SINGAPORE PAEDIATRIC BASIC AND ADVANCED LIFE SUPPORT UPDATES 2021

Gene Ong

KKH Children's Emergency, Singapore

Infant Mortality

Child mortality by income level of country

The child mortality rate measures the share of children that die before reaching the age of 5.

Our World in Data

Singapore - Under-five mortality rate

2.5

(deaths per 1,000 live births)

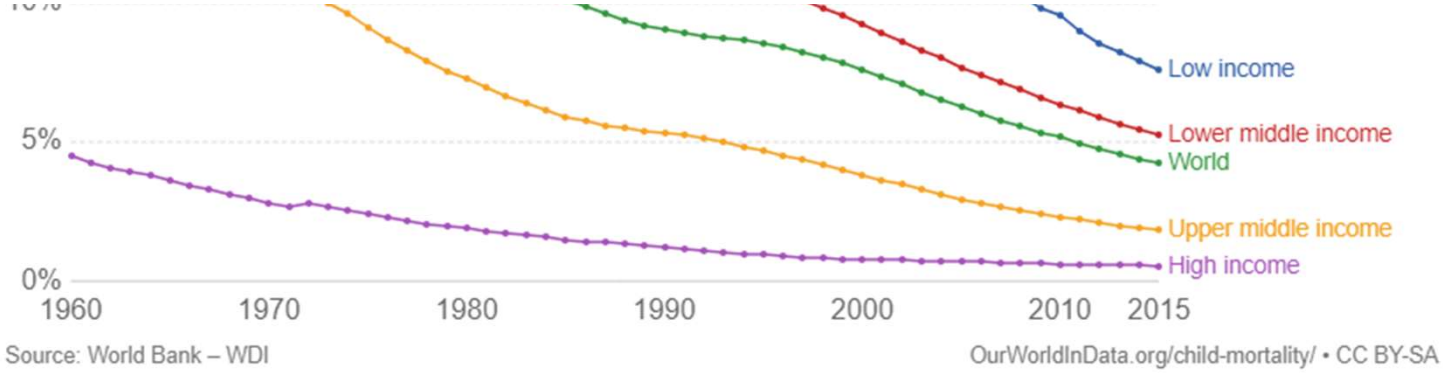
in 2019

In 2019, child mortality rate for Singapore was 2.5 deaths per 1,000 live births. Child mortality rate of Singapore fell gradually from 27.1 deaths per 1,000 live births in 1970 to 2.5 deaths per 1,000 live births in 2019.

The description is composed by our digital data assistant.

What is child mortality rate?

Under-five mortality rate is the probability per 1,000 that a newborn baby will die before reaching age five, if subject to current age-specific mortality rates.



Source: World Bank – WDI

OurWorldInData.org/child-mortality/ • CC BY-SA

Paediatric Resuscitation Guidelines

- Changes noted in terms of age definitions by ERC and AHA

- Divergence of International guidelines on paediatric life support
  - Ventilation rates post intubation
    - Previously both ERC and AHA, post advanced airway placement during paediatric cardiac arrest, ventilation rate is the same for all ages: 10/min
    - 2021 ERC: <1year-25/min, 1-8years:20/min, 9-12years: 15/min, >12years:10/min
    - 2020 AHA: 20-30/min for paediatric age group

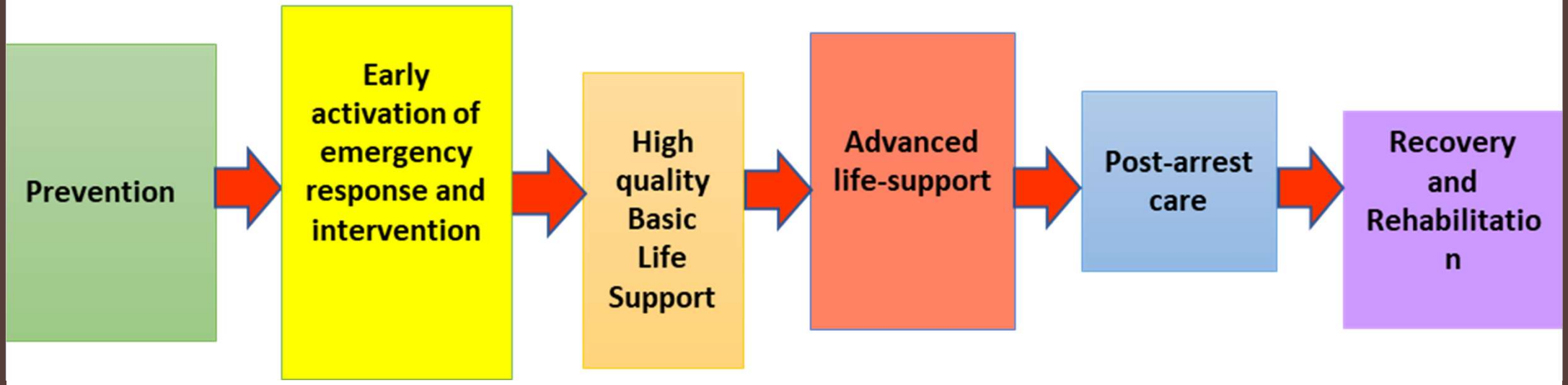
- Emphasis on early EMS or code activation
  - EMS activation “995”
  - Dispatch assistance
  - Activation of volunteers nearby – more help and getting AED

Pediatric Chain of Survival

prevention | Early CPR | EMS | Rapid PALS | Intergrated Post-cardiac Arrest care

Berg, M. D. et al. Circulation 2010;122:S862-S875

DECREASING EVIDENCE – BASED EFFECTIVENESS

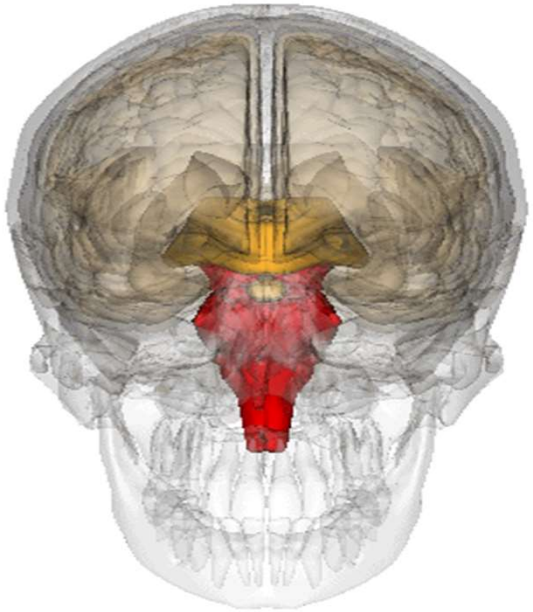


PAEDIATRIC CHAIN OF NEUROLOGICALLY-INTACT SURVIVAL

Outcomes

- **Return of Spontaneous Circulation**

- **Survival to ICU/Hospital Discharge**



Do not neglect PREVENTION AND EARLY RECOGNITION

- Most effective means
- Multi-dimensional
- Paediatricians should be community advocates for child health
  - Immunisation
  - Education
  - Training

By Lydia Lam
@LydiaLamCNA

Open verdict in death of baby found not breathing on mattress, coroner flags safe sleeping practices

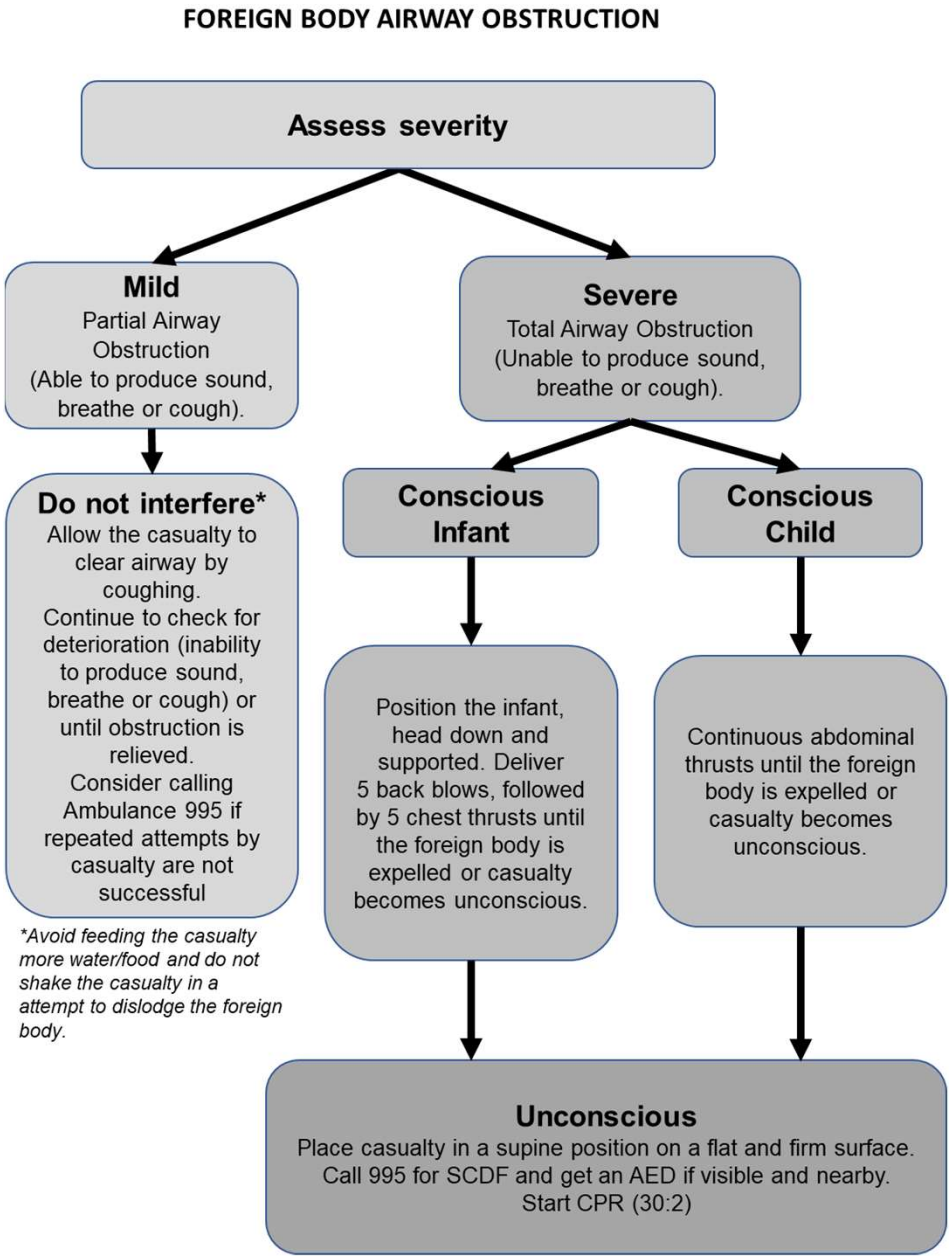
13 Oct 2020 11:18AM
(Updated: 24 Oct 2020 08:32AM)

5-year-old drowns while unattended in Bukit Timah condo pool; mum went home to cook and use toilet

Girl had only 3 swimming lessons and wasn't proficient enough to keep herself afloat

FABO

- No change from 2016
- Call for help “995”
- If willing and able, provide CPR with ventilation if unconscious
- While for paediatrics, caregivers are likely nearby and may be more willing to provide ventilations

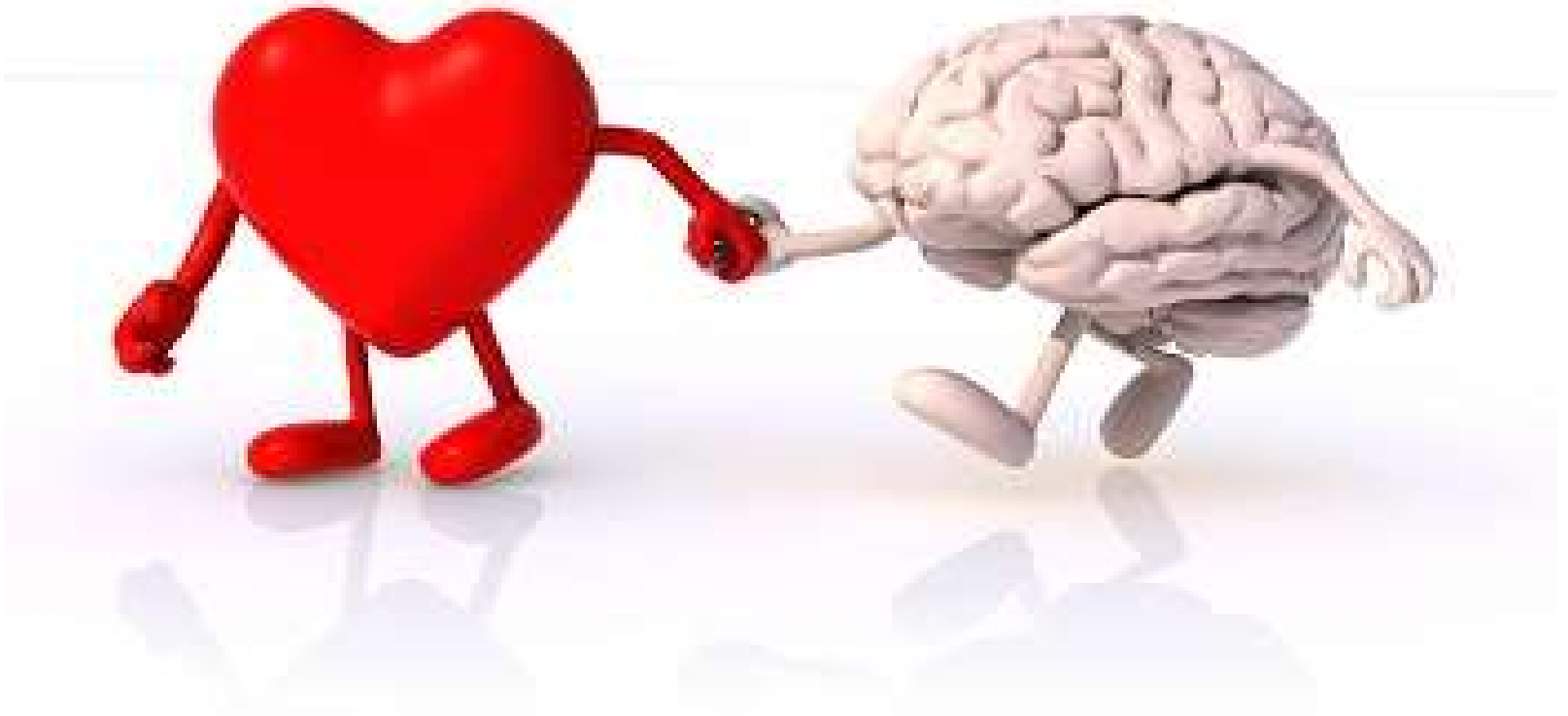


Pre-arrest (In-hospital) : Early recognition

- **Paediatric Early Warning System Score**
  - The Pediatric Early Warning System (PEWS) Score incorporates heart rate, blood pressure, capillary refill time, respiratory rate, oxygen saturation, and need for supplemental oxygen: aim to decrease unplanned ICU admission and code blue events
    - Before patients collapse
- **Medical Emergency Teams**
  - Medical emergency teams (METs) or rapid response teams (RRTs) were developed for the urgent assessment of at risk patients. These teams may function as the efferent response to the critical afferent early warning score signal.
    - Reduced in hospital mortality and cardiac arrest outside of the ICU.
    - Unplanned ICU admissions may increase following MET implementation..
- **Training**
  - Simulation based MET training exercises have been linked to improved team performance and outcomes.

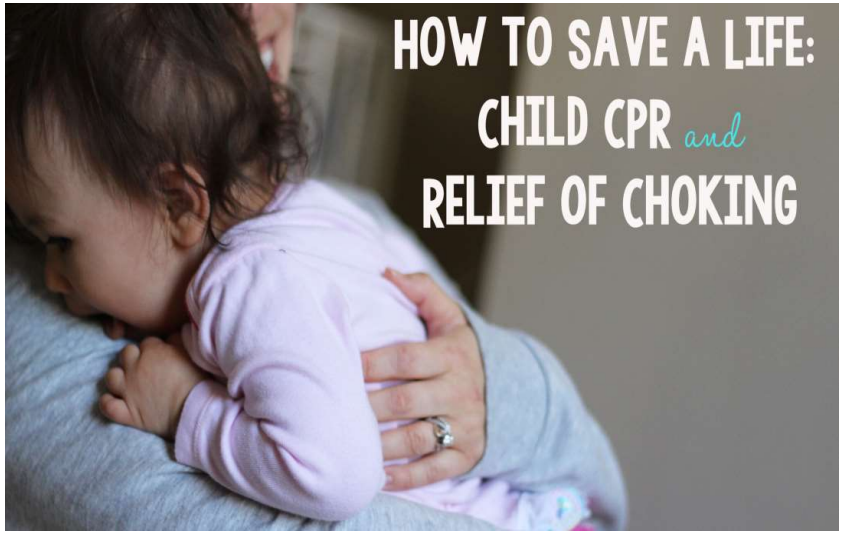
Once Paediatric Cardiac Arrests Have Occured……..

- Failure of prevention
- NEXT priority
- Return of Sustained Spontaneous Circulation
- Post-resuscitation care
  - Maintain stability
  - Minimise further damage
- Target towards neurologically intact survival



COMMUNITY / BYSTANDER CPR

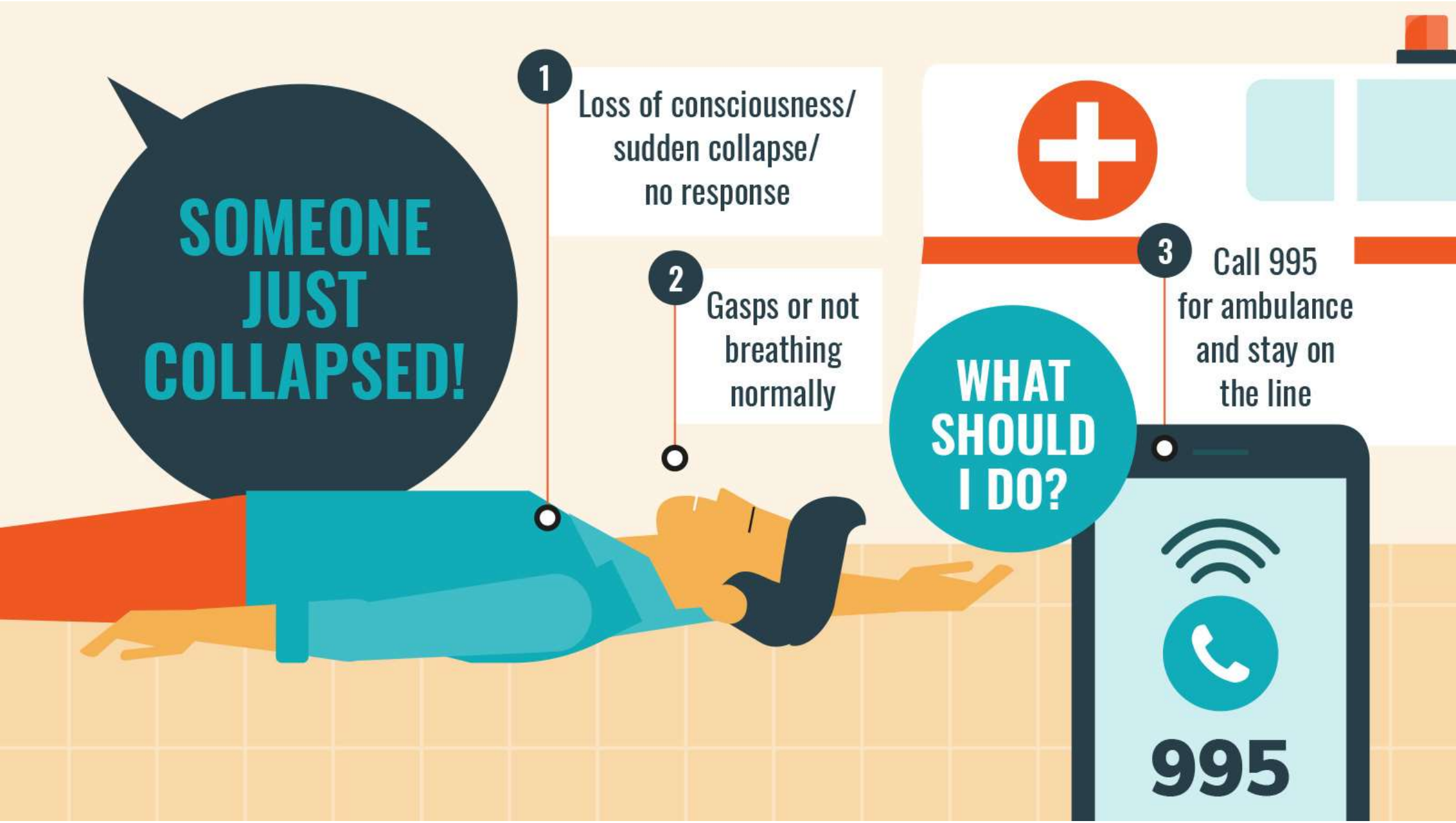
- Evidence from observational studies suggests that survival from cardiac arrest can be increased from twofold to fourfold with bystander CPR
- *Community CPR rates correlate with survival and neurological outcomes in paediatric OHCAs*
  - *Kitamura T et al. Lancet. 2010;375:1347–1354.*
  - *Goto Y et al. J Am Heart Assoc. 2014;3:e000499.*
- Paediatric bystander CPR rates are lower than adults
  - Outcomes are poor for infants
  - Ventilations with chest compressions improve outcomes



Increasing Community/Bystander CPR Rates

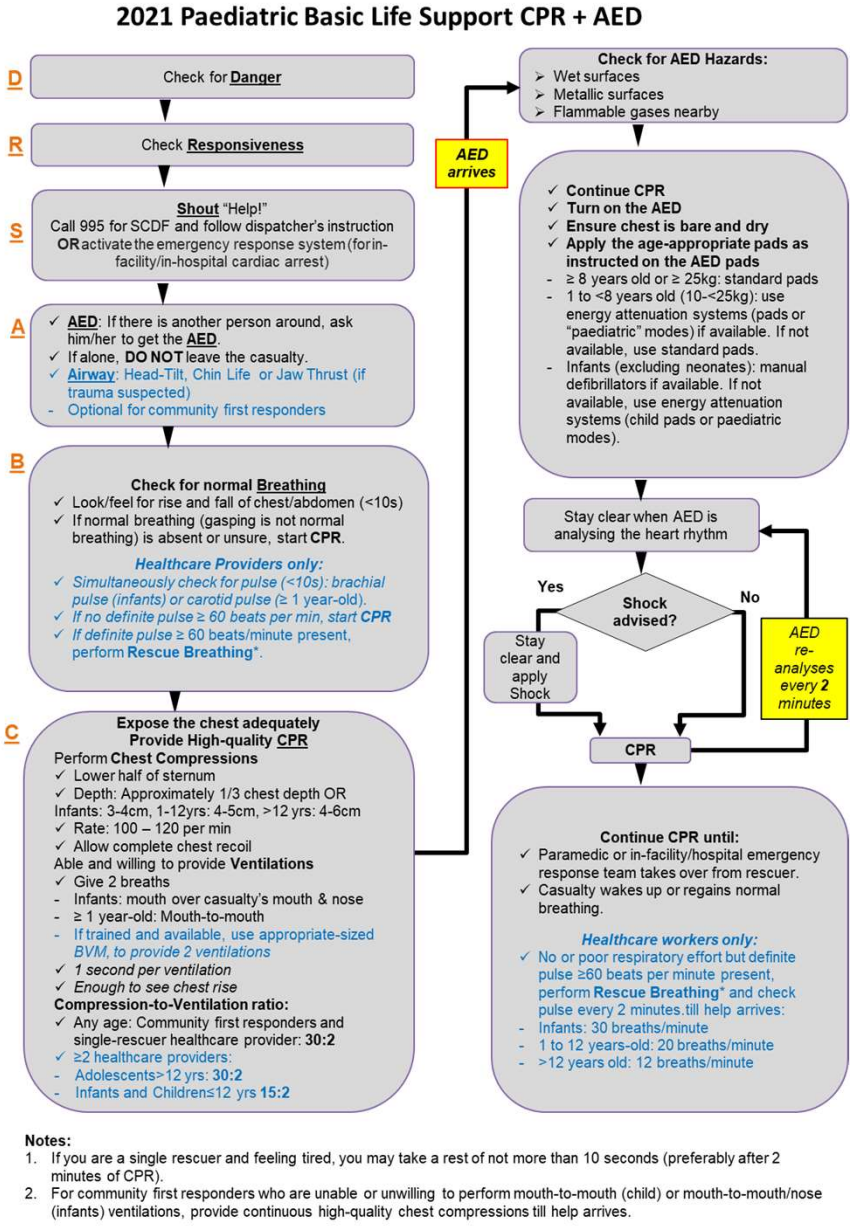
- Increase in community CPR rates (Seattle, Northern Holland, Sweden) and appears to correlate with survival outcomes

- **Layperson** Basic Life Support Instructions
  - Scientific evidence: Outcomes are better if CPR includes ventilation for paediatric cardiac arrests
  - Scientific evidence (against): pulse check
  - Includes use of AEDs (if available)


SOMEONE JUST COLLAPSED!
1
Loss of consciousness/ sudden collapse/ no response
2
Gasps or not breathing normally
WHAT SHOULD I DO?
3
Call 995 for ambulance and stay on the line
995

Paediatric Basic Life Support

- Emphasis on ventilation as part of paediatric resuscitation
- For paediatrics, caregivers may more likely be willing to provide ventilations
- Paediatric cardiac arrest are mainly due to non-cardiac causes
- Outcomes are better with ventilation in paediatrics
- No major changes except more emphasis on
  - Age group to consider for adult BLS is >12 years old (new) versus >8 years old (old)
  - Early EMS activation
    - Dispatch assistance
    - Activation of volunteers to assist and bring AEDs



BCLS (Singapore)

- Chest compression depth:
  - Relative: 1/3 chest depth
  - Absolute:
    - Infants: 3 to 4 cm
    - Child: 4 to 5 cm
    - Older children and adults: 4 to 6cm

Available online at www.sciencedirect.com

Resuscitation Plus

journal homepage: www.journals.elsevier.com/resuscitation-plus

ELSEVIER

EUROPEAN RESUSCITATION COUNCIL

Clinical paper

What is the potential for over-compression using current paediatric chest compression guidelines? — A chest computed tomography study

Gene Yong-Kwang Ong[a,], Aloysius Jian Feng Ang[b], Amirzeb S O Aurangzeb[b], Elisabeth Sue Shuen Fong[b], Jun Yuan Tan[b], Zhao Jin Chen[c], Yiong Huak Chan[c], Phua Hwee Tang[d], Jen Heng Pek[e], Ian Maconochie[f,g], Kee Chong Ng[a], Vinay Nadkarni[h]*

Abstract

Aim: We explored the potential for over-compression from current paediatric chest compression depth guidelines using chest computed tomography (CT) images of a large, heterogenous, Asian population.

Methods: A retrospective review of consecutive children, less than 18-years old, with chest CT images performed between from 2005 to 2017 was done. Demographic data were extracted from the electronic medical records. Measurements for internal and external anterior-posterior diameters (APD) were taken at lower half of the sternum. Simulated chest compressions were performed to evaluate the proportion of the population with residual internal cavity dimensions less than 0 mm (RICD < 0 mm, representing definite over-compression; with chest compression depth exceeding internal APD), and RICD less than 10 mm (RICD < 10 mm, representing potential over-compression).

Results: 592 paediatric chest CT studies were included for the study. Simulated chest compressions of one-third external APD had the least potential for over-compression; no infants and 0.3% children had potential over-compression (RICD < 10 mm). 4 cm simulated chest compressions led to 18% (95% CI 13%–24%) of infants with potential over-compression, and this increased to 34% (95% CI 27%–41%) at 4.4 cm (upper limit of "approximately" 4 cm; 4 cm + 10%). 5 cm simulated compressions resulted in 8% (95% CI 4%–12%) of children 1 to 8-years-old with potential over-compression, and this increased to 22% (95% CI 16%–28%) at 5.5 cm (upper limit of "approximately" 5 cm, 5 cm + 10%).

Conclusion: In settings whereby chest compression depths can be accurately measured, compressions at the current recommended chest compression of approximately 4 cm (in infants) and 5 cm (in young children) could result in potential for over-compression.

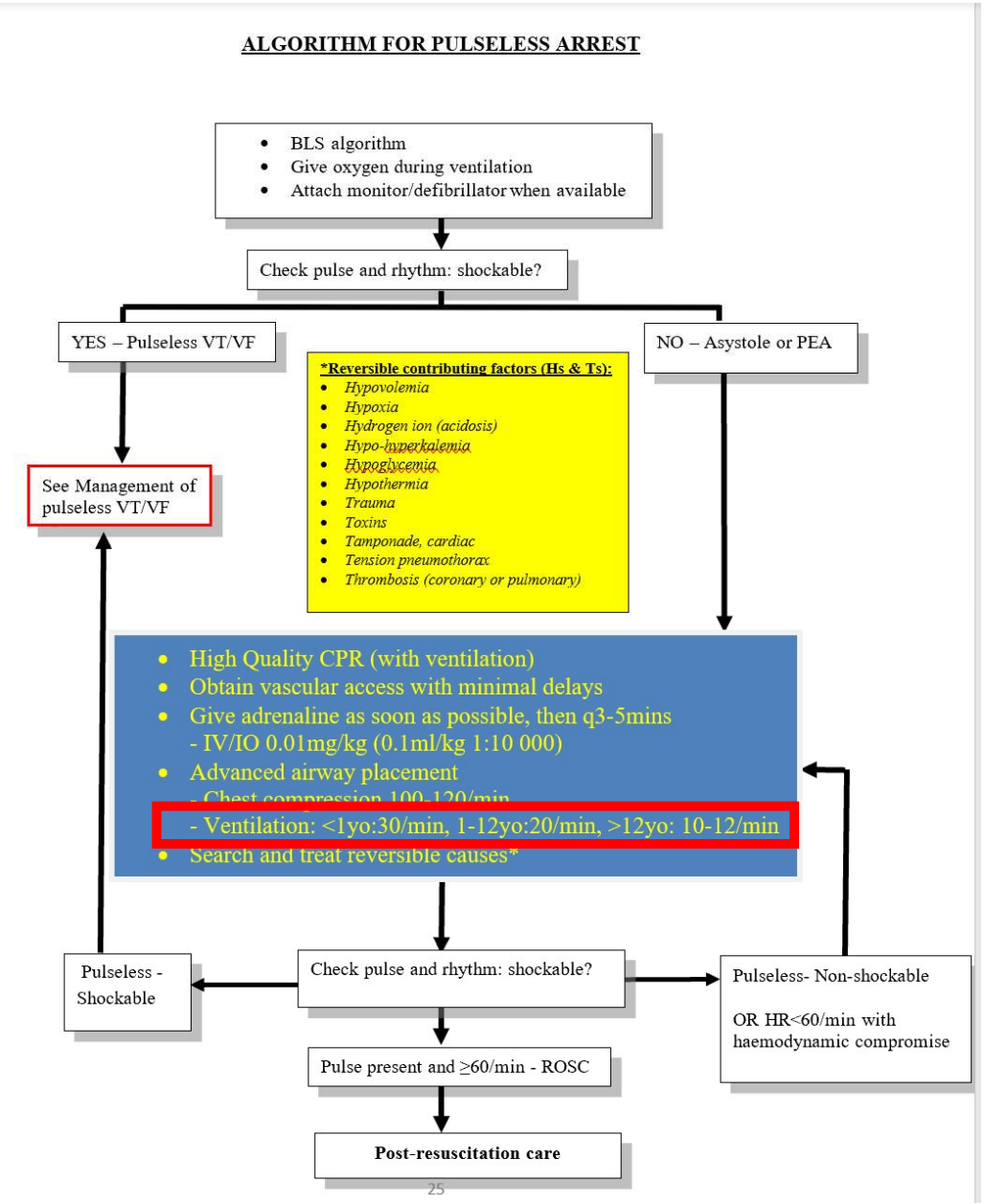
Keywords: Cardiopulmonary resuscitation, Chest compression, Computed tomography, Pediatrics

CPR summary for cardiac arrests		Adult and Adolescent >12 yrs	Child (1-12yrs)	Infant (< 1yr)
D	**Check for danger**	Ensure rescue scene is safe.		
R	**Check for responsiveness**	Tap the casualty' shoulders to get a response.		Tap the casualty' shoulders and the infant's feet to get a response.
S	**Shout for help**	Call 995 , put on speaker phone mode , follow dispatcher's instructions and/or activate in-facility/in-hospital emergency response system.		
A	**Get an AED1**	Send someone to get an AED if there is one within a 60-second walking distance. If you are the lone rescuer, do not leave the casualty.		
B	**Check for Breathing** (Recognition of Cardiac Arrest)	Look for normal breathing (If not breathing, gasping / agonal breathing) – Proceed to step C		Look for normal breathing (If not breathing, gasping / agonal breathing) – Proceed to step C
		Pulse check performed by Healthcare Providers: no definite pulse within 10s – Proceed to step C (Adult/Child: Carotid)		Pulse check performed by Healthcare Providers: no definite pulse within 10s or pulse rate <60/min – Proceed to step C (Infant: Brachial)
C	**Compression landmarks**	Lower half of sternum		Lower half of sternum (1 finger's breadth immediately below inter-mammary line)
	Compression method	Heel of 1 hand with other hand on top		2 thumb encircling hands (or ring and middle fingers for lay rescuers)
	Compression depth (Push hard with Full recoil)	4 to 6 cm	4 to 5 cm	3 to 4cm
	Compression rate	100-120/min		
Compression-ventilation ratio (Layperson) - Rescuers who are trained, willing and able to provide MTM[2] ventilations		30:2 (1 or ≥2 rescuers) 1 second per ventilation – observe for chest rise		
- Healthcare Providers (using BVM[3])		30:2 (1 or 2 rescuers)	30:2 (1 rescuer), 15:2 (≥2 rescuers)	
- Untrained, unable or unwilling to perform ventilations		Continuous high-quality chest compressions		
Rescue Breathing		1 ventilation every 5 seconds (12/min)	1 ventilation every 3 seconds (20/min)	1 ventilation per 2 seconds (30/min)
Use of AED		Use adult defibrillation pads	Under 25kg, use child defibrillation pads if available	Manual defibrillators preferred but if unavailable, use child pads

1) AED: Automated External Defibrillator, MTM: Mouth-To-Mouth, BVM: Bag Valve Mask

Paediatric Cardiac Arrest

- Non-shockable
- Emphasis on adrenaline as soon as possible then every 3-5 mins
- Look for reversible causes
- Ventilation during arrest post intubation and supraglottic airway placement
  - Same as rescue breathing



ALGORITHM FOR PULSELESS ARREST - SHOCKABLE

- BLS algorithm
- Give oxygen (via BVM ventilation),
- Attach monitor/defibrillator when available
- Provide advanced life support: Obtain advanced airway and vascular access with minimal interruptions to CPR

Check rhythm: shockable?

NOT SHOCKABLE - Asystole or PEA → See Management of Asystole or PEA

YES / SHOCKABLE - Pulseless VT/VF

1st shock 2-4J/kg Resume CPR immediately. *Can use AED if > 1 year old* *

CPR

2nd shock 4J/kg Resume CPR immediately.

CPR

3rd shock 4J/kg Resume CPR immediately.

CPR

4th shock 4J/kg Resume CPR immediately.

CPR

5th shock 4J/kg Resume CPR immediately.

CPR

6th shock 4J/kg Resume CPR immediately.

IV/IO adrenaline (0.01mg/kg; max 1mg) q3-5 mins or every other shock

IV/IO amiodarone (5mg/kg) **OR** **IV/IO lignocaine** (1mg/kg; max 100mg) initial bolus followed by infusion 20-50 microgram/kg/min.

Give adrenaline (0.01mg/kg; max 1mg) q3-5 mins, i.e. every other shock

IV/IO amiodarone (5mg/kg); max. 3 doses **OR** **IV/IO lignocaine if not given earlier** (1mg/kg; max 100mg) initial bolus followed by infusion 20-50 microgram/kg/min.

Perform 2 mins of CPR then check for pulse and rhythm – shockable?

Give adrenaline every other shock (every 3-5 mins)

Consider other antiarrhythmics:
-IV/IO lignocaine *1mg/kg (max. 100mg) initial bolus followed by infusion 20-50microgram/kg/min.*
(May repeat bolus can be given after 15 minutes after initiating infusion if delayed > 15 minutes.)
-IV/IO amiodarone *5mg/kg, up to 3 times*
-IV/IO magnesium sulphate *50mg/kg (max2g) for Torsades de Pointes*

Consider increasing energy dose of shocks to max 10J/kg for refractory VF

* ***CPR 2 mins then check pulse and rhythm – shockable?***

- *Minimise time between chest compressions and shock delivery.*
- *Check rhythm and shock immediately after chest compressions, rather than after rescue breaths, if possible.*
- *Minimise time between shock delivery and resumption of chest compressions.*

During CPR

- Monitor CPR quality
- Assess and manage for reversible causes – Hs,Ts **

Pulse present ≥60/min / return of spontaneous circulation

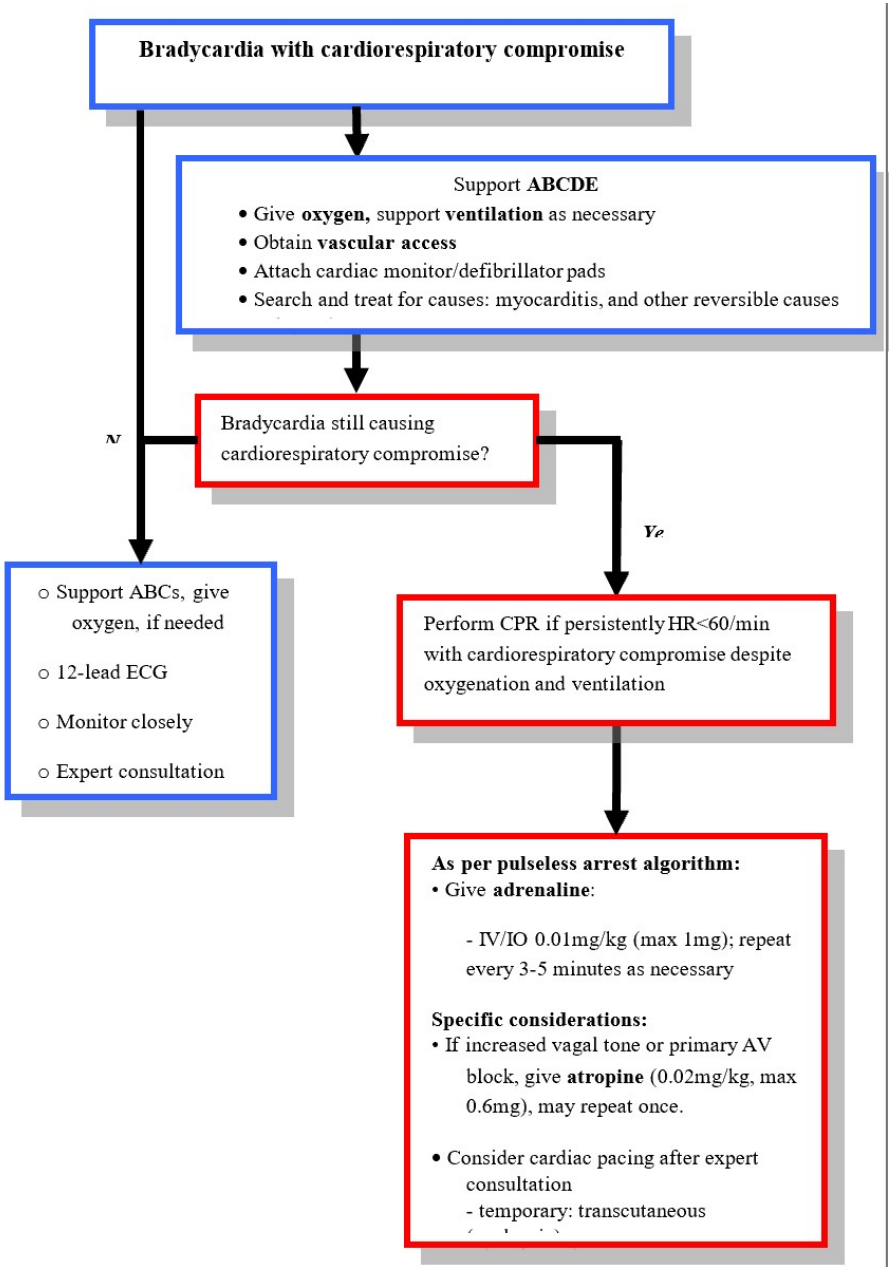
- Post-resuscitation care

** : **Search for and treat possible contributing factors (Hs & Ts):**

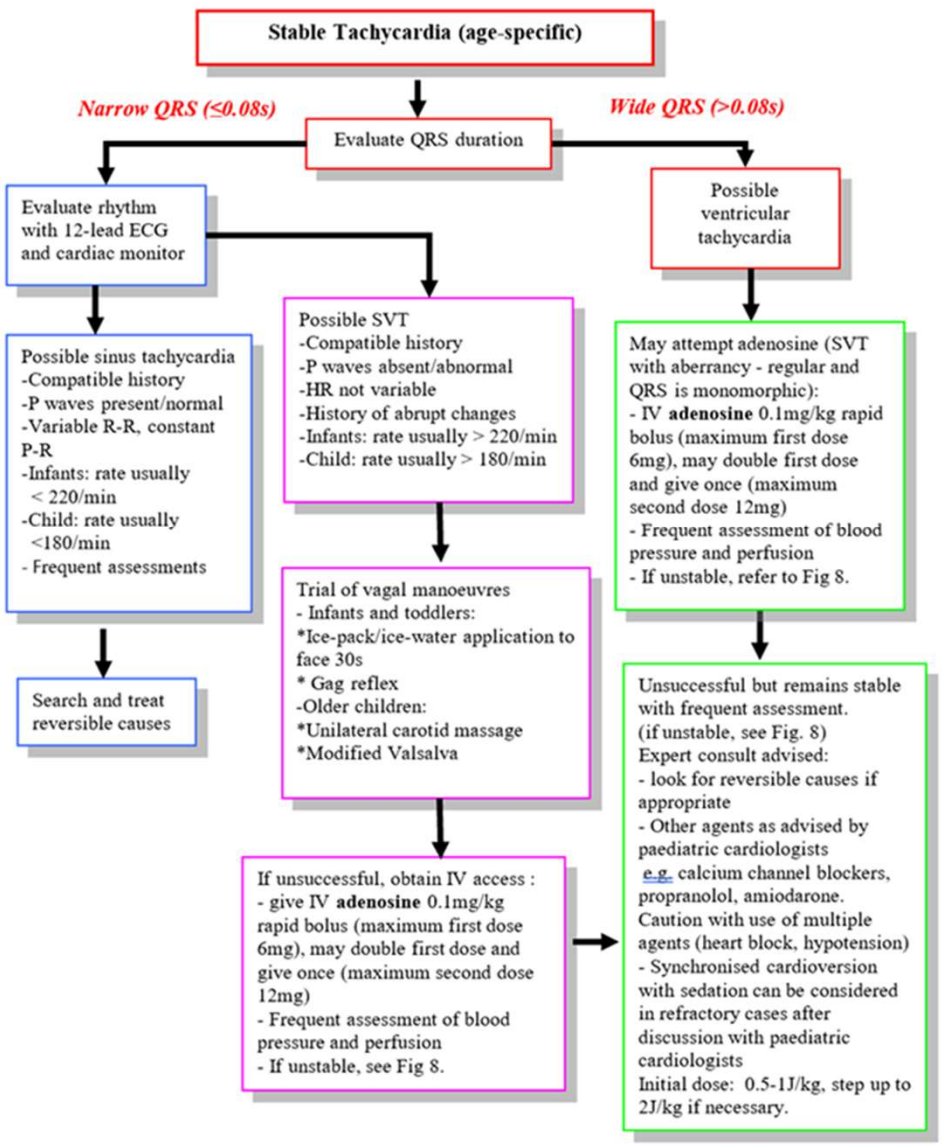
- *Hypovolemia*
- *Hypoxia*
- *Hydrogen ion (acidosis)*
- *Hypo-hyperkalemia*
- *Hypoglycemia*
- *Hypothermia*
- *Trauma*
- *Toxins*
- *Tamponade, cardiac*
- *Tension pneumothorax*
- *Thrombosis (coronary or pulmonary)*

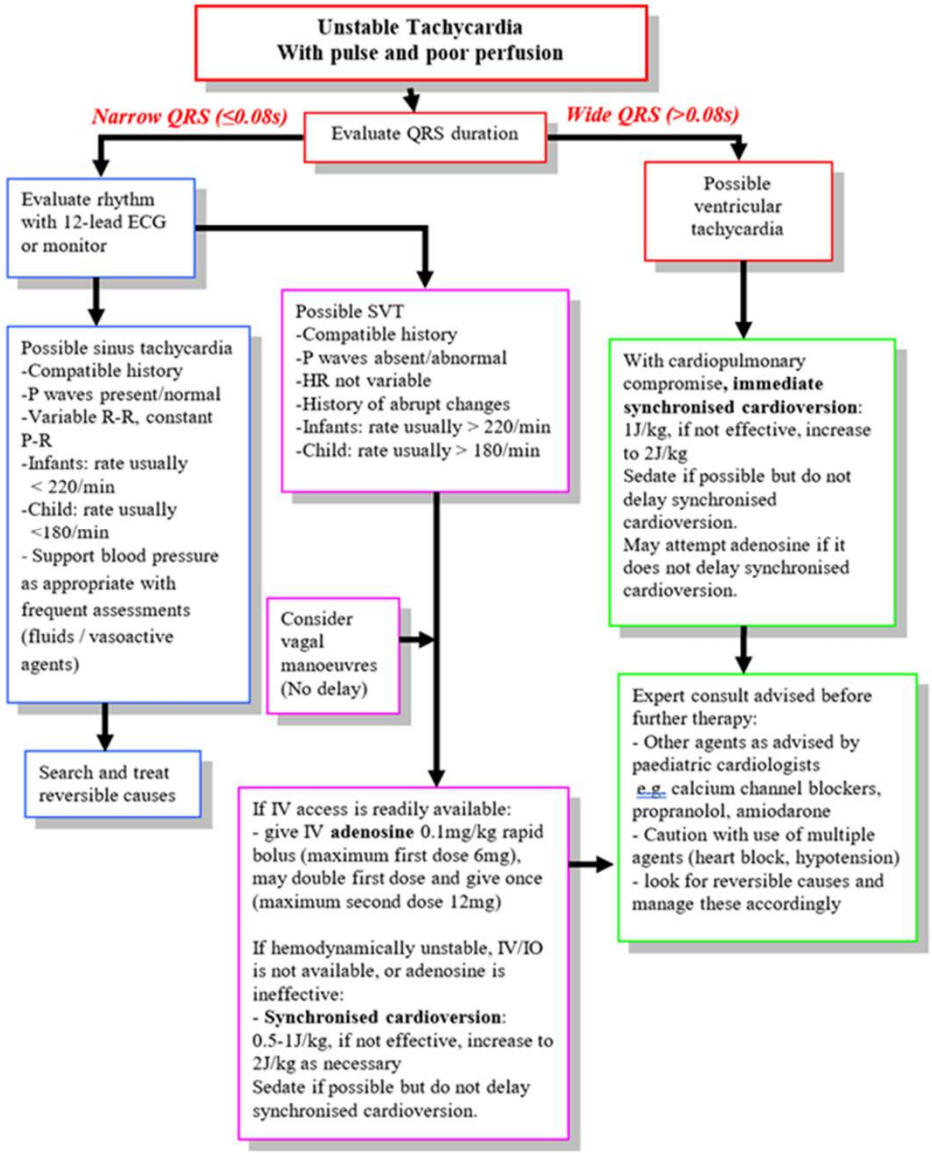
Paediatric Bradycardia

- No major changes
- Focus on stability



Paediatric tachycardia





Post Arrest Care (post-arrest syndrome)

- Goldilocks
  - Normoglycaemia
  - Normo-oxia
  - Normocapnia
  - Normotension
  - Target normothermia (active, not passive)

Bottomline: (Don’t) Take My Breath Away!

- Ventilation is important in paediatric cardiac arrest, especially for infants

BVM in paediatrics

- Healthcare setting
- ?Community use

- I would like to thank everyone who have contributed in the community and healthcare settings in preventing, resuscitating and improving outcomes for paediatric cardiac arrest!

Questions – to be discussed in the Q&A

Contact: geneong@yahoo.com