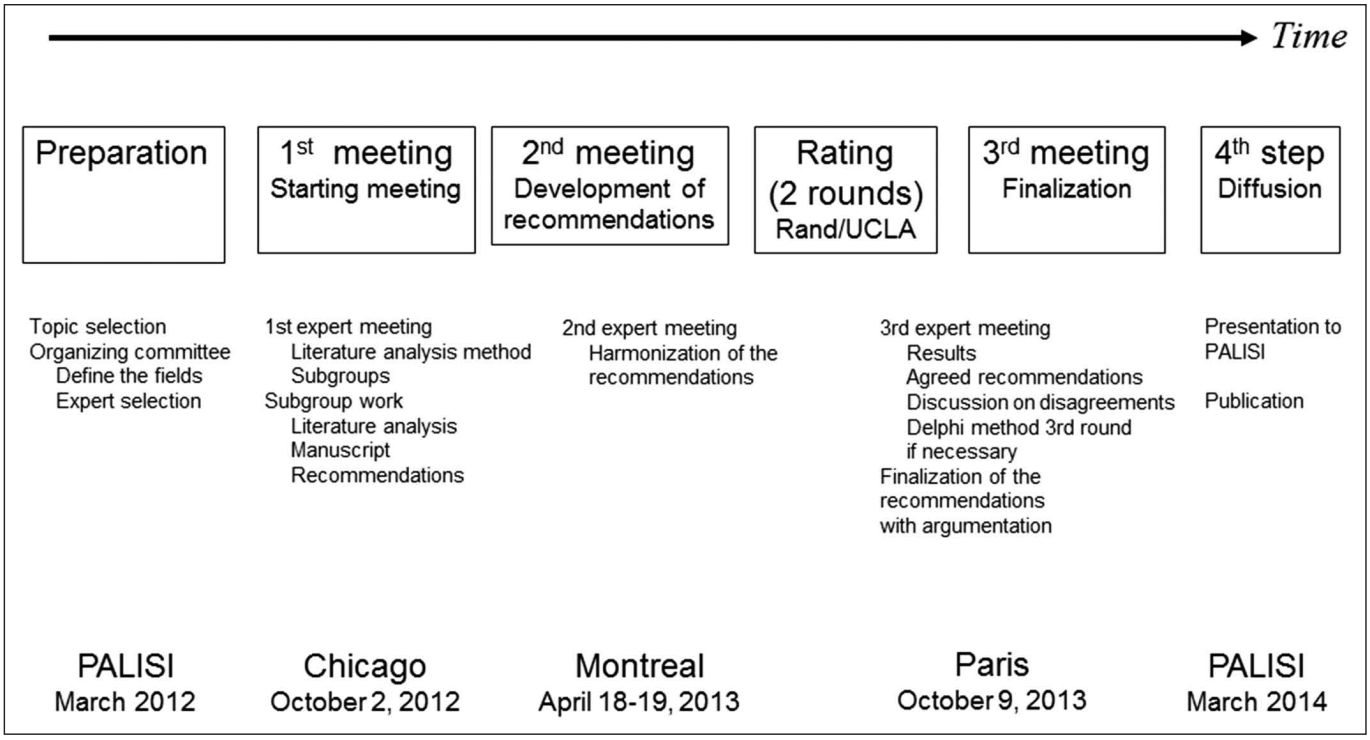

Figure 1. Plan for the three meetings of the Pediatric Acute Lung Injury Consensus Conference (PALICC). The timeline, including the tasks, that has been completed by the PALICC experts. PALISI = Pediatric Acute Lung Injury and Sepsis Investigators.

of calculation, a strong agreement corresponded to a percentage of agreement more than 95% (no more than one expert rated below 7 on the RAND/UCLA scale).

The third and final meeting took place on October 9, 2013, in Paris, France. Each group presented their final recommendations, and a third round of voting was conducted for several specific but unresolved recommendations related to the definitions. The organizers believed it was vital to achieve strong agreement regarding definitions, and this was accomplished after much dialog and debate. Additionally, each group of experts presented their consensus regarding key areas of controversy and future research.

RESULTS

The nine topics studied by PALICC resulted in 151 total recommendations, including 132 recommendations with strong agreement and 19 with weak agreement. Once restated, the final iteration of the recommendations had none with equipoise or disagreement, according to the predefined definitions by the RAND/UCLA appropriateness methodology. The recommendations for each topic are listed below, with the justification for these recommendations detailed in the supplement in this issue of *Pediatric Critical Care Medicine*.

Section 1: Definition, Prevalence, and Epidemiology

1.1 Age. 1.1.1 We recommend that there should not be age criteria for the definition of PARDS. However, exclusion criteria for PARDS should include causes of acute hypoxemia that are unique to the perinatal period, such as prematurity-related lung disease, perinatal lung injury (e.g., Meconium Aspiration Syndrome, and pneumonia and sepsis acquired during delivery), or other congenital abnormalities (e.g., congenital diaphragmatic hernia or alveolar capillary dysplasia). *Strong agreement*

1.1.2 We recommend that in the absence of a compelling rationale related to physiology or feasibility, studies of PARDS should not include age limits. In order to better understand the pathobiology of PARDS across the spectrum of age, and in the absence of a clear break point in the epidemiology of PARDS, adult and pediatric investigators should engage in collaborative studies targeting adolescents and young adults. Future studies are needed to evaluate potential age-dependent differences in the pathophysiology of PARDS across the entire pediatric age spectrum. *Strong agreement*

1.2 Timing and Triggers for PARDS. 1.2.1 We recommend that symptoms of hypoxemia and radiographic changes must occur within 7 days of a known clinical insult to qualify for PARDS. *Strong agreement*

1.3 Defining PARDS in Children With Left Ventricular Dysfunction. 1.3.1 We recommend that children with left ventricular heart dysfunction that fulfill all other PARDS criteria have PARDS if the acute hypoxemia and new chest imaging changes cannot be explained by acute left ventricular heart failure or fluid overload. *Strong agreement*

1.4 Radiographic Findings. 1.4.1 We recommend that chest imaging findings of new infiltrate(s) consistent with acute pulmonary parenchymal disease are necessary to diagnose PARDS. *Strong agreement*

1.4.2 We recommend that future clinical trials for PARDS should stratify patients by the presence or absence of bilateral

infiltrates on chest imaging. In order to minimize variability in these studies, investigators should standardize interpretation of all chest imaging. *Strong agreement*

1.4.3 We recommend that future studies are needed to determine the optimal common training or effect of automated methodologies to reduce interobserver variability in the interpretation of chest imaging for PARDS. *Strong agreement*

1.5 Measures of Oxygenation in the Definition. 1.5.1 We recommend that OI, in preference to P/F ratio, should be the primary metric of lung disease severity to define PARDS for all patients treated with invasive mechanical ventilation. *Strong agreement*

1.5.2 We recommend that P/F ratio should be used to diagnose PARDS for patients receiving noninvasive, full-face mask ventilation (continuous positive airway pressure [CPAP] or bilevel positive airway pressure [BiPAP]) with a minimum CPAP of 5 cm H_2O. *Strong agreement*

1.6 Pulse Oximetry Versus Pao$_2$. 1.6.1 We recommend that OSI should be used when an OI is not available for stratification of risk for patients receiving invasive mechanical ventilation. *Strong agreement*

1.6.2 We recommend that oxygen saturation/F_{IO_2} ratio can be used when P/F ratio is not available to diagnose PARDS in patients receiving noninvasive full-face mask ventilation (CPAP or BiPAP) with a minimum CPAP of 5 cm H_2O. *Strong agreement*

1.7 Other Markers of Lung Disease Severity. 1.7.1 We recommend that given the limited published data on dead space in PARDS, there is insufficient evidence to recommend a measure of dead space as part of the diagnostic criteria for PARDS. *Strong agreement*

1.7.2 We recommend that future study is needed to determine the potential relevance of elevated dead space for the definition of PARDS. *Strong agreement*

1.7.3 We recommend that measures of respiratory system compliance should not be used for the definition of PARDS. Future studies of respiratory system compliance with reliable and standardized methods for measurement are warranted to determine the relevance of respiratory system compliance to the diagnosis and risk stratification of PARDS. *Strong agreement*

1.8 Characterizing Oxygen Delivery for Noninvasive Ventilation. 1.8.1 We recommend that to apply Spo_2 criteria to diagnose PARDS, oxygen therapy should be titrated to achieve the Spo_2 between 88% and 97%. *Strong agreement*

1.8.2 We recommend that defining a group of patients at risk for PARDS is necessary to determine the epidemiology of disease progression and potential avenues for disease prevention. *Strong agreement*

1.9 Defining PARDS in Children With Chronic Cardiorespiratory Disease. 1.9.1 We recommend that patients with preexisting chronic lung disease who are treated with supplemental oxygen, noninvasive ventilation, or invasive ventilation via tracheostomy should be considered to have PARDS if they have acute changes that meet standard PARDS criteria (acute onset, a known clinical insult, and chest imaging supporting new onset pulmonary parenchymal disease) and have an acute deterioration in oxygenation from baseline which meets oxygenation criteria for PARDS. *Strong agreement*

1.9.2 We recommend that patients with cyanotic congenital heart disease are considered to have PARDS if they fulfill standard criteria (acute onset, a known clinical insult, and chest imaging supporting new onset pulmonary parenchymal disease) and have an acute deterioration in oxygenation not explained by the underlying cardiac disease. *Strong agreement*

1.9.3 We recommend that children with chronic lung disease who are not on mechanical ventilation at baseline or cyanotic congenital heart disease with acute onset of illness that satisfy PARDS criteria should not be stratified by OI or OSI risk categories. Future studies are necessary to determine PARDS risk stratification of patients with acute-on-chronic hypoxemic respiratory failure. *Strong agreement*

1.9.4 We recommend that future studies of PARDS should endeavor to include children with preexisting pulmonary and cardiac disease. *Strong agreement*

Based on the recommendations above, **Figure 2** details the proposed definitions of PARDS, and **Figure 3** details the proposed definitions for those children at risk for PARDS.

Section 2: Pathophysiology, Comorbidities, and Severity

2.1 Pathophysiology. 2.1.1 There may be a difference in the progression and outcome from ARDS in children as compared with adults. We recommend that future studies be designed to examine whether there are differences in the progression and/or outcome of ARDS between adults and children or between children of different ages. *Strong agreement*

2.1.2 There is a paucity of studies related to the pathophysiology of PARDS. The impact of postnatal maturational development on the pathophysiology of PARDS is unknown. We recommend that biomarker and genetic studies that may provide insight into the pathophysiology of PARDS in children, and study of pathophysiology in animals of different ages with age cutoffs informed by chronology of postnatal lung and immune system development, should be a focus of future research protocols. *Strong agreement*

2.2 Severity of Illness. Disease severity measures can be subdivided into measures that can be made at the bedside, measures requiring more in-depth calculation, biochemical measurements, and early responsiveness to therapy.

2.2.1 Of the measures available at the bedside, both oxygenation defect and ventilation defect have generally been found to be associated with outcome. There is great inconsistency in the literature, however, concerning the optimal timing of these measurements. We recommend evaluating respiratory indices and biomarkers at the onset of PARDS, within the first 24 hours of onset, as well as serial measures beyond that is indicated according to treatment and/or clinical studies. *Strong agreement*

Age	Exclude patients with peri-natal related lung disease			
Timing	Within 7 days of known clinical insult			
Origin of Edema	Respiratory failure not fully explained by cardiac failure or fluid overload			
Chest Imaging	Chest imaging findings of new infiltrate(s) consistent with acute pulmonary parenchymal disease			
Oxygenation	**Non Invasive mechanical ventilation**	**Invasive mechanical ventilation**		
	PARDS (No severity stratification)	Mild	Moderate	Severe
	Full face-mask bi-level ventilation or CPAP ≥5 cm H_20 [2] PF ratio ≤ 300 SF ratio ≤ 264 [1]	4 ≤ OI < 8 5 ≤ OSI < 7.5[1]	8 ≤ OI < 16 7.5 ≤ OSI < 12.3[1]	OI ≥ 16 OSI ≥ 12.3[1]
Special Populations				
Cyanotic Heart Disease	Standard Criteria above for age, timing, origin of edema and chest imaging with an acute deterioration in oxygenation not explained by underlying cardiac disease. [3]			
Chronic Lung Disease	Standard Criteria above for age, timing, and origin of edema with chest imaging consistent with new infiltrate and acute deterioration in oxygenation from baseline which meet oxygenation criteria above.[3]			
Left Ventricular dysfunction	Standard Criteria for age, timing and origin of edema with chest imaging changes consistent with new infiltrate and acute deterioration in oxygenation which meet criteria above not explained by left ventricular dysfunction.			

Figure 2. Pediatric acute respiratory distress syndrome definition. OI = oxygenation index, OSI = oxygen saturation index. [a]Use Pao_2-based metric when available. If Pao_2 not available, wean Fio_2 to maintain Spo_2 ≤ 97% to calculate OSI or oxygen saturation/Fio_2 ratio. [b]For nonintubated patients treated with supplemental oxygen or nasal modes of noninvasive ventilation, see Figure 3 for at-risk criteria. [c]Acute respiratory distress syndrome severity groups stratified by OI or OSI should not be applied to children with chronic lung disease who normally receive invasive mechanical ventilation or children with cyanotic congenital heart disease. OI = (Fio_2 × mean airway pressure × 100)/Pao_2. OSI = (Fio_2 × mean airway pressure × 100)/Spo_2.

mortality or length of mechanical ventilation have resulted in conflicting results; some studies exhibit associations with outcomes while others do not. We recommend that future studies incorporating variables such as tidal volume, peak and plateau airway pressures, PEEP, or Paw use explicit protocols and definitions such that these measures can be more robustly evaluated. *Strong agreement*

2.2.5 Among measures requiring more in-depth calculation, we recommend that the use of an estimate of multiple organ system failure should be included in any studies of clinical risk factors associated with outcome in patients with PARDS. *Strong agreement*

2.2.6 With respect to evaluating risk factors related to organ failure in a research related to PARDS, caution should be exercised in the use of organ failure scoring systems that include indices of respiratory failure. We recommend the development of a validated, nonpulmonary organ failure definition for use in PARDS research. *Strong agreement*

2.2.7 We recommend further research into the potential use of combinations of biomarker levels in providing a stronger prediction of outcome. *Strong agreement*

2.2.8 We recommend that early response to therapy should not be used as a primary outcome measure in phase III clinical research trials. Future research should explore the relationship of early response to therapy as an intermediate process variable linked to more clinically relevant, long-term outcomes (e.g., ventilator-free days and mortality). *Strong agreement*

2.2.2 For disease severity measures that can be made at the bedside, we recommend that future research studies evaluating both trajectory of illness and recovery should use standardized, minimal datasets with adequately explicit definitions. *Strong agreement*

2.2.3 Recent adult studies evaluating the effect of dead-space ventilation, thereby reflecting lung perfusion, have been highly predictive of outcome. We recommend that future multicenter studies should examine the association of dead space and outcome of PARDS. *Strong agreement*

2.2.4 Studies examining the relationship between tidal volume, peak airway pressures, PEEP, or mean airway pressure with

Age	Exclude patients with peri-natal related lung disease		
Timing	Within 7 days of known clinical insult		
Origin of Edema	Respiratory failure not fully explained by cardiac failure or fluid overload		
Chest Imaging	Chest imaging findings of new infiltrate(s) consistent with acute pulmonary parenchymal disease		
Oxygenation	**Non Invasive mechanical ventilation**		**Invasive mechanical Ventilation**
	Nasal mask CPAP or BiPAP	Oxygen via mask, nasal cannula or High Flow	Oxygen supplementation to maintain SpO_2 ≥ 88% but OI < 4 or OSI < 5[1]
	FiO_2 ≥ 40% to attain SpO_2 88-97%	SpO_2 88-97% with oxygen supplementation at minimum flow[2]: < 1 year: 2 L/min 1 – 5 years: 4 L/min 5 – 10 years: 6 L/min >10 years: 8 L/min	

Figure 3. At risk of pediatric acute respiratory distress syndrome definition. [a]Given lack of available data, for patients on an oxygen blender, flow for at-risk calculation = Fio_2 × flow rate (L/min) (e.g., 6 L/min flow at 0.35 Fio_2 = 2.1 L/min). [b]If Pao_2 not available, wean Fio_2 to maintain Spo_2 ≤ 97% to calculate oxygen saturation index.

Section 3: Ventilatory Support

3.1 Modes of Conventional Ventilation. 3.1.1 There are no outcome data on the influence of mode (control or assisted) during conventional mechanical ventilation. Therefore, no recommendation can be made on the ventilator mode to be used in patients with PARDS. Future clinical studies should be designed to assess control and assisted modes of ventilation on outcome. *Strong agreement*

3.2 Tidal Volume/Plateau Pressure Limitations. 3.2.1 In any mechanically ventilated pediatric patient, we recommend in

controlled ventilation to use tidal volumes in or below the range of physiologic tidal volumes for age/body weight (i.e., 5–8 mL/kg predicted body weight) according to lung pathology and respiratory system compliance. *Weak agreement* (*88% agreement*)

3.2.2 We recommend using patient-specific tidal volumes according to disease severity. Tidal volumes should be 3–6 mL/kg predicted body weight for patients with poor respiratory system compliance and closer to the physiologic range (5–8 mL/kg ideal body weight) for patients with better preserved respiratory system compliance. *Weak agreement* (*84% agreement*)

3.2.3 In the absence of transpulmonary pressure measurements, we recommend an inspiratory plateau pressure limit of 28 cm H_2O, allowing for slightly higher plateau pressures (29–32 cm H_2O) for patients with increased chest wall elastance (i.e., reduced chest wall compliance). *Weak agreement* (*72% agreement*)

3.3 PEEP/Lung Recruitment. 3.3.1 We recommend moderately elevated levels of PEEP (10–15 cm H_2O) titrated to the observed oxygenation and hemodynamic response in patients with severe PARDS. *Weak agreement* (*88% agreement*)

3.3.2 We recommend that PEEP levels greater than 15 cm H_2O may be needed for severe PARDS, although attention should be paid to limiting the plateau pressure as previously described. *Strong agreement*

3.3.3 We recommend that markers of oxygen delivery, respiratory system compliance, and hemodynamics should be closely monitored as PEEP is increased. *Strong agreement*

3.3.4 We recommend that clinical trials should be designed to assess the effects of elevated PEEP on outcome in the pediatric population. *Strong agreement*

3.3.5 We recommend careful recruitment maneuvers in the attempt to improve severe oxygenation failure by slow incremental and decremental PEEP steps. Sustained inflation maneuvers cannot be recommended due to lack of available data. *Weak agreement* (*88% agreement*)

3.3.6 We recommend that clinical trials should be designed to assess optimal recruitment strategies in infants and children with PARDS. *Strong agreement*

3.4 High-Frequency Ventilation. 3.4.1 We recommend that high-frequency oscillatory ventilation (HFOV) should be considered as an alternative ventilatory mode in hypoxic respiratory failure in patients in whom plateau airway pressures exceed 28 cm H_2O in the absence of clinical evidence of reduced chest wall compliance. Such an approach should be considered for those patients with moderate-to-severe PARDS. *Weak agreement* (*92% agreement*)

3.4.2 In HFOV, we recommend that the optimal lung volume be achieved by exploration of the potential for lung recruitment by a stepwise increase and decrease of the Paw (continuous distending pressure) under continuous monitoring of the oxygenation and Co_2 response as well as hemodynamic variables. *Strong agreement*

3.4.3 We cannot recommend the routine use of high-frequency jet ventilation (HFJV) in children with PARDS. *Strong agreement*

3.4.4 We recommend that, in addition to the use of HFOV, HFJV might be considered in patients with severe air leak syndrome. *Weak agreement* (*64% agreement*)

3.4.5 High-frequency percussive ventilation (HFPV) is not recommended for routine ventilatory management of PARDS. *Strong agreement*

3.4.6 We recommend that HFPV can be considered in patients with PARDS and secretion-induced lung collapse, which cannot be resolved with routine clinical care (e.g., inhalational injuries). *Weak agreement* (*72% agreement*)

3.5 Liquid Ventilation. 3.5.1 The clinical use of liquid ventilation cannot be recommended. *Strong agreement*

3.6 Endotracheal Tubes. 3.6.1 Cuffed endotracheal tubes (ETTs) are recommended when conventionally ventilating a patient with PARDS. *Strong agreement*

3.6.2 We recommend allowing for an ETT air leak during HFOV to augment ventilation, if needed, assuming Paw can be maintained. *Strong agreement*

3.7 Gas Exchange. 3.7.1 We recommend that oxygenation and ventilation goals are titrated based on the "perceived" risks of the toxicity of the ventilatory support required. *Strong agreement*

3.7.2 We recommend that for mild PARDS with PEEP less than 10 cm H_2O, Spo_2 should generally be maintained at 92–97%. *Weak agreement* (*92% agreement*)

3.7.3 We recommend that after optimizing PEEP, lower Spo_2 levels (in the range of 88–92%) should be considered for those with PARDS with PEEP at least 10 cm H_2O. *Strong agreement*

3.7.4 Insufficient data exist to recommend a lower Spo_2 limit. *Strong agreement*

3.7.5 When Spo_2 is less than 92%, monitoring of central venous saturation and markers of oxygen delivery is recommended. *Strong agreement*

3.7.6 We recommend that permissive hypercapnia should be considered for moderate-to-severe PARDS to minimize ventilator-induced lung injury. *Strong agreement*

3.7.7 We recommend maintaining pH 7.15–7.30 within lung protective strategy guidelines as previously described. There are insufficient data to recommend a lower limit for pH. Exceptions to permissive hypercapnia should include intracranial hypertension, severe pulmonary hypertension, select congenital heart disease lesions, hemodynamic instability, and significant ventricular dysfunction. *Weak agreement* (*92% agreement*)

3.7.8 Bicarbonate supplementation is not routinely recommended. *Strong agreement*

Section 4: Pulmonary-Specific Ancillary Treatment

4.1 Inhaled Nitric Oxide. 4.1.1 Inhaled nitric oxide is not recommended for routine use in PARDS. However, its use may be considered in patients with documented pulmonary hypertension or severe right ventricular dysfunction. In addition, it may be considered in severe cases of PARDS as a rescue from or bridge to extracorporeal life support. When used, assessment of benefit must be undertaken promptly and serially to minimize toxicity and to eliminate continued use without established

effect. Finally, future study is needed to better define its role, if any, in the treatment of PARDS. *Strong agreement*

4.2 Exogenous Surfactant. 4.2.1 At this time, surfactant therapy cannot be recommended as routine therapy in PARDS. Further study should focus on specific patient populations that may be likely to benefit and specific dosing and delivery regimens. *Strong agreement*

4.3 Prone Positioning. 4.3.1 Prone positioning cannot be recommended as routine therapy in PARDS. However, it should be considered an option in cases of severe PARDS. Further pediatric study is warranted, particular study stratifying on the basis of severity of lung injury. *Weak agreement* (*92% agreement*)

4.4 Suctioning. 4.4.1 We recommend that maintaining a clear airway is essential to the patient with PARDS. However, endotracheal suctioning must be performed with caution to minimize the risk of derecruitment. *Strong agreement*

4.4.2 There are insufficient data to support a recommendation on the use of either an open or closed suctioning system. However, in severe PARDS, consideration should be given to the technique of suctioning with careful attention to minimize the potential for derecruitment. *Strong agreement*

4.4.3 The routine instillation of isotonic saline prior to endotracheal suctioning is not recommended. However, the instillation of isotonic saline prior to endotracheal suctioning may be indicated at times for lavage to remove thick tenacious secretions. *Strong agreement*

4.5 Chest Physiotherapy. 4.5.1 There are insufficient data to recommend chest physiotherapy as a standard of care in the patient with PARDS. *Strong agreement*

4.6 Corticosteroids. 4.6.1 At this time, corticosteroids cannot be recommended as routine therapy in PARDS. Further study should focus on specific patient populations that are likely to benefit from corticosteroid therapy and specific dosing and delivery regimens. *Strong agreement*

4.7 Other Ancillary Therapies. 4.7.1 No recommendation for the use of the following ancillary treatment is supported: helium-oxygen mixture, inhaled or IV prostaglandins therapy, plasminogen activators, fibrinolytics, or other anticoagulants, inhaled β-adrenergic receptor agonists or ipratropium, IV *N*-acetylcysteine for antioxidant effects or intratracheal *N*-acetylcysteine for mobilizing secretions, dornase alpha outside of the cystic fibrosis population, and a cough-assist device. *Strong agreement*

4.7.2 No recommendation for the use of stem cell therapy can be supported. It must be considered experimental therapy at this point. *Strong agreement*

Section 5: Nonpulmonary Treatment

5.1 Sedation. 5.1.1 We recommend that pediatric patients with PARDS should receive minimal yet effective targeted sedation to facilitate their tolerance to mechanical ventilation and to optimize oxygen delivery, oxygen consumption, and work of breathing. *Strong agreement*

5.1.2 We recommend that valid and reliable pain and sedation scales should be used to monitor, target, and titrate sedation and to facilitate interprofessional communication. *Strong agreement*

5.1.3 We recommend that sedation monitoring, titration, and weaning should be managed by a goal-directed protocol with daily sedation goals collaboratively established by the interprofessional team. *Strong agreement*

5.1.4 We recommend that clinical trials in PARDS should report their sedation goal, strategy, and exposures. *Strong agreement*

5.1.5 We recommend that the reporting of sedation strategy and monitoring in clinical trials should be adequately explicit to allow comparison across studies. *Strong agreement*

5.1.6 We recommend that when physiologically stable, pediatric patients with PARDS should receive a periodic assessment of their capacity to resume unassisted breathing (e.g., extubation) that is synchronized with sedative titration to an aroused state. *Strong agreement*

5.1.7 We recommend an individualized sedation weaning plan, guided by objective withdrawal scoring and assessment of patient tolerance that is developed by the clinical team and managed by the bedside nurse. *Strong agreement*

5.2 Neuromuscular Blockade. 5.2.1 We recommend that if sedation alone is inadequate to achieve effective mechanical ventilation, neuromuscular blockade (NMB) should be considered. When used, pediatric patients with PARDS should receive minimal yet effective NMB with sedation to facilitate their tolerance to mechanical ventilation and to optimize oxygen delivery, oxygen consumption, and work of breathing. *Strong agreement*

5.2.2 We recommend that when used, NMB should be monitored and titrated to the goal depth established by the interprofessional team. Monitoring may include effective ventilation, clinical movement, and train-of-four response. *Strong agreement*

5.2.3 We recommend that if full chemical paralysis is used, the team should consider a daily NMB holiday to allow periodic assessment of the patient's level of NMB and sedation. *Strong agreement*

5.2.4 We recommend that clinical trials in PARDS should report their NMB goal, strategy, and exposure. *Strong agreement*

5.2.5 We recommend that the reporting of NMB strategy and monitoring in clinical trials should be adequately explicit to allow comparison across studies (e.g., type of NMB agent and use of steroids). *Strong agreement*

5.2.6 We recommend that further studies are needed to better understand the short- and long-term outcomes of NMB use. *Strong agreement*

5.3 Nutrition. 5.3.1 We recommend that pediatric patients with PARDS should receive a nutrition plan to facilitate their recovery, maintain their growth, and meet their metabolic needs. *Strong agreement*

5.3.2 We recommend that enteral nutrition, when tolerated, should be used in preference to parenteral nutrition. *Strong agreement*

5.3.3 We recommend that enteral nutrition monitoring, advancement, and maintenance should be managed by a

goal-directed protocol that is collaboratively established by the interprofessional team. *Strong agreement*

5.3.4 We recommend that clinical trials in PARDS should report their nutritional/feeding goals, strategy, and exposure. *Strong agreement*

5.3.5 We recommend that the reporting of the nutrition strategy, exposure, and monitoring in clinical trials should be adequately explicit to allow comparison across studies (e.g., route, composition, calories delivered, use of additives, and time to reach nutrition goal). *Strong agreement*

5.4 Fluid Management. 5.4.1 We recommend that pediatric patients with PARDS should receive total fluids to maintain adequate intravascular volume, end-organ perfusion, and optimal delivery of oxygen. *Strong agreement*

5.4.2 After initial fluid resuscitation and stabilization, we recommend goal-directed fluid management. Fluid balance should be monitored and titrated to maintain adequate intravascular volume while aiming to prevent positive fluid balance. *Strong agreement*

5.4.3 We recommend that fluid titration be managed by a goal-directed protocol that includes total fluid intake, output, and net balance. *Strong agreement*

5.4.4 We recommend that clinical trials in PARDS should report their fluid management goals, strategy, and exposure. *Strong agreement*

5.4.5 We recommend that the reporting of fluid strategy and monitoring in clinical trials should be adequately explicit to allow comparison across studies (e.g., fluid bolus trigger, type of fluid, central venous pressure goal, use of ultrasound, or impedance monitoring). *Strong agreement*

5.4.6 We recommend that clinical trials in PARDS should use a clinical protocol to guide fluid management. *Strong agreement*

5.4.7 We recommend that further studies are needed to definitively determine the optimal fluid management strategy in pediatric patients with PARDS. *Strong agreement*

5.5 Transfusion. 5.5.1 In clinically stable children with evidence of adequate oxygen delivery (excluding cyanotic heart disease, bleeding, and severe hypoxemia), we recommend that a hemoglobin concentration up to 7.0 g/dL be considered a trigger for RBC transfusion in children with PARDS. *Strong agreement*

5.5.2 We recommend that clinical trials in PARDS should report their blood product transfusion triggers, strategies, and exposures. *Strong agreement*

5.5.3 We recommend that the reporting of transfusion trigger, strategy, and monitoring in clinical trials should be adequately explicit to allow comparison across studies (e.g., whole vs packed RBCs, age of blood, use of leukoreduction, fresh-frozen plasma, and platelets). *Strong agreement*

5.5.4 We recommend that clinical trials in PARDS should use a clinical protocol to guide blood product transfusion. *Strong agreement*

5.5.5 We recommend that further studies are needed to definitely determine the risks and benefits of transfusion in pediatric patients with PARDS. *Strong agreement*

Section 6: Monitoring

6.1 General Monitoring. 6.1.1 We recommend that all children with or at risk of PARDS should receive the minimum clinical monitoring of respiratory frequency, heart rate, continuous pulse oximetry, and noninvasive blood pressure. *Strong agreement*

6.1.2 We recommend that specific alarms should be available when the monitored variables are outside predefined ranges. *Strong agreement*

6.1.3 We recommend that some monitored values (e.g., tidal volume and compliance of the respiratory system) should be interpreted after standardization to body weight. Hence, accurate weight is critical. Predicted body weight should be used, based on calculation from gender and from height or length or from ulna length. *Strong agreement*

6.2 Respiratory System Mechanics. 6.2.1 We recommend that during invasive ventilation in children with PARDS, the exhaled tidal volume should be continuously monitored to prevent injurious ventilation. *Strong agreement*

6.2.2 We recommend that monitoring of ventilatory inspiratory pressure is important to prevent ventilator-induced lung injury. It should be based on peak pressure in pressure-regulated modes and plateau pressure during ventilation in volume-control modes. It should be interpreted with caution in patients with suspected abnormal chest wall compliance or with spontaneous breathing. *Strong agreement*

6.2.3 We recommend the monitoring of flow-time and pressure-time curves to assess the accuracy of respiratory timings and to detect expiratory flow limitation or patient-ventilator asynchrony. *Strong agreement*

6.2.4 We recommend that in infants and smaller children, the exhaled tidal volumes should be monitored at the end of the endotracheal tube and/or with appropriate compensation for circuit compliance. *Strong agreement*

6.2.5 There is insufficient evidence to recommend the systematic monitoring of the following variables of respiratory system mechanics: flow-volume loop, static pressure-volume loop, dynamic pressure-volume loop, dynamic compliance and resistance, stress index, intrinsic PEEP, esophageal manometry and transpulmonary pressure, work of breathing, corrected minute ventilation, functional residual capacity, dead space/tidal volume ratio, assessment of respiratory muscle activity using airway occlusion pressure (P0.1), esophageal pressure rate product, electrical activity of diaphragm, ultrasonography of the diaphragm, or thoracoabdominal asynchrony quantification by respiratory inductance plethysmography. *Weak agreement* (*92% agreement*)

6.3 Oxygenation Variables, Severity Scoring, and Co_2 Monitoring. 6.3.1 Monitoring of Fio_2, Spo_2 and/or Pao_2, Paw, and PEEP is recommended to detect PARDS, to assess PARDS severity, and to guide the management of oxygenation failure. *Strong agreement*

6.3.2 We recommend that blood pH and $Paco_2$ measurement frequency should be adjusted according to PARDS severity, noninvasive monitoring data, and stage of the disease. *Strong agreement*

6.3.3 Peripheral venous blood gas sampling is not recommended. *Weak agreement* (*83% agreement*)

6.3.4 Continuous monitoring of Co_2 is recommended in children with invasive mechanical ventilation, using end-tidal Co_2/time curves, volumetric capnography, and/or transcutaneous Co_2 measurements. *Strong agreement*

6.4 Specific Weaning Considerations. 6.4.1 We recommend at least daily assessment of predefined clinical and physiologic criteria of extubation readiness in order to avoid unnecessary prolonged ventilation. *Strong agreement*

6.4.2 We recommend that Spontaneous Breathing Trials and/or Extubation Readiness Tests should be performed. *Strong agreement*

6.4.3 We recommend that for research studies, Spontaneous Breathing Trials and Extubation Readiness Tests should be standardized. *Strong agreement*

6.5 Imaging. 6.5.1 We recommend that chest imaging is necessary for the diagnosis of PARDS and to detect complications such as air leak or equipment displacement. Frequency of chest imaging should be predicated on patient clinical condition. *Strong agreement*

6.5.2 There is insufficient evidence to recommend the systematic use of chest CT scan, lung ultrasonography, and electrical impedance tomography. *Strong agreement*

6.6 Hemodynamic Monitoring. 6.6.1 Hemodynamic monitoring is recommended during PARDS, in particular, to guide volume expansion in the context of fluid restrictive strategy, to evaluate the impact of ventilation and disease on right and left cardiac function, and to assess oxygen delivery. *Strong agreement*

6.6.2 In patients with suspected cardiac dysfunction, echocardiography is recommended for noninvasive evaluation of both left and right ventricular function, the preload status, and pulmonary arterial pressures. *Strong agreement*

6.6.3 We recommend that a peripheral arterial catheter should be considered in patients with severe PARDS for continuous monitoring of arterial blood pressure and arterial blood gas analysis. *Strong agreement*

6.6.4 There is insufficient evidence to recommend the systematic use of the following hemodynamic monitoring devices: pulse contour with transpulmonary dilution technology, pulmonary artery catheters, alternative devices to monitor cardiac output (ultrasonic cardiac output monitoring, transesophageal aortic Doppler, and noninvasive monitoring of cardiac output based on changes in respiratory Co_2 concentration caused by a brief period of rebreathing), central venous oxygenation monitoring, and B-type natriuretic peptide measurements. *Strong agreement*

Section 7: Noninvasive Support and Ventilation

7.1 Indications for Noninvasive Support Ventilation. 7.1.1 We recommend that noninvasive positive pressure ventilation (NPPV) is considered early in disease in children at risk for PARDS to improve gas exchange, decrease work of breathing, and potentially avoid complications of invasive ventilation. *Weak agreement* (*88% agreement*)

7.1.2 We recommend that selected populations of children, such as children with immunodeficiency who are at greater risk of complications from invasive mechanical ventilation, may benefit more from earlier NPPV to avoid invasive mechanical ventilation. *Weak agreement* (*80% agreement*)

7.2 Team Training. 7.2.1 We recommend that although noninvasive, NPPV should be delivered in a setting with trained experienced staff and where close monitoring is available to rapidly identify and treat deterioration. *Strong agreement*

7.3 Noninvasive Support Ventilation Management. 7.3.1 We recommend that intubation should be considered in patients receiving NPPV who do not show clinical improvement or have signs and symptoms of worsening disease, including increased respiratory rate, increased work of breathing, worsening gas exchange, or an altered level of consciousness. *Strong agreement*

7.3.2 We recommend the use of an oronasal or full facial mask to provide the most efficient patient-ventilator synchronization for children with PARDS. *Weak agreement* (*84% agreement*)

7.3.3 We recommend that children using NPPV should be closely monitored for potential problems, such as skin breakdown, gastric distention, barotrauma, and conjunctivitis. *Strong agreement*

7.3.4 Heated humidification is strongly recommended for NPPV in children. *Strong agreement*

7.3.5 We recommend that to allow the most efficient patient-ventilator synchronization and tolerance, sedation should be used only with caution in children receiving NPPV for PARDS. *Weak agreement* (*88% agreement*)

7.3.6 To reduce inspiratory muscle effort and improve oxygenation, we recommend noninvasive pressure support ventilation combined with PEEP in patients with PARDS. Continuous positive airway pressure alone may be suitable for those children who are unable to attain patient ventilatory synchrony or when using nasal interface. *Weak agreement* (*92% agreement*)

7.4 Other Modes of Noninvasive Support Ventilation. 7.4.1 We recommend that further studies are needed to identify clinical indications for high-flow nasal cannula in patients at risk of PARDS. High-flow nasal cannula has not been demonstrated to be equivalent to NPPV. *Strong agreement*

7.4.2 NPPV is not recommended for children with severe disease. *Strong agreement*

Section 8: Extracorporeal Support

8.1 Indications for Extracorporeal Membrane Oxygenation in Children With PARDS. 8.1.1 We recommend that extracorporeal membrane oxygenation (ECMO) should be considered to support children with severe PARDS where the cause of the respiratory failure is believed to be reversible or the child is likely to be suitable for consideration for lung transplantation. *Strong agreement*

8.1.2 It is not possible to apply strict criteria for the selection of children who will benefit from ECMO in PARDS. We

recommend that children with severe PARDS should be considered for ECMO when lung protective strategies result in inadequate gas exchange. *Strong agreement*

8.1.3 We recommend that decisions to institute ECMO should be based on a structured evaluation of case history and clinical status. *Strong agreement*

8.1.4 We recommend that serial evaluation of ECMO eligibility is more useful than single-point assessment. *Strong agreement*

8.1.5 We recommend that careful consideration of quality of life and likelihood of benefit should be assessed. *Strong agreement*

8.2 Contraindications to ECMO in Children With Severe PARDS. 8.2.1 We recommend that ECMO should not be deployed in patients in whom life-sustaining measures are likely to be limited. *Strong agreement*

8.3 Team Training and Organization. 8.3.1 We recommend that ECMO programs should have clearly defined leadership structure, including administrative support. *Strong agreement*

8.3.2 We recommend that all personnel directly caring for the patient should have an understanding of the ECMO circuit and the physiologic interactions between it and the patient. Competencies for physicians with primary patient care duties and ECMO specialists should be required. *Strong agreement*

8.3.3 We recommend that all centers providing ECMO support should belong to The Extracorporeal Life Support Organization (ELSO) and report all patient activity to ELSO or similar organization. *Strong agreement*

8.3.4 We recommend that ECMO programs should benchmark themselves against other programs via the ELSO registry or similar. *Strong agreement*

8.4 Other Modes of Extracorporeal Lung Support. 8.4.1 We recommend that patients suffering from extreme hypercarbia and mild-to-moderate hypoxia may benefit from new extracorporeal devices which provide partial respiratory support. Such devices may be effective in removing all carbon dioxide and may not require a pump to provide blood flow but may instead use the patient's own generated systemic blood pressure to drive blood through a low-resistance oxygenator. *Weak agreement* (*63% agreement*)

Section 9: Morbidity and Long-Term Outcomes

9.1 Pulmonary Function. 9.1.1 We recommend screening for pulmonary function abnormalities within the first year after discharge, including a minimum of respiratory symptom questionnaires and pulse oximetry for all children with PARDS who undergo invasive mechanical ventilation. *Strong agreement*

9.1.2 We recommend that for all children with PARDS who undergo invasive mechanical ventilation and are of sufficient developmental age and capabilities, spirometry should also be performed for the screening for pulmonary function abnormalities within the first year after discharge. *Strong agreement*

9.1.3 We recommend that when deficits in pulmonary function are identified, patients should be referred to a pediatric pulmonologist for further assessment, treatment, and long-term pulmonary follow-up. *Strong agreement*

9.2 Neurocognitive Development. 9.2.1 We recommend that physical, neurocognitive, emotional, family, and social function be evaluated within 3 months of hospital discharge for children who survive moderate-to-severe PARDS. *Strong agreement*

9.2.2 We recommend that for younger patients (infants and toddlers), additional evaluation of physical, neurocognitive, emotional, family, and social function should be performed prior to entering school. *Strong agreement*

9.2.3 We recommend that when abnormalities are identified, children should be treated or referred for more in-depth assessment and treatment by appropriate subspecialists and educators (e.g., when learning deficits are identified). *Strong agreement*

9.3 Outcome Measures. 9.3.1 Given decreasing mortality among children with PARDS, we recommend research into the following potential alternative endpoints for clinical trials: longer term mortality (e.g., 90 d), rates of new or progressive organ dysfunction, organ failure- or treatment-free days, ventilator-free days (with and without noninvasive ventilation), duration of oxygen therapy (or a higher concentration of oxygen for subjects on chronic supplemental oxygen), risk-adjusted hospital and PICU lengths of stay, hospital and PICU readmissions (e.g., within 30 d of discharge), quality of life, neurocognitive function, and emotional health. *Strong agreement*

DISCUSSION

The PALICC was convened to identify and articulate differences between adult and pediatric ARDS. The conference made important first steps in this process. We recognize that further work is required to build on these initial efforts, and we hope these recommendations provide a roadmap to future areas of investigation. The details of each section along with the extensive literature researched are presented in the supplement to this issue of *Pediatric Critical Care Medicine* published with this article. The Conference identified many areas of agreement, but its primary benefit may well be in illustrating how little is known about this relatively common condition in children.

The process by which the recommendations were developed was based on previously published methods (13) and was chosen due to the relative paucity of data in PARDS. The experts in each group were tasked with synthesizing the data on their specific topic and developing recommendations based on peer-reviewed, pediatric-specific data. If no pediatric data were available, experts were directed to use data generated from either adults with ARDS or neonates with lung injury, to solidify their recommendations. Finally, expert opinion was used when no data were available. Once the initial recommendations were presented, each of the PALICC members had equal input on each recommendation. One advantage of the RAND/UCLA appropriateness method is that it diminishes the "leader effect" and provides every

member an equal vote (15), which was felt to be extremely important to the process.

Perhaps, the most controversial recommendations will be those regarding definitions. Much like the Berlin Conference (3), we abandoned the previous category of "ALI" in favor of grading PARDS by severity (16). Unlike the Berlin group, however, we chose to use the OI (or, if an arterial blood gas is not available, the OSI) rather than the P/F ratio because of the less standardized approach to positive pressure ventilation in children relative to adults. We also chose to eliminate the requirement for "bilateral" pulmonary infiltrates as the distinction between bilateral and unilateral is often difficult, and there is no evidence that etiology, treatment, or outcomes are different between patients with and without bilateral infiltrates. We also chose not to state specific age criteria for PARDS, as described in recommendation 1.1.1. However, the purpose was clearly to define PARDS in the patient population generally cared for by pediatric intensivists. The inclusion of nonintubated children within the definition of PARDS (or at risk) acknowledges the increasing use of noninvasive positive pressure support and focuses appropriate attention on possible early intervention in PARDS. Finally, we have offered definitions for PARDS in patients with congenital heart disease and chronic lung disease. Undoubtedly, this will prove controversial, but we recognize that many of the patients we care for in the PICU have underlying chronic conditions, and chronic disease does not preclude the possibility of superimposed ARDS.

The therapeutic recommendations from the group are also likely to provoke argument, some because they are too generic and others because they are too prescriptive. As these recommendations are clearly a starting point, we expect that few of these recommendations will weather the test of time, being replaced with higher levels of evidence. All recommendations were made after a thorough review of the current literature, but high levels of evidence were often lacking. Nonetheless, it was the purpose of the conference to offer recommendations based on the best available evidence. When only insufficient evidence was available expert opinion or expert interpretation of the available data was utilized.

The final purpose of the Conference was to increase interest in research in PARDS. Although it appears as if mortality has steadily improved over the last 2–3 decades, PARDS remains a relatively common clinical problem in the PICU with few effective therapies. Indeed, the failures of many therapies are addressed specifically in the conference recommendations not to use them for patients with PARDS. By identifying the deficiencies in our understanding, the failure of multiple past clinical trials, and the paucity of information on outcomes other than mortality, we hoped to identify the key areas for future investigation. The experts in each area have highlighted the lack of published data, and in doing so, hopefully, they have illuminated the initial way forward. It is clear that we have a long way to go.

These recommendations represent the consensus achieved by 27 experts from eight different countries. Although each of the recommendations is based on a thorough review of the existing literature, given the paucity of science on many of these topics some undoubtedly contain a large element of interpretation and opinion. Precisely because consensus was required, some of the recommendations may also appear pedestrian and even commonsensical. We would urge the clinician searching for more detail, more controversy, or perhaps more prescriptive recommendations to read the supporting evidence in the supplement. The conference identified more questions than answers, and this is evident in the supplement. It is our hope that identifying the questions will lead others to pursue research in this area to address some of the limitations in our current understanding of PARDS.

In summary, the PALICC developed pediatric-specific definitions for ARDS and recommendations regarding treatment and future research priorities. These are intended to initiate discussion regarding optimization and consistency of care for children with PARDS and to identify areas of controversy requiring further investigation.

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APPENDIX 1. PEDIATRIC ACUTE LUNG INJURY CONSENSUS CONFERENCE GROUP

Organizing Committee: Philippe Jouvet, University of Montreal, Canada; Neal J. Thomas, Pennsylvania State University; Douglas F. Willson, Medical College of Virginia.

Section 1: Definition, prevalence, and epidemiology: Simon Erickson, Princess Margaret Hospital for Children, Australia; Robinder Khemani, University of Southern California; Lincoln Smith, University of Washington; Jerry Zimmerman, University of Washington.

Section 2: Pathophysiology, comorbidities, and severity: Mary Dahmer, University of Michigan; Heidi Flori, Children's Hospital & Research Center Oakland; Michael Quasney, University of Michigan; Anil Sapru, University of California San Francisco.

Section 3: Ventilatory support: Ira Cheifetz, Duke University; Peter C. Rimensberger, University Hospital of Geneva, Switzerland.

Section 4: Pulmonary-specific ancillary treatment: Martin Kneyber, University Medical Center Groningen, The Netherlands; Robert F. Tamburro, Pennsylvania State University.

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Section 9: Morbidity and long-term outcomes: Yolanda Lopez-Cruces, University Hospital, Spain; Michael Quasney, University of Michigan; Miriam Santschi, Universite de Sherbrooke, Canada; R. Scott Watson, University of Pittsburgh.

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