

## Figure S1. Test Question

**Note: the total score of the questions is 100 points, there are 10 topics, each topic is worth 10 points, each topic has 5-6 questions, and 10 points are given if 5 answers are correct.**

### Pediatric Sepsis and Septic Shock

1. Which of the following is the most common cause of sepsis in pediatric patients?

- A. Viral infections
- B. Bacterial infections, particularly from respiratory pathogens
- C. Fungal infections
- D. Parasitic infections

Answer: B. Bacterial infections, particularly from respiratory pathogens

Explanation: Bacterial infections, especially those caused by respiratory pathogens like *Streptococcus pneumoniae* and *Staphylococcus aureus*, are the most common cause of sepsis in children.

2. In children with suspected sepsis, which laboratory test is considered a useful biomarker for diagnosis?

- A. Serum glucose
- B. Procalcitonin
- C. Complete blood count (CBC)
- D. Liver function tests

Answer: B. Procalcitonin

Explanation: Procalcitonin is a biomarker that is useful in the diagnosis of sepsis, particularly in differentiating between bacterial and viral infections. It is often elevated in bacterial infections and can help guide the initiation of antibiotics.

3. Which of the following is NOT a component of the initial resuscitation in pediatric septic shock?

- A. Fluid bolus administration
- B. Initiating broad-spectrum antibiotics
- C. Administering high-dose corticosteroids immediately
- D. Monitoring vital signs closely

Answer: C. Administering high-dose corticosteroids immediately

Explanation: The initial resuscitation for pediatric septic shock typically involves fluid bolus administration, initiating broad-spectrum antibiotics, and monitoring vital signs closely. High-dose corticosteroids are not part of the initial resuscitation but may be considered later based on clinical response and specific guidelines.

4. What is the recommended initial fluid resuscitation volume for a child in septic shock?

- A. 5 mL/kg
- B. 10 mL/kg
- C. 20 mL/kg
- D. 40 mL/kg

Answer: B. 10 mL/kg

Explanation: The recommended initial fluid resuscitation volume for a child in septic shock is 10 mL/kg. This is given as an initial bolus to ensure adequate intravascular volume and improve perfusion.

5. What is the primary goal of the Surviving Sepsis Campaign guidelines in pediatric patients?
- A. To increase hospital admissions
  - B. To decrease the administration of antibiotics
  - C. To improve outcomes by providing early and appropriate treatments
  - D. To minimize the use of fluids during resuscitation

Answer: C. To improve outcomes by providing early and appropriate treatments

Explanation: The primary goal of the Surviving Sepsis Campaign guidelines in pediatric patients is to improve outcomes by providing early and appropriate treatments. This includes recognizing sepsis early, initiating timely interventions, and optimizing systemic organ support.

6. In the treatment of septic shock, which class of medications is commonly used to support blood pressure?
- A. Antibiotics
  - B. Vasoactive agents
  - C. Antipyretics
  - D. Anticonvulsants

Answer: B. Vasoactive agents

Explanation: Vasoactive agents, such as catecholamines (e.g., dopamine, norepinephrine), are commonly used to support blood pressure in the treatment of septic shock. They help maintain adequate perfusion and organ function by increasing vascular tone.

### **Pediatric advanced life support**

1. When assessing the respiratory status of a pediatric patient, what is the primary initial step?
- A. Check the pulse
  - B. Assess breathing pattern and rate
  - C. Use an electrocardiogram (ECG)
  - D. Use pulse oximetry

Answer: B. Assess breathing pattern and rate

Explanation: Assessing breathing pattern and rate is the primary step to determine whether the airway is clear and if breathing is normal.

2. In PALS, what is the recommended initial intervention for a child in pulseless ventricular fibrillation?
- A. High-quality chest compressions
  - B. Airway management
  - C. Administering epinephrine

- D. Defibrillation

Answer: D. Defibrillation

Explanation: Ventricular fibrillation is a form of cardiac arrest, and the primary intervention is immediate defibrillation.

3. Which medication is most commonly used during pediatric cardiac arrest?

- A. Atropine
- B. Norepinephrine
- C. Epinephrine
- D. Aspirin

Answer: C. Epinephrine

Explanation: In cases of pediatric cardiac arrest, epinephrine is commonly used to increase the likelihood of spontaneous circulation.

4. PALS recommends monitoring a pediatric patient's temperature during resuscitation, as hypothermia can negatively affect resuscitation efforts. What is the target temperature range?

- A. 33-35°C (91.4-95°F)
- B. 36-37°C (96.8-98.6°F)
- C. 37.5-38°C (99.5-100.4°F)
- D. 38.5-39°C (101.3-102.2°F)

Answer: B. 36-37°C (96.8-98.6°F)

Explanation: PALS recommends maintaining a target temperature range of 36-37°C to optimize resuscitation outcomes.

5. During pediatric resuscitation, if using assisted ventilation, what is the recommended ventilation rate?

- A. 10 breaths per minute
- B. 12-20 breaths per minute
- C. 6-8 breaths per minute
- D. 20-30 breaths per minute

Answer: B. 12-20 breaths per minute

Explanation: During pediatric resuscitation, the recommended assisted ventilation rate is 12-20 breaths per minute to ensure adequate oxygenation.

## **Diabetic ketoacidosis**

1. Which of the following is a primary cause of Diabetic Ketoacidosis (DKA)?

- A. Low insulin levels
- B. Low blood sugar
- C. Excessive carbohydrate intake

- D. Dehydration

Answer: A. Low insulin levels

Explanation: DKA occurs when insulin levels are too low, leading to high blood glucose and the body breaking down fat for fuel, producing ketones.

2. A classic sign of Diabetic Ketoacidosis is "Kussmaul breathing." What is the characteristic of this type of breathing?

- A. Rapid and shallow
- B. Slow and shallow
- C. Deep and labored
- D. Intermittent and irregular

Answer: C. Deep and labored

Explanation: Kussmaul breathing is a compensatory mechanism for acidosis, where breathing becomes deep and labored to reduce blood acidity.

3. In Diabetic Ketoacidosis, which of the following laboratory findings is typically expected?

- A. Low blood glucose
- B. High blood ketone levels
- C. Elevated blood pH
- D. Increased blood calcium

Answer: B. High blood ketone levels

Explanation: High blood ketone levels are typical in DKA, as the body produces ketones due to insufficient insulin.

4. Which electrolyte imbalance is commonly associated with Diabetic Ketoacidosis?

- A. Hypercalcemia
- B. Hyperkalemia
- C. Hypomagnesemia
- D. Hypoglycemia

Answer: B. Hyperkalemia

Explanation: In DKA, potassium levels are often elevated (hyperkalemia) due to the shift of potassium out of cells in response to acidosis.

5. What is the first priority in the treatment of a patient with Diabetic Ketoacidosis?

- A. Administering insulin
- B. Rehydrating with intravenous fluids
- C. Correcting blood pH with sodium bicarbonate
- D. Giving potassium supplements

Answer: B. Rehydrating with intravenous fluids

Explanation: The initial treatment priority in DKA is rehydration with IV fluids to counteract dehydration and restore blood volume.

### **Acute respiratory distress syndrome**

1. Which of the following is a hallmark characteristic of Acute Respiratory Distress Syndrome (ARDS)?

- A. Pulmonary hypertension
- B. Hypoxemia that doesn't improve significantly with supplemental oxygen
- C. Hypercapnia with respiratory alkalosis
- D. Pleural effusion

Answer: B. Hypoxemia that doesn't improve significantly with supplemental oxygen

Explanation: In ARDS, severe hypoxemia that is refractory to oxygen therapy is a key characteristic due to impaired gas exchange in the lungs.

2. Which condition is a common direct cause of ARDS?

- A. Diabetes mellitus
- B. Liver cirrhosis
- C. Pneumonia
- D. Hypertension

Answer: C. Pneumonia

Explanation: Pneumonia is a direct cause of ARDS because it can trigger widespread inflammation in the lungs, leading to respiratory failure.

3. Which of the following ventilator strategies is generally recommended for patients with ARDS?

- A. High tidal volume and low PEEP
- B. Low tidal volume and high PEEP
- C. Low tidal volume and low PEEP
- D. High tidal volume and high PEEP

Answer: B. Low tidal volume and high PEEP

Explanation: Low tidal volume ventilation and high PEEP (positive end-expiratory pressure) help reduce lung injury and maintain oxygenation in ARDS patients.

4. What is the typical presentation of ARDS on a chest X-ray?

- A. Ground-glass opacities
- B. Pneumothorax
- C. Patchy or bilateral infiltrates
- D. Pleural effusion

Answer: C. Patchy or bilateral infiltrates

Explanation: ARDS typically shows bilateral infiltrates on chest X-ray due to widespread

inflammation and fluid accumulation in the lungs.

5. Which of the following criteria is NOT part of the Berlin Definition for diagnosing ARDS?

- A. Respiratory symptoms must have developed within one week of a known clinical insult.
- B. Chest imaging must show bilateral opacities not fully explained by effusions or lung collapse.
- C. Left heart failure must be present.
- D. Hypoxemia is assessed based on the  $\text{PaO}_2/\text{FiO}_2$  ratio.

Answer: C. Left heart failure must be present

Explanation: Left heart failure is not part of the ARDS diagnostic criteria; ARDS is defined by hypoxemia and lung changes that are not fully explained by cardiac failure.

### **Oxygen therapy**

1. What is the primary goal of oxygen therapy in pediatric patients?

- A. To increase respiratory rate
- B. To improve ventilation
- C. To correct hypoxemia and maintain adequate oxygen saturation
- D. To lower heart rate

Answer: C. To correct hypoxemia and maintain adequate oxygen saturation

Explanation: The main goal of oxygen therapy in children is to correct low oxygen levels (hypoxemia) and maintain safe oxygen saturation.

2. Which of the following oxygen delivery methods is generally suitable for children with mild hypoxemia who require low-flow oxygen?

- A. Nasal cannula
- B. Non-rebreather mask
- C. High-flow nasal cannula (HFNC)
- D. Mechanical ventilation

Answer: A. Nasal cannula

Explanation: A nasal cannula is often used for low-flow oxygen delivery in children with mild hypoxemia as it is comfortable and easy to use.

3. In pediatric patients, what oxygen saturation level is typically the target range to maintain with oxygen therapy?

- A. 85-90%
- B. 90-92%
- C. 94-98%
- D. 100%

Answer: C. 94-98%

Explanation: For most pediatric patients, maintaining an oxygen saturation of 94-98% is generally the target range to ensure adequate oxygenation without excessive oxygen exposure.

4. What is a potential complication of prolonged, high-concentration oxygen therapy in neonates?

- A. Respiratory alkalosis
- B. Retinopathy of prematurity (ROP)
- C. Increased heart rate
- D. Hypertension

Answer: B. Retinopathy of prematurity (ROP)

Explanation: High-concentration oxygen therapy in neonates, especially preterm infants, can lead to ROP, a condition that affects retinal blood vessel development.

5. Which device is typically used to deliver high-flow oxygen therapy in pediatric patients with moderate to severe respiratory distress?

- A. Simple face mask
- B. High-flow nasal cannula (HFNC)
- C. Nasal cannula
- D. Venturi mask

Answer: B. High-flow nasal cannula (HFNC)

Explanation: HFNC is often used for children with moderate to severe respiratory distress as it can deliver higher flows and improve oxygenation and ventilation.

## **Respiratory failure**

1. Which of the following is a common early sign of respiratory failure in pediatric patients?

- A. Bradycardia
- B. Hypotension
- C. Increased work of breathing, such as nasal flaring and retractions
- D. Cyanosis

Answer: C. Increased work of breathing, such as nasal flaring and retractions

Explanation: Increased work of breathing is often an early sign of respiratory distress, which can progress to respiratory failure if untreated.

2. What is the most common cause of respiratory failure in pediatric patients?

- A. Cardiogenic shock
- B. Neuromuscular disorders
- C. Upper respiratory infections
- D. Lower respiratory tract infections, such as pneumonia or bronchiolitis

Answer: D. Lower respiratory tract infections, such as pneumonia or bronchiolitis

Explanation: Lower respiratory tract infections are a frequent cause of respiratory failure in children due to the impact on lung function and gas exchange.

3. Which of the following blood gas findings is typically associated with hypoxemic respiratory failure in pediatric patients?

- A.  $\text{PaO}_2 < 60 \text{ mmHg}$
- B.  $\text{PaCO}_2 > 60 \text{ mmHg}$
- C. Normal  $\text{PaO}_2$  and  $\text{PaCO}_2$
- D.  $\text{PaCO}_2 < 35 \text{ mmHg}$

Answer: A.  $\text{PaO}_2 < 60 \text{ mmHg}$

Explanation: Hypoxemic respiratory failure is characterized by low oxygen levels ( $\text{PaO}_2 < 60 \text{ mmHg}$ ) despite adequate ventilation.

4. Which oxygen delivery method is preferred for initial management in a pediatric patient with mild respiratory failure?

- A. Mechanical ventilation
- B. Nasal cannula
- C. High-flow nasal cannula (HFNC)
- D. Non-rebreather mask

Answer: B. Nasal cannula

Explanation: For mild respiratory failure, a nasal cannula can provide adequate oxygen support while being comfortable for the child.

5. Which of the following is an indicator for intubation and mechanical ventilation in pediatric respiratory failure?

- A. Mild hypoxemia that improves with supplemental oxygen
- B. Respiratory acidosis with  $\text{PaCO}_2 > 50 \text{ mmHg}$  and altered mental status
- C. Slight increase in respiratory rate
- D. Ability to maintain oxygen saturation with a nasal cannula

Answer: B. Respiratory acidosis with  $\text{PaCO}_2 > 50 \text{ mmHg}$  and altered mental status

Explanation: Severe hypercapnia with respiratory acidosis and altered mental status indicates respiratory failure, warranting intubation and mechanical ventilation.

### **Acute liver failure**

1. Which of the following is a common cause of acute liver failure in pediatric patients?

- A. Viral infections, such as hepatitis
- B. Gastroesophageal reflux
- C. Type 1 diabetes
- D. Appendicitis

Answer: A. Viral infections, such as hepatitis

Explanation: Viral infections, especially hepatitis, are a common cause of acute liver failure in



children due to liver cell injury and dysfunction.

2. What is the hallmark laboratory finding in pediatric acute liver failure?

- A. Elevated blood glucose
- B. Hypocalcemia
- C. Elevated serum ammonia and transaminases
- D. Low white blood cell count

Answer: C. Elevated serum ammonia and transaminases

Explanation: High levels of serum ammonia and liver transaminases (ALT and AST) are key indicators of liver dysfunction in acute liver failure.

3. Which of the following clinical signs is often associated with encephalopathy in pediatric acute liver failure?

- A. Hypotension
- B. Abdominal pain
- C. Altered mental status, such as confusion or lethargy
- D. Tachycardia

Answer: C. Altered mental status, such as confusion or lethargy

Explanation: Encephalopathy due to liver dysfunction often presents as altered mental status in pediatric patients with acute liver failure.

4. In managing pediatric acute liver failure, which of the following is often considered a priority?

- A. Immediate administration of anticoagulants
- B. Correction of hypoglycemia
- C. Increasing dietary protein intake
- D. Prescribing diuretics

Answer: B. Correction of hypoglycemia

Explanation: Hypoglycemia is common in acute liver failure, so maintaining normal blood glucose levels is a critical part of management.

5. Which of the following is an indication for liver transplantation in a child with acute liver failure?

- A. Stable serum ammonia levels
- B. Rapid improvement of liver enzymes
- C. Persistent encephalopathy and coagulation abnormalities
- D. Normal blood glucose levels

Answer: C. Persistent encephalopathy and coagulation abnormalities

Explanation: Persistent encephalopathy and abnormal coagulation (such as prolonged INR) indicate severe liver dysfunction and may necessitate liver transplantation.

### **Acute kidney injury**

1. Which of the following is a common cause of acute kidney injury in pediatric patients?

- A. Viral hepatitis
- B. Dehydration and hypovolemia
- C. Chronic hypertension
- D. Appendicitis

Answer: B. Dehydration and hypovolemia

Explanation: Dehydration and hypovolemia reduce blood flow to the kidneys, which is a common cause of AKI in children.

2. Which laboratory finding is typically used to diagnose acute kidney injury in children?

- A. Elevated liver enzymes (ALT, AST)
- B. High serum creatinine
- C. Low blood glucose
- D. High white blood cell count

Answer: B. High serum creatinine

Explanation: Elevated serum creatinine is a key indicator of impaired kidney function and is commonly used to diagnose AKI.

3. Which of the following clinical signs is commonly associated with pediatric acute kidney injury?

- A. Decreased urine output
- B. Increased appetite
- C. Jaundice
- D. Bradycardia

Answer: A. Decreased urine output

Explanation: Oliguria (low urine output) is a common sign of AKI as the kidneys are unable to filter and excrete waste properly.

4. What is a primary treatment goal for managing pediatric acute kidney injury?

- A. Increase dietary protein intake
- B. Maintain fluid and electrolyte balance
- C. Lower blood glucose levels
- D. Administer anticoagulants

Answer: B. Maintain fluid and electrolyte balance

Explanation: Managing fluid and electrolyte balance is critical in AKI to prevent complications and support kidney recovery.

5. Which of the following is an indication for dialysis in a child with acute kidney injury?

- A. Mild electrolyte abnormalities
- B. Stable urine output

- C. Severe hyperkalemia and fluid overload unresponsive to other treatments
- D. Normal blood pressure

Answer: C. Severe hyperkalemia and fluid overload unresponsive to other treatments

Explanation: Severe electrolyte imbalances and fluid overload that do not respond to conservative measures are indications for dialysis in AKI.

### **Intracranial hypertension syndrome**

1. Which of the following is a common symptom of intracranial hypertension in pediatric patients?

- A. Frequent nosebleeds
- B. Seizures
- C. Persistent headache, often worse in the morning
- D. Increased appetite

Answer: C. Persistent headache, often worse in the morning

Explanation: A headache that is more intense in the morning is a classic symptom of intracranial hypertension due to pressure changes with position.

2. What is a major risk factor for developing intracranial hypertension in children?

- A. Dehydration
- B. Obesity
- C. Low blood pressure
- D. Vitamin deficiency

Answer: B. Obesity

Explanation: Obesity is a significant risk factor for pediatric intracranial hypertension, particularly in idiopathic cases.

3. Which diagnostic procedure is commonly used to confirm elevated intracranial pressure in pediatric patients?

- A. Electroencephalogram (EEG)
- B. Spinal tap (lumbar puncture)
- C. Blood pressure measurement
- D. Skin biopsy

Answer: B. Spinal tap (lumbar puncture)

Explanation: A lumbar puncture can measure cerebrospinal fluid pressure, which helps confirm elevated intracranial pressure.

4. Which of the following visual symptoms might indicate intracranial hypertension in a child?

- A. Double vision (diplopia) and papilledema
- B. Blurred vision only after exercise
- C. Yellowish sclera

- D. Increased visual acuity

Answer: A. Double vision (diplopia) and papilledema

Explanation: Papilledema (optic disc swelling) and double vision are common visual signs of elevated intracranial pressure in children.

5. Which of the following medications is commonly used to reduce intracranial pressure in pediatric intracranial hypertension?

- A. Acetaminophen
- B. Furosemide
- C. Acetazolamide
- D. Prednisone

Answer: C. Acetazolamide

Explanation: Acetazolamide is a diuretic that reduces cerebrospinal fluid production and is often used to lower intracranial pressure in pediatric patients.

### **Electrolyte imbalance**

1. Which of the following is a common cause of electrolyte imbalance in pediatric patients?

- A. Excessive physical activity
- B. Chronic hypertension
- C. Gastroenteritis with vomiting and diarrhea
- D. High protein diet

Answer: C. Gastroenteritis with vomiting and diarrhea

Explanation: Gastroenteritis can cause significant fluid and electrolyte losses, especially sodium, potassium, and chloride, leading to imbalance.

2. Which electrolyte imbalance is commonly associated with muscle cramps and cardiac arrhythmias in children?

- A. Hypercalcemia
- B. Hypokalemia
- C. Hyperglycemia
- D. Hypomagnesemia

Answer: B. Hypokalemia

Explanation: Low potassium levels (hypokalemia) can cause muscle cramps and arrhythmias, as potassium is essential for muscle and heart function.

3. In pediatric patients, which of the following signs might indicate hyponatremia?

- A. Dehydration and lethargy
- B. Increased energy and hyperactivity

- C. Muscle rigidity and hypercalcemia
- D. Elevated blood glucose levels

Answer: A. Dehydration and lethargy

Explanation: Hyponatremia (low sodium) can cause dehydration, lethargy, and other neurological symptoms due to fluid shifts in cells.

4. What is the recommended treatment for hyperkalemia in pediatric patients that could prevent cardiac complications?

- A. Administration of glucose and insulin
- B. Increased water intake
- C. Acetaminophen for pain relief
- D. Restricting calcium intake

Answer: A. Administration of glucose and insulin

Explanation: Glucose and insulin help shift potassium back into cells, temporarily lowering serum potassium to reduce cardiac risk.

5. Which of the following electrolyte imbalances is associated with seizures in pediatric patients?

- A. Hyperglycemia
- B. Hypocalcemia
- C. Hypermagnesemia
- D. Hyperkalemia

Answer: B. Hypocalcemia

Explanation: Hypocalcemia (low calcium) can cause neuromuscular excitability, leading to seizures and tetany in pediatric patients.