

# Shock in Children

Jon D. Mason MD, FAAP, FACEP  
Children's Hospital of the King's Daughters  
Eastern Virginia Medical School

# Objectives

- Be able to define the various types of shock:
  - Hypovolemic
  - Distributive
    - Anaphylactic
    - Septic
    - Spinal
  - Cardiogenic
- Define compensated and uncompensated shock
- Know what first responder interventions are most important to utilize

# Clinical spectrum of shock

- 147 patients in Nevada Peds ED
- Most common in the ED
  - Septic shock 57%
  - Hypovolemic 24%
  - Distributive 14%
  - Cardiogenic 5%

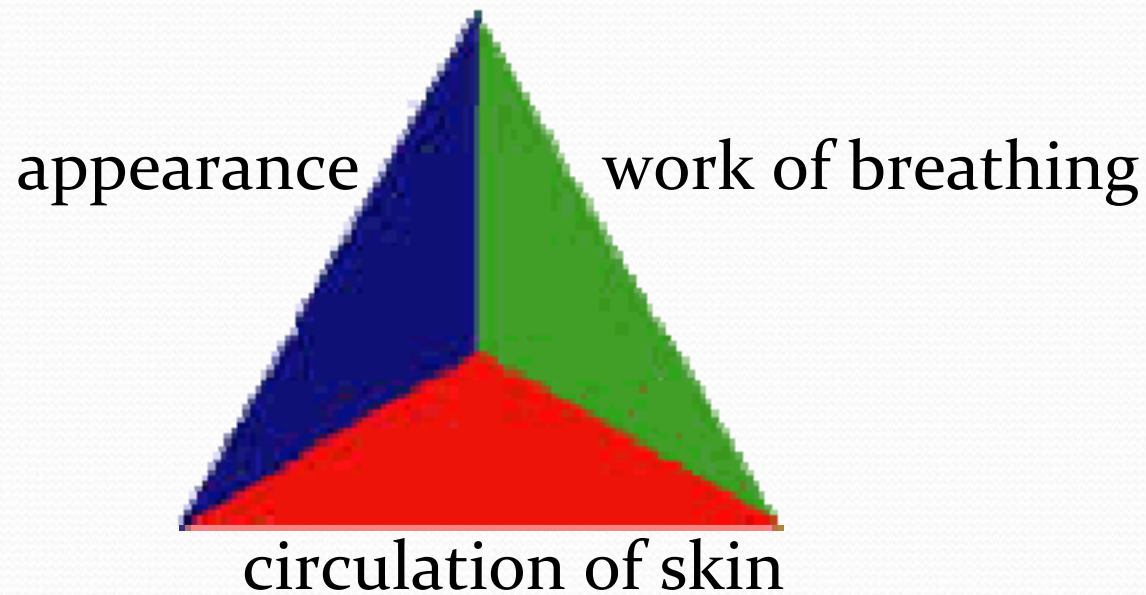


# Some reminders

- TICLS
  - Tone
  - Consolability
  - Look/gaze
  - Speech/cry
- AVPU
- ABCDE
- GCS

# Pediatric assessment triangle

- PAT





# Case 1

- You are called to a home with a child with “not acting normally”. A 12 month old male has been having vomiting and diarrhea for the past week and even clear liquids are not staying down. The child has the following VS: T. 100.2, Resp 60, Pulse 178, BP 60/p. Cap refill is 4 seconds. The baby is not crying much when you attempt an IV and the infant has an oxygen sat of 95% on room air.

# Case 1

- Pediatric Assessment Triangle
  - Appearance
  - Work of Breathing
  - Circulation to skin



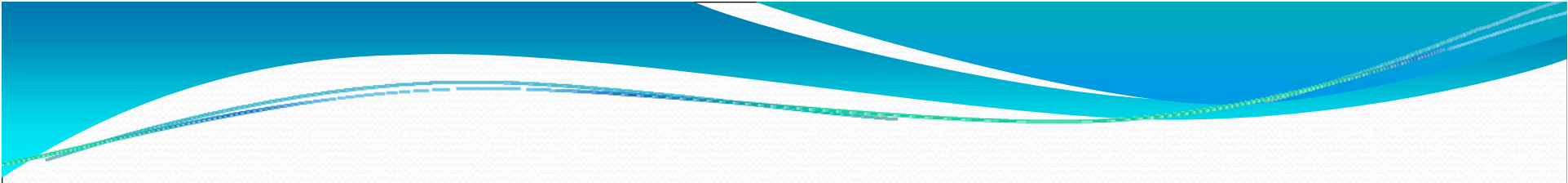
# Case 1

- Pediatric Assessment Triangle
  - Appearance—poor eye contact, lethargic?, decreased responsiveness
  - Work of Breathing
  - Circulation to skin



# Case 1

- Pediatric Assessment Triangle
  - Appearance—poor eye contact, lethargic?, decreased responsiveness
  - Work of Breathing—increased wob, tachypnea
  - Circulation to skin



# Case 1

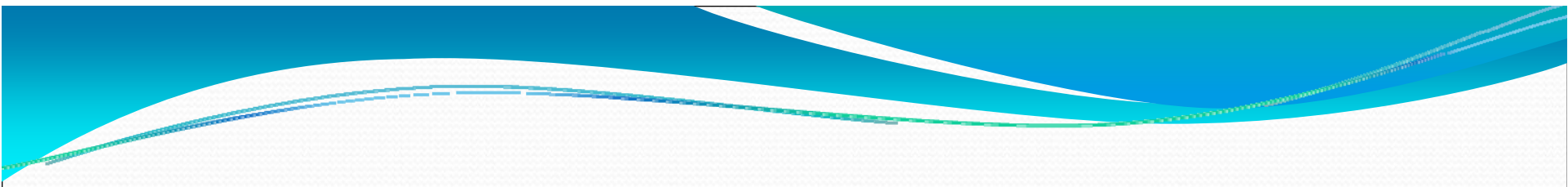
- Pediatric Assessment Triangle
  - Appearance—poor eye contact, lethargic?, decreased responsiveness
  - Work of Breathing—increased wob, tachypnea
  - Circulation to skin—delayed CR, pale



# Definition of shock

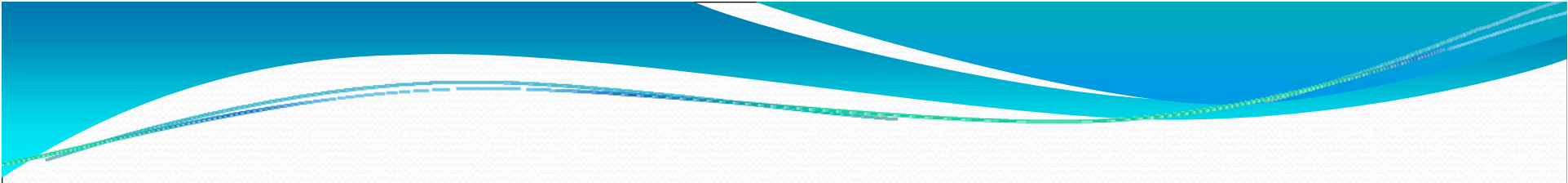
- Inadequate perfusion and oxygen delivery to the tissues (cells).
- “Fuel” for cells includes oxygen and glucose.
- Cellular dysfunction/death may occur if shock not reversed.





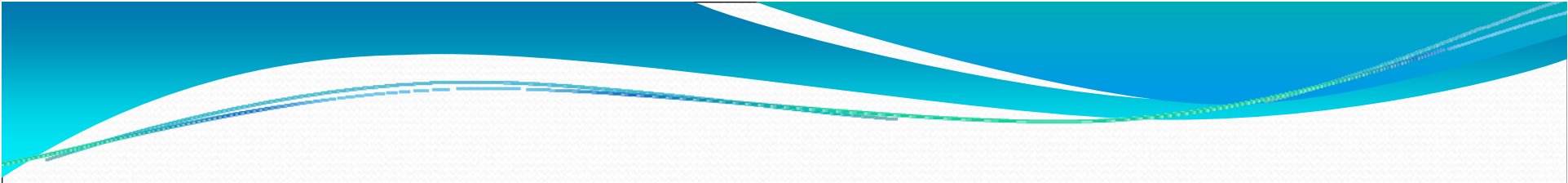
# Compensated or uncompensated?

- Babies and young children can maintain blood pressure despite early shock states
- If the blood pressure is normal in a state of shock, the term to describe this is “compensated shock”



# Uncompensated shock

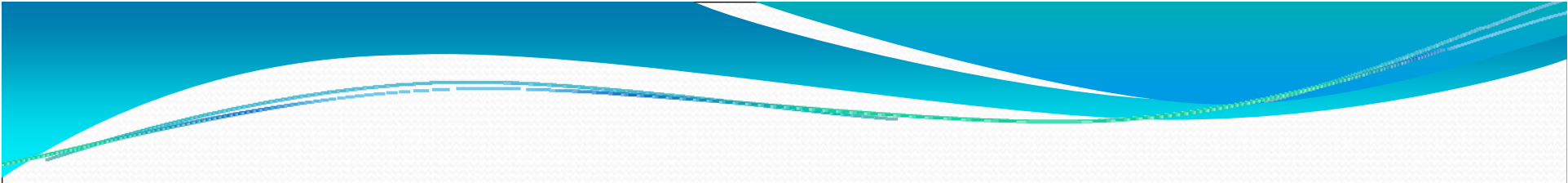
- When the blood pressure begins to drop in the face of shock, it is called “uncompensated” shock



# Compensated shock

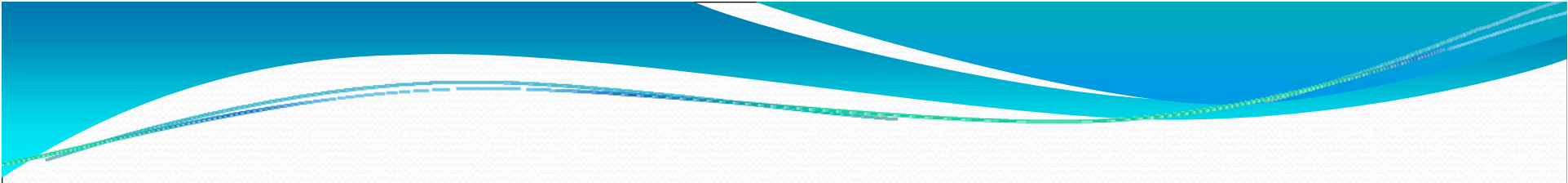
- The body compensates to maintain perfusion to vital organs by:
  - Increasing catecholamines
    - Carotid body-pressure
    - Right atrium-volume
    - Aortic arch-pH, chemical alterations





# Hypovolemic shock

- In the world, the most common form of shock
  - GI losses from gastroenteritis
- Trauma—blood loss



# Blood pressure in children

- What is an easy formula to remember to know the limits of BP in children?

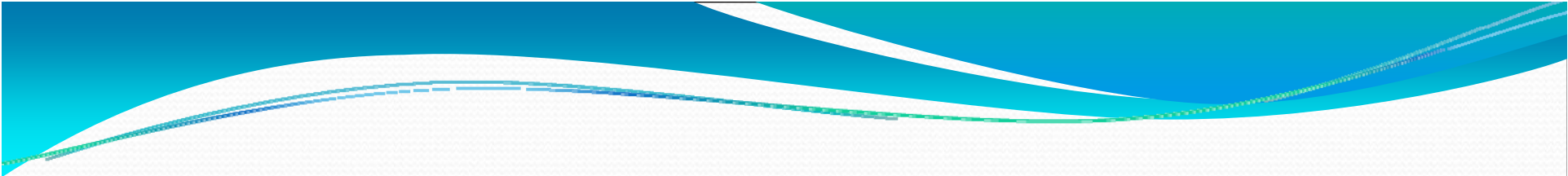
# Blood pressure in children

- What is an easy formula to remember to know the limits of BP in children?
- $70 + (2 \times \text{age in years})$



# Blood pressure

- Infant > 60
- Toddler >70
- Pre-schooler >75
- School-age >80
- Adolescent >90



# Recognizing shock

- Vital signs
- Capillary refill
- Cool extremities (except “warm” shock)
- Fontenelle
- Skin Turgor
- Sunken eyes
- Altered mental status
- Historical questions



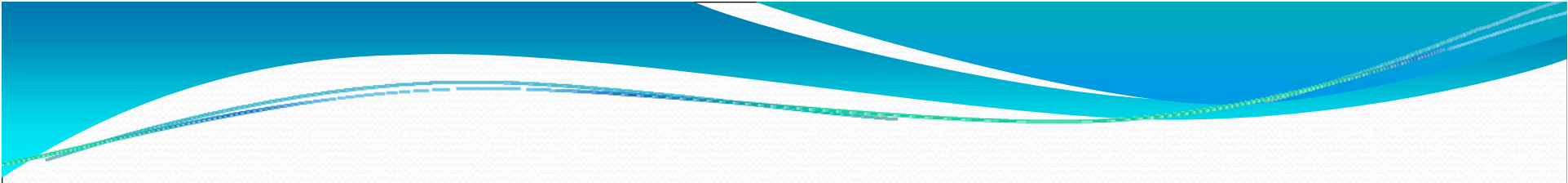
## Case 2

- A 22 month old girl who had a heart transplant 1 year ago has not been feeding well and is “not acting herself”. She is pale and has a heart rate of 190. Her capillary refill is greater than 3 seconds and she is “quiet”. Her BP is 80. Her extremities are cool to the touch. She has a loud murmur over her precordium and a well-healed surgical scar over her sternum. Her liver is not enlarged by palpation. Her temp is 99.9 F Her breathing is calm, clear lungs with resp rate of 38.



# What is her problem?

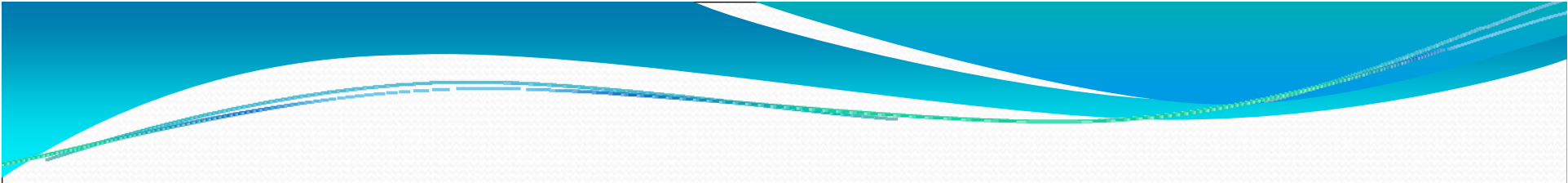
- Pediatric Assessment Triangle (PAT)
- Appearance: quiet, but alert
- Work of breathing: not increased
- Circulation: prolonged CR with cool extremities



# Cardiogenic shock

- This little girl had a wide-complex tachycardia that was diagnosed as SVT. She is not respond to vagal maneuvers (heart transplant)
- She responded to adenosine





# Cardiogenic shock

- Poor myocardial function
- Often occurs early in life due to congenital heart disease
- Pulmonary pressures change dramatically
- Ductus arteriosus closes—and may be needed to oxygenate the blood (prostaglandins used to keep it open)



# Cardiogenic shock

- Poor feeding—tires out
- Sweating with feeding
- Cyanosis
- Poor capillary refill
- Heart murmur
- Tachycardia
- Tachypnea
- Liver enlarged

## Case 3

- One month old infant boy presents with lethargy and poor feeding. VS reveal a pulse of 200, BP 50/20, Respiratory rate of 60, Temp of 38.1 C Breath sounds are normal without wheezes. Abdomen is soft. There has been no vomiting or diarrhea and there is no signs of trauma noted. He is pale and skin mottled with capillary refill markedly delayed. Pulses rapid and weak. Fontanelle is flat and not tense. He is minimally responsive to pain. He does not cry when attempting an IV.



# Case 3

- Pediatric Assessment Triangle:
  - Appearance
  - Work of breathing
  - Circulation of skin



# Septic shock

- Most common type of shock seen in the report from Nevada mentioned earlier.
- Major emergency in the infant
- Temp over 38.0 C is of concern
- Sepsis workup after fluid resuscitation
- Early antibiotics
- Survival is based on early intervention

# Septic shock

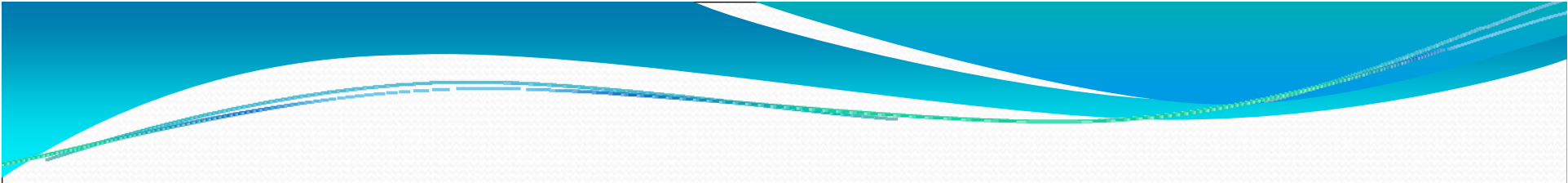
- Once the diagnosis is made each hour left untreated doubles the risk of death
  - Dr. Jerry McLaughlin—*ACEP News*, Sept 2010
- There is a “golden hour” concept in sepsis



# Septic shock

- Ten times more infants become septic than older children
- Of the reported cases of sepsis in children, 10% are fatal (47,000 cases reported)
  - Dr. Jerry McLaughlin—*ACEP News*





# Distributive shock

- Caused by inappropriate vasodilatation with maldistribution of blood flow
- Increased vascular capacity

# Distributive shock

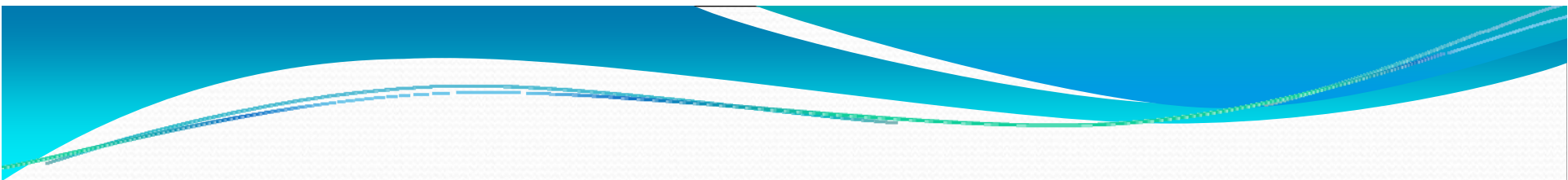
- Sepsis
  - Early—warm extremities
  - Vasodilation due to toxins from bacteria
- Anaphylaxis
  - Capillaries become “leaky”
  - Vasodilation from histamine release
- Spinal trauma
  - Loss of sympathetic tone



# Distributive shock

- Anaphylaxis
  - Hives/flushed skin
  - Angioedema
  - Hoarse voice/stridor
  - Respiratory distress, wheezing
  - Tachycardia, dysrhythmias
  - Hypotension



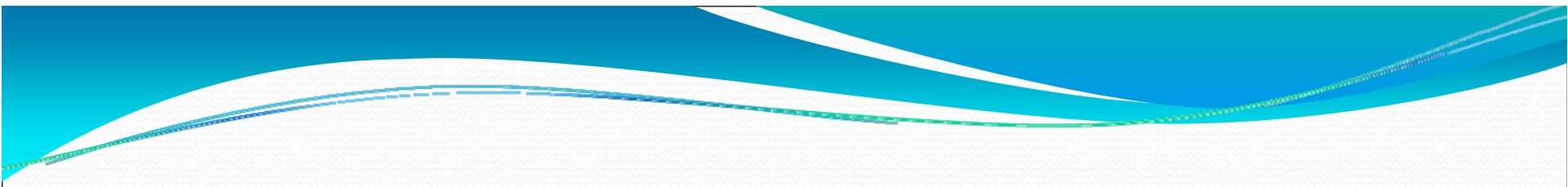


# Treatment of shock

- EMS priorities
  - Assure adequate airway/oxygenation
  - IV access
  - Cardiac monitor
  - Fluid bolus with NS
  - Accucheck—treat hypoglycemia
  - Rapid transport
  - Attention to temperature concerns
  - Psychosocial support

# Treatment of shock

- If anaphylaxis is diagnosed
  - IV fluids
  - Diphenhydramine (Benadryl)
  - Steroids
  - Albuterol
  - Epinephrine



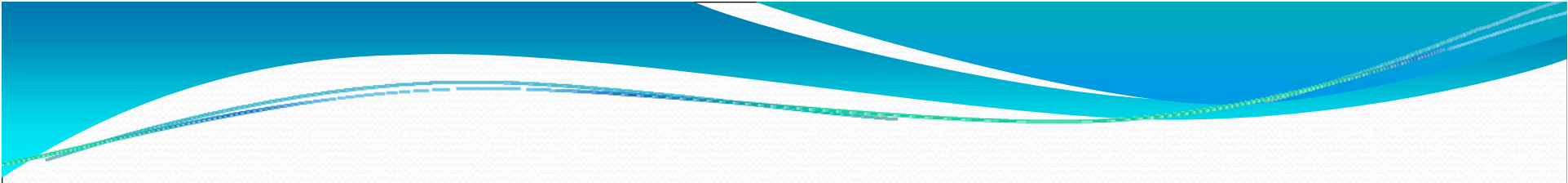
# Treatment of shock

- If cardiogenic shock is suspected
  - Fluid bolus decreased (10 cc/kg NS)
  - Oxygen
  - Cardiac monitor strip



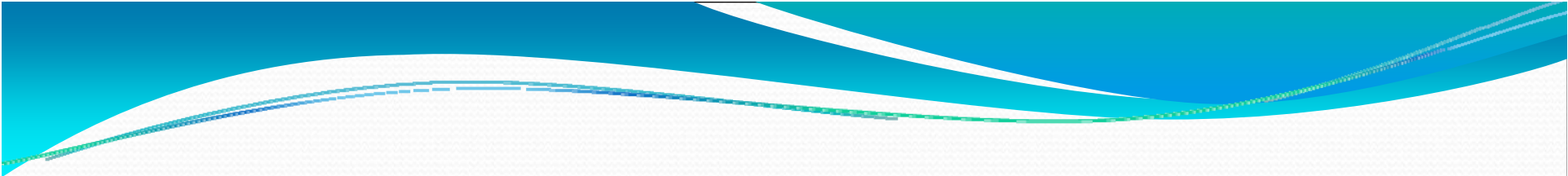
# Treatment of shock

- Hypovolemic shock
  - Control any blood loss
  - IV x 2
  - 20 cc/kg NS as fast as possible
  - Rapid transport



# Treatment of shock

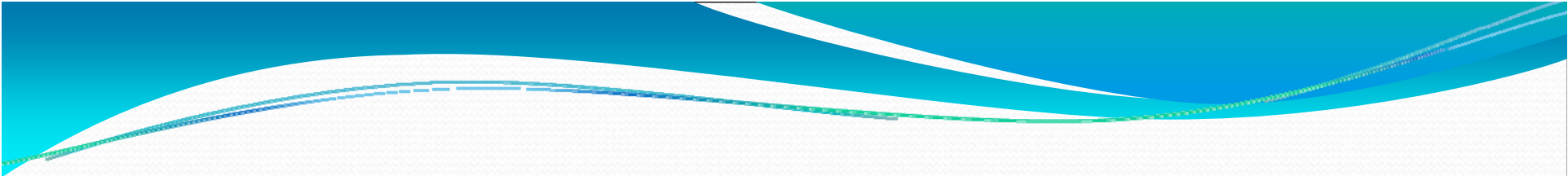
- Upon arrival in the ED
  - Rapid assessment
  - Possible second IV
  - Labs—sepsis workup
  - Radiographs
  - Specialized treatments
    - Steroid
    - Antibiotics
    - Prostaglandin
    - Central line



# Shock recognition

- Remember that child abuse can present with shock states
  - Trauma
  - Malnutrition
  - Child neglect





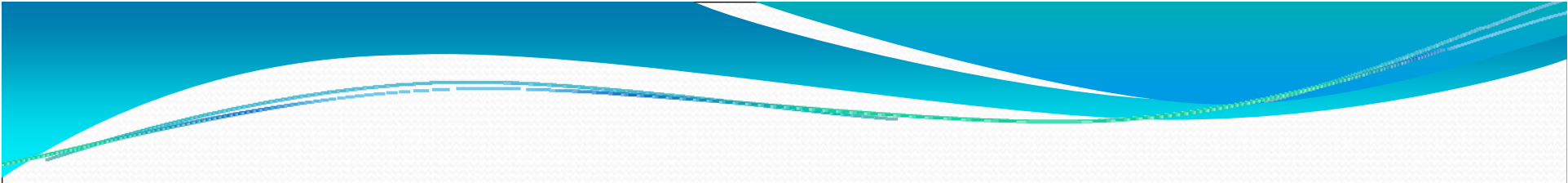
# Summary

- Early shock states can be difficult to identify
- Children often don't drop their blood pressure until late in the course of their disease
- Shock mortality can be improved with early recognition and treatment
- Pediatric assessment skills can be enhanced using the PAT rapid assessment

# Summary

- Remember that shock states come in different varieties
  - Septic
  - Cardiogenic
  - Distributive
  - Hypovolemic





# Summary

- Compensatory mechanisms can prevent a child from dropping their blood pressures until late in the course when the patient “decompensates” or causes a low BP
- Therefore shock often is present in children and infants who have normal blood pressures