Question 1

A 6-month-old child is brought in with 2-day h/o vomiting and diarrhea. He has refused to drink for the past few hours. He is afebrile with a HR of 170/min, RR of 52/min, BP of 85/60 mm Hg and SpO₂ of 98%. Capillary refilling time is 3 s. His eyes and ant. fontanelle are sunken. Skin turgor is diminished. He opens his eyes briefly and moans when intravenous access is obtained. Five ml of urine is obtained when a urinary catheter is placed.

Which of the following is most appropriate?

A. Administer 20 ml/kg NS rapidly to restore tissue perfusion as the infant is in shock and then reassess and repeat if needed
B. Administer 20 ml/kg NS over 1 hour and then administer iv fluids over 24 h to restore deficit equaling severe dehydration, provide maintenance and keep up with ongoing losses
C. Administer iv fluids over 24 h to restore deficit equaling severe dehydration, provide maintenance and keep up with ongoing losses
D. Administer 20 ml/kg NS rapidly and then administer iv fluids over 24 h to restore deficit equaling moderate dehydration, provide maintenance and keep up with ongoing losses
E. Administer iv fluids over 24 h to restore deficit equaling moderate dehydration, provide maintenance and keep up with ongoing losses
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**Shock**

- Shock results from inadequate blood flow and oxygen delivery to meet tissue metabolic demands
- Normal BP does not preclude shock
- Shock manifests as tachycardia, tachypnea, pallor, peripheral cyanosis, mottling of the skin, ↓ urine output, metabolic acidosis, ↓ mental status, weak or absent peripheral pulses, weak central pulses, and ↓BP
Immediately after establishing IV or IO access, rapid administration of 20 ml/kg isotonic fluids should be initiated to reverse shock.

Repeat the bolus quickly up to 60-80 ml/kg and titrate to normalize HR, UO, cap refilling time & mental status.

Question 2
Which of the following patients is at risk for malignant hyperthermia during general anesthesia?

A. A 15-year-old girl with a myopathy identified as central core disease on baclofen
B. A 14-year-old boy with schizophrenia on risperidone
C. A 6-month-old girl with cerebral palsy and delayed gastric emptying on metoclopramide
D. A 16-year-old girl with dystonia recently taken off levodopa
E. A 13-year-old boy with spastic quadriplegia with a baclofen pump failure

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kd3  Recognize condns assoc with malig hyperthermia
daphtak, 7/27/2012

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Malignant Hyperthermia

- Occurs in central core disease and other myopathies, muscular dystrophies, scoliosis & in an isolated syndrome
- Usually inherited as an autosomal dominant trait, gene is at the 19q13.1 locus
- Precipitated by general anesthesia
- Characterized by sudden extreme fever, muscle rigidity, metabolic & respiratory acidosis, rhabdomyolysis
- Treatment: dantrolene sodium

Neuroleptic Malignant Syndrome

- Potentially fatal reaction that can occur with antipsychotic agents, dopamine-blocking agents
- Manifests as fever, muscle rigidity, autonomic instability, delirium

Question 3

A 5-year-old child is brought to the ED after being struck by a car while crossing the street. He had a brief loss of consciousness at the scene. In the ED, he is alert and interactive and complains of a headache. While waiting for a CT scan of the brain to be done, he becomes unresponsive, with irregular respirations and unequal pupils. The left pupil is 6 mm and non-reactive to light and the right pupil is 2 mm.
What do you expect the CT scan of the brain to show?

A. Transtentorial herniation
B. Transcalvarial herniation
C. Cerebellar tonsillar herniation
D. Diffuse axonal injury
E. Obstructive hydrocephalus

Lucid interval suggest an epidural hematoma
Brain herniations represent a shift of the brain through or across regions to another site because of mass effect
Transcalvarial
Subfalcine
Uncal
Thru foramen magnum

Transtentorial herniation
- Supratentorial mass effect forces cerebral structures downward through the opening (incisura) of the tentorium
- Oculomotor palsy by compression against the tentorial edge -- ipsilateral fixed, dilated pupil
- Damage to pyramidal tracts -- contralateral hemiparesis
- Kernohan's (notch) phenomenon: compression of contralateral cerebral peduncle against tentorial edge -- ipsilateral hemiparesis
- Uncal herniation is a subset

Question 4
Which of the following is an essential component in the determination of death by neurologic criteria?
A. Reversible or irreversible cause of coma
B. Absence of brainstem reflexes
C. Absence of respiratory effort in response to an adequate stimulus, usually $P_{CO2} > 40$ mm Hg
D. A valid EEG
E. Nuclear medicine cerebral flow scan
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**Determination of brain death**

- **Clinical diagnosis** based on the absence of neurologic function with a known irreversible cause of coma  
- Hypotension, hypothermia, & metabolic disturbances should be treated & corrected, & medications that can interfere should be discontinued evaluation  
- 2 exams performed by different attending physicians separated by an observation period required

- Apnea testing requires documentation of $PaCO_2$ 20mmHg above the baseline and $\geq 60$mmHg with no respiratory effort  
- Ancillary studies may be used if parts of the exam cannot be performed safely, uncertainty about results, medication effect is present, to reduce observation period
Question 5

A 6-month-old child presents with a 2 day history of diarrhea, vomiting and decreased urine output. She appears severely dehydrated. Her laboratory studies are as follows: Na 134 mEq/L, K 5 mEq/l, Cl 100 mEq/l, CO$_2$ 14 mEq/l, BUN 44 mg/dl, Cr 1.6 mg/dl, urine Na 16 mEq/l, urine Cr 10 mg/dl.

What is the most likely diagnosis?

A. Prerenal azotemia
B. Renal azotemia
C. Postrenal azotemia
D. SIADH
E. Adrenal insufficiency
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A. Prerenal azotemia- u Na < 20  
B. Renal azotemia- u Na > 30  
C. Postrenal azotemia- does not fit clinically  
D. SIADH- euvolemic  
E. Adrenal insufficiency- u Na not low

Question 6
A previously healthy 10-month-old presents with a 5 day h/o low grade fever, poor PO intake and a 2 day h/o vomiting and fussiness. His parents state that his sleep rhythm has changed and he is awake at night and sleeps during the day. On examination, his vital signs are normal except for an elevated respiratory rate. His sclera is icteric. Heart sounds are normal. His respirations are deep but unlabored. His lungs are clear to auscultation. His liver is palpable 2 cm below the subcostal margin. He is drowsy, has good tone and moves all extremities.

Lab studies reveal blood glucose of 45 mg/dl, ALT of 112 mg/dl, total bilirubin of 8 mg/dl and INR of 3.

Which of the following is most appropriate after the patient has been stabilized?
A. Outpatient management  
B. Observation for 23 hours  
C. Admission to the regular nursing floor at the local hospital  
D. Admission to the ICU at the local hospital  
E. Transfer to a hospital that performs liver transplantation
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Acute Liver Failure

- Acute liver failure is a clinical syndrome resulting from massive necrosis or severe functional impairment of hepatocytes
- The definition includes
  - biochemical acute liver injury (< 8 wk duration)
  - no chronic liver disease
  - coagulopathy not corrected by vit K
  - clinical hepatic encephalopathy
- Progressive jaundice, fetor hepaticus, fever, anorexia, vomiting, abd pain common
- Rapid decrease in liver size without clinical improvement is an ominous sign
- Hepatic encephalopathy initially presents as sleep disturbances
- Irritability, poor feeding in infants

- Older children may have asterixis
- Later- somnolent, confused, combative, unresponsive
- Initially, respirations increased but later respiratory failure
- Infants & children with acute hepatic failure should be cared for in an institution able to perform a liver transplantation if necessary & managed in an ICU

**Question 7**

A 15-year-old female presents with a 6-month history of fatigue, malaise, anorexia and vomiting. She has lost weight. On examination, she has orthostatic hypotension and generalized hyperpigmentation. Lab studies reveal a serum Na of 128 mEq/l, K of 5 mEq/l, Cl of 98 mEq/l, HCO₃ of 18 mEq/l, BUN of 24 mg/dl and blood glucose of 54 mg/dl.
What is the most likely diagnosis?

A. SIADH
B. Chronic diuretic use
C. Adrenal insufficiency
D. Chronic renal failure
E. Eating disorder

What is the most likely diagnosis?

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Adrenal insufficiency

- Cortisol def. → ↓ cardiac output & vascular tone → **orthostatic hypotension**
- Aldosterone def. → ↓ sodium resorption in distal nephron → **hypovolemia, hyponatremia, hyperkalemia**
- Cortisol def. → ↓ negative feedback on hypothalamus & pituitary → ACTH & other peptide secretion → **hypermegmentation**
- SIADH- euvolemic
- Chronic use of diuretics- hypokalemic, metabolic alkalosis, volume depletion, increased $U_{Na}$ and $Cl$
- Eating disorder- Bulimics purge by vomiting, abuse of laxatives or diuretics. Usually have hypokalemia

**Question 8**

A 17-year-old-female presents with a 1 day h/o fever, malaise and nausea. Her T- 39ºC, P- 134, RR-28, BP-85/36, SpO$_2$- 98% RA
She is obtunded, has cool extremities, poor peripheral pulses, and her capillary refilling time is 4 s. She has no focus of fever.

She has a rash over trunk and extremities that is rapidly progressing.
What is the most appropriate antibiotic therapy for this patient?

A. Ceftriaxone and vancomycin
B. Ceftriaxone
C. Ciprofloxacin and bactrim
D. Doxycycline
E. Ceftazidime and tobramycin

Meningococcal disease can appear similar to sepsis caused by g-bacteria, S. pneumoniae, S. aureus, group A streptococcus, Rocky Mountain spotted fever, ehrlichiosis, epidemic typhus

- Fine maculopapular rash, prominent petechiae & purpura
### TREATMENT OF NEISSERIA MENINGITIDIS INVASIVE INFECTIONS

<table>
<thead>
<tr>
<th>DRUG</th>
<th>ROUTE</th>
<th>DOSE</th>
<th>DOSING INTERVAL (hr)</th>
<th>MAX DAILY DOSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin G</td>
<td>IM or IV</td>
<td>250,000-300,000 U/kg/day</td>
<td>4 to 6</td>
<td>24 million U</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>IM or IV</td>
<td>200-400 mg/kg/day</td>
<td>6</td>
<td>6-12 g</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>IM or IV</td>
<td>200-300 mg/kg/day</td>
<td>6-8</td>
<td>8-10 g</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>IM or IV</td>
<td>100 mg/kg/day</td>
<td>12-24</td>
<td>4 g</td>
</tr>
</tbody>
</table>

Alternative therapy in the face of life-threatening β-lactam allergy:
- Chloramphenicol | IV 50-100 mg/kg/day | 6 | 2-4 g |
- Ciprofloxacin   | IV 18-30 mg/kg/day | 5-12 | 800-1600 mg |
- Meropenem       | IV 60-120 mg/kg/day | 8 | 4-6 g |

- Empirical therapy should be initiated immediately for possible invasive meningococcal infections
- β-Lactam antibiotics are the drugs of choice. Because of concerns about penicillin- or cephalosporin-resistant S. pneumoniae, IV vancomycin should be added empirically for bacterial meningitis of unknown cause

### Question 9

What size endotracheal tube would you use to tracheally intubate a 4-year-old child?

A. 5.5 mm uncuffed endotracheal tube
B. 4.5 mm uncuffed endotracheal tube
C. 5.0 mm uncuffed endotracheal tube
D. 5.0 mm cuffed endotracheal tube
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E. 5.5 mm cuffed endotracheal tube
Endotracheal tube size

- Term neonates: 3.5 mm uncuffed, 3.0 mm cuffed
- Infants: 4.0 mm uncuffed, 3.5 mm cuffed
- > 2 y of age:
  - Uncuffed tube = (age/4) + 4
  - Cuffed tube = (age/4) + 3 or (age/4) + 3.5
- Size of little finger

Depth of insertion:

- Tube size x 3
- > 2 y of age: Depth = (age/2) + 12

Question 10

A patient with septic shock who is intubated and mechanically ventilated develops worsening oxygenation. CXR shows development of new bilateral infiltrates suggestive of pulmonary edema. The most appropriate next step is:

A. Administration of furosemide
B. Increase PEEP
C. Increase respiratory rate
D. Start methylprednisolone
E. Increase inspiratory time
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**Pulmonary edema**

- Pulmonary edema develops when liquid moves from blood vessels to interstitial space & sometimes into alveoli
- Initiated by imbalance of Starling forces or damage to alveolar-capillary membrane
- May be cardiogenic or non-cardiogenic
- Role of PEEP is to avoid collapse of alveoli & maintain inflation throughout respiratory cycle

**Positive End Expiratory Pressure (PEEP)**

- PEEP increases FRC
- PEEP increases lung compliance
- PEEP decreases intrapulmonary shunting
- PEEP increases PO$_2$ and allows lowering of FiO$_2$
Question 11
An 8-year-old child presents to the ED in hypovolemic shock. The nurse fails to get intravenous access after multiple attempts. Which of the following is the most appropriate next step?

A. Consult Pediatric Critical Care to obtain central venous access
B. Try cannulating the median antecubital, cephalic or great saphenous vein
C. Access the radial artery
D. Obtain intraosseous access
E. Consult Pediatric Surgery to do a venous cut down

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Vascular access
- Establishment of access to circulation is a critical component of resuscitation
- Preferred is largest, most accessible vein that does not require interruption of resuscitation
- Limit time spent attempting to establish peripheral venous access
- IO can be used even for patients > 6 y
Intraosseous access

- All IV medications can be given IO including epinephrine, adenosine, fluids & blood products
- Central venous catheter placement requires training & can be time-consuming

Question 12

The outcome of a child with submersion injury is primarily determined by which one of the following factors:

A. The effectiveness of resuscitation efforts at the scene
B. Fresh water versus salt water drowning
C. Wet versus dry drowning
D. Volume of aspirated fluid
E. Initial ECG rhythm
Predictors of Outcome (drowning)

- Outcome is related to extent of cerebral injury; prognosis depends on neurological status after resuscitation
- Poor prognosis if:
  - Unwitnessed event
  - Prolonged time to resuscitation
  - Need for CPR at the scene & ED
  - Prolonged coma
  - Longer submersion time
  - Higher lactic acid, blood glucose, lower GCS, apnea, bradycardia, pupillary reactivity at admission

Question 13

A 5-month-old infant presents with a 2 week h/o difficulty in feeding & diaphoresis. He has failed to gain weight. On examination, his temperature is 37°C, HR 180/m, RR 56/m, BP 88/50 mm Hg, SpO₂ 92%. He is lethargic, has cool hands & feet. Heart sounds are normal, there is no murmur. He has bilateral crackles over his lung bases. The liver is palpable 4 cm below the subcostal margin with a span of 8 cm.

What is the most likely diagnosis:

A. Heart failure
B. Sepsis
C. Bronchiolitis
D. Congenital adrenal hyperplasia
E. Nephrotic syndrome
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Heart Failure in Infants

- Depending on cardiac reserve, manifestations of heart failure may occur at rest or during activity
- Infants have feeding difficulty, poor weight gain, tachypnea, excessive perspiration, irritability, labored respiration
- Wheezing may more prominent than rales and can be confused with bronchiolitis

- Hepatomegaly, cardiomegaly, tachycardia, gallop rhythm seen
- JVD difficult to see because of short neck
- Edema less often seen on legs and feet
Question 14

A 14-year-old girl with lupus presents with sharp chest pain that increases on inspiration & is relieved by sitting upright or prone. She is afebrile with a HR of 124/m, RR of 26/m, BP of 90/78 mm Hg & has SpO₂ of 96%. She has distended neck veins. ECG shows non-specific abnormalities of the ST segments & low voltage QRS amplitude.

What is the most likely diagnosis?

A. Pleural effusion
B. Pericardial effusion
C. Pneumothorax
D. Pulmonary embolism
E. Myocardial infarction
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Cardiac tamponade

- Cardiac tamponade is life-threatening, slow or rapid compression of the heart due to the pericardial accumulation of fluid, pus, blood, clots, or gas
- The primary abnormality is rapid or slow compression of all cardiac chambers as a result of increasing intrapericardial pressure
- As the chambers become progressively smaller and myocardial diastolic compliance is reduced, cardiac inflow becomes limited

- Manifestations include tachypnea, tachycardia, narrow pulse pressure, jugular venous distension, pulsus paradoxus, pericardial rub, attenuated heart sounds, quiet precordium, hypotension, cool hands and feet
- ECG abnormal, nonspecific
- CXR- Erlenmeyer flask with pericardial effusion
- Echocardiogram sensitive- compression and collapse of RA and/or RV present in cardiac tamponade
Question 15

A 6-year-old child was an unrestrained back seat passenger in a car that was involved in a head on collision with another car. He is tachycardic, tachypneic and hypoxic. He has paradoxical chest wall movement with inward movement on inspiration. Trachea is midline. There is decreased air exchange on the right side. CXR shows multiple bilateral rib fractures and airspace opacity on the right.

Which of the following is most appropriate:

A. Tracheal intubation and administration of PEEP
B. Insertion of a large bore thoracostomy tube
C. Needle aspiration followed by placement of a thoracostomy tube
D. Tracheal intubation followed by thoracotomy
E. Tracheal intubation and strapping the chest

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**Flail Chest**

- Fracture of 2 or more ribs in 2 or more places
- Paradoxical chest wall motion:
  - move inwards with inspiration & push outward with exhalation

**THE MECHANISM OF A FLAIL CHEST**

- inspiration
- expiration
- mediastinum shifts with each breath
- Fractures require NO treatment
- Major physiological insult is contusion
- 90% will have associated injuries & 3 out of 4 require tube thoracostomy for hemopneumothorax
- **Mechanical ventilation with adequate PEEP to stabilize the abnormal segment**
- Weaning should not wait till paradoxical movement improves, rather should be initiated when gas exchange is adequate

**Question 16**

A 6-month-old child is brought in by his mother who noticed abnormal jerking movements of his extremities associated with eye deviation. Following a dose of lorazepam, the movements stop.

On examination, you see bruising and bogginess behind his right ear. The tympanic membrane is intact but appears purplish. His anterior fontanelle is tense. He has some old and new bruises over his body. Examination of the cardiovascular and respiratory system and the abdomen, genitourinary system, and musculoskeletal system is unremarkable.

You request a CT scan of the brain. **What other examination should you consider?**

A. Retinal examination
B. Audiometry
C. Coagulation profile
D. Drug screen
E. Testing for osteogenesis imperfecta
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**Basilar skull fractures**

- Children are prone to basilar skull fractures which usually involve temporal bone
- Temporal bone fractures manifest as postauricular ecchymosis (Battle sign), hemotympanum, hearing loss, facial paralysis, CSF otorrhea or rhinorrhea, vertigo, tinnitus, nausea, vomiting
Abusive head trauma

- Possibility of abusive head trauma must be considered
- May be caused by direct impact, asphyxia or shaking
- External signs of injury may not be evident even with serious intracranial trauma
- In preverbal children, an index of suspicion should exist when they present with lethargy, vomiting, altered neurologic status or seizures
- Retinal hemorrhages are an important marker and a dilated, indirect exam by a pediatric ophthalmologist should be performed