Paediatric Organ Failure Scores

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Qualitative Definition

Goldstein Pediatr Crit Care Med 2005; 6: 2-8

Table 4. Organ dysfunction criteria

Cardiovascular dysfunction

Despite administration of isotonic intravenous fluid bolus ≥40 mL/kg in 1 hr

- Decrease in BP (hypotension) <5th percentile for age or systolic BP <2 SD below normal for age[a]

OR

- Need for vasoactive drug to maintain BP in normal range (dopamine >5 μg/kg/min or dobutamine, epinephrine, or norepinephrine at any dose)

OR

- Two of the following

  Unexplained metabolic acidosis: base deficit >5.0 mEq/L
  Increased arterial lactate >2 times upper limit of normal
  Oliguria: urine output <0.5 mL/kg/hr
  Prolonged capillary refill: >5 secs
  Core to peripheral temperature gap >3°C

Respiratory[b]

- Pao_2/Fio_2 <300 in absence of cyanotic heart disease or preexisting lung disease

OR

- $Paco_2$ >65 torr or 20 mm Hg over baseline $Paco_2$

OR

- Proven need[c] or >50% Fio_2 to maintain saturation ≥92%

OR

- Need for nonelective invasive or noninvasive mechanical ventilation[d]

Neurologic

- Glasgow Coma Score ≤11 (57)

OR

- Acute change in mental status with a decrease in Glasgow Coma Score ≥3 points from abnormal baseline

Hematologic

- Platelet count <80,000/mm^3 or a decline of 50% in platelet count from highest value recorded over the past 3 days (for chronic hematology/oncology patients)

OR

- International normalized ratio >2

Renal

- Serum creatinine ≥2 times upper limit of normal for age or 2-fold increase in baseline creatinine

Hepatic

- Total bilirubin ≥4 mg/dL (not applicable for newborn)

OR

- ALT 2 times upper limit of normal for age

[a]See Table 2; [b]acute respiratory distress syndrome must include a Pao_2/Fio_2 ratio ≤200 mm Hg, bilateral infiltrates, acute onset, and no evidence of left heart failure (Refs. 58 and 59). Acute lung injury is defined identically except the Pao_2/Fio_2 ratio must be ≤300 mm Hg; [c]proven need assumes oxygen requirement was tested by decreasing flow with subsequent increase in flow if required; [d]in postoperative patients, this requirement can be met if the patient has developed an acute inflammatory or infectious process in the lungs that prevents him or her from being extubated.

Composite Qualitative Resolution Score *Nadel Lancet 2007; 369: 836*

Composite **T**ime to **C**omplete **O**rgan **F**ailure **R**esolution

Cardiovascular

<5 mcg/kg/min dopamine/dobutamine, no adrenaline/noradrenaline/phenylephrine

Respiratory

Cessation of invasive mechanical ventilation (incl. BiPAP/CPAP)

Renal

Cessation of renal replacement therapy

If CTCOFR not resolved by Day 14: CTCOFR = 15

Death: CTCOFR = 16

Quantitative Definition: PELOD *Leteurtre Med Decis Making 1999; 19; 399*

Organ System and Variable	Score 0	1	10	20
Neurologic				
Glasgow coma score*	12–15	7–11	4–6	3
	and		*or*	
Pupillary reactions	Both reactive		Both fixed	
Cardiovascular				
Heart rate				
<12 years	≤195 beats/min		>195 beats/min	
≥12 years	≤150		>150	
	and		*or*	
Systolic blood pressure				
<1 month	>65 mm Hg		35–65 mm Hg	<35 mm Hg
≥1 month <1 year	>75		35–75	<35
≥1 year <12 years	>85		45–85	<45
≥12 years	>95		55–95	<55
Renal				
Creatinine				
<7 days	<140 μmol/L		≥140 μmol/L	
≥7 days <1 year	<55 μmol/L		≥55 μmol/L	
≥1 year <12 years	<100 μmol/L		≥100 μmol/L	
≥12 years	<140 μmol/L		≥140 μmol/L	
Pulmonary				
Pao_2/Fio_2† ratio	>70 mm Hg		≤70 mm Hg	
	and		*or*	
$Paco_2$	≤90 mm Hg (≤11.7 kPa)		>90 mm Hg (>11.7 kPa)	
	and			
Mechanical ventilation‡	No ventilation	Ventilation		
Hematologic				
White blood cell count	≥4.5 10^9/L	1.5–4.4 10^9/L	<1.5 10^9/L	
	and	*or*		
Platelets	≥35 10^9/L	<35 10^9/L		
Hepatic				
Serum glutamic oxalo-acetic transaminase	<950 IU/L	≥950 IU/L		
	and	*or*		
Prothrombin time	>60 %	≤60%		

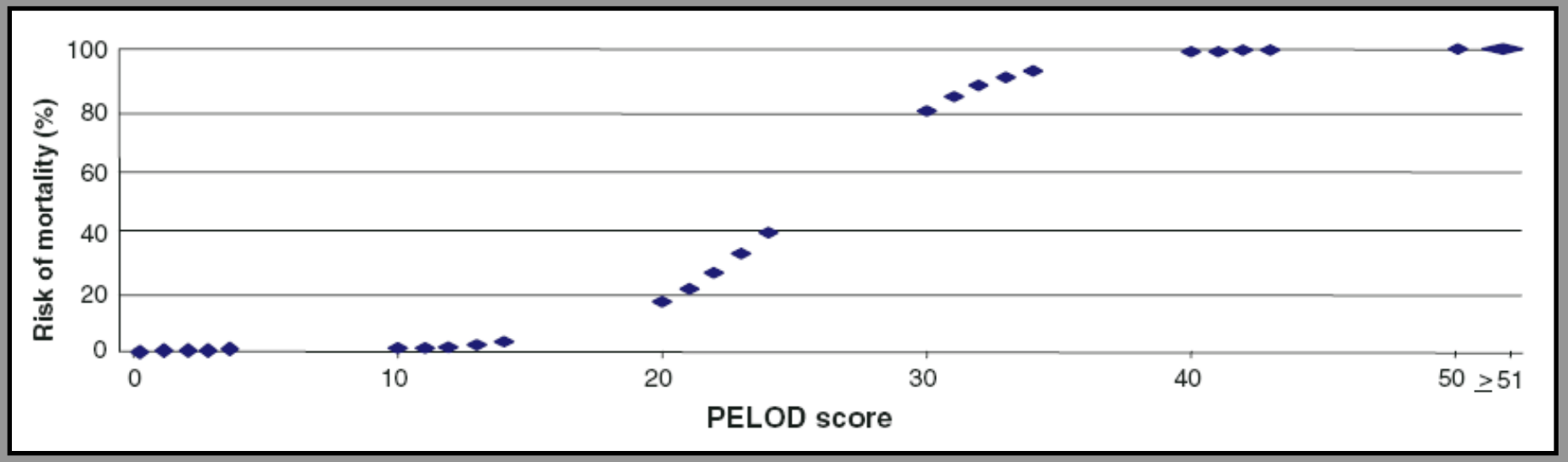
Quantitative Definition: PELOD *Leteurtre Med Decis Making 1999; 19; 399*

Ordinal, 33 ranks between 0 and 71, mortality risk from logistic transformation

Heavily weighted towards cardiovascular and neurologic OF (>80% variability)

Ranks not evenly distributed, large gaps in mortality risk

Doesn't calibrate, even in authors own institutions (*Leteurtre, Lancet 2003, n = 1806 & Lancet 2006*) or elsewhere (*Garcia, ICM 2010, n = 1476*)

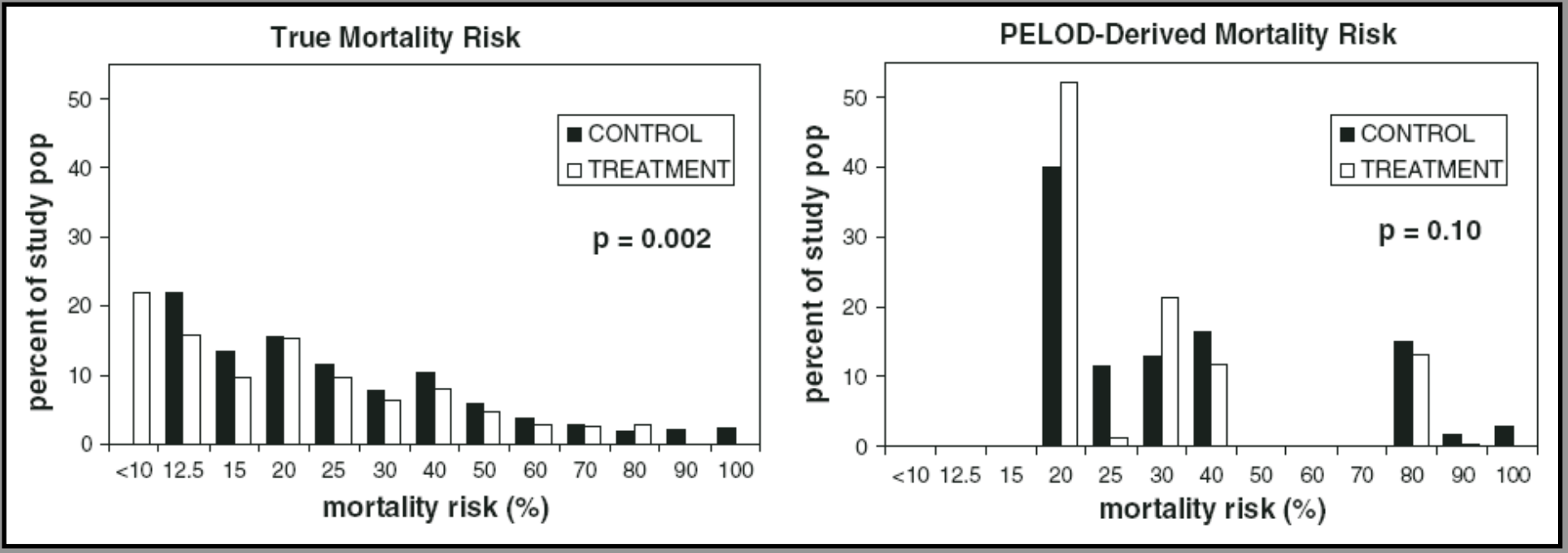


Quantitative Definition: PELOD *Leteurtre Med Decis Making 1999; 19; 399*

Ordinal, 33 ranks between 0 and 71, mortality risk from logistic transformation

Ranks not evenly distributed, large gaps in mortality risk

May result in underpowered clinical trial (*Tibby, ICM 2010*)



Quantitative Definition: P-MODS *Graciano Crit Care Med 2005; 33:1484*

Table 2. Pediatric Multiple Organ Dysfunction Score (P-MODS)

Score	0	1	2	3	4
Lactic acid, mmol/L	<1	1–2	2–5	5–7.5	>7.5
Pa_{O_2}/F_{IO_2}	>150	150–100	100–75	75–50	<50
Bilirubin[a]					
μmol/L	<8.5	8.5–34.2	34.2–85.5	85.5–171	>171
mg/dL	<0.5	0.5–2.0	2.0–5.0	5.0–10.0	>10
Fibrinogen[b]					
μmol/L	>4.40	4.40–3.70	3.70–3.0	3.0–2.20	<2.20
mg/dL	>150	150–125	125–100	100–75	<75
BUN[c]					
μmol/L	<7.10	7.10–14.3	14.3–21.4	21.4–28.5	>28.5
mg/dL	<20	20–40	40–60	60–80	>80

BUN, blood urea nitrogen.

[a]Bilirubin (μmol/L) divided by 17.1 = mg/dL; [b] fibrinogen (μmol/L) divided 0.0294 = mg/dL; [c] BUN (μmol/L) divided by 0.357 = mg/dL. Summing the individual worst value: score range 0–20.

Quantitative Definition: P-MODS

Graciano Crit Care Med 2005; 33:1484

Five organs, ordinal 0 – 20 (increments of 1)

Development and internal validation in single centre *(n = 6456, AUC 0.78)*

Assumes risk evenly divided between intervals, organs weighted equally

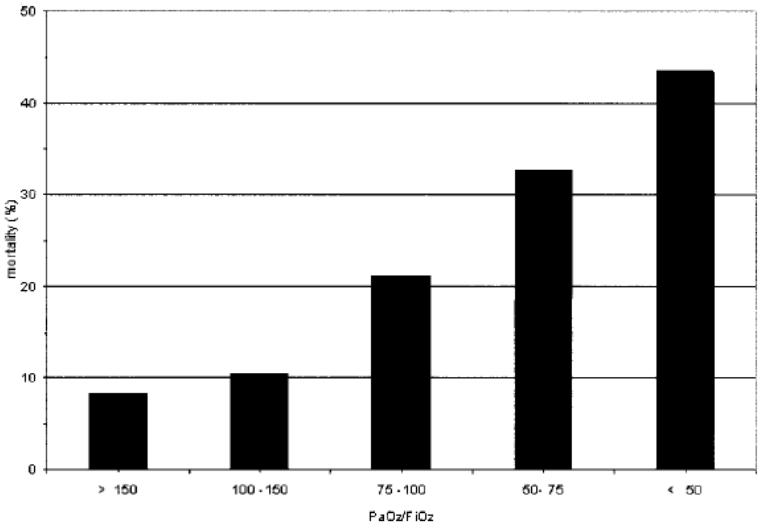


Figure 1. Correlation between respiratory dysfunction, quantified using the worst Pao_2/Fio_2 ratio, and the pediatric intensive care unit mortality rate. R = .955, p .012.

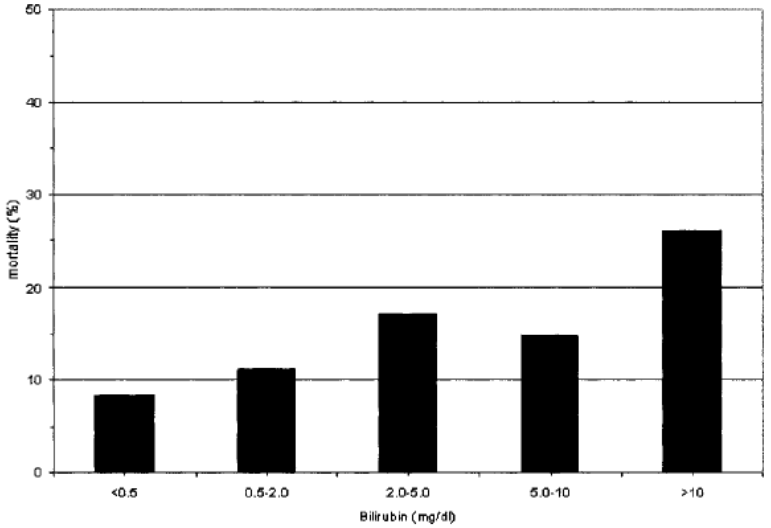


Figure 4. Correlation between bilirubin levels (mg/dL) and pediatric intensive care unit mortality rate. R = .93, p = .21. To convert bilirubin from μmol/L to mg/dL, divide the value by 17.1.

Quantitative Definition: P-SOFA

Shime JTCVAnesth 2001; 15:463

Table 1. Modified Sequential Organ Failure Assessment score

	0	1	2	3	4
Respiration					
PaO_2/F_IO_2 (mmHg)	>400	400-301	300-201	200-101	≤100
Coagulation					
Platelet counts ($\times 10^3/mm^3$)	>150	150-101	100-51	50-21	≤20
Liver					
Total bilirubin (mg/dL)	<1.2	1.2-1.9	2.0-5.9	6.0-11.9	>12.0
Cardiovascular					
Hemodynamic support	No cardiovascular agents	Any cardiovascular agents (phosphodiesterase inhibitors or vasodilators)	Dopamine, <5 μg/kg/min, or dobutamine (any dose)	Dopamine, 5-15 μg/kg/min, or epi, ≤0.1 μg/kg/min, or norepi,≤0.1 μg/kg/min	Dopamine, > 15 μg/kg/min, or epi, >0.1 μg/kg/min, or norepi, >0.1 μg/kg/min
Renal					
Creatinine (mg/dL)	<1.2	1.2-1.9	2.0-3.4	3.5-4.9	>5.0

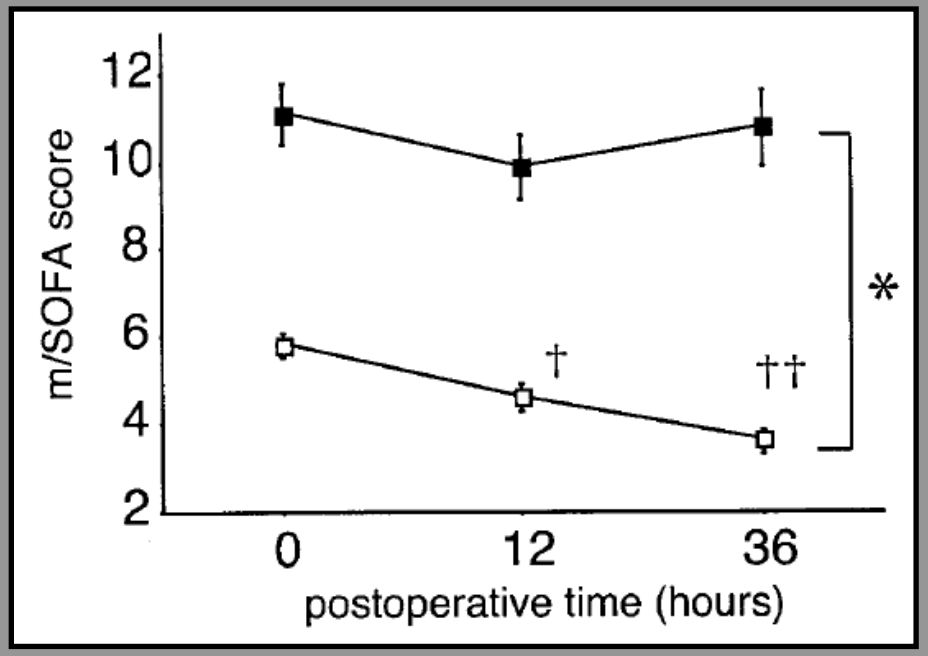
Abbreviations: PaO_2, arterial oxygen pressure; F_IO_2, fraction of inspired oxygen; epi, epinephrine; norepi, norepinephrine.

Adaptation of validated adult score

Five organs, ordinal 0 – 20 (increments of 1)

Assumes risk evenly divided between intervals, organs weighted equally

Internal validation in single centre, cardiac Sx, **sequentially** 0 - 36hrs



Quantitative Definition: PRISM III-APS *Pollack J Pediatr 1997; 131:575*

21 variables, 59 ranges ????

First 24 hours only

OF as a surrogate for mortality?

Prentice Criteria (*Stat Med 18:1905*)

Biological plausibility of a causal link between OF and death ✓

Epidemiological studies → prognostic value of OF for mortality ✓

Evidence from clinical trials that treatment effects on the surrogate (OF) produce similar effects on the main outcome (death) **X**

Multiple examples where this is not the case (*Int J Clin Oncol 14:102*)

Could OF be a protective, adaptive response? (*Singer, Lancet 364:545)*