

Table 3: Recommendations on the use of cardiac ultrasound and other methods to estimate cardiac output for hemodynamic monitoring in critically ill children

Sr No	Recommendation	Level of agreement
Echocardiography / Cardiac ultrasound		
1.	We recommend to use cardiac ultrasound as an adjunct to gain additional information required for making accurate clinical decisions in infants and children with hemodynamic instability but not as a tool for routine hemodynamic monitoring in intensive care setting.	Strong agreement
2.	Cardiac ultrasound can help in diagnosing pulmonary hypertension and assessing severity of pulmonary hypertension, and in detecting cardiac tamponade.	Strong agreement
3.	We recommend monitoring of pulmonary artery pressure (PAP) using ultrasound with refractory shock states to exclude pulmonary hypertension. Cardiac ultrasound may help in identifying underlying pathophysiology of shock and choosing the right intervention based upon deranged hemodynamic physiology (preload, afterload or cardiac function).	Strong agreement
4.	Cardiac ultrasound may help in assessing fluid responsiveness and we recommend using velocity time integral (VTI) across aortic valve for assessing fluid responsiveness rather than inferior vena cava collapsibility in mechanically ventilated infants and children.	Strong agreement
5.	We recommend using serial longitudinal assessments to assess response to therapy in patients with significant hemodynamic instability.	Strong agreement

Cardiac output measurement and transpulmonary indicator dilution		
6.	We recommend to use ultrasound/Doppler based methods of estimating CO in stable patients, for the initial assessment of unstable patients and to decide if a more invasive method is required. When reliable absolute measurements of CO are deemed necessary, thermodilution (TPD) is the method of first choice.	Strong agreement
7.	In patients with a refractory shock when an accurate measurement of CO is needed, we recommend to use transpulmonary thermodilution (TPTD) or semi-invasive transpulmonary ultrasound dilution (TPUD).	Weak agreement
8.	We recommend to use invasive (and if possible continuous) CO monitoring in unstable post-operative patients after major (cardiothoracic) surgery, multiple trauma injuries or burns or patients with complex cardiopulmonary interactions.	Strong agreement
9.	We recommend against targeting fluid therapy based upon blood volumes measured with TPD or targeting hemodynamic therapy based upon lung water measurement to assess pulmonary oedema in critically ill children.	Strong agreement
10.	Because of their intermittent measurement technique, TPD methods are not suitable for the detection of fast changes in CO unless used in conjunction with continuous trend monitoring using pulse contour analysis, calibrated by transpulmonary indicator dilution technology.	Strong agreement
Pulmonary artery pressure		
11.	We do not recommend to use pulmonary artery catheter (PAC) to measure CO in children. However, monitoring of left atrial pressure only in selected cardiac surgery patients or patients after lung transplant using a surgically inserted catheter can be helpful	Strong agreement