1 PREM Triangle

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Introduction

The PREM triangle[1] has been designed to enable decision-making to be a "simple math" for junior residents during resuscitation **(Fig. 1.1).**

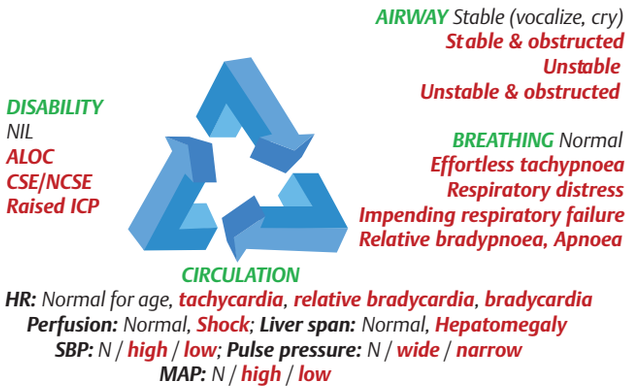

Fig. 1.1 PREM triangle.

The PREM triangle is derived by a cyclical process comprising of four steps: The 1-minute mRCPCA, documentation, interpretation of vitals, and derivation of the physiological status. This cycle is repeated for every critical care intervention, viz., fluid bolus, nebulization, anti-seizure medications, intubation, etc. until hypoxia, shock, cardiac dysfunction, and NCSE (Fig. 1.2) are resolved.

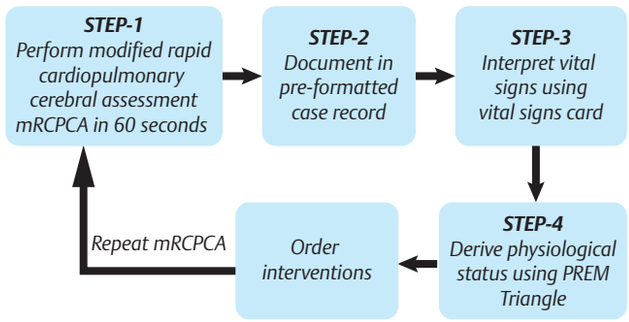

Fig. 1.2 PREM process.

Airway[1]

- The airway is a tube of muscle that extends from the tip of nose to the glottis. The inherent tone of the muscles lining the airway tube and the tongue keeps it patent and unobstructed, thereby permitting entry of oxygen into the lung (**Table 1.1**).[1]

Voice or cry = Airway is stable

- Airway collapse occurs when consciousness is lost. The loss of inherent tone and posture of the airway tube contributes to the collapse. Falling back of the tongue worsens obstruction. Loss of airway protective reflexes (cough, swallow) aggravate obstruction by pooling of secretions. In the unresponsive victim, one or all the factors can cause an obstruction to the passage of air into the lungs.

Unresponsive + No voice = Airway is unstable

Unresponsive + No voice + Noise (heard or felt) = Airway is unstable obstructed (neurogenic stridor)

Table 1.1 Interpreting the airway

How to evaluate	Inference	Cause
Cry/voice/talk	Stable	Normal tone and posture of the muscles of the airway
Voice + Noise	Stable Obstructed	Structural obstruction of the upper airway
No voice (Unresponsive)	Unstable	Loss of tone and posture of the airway muscles causing collapse of the airway tube
No voice (Unresponsive) + Noise	Unstable Obstructed (Neurogenic stridor)	Obstructed airway with spontaneous breathing

■ Breathing

Effortless Tachypnoea

Tissue hypoperfusion leads to cellular hypoxia. Lack of oxygen results in anaerobic metabolism, leading to increased lactic acid formation and H^+ production. The ensuing fall in pH triggers the chemoreceptors in the respiratory centres in the brain, increasing (RR). The latter leads to CO_2 washout and normalization of pH. The lung parenchyma is normal (**Table 1.2; Fig. 1.3**).

Increased (↑) RR + No retractions = Effortless tachypnoea

Relative Bradypnoea

As compensation fails, RR starts falling to the normal range. Progressive slowing of RR due to respiratory muscle fatigue or decompensation manifests as "normal" RR **(Fig. 1.3).** Failure to recognize relative bradypnoea and intervene appropriately can result in respiratory arrest.[2] The PREM triangle is used to differentiate between normal and "relative bradypnoea."[1]

Unstable airway + RR "normal" range for age + Unresponsiveness = Relative bradypnoea

Retractions

Parenchymal or bronchiolar pathology (pneumonia, bronchiolitis, asthma, or congestive heart failure) causes recruitment of the accessory muscles of respiration. The work of breathing increases to meet oxygen demand.

Tachypnoea + Retractions = Respiratory distress

- Critical non-lung aetiologies, such as SE, sepsis, and scorpion and snake envenomation, cause ALI and POd due to CD. ALI and POd manifest clinically as respiratory distress.

Consider cardiogenic or non-cardiogenic POd if respiratory distress is noted in "non-lung" shock aetiologies.

Grunt (Video 1.1)

"Grunt" is an important sign differentiating respiratory failure from respiratory distress. An audible sound produced in the expiration phase of respiration, grunt is a physiological manoeuvre that generates PEEP.[3] PEEP helps to open alveoli during expiration, thereby ensuring improvement in oxygenation. Grunt also augments left ventricular function during spontaneous ventilation in severe left ventricular failure.[4] A predictor of increased risk of mortality,[5] grunt is an ominous sign of impending respiratory failure and hypoxaemia.[6]

Grunt + Respiratory distress = Impending respiratory failure

- Grunting respiration can rapidly progress to gasping or apnoea. It would be reasonable to presume that if grunt is noted, LOC is "Pain responsive" on the AVPU scale.

The severity score for "grunt" in the modified GCS for children is V2.[7] V2 correlates with "responsive to pain" on the AVPU scale.

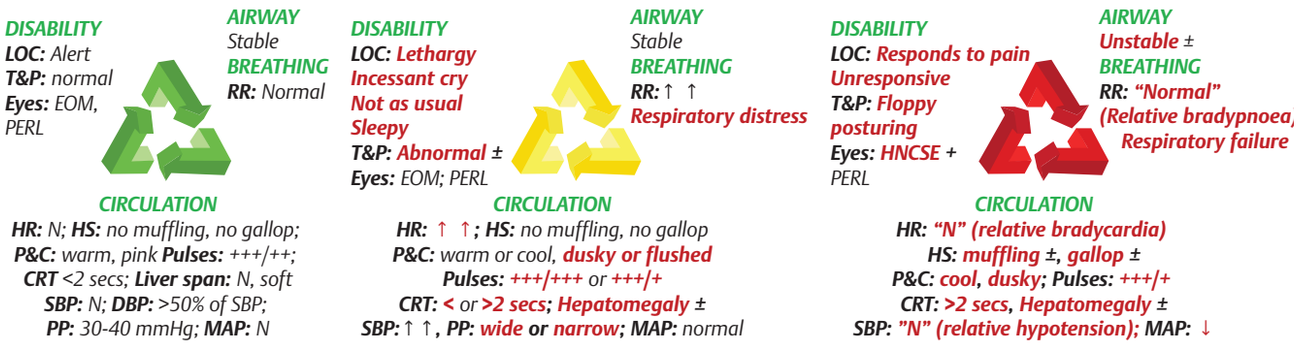

Fig. 1.3 PREM triangle to differentiate true normal from "normal looking but dangerous" vital signs.

PREM Triangle Acronyms

N - normal; "N" - in normal-range but caution as this may be abnormal in the clinical picture e.g. normal heart rate with signs of shock or respiratory failure = relative bradycardia; RR - respiratory rate; HR - heart rate; P& C - peripheries and colour; Pulses: + = weak / ++ = normal / +++ = bounding; CRT - capillary refill time; SBP - systolic blood pressure; PP - pulse pressure; MAP - mean arterial pressure; LOC - level of consciousness; ALOC - altered LOC; CSE - convulsive status epilepticus; NCSE - non-convulsive status epilepticus; HNCSE - hypoxic NCSE; ICP- intracranial pressure; T&P - tone and posture; EOM - extraocular movements; PERL - pupils equal and reactive.

- If the ***breathing side*** of triangle (grunt) and ***disability side*** are "pain responsive" anticipate that the ***circulation side*** of triangle is also affected **(Fig. 1.4).**

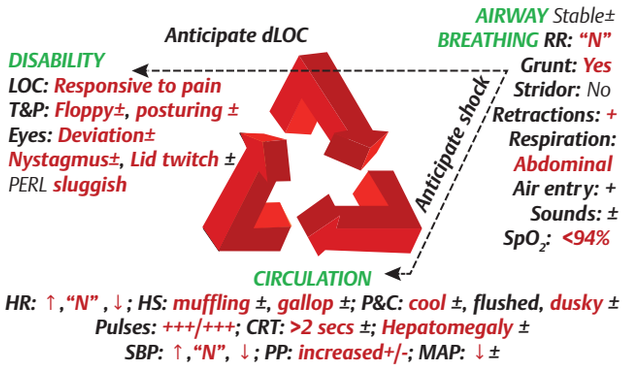

Fig. 1.4 PREM triangle: What to anticipate when you hear grunt.

- If a febrile child presents with dLOC and grunt, consider the possibility of POd + shock (cardiogenic shock) or pneumonia with shock.
- If grunt is noted in an asthmatic exacerbation, it is probably a near-fatal attack of asthma with shock.

Thoracic Respiration

This is a normal pattern in all ages (except the neonate) and is suggestive of normal intercostal muscle activity.

Abdominal Respiration

When intercostals fatigue, the diaphragm takes over the work of breathing. An ineffective form of ventilation, abdominal respiration is suggestive of impending respiratory failure.

RD + Abdominal respiration = Impending respiratory failure

Assessment of Breathing (Fig. 1.5)

Fig. 1.5 The mRCPCA[1] starts by placing both hands, palms down (one on the chest and the other on the abdomen). RR is counted for 6 seconds and multiplied by 10. Note the stooped posture of the physician. The proximity ensures that the physician can listen for stridor or grunt.

- Cyclical estimation of RR on arrival and after every intervention helps to recognize and provide respiratory support if relative bradypnoea or apnoea develops (**Video 1.2**).
- While counting listen closely for grunt and stridor (see above).
- Simultaneously look for retractions and pattern of respirations: thoracic or abdominal.
- Auscultate the infra-axillary region for air entry and added sounds.

Effect of Hypoxia on Circulation

- Tachycardia is an early response.
- Vascular tone is maintained between local vasodilator mechanisms which attempt to secure adequate blood flow for metabolic demand and neural vasoconstrictor reflexes that maintain arterial pressure.[8,9] Sepsis and hypoxic insults due to asthma, SE, submersion injury, etc. are potent vasodilators that are not affected by sympathetically mediated vasoconstriction. As hypoxia worsens, vasodilatory shock develops.[10]

Hypoxic respiratory failure can present with tachycardia; bounding pulses; warm, bright pink, flushed peripheries; and fall in diastolic BP and MAP.

- Cyanosis is a late sign.

Effect of Hypoxia on the CNS

- The mother's history of dLOC in a child with respiratory distress is the earliest symptom of cerebral hypoxia.
- As hypoxia worsens (e.g. bronchiolitis with respiratory failure or near-fatal attack of asthma), the child can develop conjugate deviation of eyes, nystagmus or eye lid twitch. Any one or a cluster of eye signs herald significant hypoxia. If hypoxia remains uncorrected, this can progress to cardiac arrest.
- Progression to unresponsiveness, apnoea, bradycardia, cardiogenic shock, hypotension, and HNCSE suggest lethal hypoxia.

Table 1.2 Interpretation of breathing

Respiratory rate	Normal for age	↑ for age	↑ for age	↑ for age	Normal for age (relative bradypnoea)	0
Grunt	×	×	×	+	±	×
Retractions	×	×	✓	✓	✓	×
Thoracic	✓	✓	✓	×	×	×
Abdominal	×	×	×	✓	✓	×
Inference	**Normal**	**Effortless tachypnoea**	**Respiratory distress**	**Impending respiratory failure**	**Relative bradypnoea**	**Apnoea**

■ Assessment of Circulation

- Avoid counting as soon as the stethoscope is placed on the precordium. Wait for the 2nd hand on the watch to touch the minute marking to start counting. Missing a count of one can result in loss of 10 beats per minute (**Fig. 1.6; Table 1.3**).

Fig. 1.6 Auscultate and count for HR for 6 seconds and multiply by 10.

Sinus tachycardia of 220–230 beats/min has been noted as compensatory response to hypoxia, shock, or seizures. Normalization of HR during resuscitation is one of the most reassuring signs of recovery. Anxiety, fever, and pain are other common triggers of tachycardia. To minimize the impact of anxiety on vital signs, assessment and resuscitation are performed on the mother's lap. Neonates may develop paradoxical bradycardia in response to shock.

HR falls to the "normal range" (relative bradycardia) as hypoxia or shock worsens[1] (Fig. 1.3).

- While counting, listen to the quality of heart sounds; is it too soft or easy to hear? Gallop? Muffling indicates severe CD. As the haemodynamic status improves, HS are better heard.

Relative bradycardia, absolute bradycardia, muffling, and gallop are suggestive of CD. An ominous finding preceding arrest, recognition of muffling or gallop on arrival or during resuscitation can help strategize urgent initiation of epinephrine infusion and intubation.

Core–Peripheral Temperature Gap (CPT Gap) (Fig. 1.7)

Fig. 1.7 CPT gap is estimated by placing the dorsum of one hand on the abdomen to feel its temperature, while sliding the dorsum of the other hand down the leg to the ankle. This helps to find out the difference in temperature.

- Peripheral vasoconstriction of vessels furthermost from the heart (lower limb) diverts blood to the vital organs, resulting in cool peripheries. As shock worsens, coolness progresses proximally. On the contrary, warm peripheries may herald vasodilatory shock, especially in hypoxic insults and sepsis.
- CPT gap is rated as cool below the ankle, cool below the knee, cool below the thigh, or warm throughout.

Comparison of Pulses (Fig. 1.8)

Fig. 1.8 In young infants, the index finger is placed snugly into the inguinal region to feel the femoral (central) pulse, while three fingers of the other hand are placed perpendicularly on the dorsum of the foot to feel the dorsalis pedis. In older children, the tip of the index and middle fingers are used to palpate the femoral pulse.

- Based on their strength, the pulses are rated as shown in **Table 1.3**.

Table 1.3 Interpretation of pulses

Femoral pulse	Dorsalis pedis (DP)	Pulse pressure	Inference
+++	++	30–40 mm Hg	Normal
+++	+++	>50 mm Hg	Vasodilation (wide pulse pressure shock)
+++	+	<40 mm Hg	Narrow pulse pressure shock
+++	***0****	***Not recordable***	***Hypotensive shock***
+ or 0	0	Not recordable	Imminent arrest
0	++	Variable	Coarctation of aorta with collaterals

Note: **DP may not be palpable in 12% of the population due to normal anatomical variation (other variables and the overall physiological status will be normal).*

Colour (Fig. 1.9)

Fig. 1.9 Compare the colour of the sole with your palm. Check whether it is ashen, dusky, pale (cool shock), or flushed (vasodilatory shock).

Capillary Refill Time (Fig. 1.10)

Fig. 1.10 Elevate limb above the level of the heart to let it blanch. In a normal child, CRT is almost immediate. A delay or rapid refill time is evidence of warm or cool shock if the other parts of the triangle are abnormal.

Caveats: In a cold environment, neonates and young infants might present with prolonged CRT, dusky colour, and cool peripheries. In the absence of mother's history of dLOC, tachypnoea, and tachycardia, the diagnosis of shock is unlikely.

- In vasodilatory shock the warm, pink, well-felt pulse mimics normal perfusion. Mum's history of dLOC, careful evaluation of the DBP and the other parts of the triangle helps to differentiate normal perfusion from vasodilatory shock.

Flushed sole + Warm periphery + Rapid CRT + Wide pulse pressure, low diastolic BP + dLOC + Respiratory distress = Warm shock

Liver Span (Fig. 1.11a, b)

Fig. 1.11 (a) Place the palm of the dominant hand parallel to the right costal margin, starting from the inguinal region and progressing upwards. Mark with a pen, wherever the liver edge is palpated. **(b)** Percuss the upper border, downwards from the 2nd intercostal space. Wherever dullness is felt, mark the upper border, drawing a horizontal line. Measure the span using a measuring tape in the mid-clavicular line.[9]

Congested liver is a marker of CD. Identification of hepatomegaly aids in determining whether RD is heart failure or not.[2,11]

- The normal lower border is soft and difficult to palpate. If not palpable, the margin of the right

costal margin is taken as the reference. The edge of the congested liver is easy to feel. Note whether edge is firm or not.

Monitored on arrival and at every step of resuscitation, regression of hepatomegaly during fluid resuscitation for shock occurs as pre-load improves cardiac contractility.[11]

Caveat: Pneumothorax and pleural effusion can obliterate the upper border. Congenital diaphragmatic hernia, causing shift of the mediastinum, can also prevent clear demarcation of the lung and the liver.

A vital sign card, with values of normal liver span[12] for the age, is used to interpret this indirect indicator of cardiac function **(Table 1.4).**

Table 1.4 Liver span for age

Age	Span (cm)
Birth	5.6–5.9
2 mo	5
1 year	6
2 years	6.5
3 years	7
4 years	7.5
5 years	8
12 years	9

Blood Pressure (BP)

An age-appropriate BP cuff is tied on arrival and reassessed manually by a designated member of the team. Covering two-thirds of the upper arm, the correct size BP cuff is essential to obtain the right value. BP is reassessed and announced after every intervention. It includes four variables: systolic BP (SBP), diastolic BP (DBP), PP, and MAP.

- A dramatic increase in SBP occurs in early hypoxia, shock, or SE. As the physiological status improves, SBP normalizes. If decompensation sets in, SBP falls to the "normal" range.

If a child who is responsive to pain or worse, has bradypnoea, is bradycardic, and the SBP is within the normal range, consider "relative hypotension."

- Normal DBP is more than 50% SBP; PP is between 30 and 40 mmHg. PP widens and DBP drops as vasodilation develops.

Vasodilatory shock is the final common pathway for long-lasting and severe shock of any cause.[10]

Effect of Shock on the CNS (see below)

Interpretation of circulation is given in **Table 1.5**.

■ Disability

To assess decrease in level of consciousness, refer **Table 1.6.**

Table 1.5 Interpretation of circulation

Heart rate	Normal for age	Tachycardia with warm shock	Tachycardia with cool shock	Relative bradycardia	Bradycardia
Muffled?	×	×	±	✓	✓
Gallop	×	±	±	±	–
Core–peripheral temperature gap	Warm	Warm	Cool below ankle	Cool below ankle	Below knee/thigh
Comparison of femoral with dorsalis pedis	+++/++	+++/+++	+++/+	+++/+ +++/–	+++/0 ++/0
Colour	Normal	Flushed	Dusky	Abnormal	Abnormal
CRT	<2 seconds	Rapid (<<2 seconds)	>2 seconds	>2 seconds	>2 seconds
Liver span	Normal	Normal / hepatomegaly	Normal/ hepatomegaly	Hepatomegaly	Hepatomegaly
Is liver firm?	×	±	±	±	✓
SBP	Normal	High	High	Low normal	Low
DBP	Normal	Low	Low/Normal	Low	Not recordable
Pulse pressure	40 mmHG	Wide	Wide/Narrow	Wide/Narrow	Not recordable
MAP	Normal for age	High/Normal	High/Normal	Low	Not recordable
Inference	**HR: N** **Perfusion: No shock** **Liver span: N** **SBP: N** **PP: N** **MAP: N**	**HR: ↑** **Perfusion: Shock** **Hepatomegaly±** **SBP: ↑** **PP: Wide** **MAP: ↑ or N**	**HR: ↑** **Perfusion: Shock** **Hepatomegaly ±** **SBP: ↑** **PP: Wide/N** **MAP: ↑ or N**	**HR: "N" for age ±** **Perfusion: Shock** **Hepatomegaly ±** **SBP: "N" for age ±** **Pulse pressure: wide/narrow** **MAP: ↓**	**HR: ↓** **Perfusion: Shock** **Hepatomegaly** **SBP: ↓**

Table 1.6 Interpreting disability

Level of consciousness	Alert	Responsive to voice	Responsive to pain	Unresponsive
Tone and posture	Normal	Normal	Abnormal	Abnormal
Eye position	Mid-position	Mid-position	±	±
Conjugate deviation	×	×	±	±
Nystagmus	×	×	±	±
Lid twitch	×	×	±	±
Pupils: Response to light **Other findings**	PERL	PERL	Sluggish Unequal/Pinpoint	Sluggish Unequal/Pinpoint
Generalized tonic-clonic seizures (GTCs)	Nil	Nil	Nil	+
Inference	No ALOC	ALOC	ALOC + Non-convulsive status epilepticus ±	ALOC + Convulsive status epilepticus ICP ±

Definition: *A decreased consciousness level is defined as being responsive only to voice, or pain, or being unresponsive on the AVPU scale, or a GCS or modified GCS of 14 or less.*[12]

- The commonest causes for acute dLOC in the OPD is hypoxia (due to bronchiolitis or asthma or pneumonia) or shock due to diarrhoea, sepsis, or anaphylaxis.
- Discerning between "responsive to voice" and "alert" in busy OPD settings is a challenge, especially in pre-communicative infants.[2]

The mother's intuition can be tapped to recognize an early subtle drop in mental status.

Responsive to Voice

- Children under 18 months do not reliably obey commands because their receptive language is not sufficiently developed.[13]

Although difficult to standardize early dLOC, incessant cry, lethargy, excessive sleepiness, or "not as usual" helps to rapidly identify and triage children with shock.[11]

- If the mother reports dLOC, document "Responsive to voice" and perform a meticulous mRCPCA to rule out hypoxia or shock (it takes only a minute). At this stage, tone and posture are normal. If the child is unable to maintain normal tone and posture, consider "responsive to pain" **(Fig. 1.12a–d).**

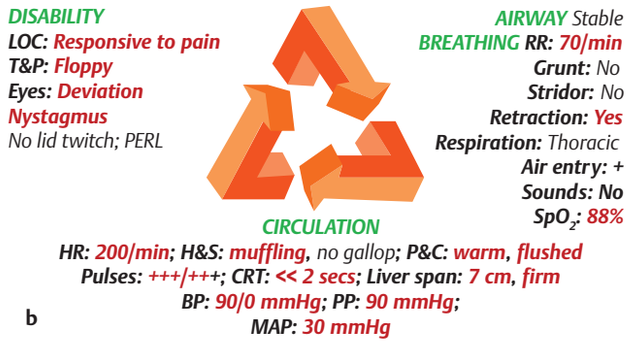

Fig. 1.12 **(a)** Febrile child reports decreased level of consciousness and breathlessness. **(b) A:** Stable; **B:** Respiratory distress; **C:** Tachycardia, vasodilatory cardiogenic shock with low MAP; **D:** dLOC with hypoxic NCSE.

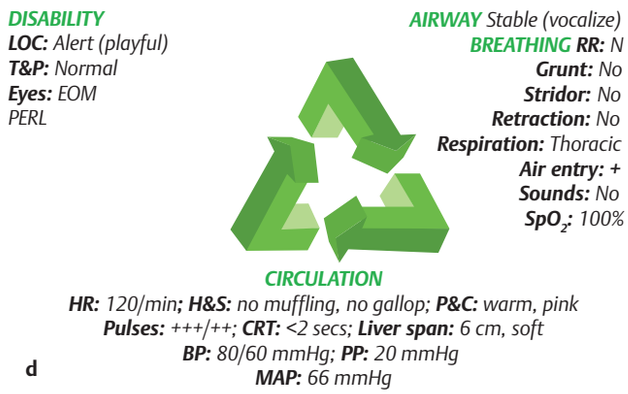

Fig. 1.12 **(c)** Post O_2 via JR, 50 mL/kg NS and dopamine infusion, the infant has become alert with normal tone and posture. **(d) A:** Stable; **B:** Normal; **C:** HR normal, no shock, MAP is normal; **D:** Alert.

Dismissing as "child looks OK, mother is fussy" has often resulted in fatal delay in resuscitation.

Caveat: Confirm whether crying is truly inconsolable. Precipitated by multiple reasons, crying can occur due to anxiety, stranger distress, need for cuddling, wet nappy, teething, thirst, hunger, etc. Check to find out whether parents have attended to these causes.

Responsive to Pain

- Children under the age of 9 months cannot consistently localize a painful stimulus.[14] A drop in mental status associated with altered tone and posture is characteristic of "P" (responsive to pain).

Acute onset of posturing, flexor or extensor stiffening, upward gaze, sudden hypotonia, and squirming in children presenting with diarrhoea, fever, and breathlessness are characteristics of "pain responsive."

- Older children with fever, AWD, or breathlessness, who are unable to walk without support, are carried into the OPD, or lie quietly when their parents are out of sight should be considered to have a mental status which has dropped to "P."[2]

Fighting the oxygen mask, agitation, combativeness,[11] abusive, or desperately asking for water indicates pre-terminal drop in LOC in children presenting with hypoxia and shock due to sepsis or near-fatal asthma.

Unresponsive

- Often, seriously ill children are mistaken to be "sleeping" (**Video 1.3**). Unresponsiveness with hypotonia or GTCs or extensor posturing could be signs of cardio-respiratory failure.
- NCSE has been reported in aт third of hypoxic-ischaemic patients in PICU.[15] As hypoxia improves, these findings resolve, resulting in normal eye position and movements (**Video 1.4**).[2]

*Checking for eye position and movements at every step of resuscitation aids in identification of NCSE, not only in SE but also in severely hypoxic and shocked children[1,2] (**Fig. 1.13**).*

Fig. 1.13 Hold the torch as close to the eyes as possible. Approach from lateral to medial to observe the response to light. Concurrently examine the eyes for position and movements.

- As hypoxia or shock improves, pupillary response to light will improve. Unequal pupils are suggestive of uncal herniation in the unresponsive child.

Step 2: Documentation

- The findings of the mRCPCA are immediately documented in a pre-formatted case record after every drug, bolus, intubation, cycle of chest compression, cardioversion, etc.
- Positive findings are encircled, and negative findings are scored out. As resuscitation progresses, the 60-second assessment is repeated and re-documented until every clinical variable of hypoxia, shock, CD, and SE or raised ICP have resolved.
- Each set of variables is compared with the previous assessment.

This process aids the novice physician to find out whether an individual variable has resolved, worsened, or improved. Progressive improvement in the individual variables of the mRCPCA is suggestive that resuscitation decisions have been appropriate. Variables that remain unchanged or have worsened are ominous, indicating progressive severity of the illness or inappropriate decisions (see **Annexure 1** and **2**) (**Video 1.5**).

Step 3: Interpretation of Vital Signs

The ability to understand and document, whether the vital signs are truly normal or falling to the "normal" range, is crucial.

- Vital signs change with age, and the normal HR and RR values seem to differ significantly within existing published data.[16]
- Differentiation of true normal versus ***relative*** bradypnoea, bradycardia, or hypotension (often pre-terminal signs) provides the 60-second advantage in the race against death. Measures such as discontinuing the drug or intervention that preceded these findings, initiating epinephrine, and planning intubation, can help prevent a potential catastrophe.
- If vital signs are truly normalizing, the other parts of the triangle also improve. The analysis of vital signs requires use of a memoire card (**Video 1.6**).

Step 4: Derivation of the Physiological Status Using the PREM Triangle (See Annexure 3)

Key Points

- The PREM process is based on four steps: (1) Assessment of the mRCPCA, (2) documentation, (3) interpretation of vital signs, and (4) derivation of physiological status using the PREM triangle.
- Anticipating and taking corrective steps when signs of POd, CD, and/or NCSE (orange triangle) are observed help to avoid preventable mortality.
- The four steps are repeated after every critical care intervention until therapeutic goals are achieved.
- Every variable is compared with the previous assessment for improvement, status quo, or deterioration to evaluate trend.
- The process is activated by the mother's history of "not OK."

Common Errors

- Lack of ***practice*** in the skills needed to implement the PREM process can delay time-sensitive resuscitation.
- Failing to have a sense of urgency that "cardiac arrest is just around the corner" in every resuscitation.

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Paediatric Resuscitation & Emergency Medicine Case Record

Name:	**Age/Sex:**	**Weight:**
Date:	**Development:**	**Temperature:** @
Time of Arrival:	**Time of Transfer:**	**CBG:** @
Brought by: Parent/Ambulance/others	**Emergency Registration No.:**	**OP No.:**

Primary Complaints:
1) **Breathlessness**/episodic/acute on chronic
2) **Unresponsive**/GTCS/Posturing/upward gaze
Time: Where: Regained basal level: Yes/No
Precipitating events:
Fever URI/AWD/Vomiting/Noise/FB
Abdominal pain/distension/GI bleed
Jaundice/Rash/Skin bleed

Duration
Snake/Scorpion
Submersion/Toxin
Fall/RTA/Assault/Trauma
ALOC after precipitating event:
Incessant cry/Lethargy/Not as usual/
More sleepy

Past History
CVS: CHD/RHD/CMY
CNS/Seizure/NDD/Malformation
Renal/Liver disease/Malformation
RS: AB/ILD/Malformation/TB
Metabolic/Malignancy/Blood
Bottle feed/PLHA/Sib death
Drugs

Cardiopulmonary cerebral assessment:
Airway: Stable/Unstable/Obstructed/ET
Breathing: RR
Nasal flare/Grunting/Stridor/Retractions
Abdominal/Thoracic/Air-entry
Rales/Wheeze
Color: Normal/abnormal/Flushed
Circulation: HR
Sounds: Muffled/gallop
Pulse volume
Cool below thigh/knee/ankle/warm
CRT
Liver span: Firm/Normal BP mmHg
Disability:
Alert/Verbal/Pain/Unresponsive GTCS
Pupils
Eyes: Mid position/Conjugate Deviation
Lid twitch/Nystagmus
DEM/EOM
Tone/posture
SaO_2

O_2: NRM/BVM/JR/ET
Neb: Salbutamol/Ipratropium Bromide
Inj. Hydrocortisone/T. Prednisolone
Inj. Dexamethasone

ECM: 15: 2

Pre-Hospital Resuscitation
A
B
C
D
Others

Circulation	Dose/kg	Total	Time
Fluids: NS/RL			
Epinephrine bolus			
Epinephrine infusion			
Dopamine			
Disability			
10% GDW			
Lorazepam			
Midazolam			
Fos-PHT			
Levetiracetam			
10% Calcium			
Paracetamol			
Antibiotic			
Ondansetron			
Vit K			

Others

Physiological Status:

Airway: stable	**Breathing: Normal**	**Circulation: HR N/Perfusion N**	**Disability: Nil**
Not stable	**Effortless tachypnoea**	**Tachycardia/Relative brady/brady**	**ALOC**
Obstructed	**Respiratory distress/Failure**	**Shock/Liver span N/Hepatomegaly**	**CSE/NCSE**
ET	**Relative Bradypnoea**	**Cardiogenic shock**	**ICP**
Tracheostomy	**Apnoea**	**Systolic BP N/Low/High**	
		Pulse pressure: N/Wide/Narrow	
ABG:		**MAP: N/Low**	

CXR:

CT

Time				
HCT				
Platelet count				

CBC
RFT
LFT
Electrolytes
Lactate

USG/ECHO

Annexure 1

Emergency Critical Care Data Flow Sheet

Name: **Age:** **Sex:** **Wt:** **Emergency Reg. No.:**

Date/Time						
Symptoms						
Airway						
RR						
Grunt/Stridor						
Retractions						
Abdominal/thoracic						
Air entry						
Added sounds						
Color						
SaO_2						
HR						
Muffled/Gallop						
Central/Distal pulse						
CPT gap						
CRT						
Liver span						
BP						
AVPU						
Pupils						
Eye deviated/MP						
Nystagmus						
Lid twitch						
DEM/EOM						
Tone/Posture						
Fits						
Urine output						
Physiological Status	**Airway**					
	Breathing					
	Circulation					
	Disability					
Interventions	**A:**					
	B:					
	C: Fluids Dopa/Dob Nor-Epi/Epinephrine					
	D: Anti-fit/3%NS					
	Others					
	Total volume/kg					
	No. of drug					
	Inotrope trigger					
	ET trigger					

Annexure 1 (*continued*)

PREM Triangle: Recognition of Relative Bradypnoea, Relative Bradycardia & Relative Hypotension

Normal

DISABILITY
LOC: *Alert*
T&P: *Normal*
Eyes: *EOM*
Pupils: *PERL*

AIRWAY *Vocalize*
BREATHING ***RR:*** *N*
Grunt, stridor: *No*
Retractions: *No*
Respiration: *Thoracic*
Bilateral air-entry: *Yes*
Added sounds: *No*
SpO_2: *>94%*

CIRCULATION
HR: *N*; ***HS:*** *No muffling, no gallop*; ***P&C:*** *Warm, pink*
Pulses: *+++/++*; ***CRT:*** *<2 seconds*; ***Liver span:*** *N*
SBP: *N*; ***DBP:*** *>50% of SBP*; ***PP:*** *30–40 mmHg*; ***MAP:*** *N*

NORMAL VITAL SIGNS

Age	*Weight (kg)*	*Respiratory rate (BPM)*	*Heart rate (BPM)*	*SBP (mm Hg)*	*MAP (mm Hg)*
Neonate	3.5	30–60	90–180	50–70	45
6 months	7	24–40	85–170	65–106	
1 year	10	20–40	80–140	72–110	
3 years	14	20–30	80–130	78–114	50
6 years	20	18–25	70–120	80–115	
8 years	25	18–25	70–110	84–122	60
10 years	30	16–20	65–110	90–130	
12 years	30–40	14–20	60–110	94–136	65

NORMAL LIVER SPAN

Age	*Liver span (cm)*
2 months	5
1 year	6
2 years	6.5
3 year	7
4 years	7.5
5 years	8
12 year	9

Progressive Hypoxia/Shock

↓

Compensatory mechanisms: ↑ Respiratory rate (RR), ↑ Heart rate (HR) and ↑ Systolic blood pressure (SBP).

↓

Compensation fails: RR↓, HR↓ and SBP↓ fall to "normal range for age."

VITAL SIGNS (NORMAL RANGE) ARE *FAILING* (RELATIVE BRADYPNOEA, BRADYCARDIA, HYPOTENSION) IF OTHER PARTS OF TRIANGLE ARE *ABNORMAL*

DISABILITY
LOC: *Pain or unresponsive*
T&P: *Posturing ±, floppy ±, GTCs ±*
Eyes: *Conjugate deviation ± lid twitch ±, nystagmus ±*
Pupils: *sluggish*

AIRWAY *Unstable ±, obstructed ±*
BREATHING ***RR:*** *"Normal" for age*
Grunt ±; stridor ±
Retractions: *±*
Respiration: *Abdominal ±*
Air-entry: *Bilateral*
Added sounds: *±*
SpO_2: *≤94% ±*

CIRCULATION
HR: *"Normal" for age*; ***HS:*** *muffling ±, gallop ±*; ***P&C:*** *cool, dusky*
Pulses: *++/0, +++/0*; ***CRT:*** *>2 seconds*; *Hepatomegaly*
SBP: *"Normal" for age*; ***MAP:*** *Low*

- ***Being reassured by "normal" vital signs on the monitor can be misleading and dangerous.***
- ***PREM Process: Repeated cardiopulmonary cerebral assessment, documentation, interpretation of vital signs, and derivation of physiological status (PREM triangle) are crucial to determine whether vital signs are "normal" or not. It also provides information on the trend & change in haemodynamic status.***
- ***Although, SBP may be normal or high, if diastolic BP is <50% of SBP and MAP (for age) has fallen, consider HYPOTENSION.***

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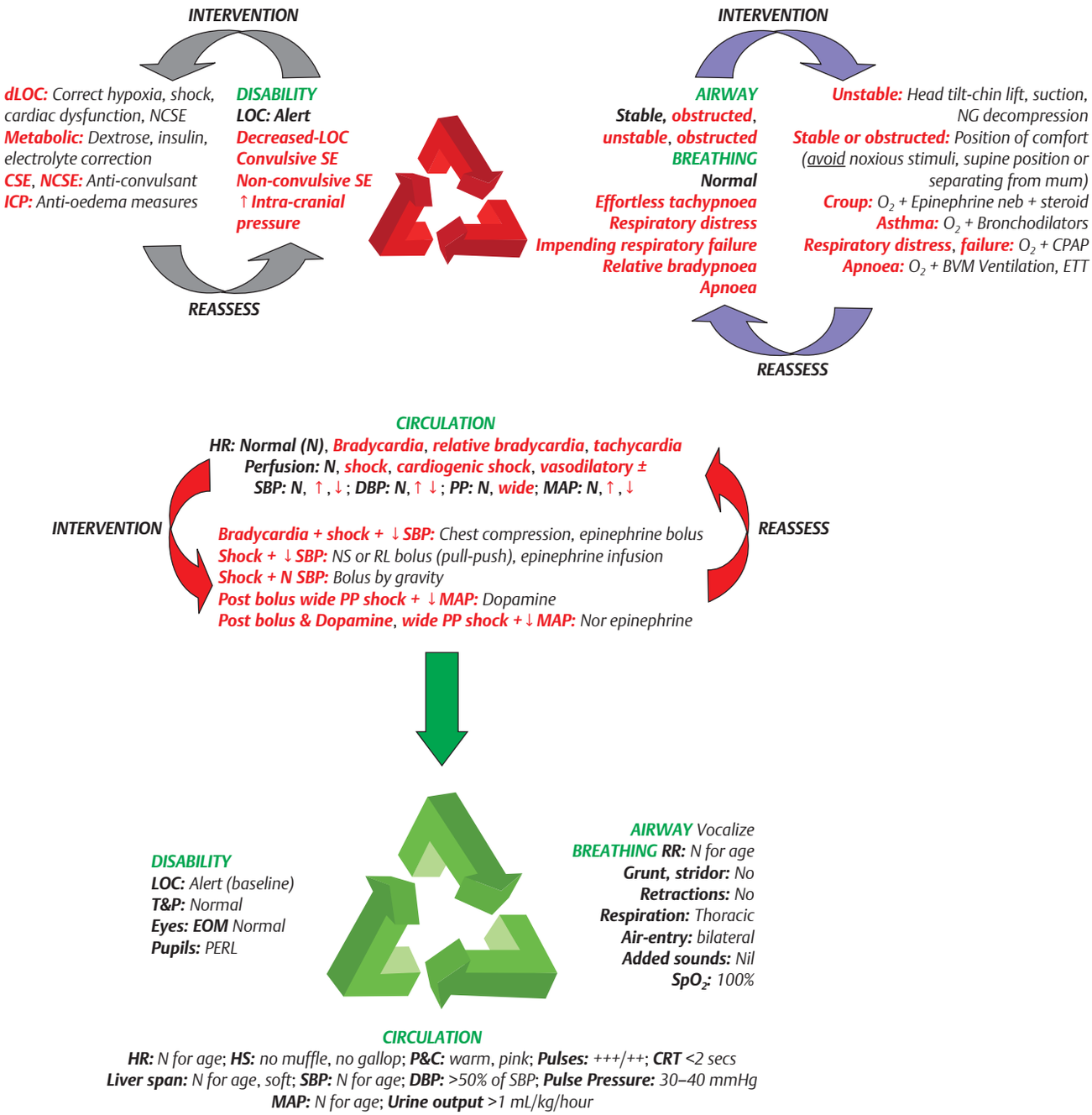
PREM Triangle: Decision-Making Tool for Resuscitation



PREM Process: After every intervention (bronchodilator, fluid bolus, intubation, anti-convulsant etc.), perform the 1-minute modified rapid cardio-pulmonary-cerebral assessment, document, interpret vital signs and derive physiological status to decide the next step. Even if 1 sign of deterioration is noted, interrupt current intervention and reconsider. If all variables show improvement, continue till therapeutic goals are achieved (green triangle).

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Annexure 2

Triage & Resuscitate Using PREM Triangles

NORMAL PHYSIOLOGICAL STATUS

DISABILITY
LOC: *Alert*
T&P: *N*
Eyes: *EOM*
PERL

AIRWAY *Stable (vocalizes)*
BREATHING ***RR:*** *N*
Grunt, stridor: *No*
Retractions: *No*
Respiration: *Thoracic*
Air-entry: *+*
Added sounds: *No*
SpO_2: *>94%*

CIRCULATION
HR: *N (for age)*; ***HS:*** *No muffling or gallop*; ***P&C:*** *Warm, pink sole of foot*
Pulses** *+++/++*; ***CRT: *<2 seconds*; ***Liver span:*** *N*; ***Blood Pressure: SBP N***
Diastolic BP: *<50% SBP*; ***Pulse Pressure:*** *30-40 mm Hg*, ***MAP:*** *N*

**Pulses: Femoral (F) & Dorsalis Pedis (DP) +++/++ means both normal volume*
Note: +++/+++ F = DP; ++/0 or +/0 = weak FP but no DP

PREM Terminology & Definitions:

- ***Breathing normal** = Normal RR + normal work of breathing*
- ***Respiratory distress** = Increased RR + retractions*
- ***Impending respiratory failure** = Grunt + respiratory distress*
- ***Relative bradycardia** = Heart rate within normal range for age whilst other sides of the triangle are abnormal*
- ***Wide pulse pressure** = SBP-DBP >40 mm Hg*
- ***Vasodilatory shock** = DBP <50% SBP + wide PP with or without low MAP*
- ***Mean arterial pressure** = DBP + one-third pulse pressure*
- ***Liver span** = Mark lower border along right costal margin, percuss & mark upper border for liver dullness. Measure span (cm) in the mid-clavicular line. Check lower border & remeasure span after every intervention.*
- ***Non-convulsive status epilepticus** = LOC: Responsive to pain or unresponsive + 1 or more abnormal EOM: Conjugate deviation, nystagmus, lid twitch*

RESPIRATORY DISTRESS

DISABILITY
LOC: *Alert*
T&P: *N*
Eyes: *EOM*
PERL

AIRWAY *Stable*
BREATHING ***RR:*** ↑
Grunt, stridor: ±
Retractions: *+*
Respiration: *Thoracic*
Air-entry: *+*
Added sounds: ±
SpO_2: *>94%*

CIRCULATION
HR: ↑ ±; ***HS:*** *N*; ***P&C:*** *Warm, pink*; ***Pulses:*** *+++/++*
CRT: *<2 seconds*; *No shock*; ***Liver span:*** *N*
SBP: *N*; ***DBP:*** *N*; ***PP:*** *N*; ***MAP:*** *N*

CARDIAC FAILURE

DISABILITY
LOC: *Alert*
T&P: *N*
Eyes: *EOM*
PERL

AIRWAY ***Stable***
BREATHING ***RR:*** ↑
Grunt, stridor ±
Retractions: *+*
Respiration: *Thoracic*
Air-entry: *+*
Added sounds: ±
SpO_2: *>94%*
(Exception: CCHD)

CIRCULATION
HR: ***Tachycardia***; ***HS:*** *N*; ***P&C:*** *Warm, pink or dusky*
Pulses: *+++/++*; ***CRT:*** *<2 seconds*; *No shock*;
Hepatomegaly; ***SBP:*** *N*; ***DBP:*** ***low***
PP: ***Wide*** *(shunt lesion)*; ***MAP:*** *N*

VASODILATORY CARDIOGENIC SHOCK (MAP N)

DISABILITY
LOC:
Incessant cry ±
Not usual self ±
Lethargic ±
Sleepy ±
T&P: *N*
Eyes: *EOM*
PERL

AIRWAY ***Stable***
BREATHING ***RR:*** ***N***
Grunt, stridor: ±
Retractions: *+*
Respiration: ***Abdomnal*** ±
Air-entry: *+*
Added sounds: ±
SpO_2: ***≤94%*** ±

CIRCULATION
HR: ***Tachycardia***; ***HS:*** ***muffling*** ±, ***gallop*** ±
P&C: ***Warm***, ***pink***; ***Pulses:*** ***+++/+++***; ***CRT:*** ***instant***; ***Shock***
Hepatomegaly ±; ***SBP:*** ↑ ; ***DBP:*** ↓ ; ***PP:*** ***Wide***; ***MAP:*** *N*

Annexure 3

RESPIRATORY FAILURE (RESPIRATORY EMERGENCIES)

DISABILITY
LOC: Responds to pain Agitated Combative Fighting mask
T& P: Floppy Posturing ±
Eyes: NCSE ±
PERL

AIRWAY
Unstable
BREATHING RR: ↑ ↓
Grunt, stridor: ±
Retractions: +
Respiration: abdom ±
Air-entry: ±
Added sound: ±
SpO_2: ≤94% ±

CIRCULATION
HR: Tachycardia; **HS:** N; **P&C:** Warm, pink
Pulses: +++/+++; **CRT:** <2 seconds; **Shock** +
Liver span: N; **SBP:** N; **DBP:** ↓; **PP:** Wide; **MAP:** N

VASODILATORY CARDIOGENIC LOW MAP SHOCK

DISABILITY LOC:
Responds to pain
Thirsty, agitated
Combative
Fighting mask
T&P: Floppy ±
Posturing ±
Eyes: NCSE ±
PERL

AIRWAY: Unstable±
BREATHING RR: ↑ ↓
Grunt, stridor: ±
Retractions: +
Respiration: Abdominal
Air-entry +
Added sounds: ±
SpO_2: ≤94% ±

CIRCULATION
HR: Tachycardia/relative bradycardia
HS: muffling ±, gallop ±; **P&C:** Warm, pink
Pulses: +++/+++; **CRT:** instant; **Shock**; Hepatomegaly ±
SBP: N; **DBP:** ↓; **PP:** Wide; **MAP:** N

LOW SBP SHOCK

DISABILITY LOC:
Responds to pain
Thirsty, agitated
Combative
Fighting mask
T&P: Floppy
Posturing ±
Eyes: NCSE ±
PERL

AIRWAY: Unstable
BREATHING RR: ↑ ↓
Grunt, stridor: ±
Retractions: +
Respiration: Abdominal
Air-entry: +
Added sounds: ±
SpO_2: ≤94% ±

CIRCULATION
HR: ↑ ↓; **HS:** muffling ±, gallop ±
P&C: Cool, dusky; **Pulses:** ++/+, ++/0 or +/0
CRT: >2 seconds; **Shock**; Hepatomegaly ±
SBP: ↓; **MAP:** ↓

IMMINENT ARREST

DISABILITY
LOC: Unresponsive
T&P: Floppy
Posturing; GTCS ±
Eyes: NCSE ±
Pupils: Sluggish

AIRWAY Unstable
BREATHING
Bradypnoea or apnoea
Little/no respiratory effort
Reduced or absent breath sounds
SpO_2: ≤94% ±

CIRCULATION
HR: ↓; **HS:** muffled ±, gallop ±; **P&C:** Cool, dusky
Pulses: ++/0 or +/0; **CRT:** >>2 seconds; **Shock**
Hepatomegaly; **SBP:** ↓; **MAP:** ↓

Note:
All Normal (N), Increased (↑) or Decreased (↓) values are interpreted with respect to normal ranges for age

RR: Respiratory Rate
HR: Heart Rate
HS: Heart Sounds
P&C: Peripheries (warmth) & Colour (foot-sole)
LOC: Level of Consciousness
T&P: Tone & Posture
EOM: Extra Ocular Movements
PERL: Pupils Equal, Reacting to Light
SBP: Systolic Blood Pressure
DBP: Diastolic Blood Pressure
PP: Pulse Pressure
MAP: Mean Arterial Pressure
NCSE: Non-Convulsive Status Epilepticus
GTCS: Generalised Tonic Clonic Seizures
CCHD: Cyanotic Congenital Heart Disease

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