

O2. When planning continuous intravenous sedation and analgesia for a 3-month-old patient in the PICU, which would be most appropriate?

- a. Continuous infusions of dexmetomidine 2mg/kg/hr and fentanyl 2mcg/kg/hr.
- b. Intermittent bolus doses of morphine sulfate and dexmetomidine
- c. Continuous infusion of fentanyl 1mcg/kg/hr and Midazolam 0.3mg/kg/hr
- d. Intermittent doses of fentanyl 1mcg/kg and diazepam 3mg/kg every 1 – 2 hours

O3. A 4-year-old has respiratory distress and hypoxia secondary to suspected empyema. Which of the following sedation plans is MOST appropriate to facilitate chest tube placement?

- a. Local anesthetic and child life therapist presence
- b. Dexmetomidine and fentanyl
- c. Ketamine and midazolam
- d. Etomidate and midazolam

O4. An 8-year-old with history of obstructive sleep apnea, obesity, admitted with osteomyelitis needs a PICC line for long-term antibiotic therapy. He is noted to have Werdnig-Hoffman Syndrome with a difficult airway. Which sedation plan is MOST appropriate for this patient?

- a. Fentanyl and midazolam doses titrated to desired effect
- b. Single dose of propofol
- c. Single dose of fentanyl and midazolam
- d. Local anesthetic with child life therapist support during procedure

O5. A 5-year-old with ataxia needs a lumbar puncture. Which of the following sedation plans would be most efficient with the least side effects to complete this diagnostic test?

- a. Ketamine and midazolam
- b. Fentanyl and midazolam
- c. Fentanyl and lorazepam
- d. Etomidate and morphine

O6. A 3-year-old has undergone frequent orthopedic procedures and is now returning from the PACU, and is hypertensive, tachycardic, and minimally hypoxic. He is awake and crying, despite the recent application of an epidural catheter with fentanyl and bupivacaine. After careful evaluation, what is the most appropriate management?

- a. Discontinue the epidural catheter while administering intravenous morphine
- b. Administer small amounts of narcotic analgesic until the pain is controlled
- c. Administer a sedative such as lorazepam
- d. Administer oral oxycodone and assess again in 2 hours

Part P: Technical Skills/Procedures

P1. When preparing to place a chest tube to assist in draining a pleural effusion, the catheter should be inserted:

- a. at the 6th – 7th intercostal space along the mid-clavicular line
- b. at the 2th – 3rd intercostal space along the mid-axillary line

- c. using the Trocar technique, which aligns the chest tube at the largest collection of fluid
- d. using the Seldinger technique, at the 4th to 5th intercostal space along the mid-axillary line

P2. A patient with a pneumothorax as a result of trauma has a chest tube in place. The PNP is alerted that the patient has required increased oxygen and is more tachypneic. On exam, there is crepitus around the insertion site of the CT. There is also an air leak noted in the chest tube water-seal chamber. What is the next step in management?

- a. Alert the surgeon of the air leak and need to remove the chest tube
- b. Obtain a chest xray to evaluate placement of tube and presence of air in the pleural space
- c. Increase the suction parameter on the chest tube drainage system
- d. Place the patient on a high flow nasal cannula for additional respiratory support

P3. When placing a central venous line inserted to the internal jugular vein, obtaining an xray prior to starting intravenous fluids is important to document positioning:

- a. of the catheter in the right ventricle through the superior vena cava
- b. of the catheter in the left atrium through the mitral valve
- c. and identify the presence of kinks in the catheter or a pneumothorax from insertion process
- d. and identify the presence of clots on the end of the catheter

P4. The ACPNP is completing a lumbar puncture on a 6-week-old infant who presented with lethargy and fever after obtaining a head CT which was read as normal. In addition to obtaining fluid for protein and glucose, the other most important testing includes which of the following?

- a. opening pressure, fluid for culture, cell count and HSV
- b. opening pressure, fluid for culture, cell count, and fungal culture
- c. obtaining fluid for culture, cell count, and HSV
- d. obtaining fluid for cell count, HSV, and fungal culture

Correct Answers to Multiple Choice Questions with rationale:

Part A: Acute Care PNP role/Growth and Development/Mental Health

A1-Correct A- address and support patient safety and quality of care

Central line infections are considered a patient safety issue as a healthcare-associated infection (HAI) and do increase morbidity and mortality, contributing to additional costs in care. Central line associated bloodstream infections (CLABSI) are the most common HAI in neonates and children. Concern when the incidence of infection increases is appropriate and next steps include evaluating the rationale. A quality improvement project includes identifying a problem and uses a method such as PDSA (Plan, Do, Study, Act) to evaluate the problem and identify solutions to improve the process of care.

A2-Correct B- Discuss the importance of allowing child to know his illness now and be involved in any decision making

A school aged child who is diagnosed with any illness, but especially a life-threatening one, should be allowed to participate in decision making, with a full awareness of his illness. In the case of participation in a study medication or protocol, the child would also be asked to provide assent while the parents' consent, so transparency is important in this situation.

A3-Correct B- Ask to speak to the other provider in private and discuss the missing information
Informed consent requires the provider to offer any and all information about the procedure and any important background information, potential complications or untoward events. Obtaining the consent and/or signing as a witness requires that the patient and/or family receives all appropriate information.

A4-Correct B- Credentialing

The process of verifying and documenting the education, certification and licensing of a provider is called credentialing. Privileging refers to the set of patient care skills the provider will be able to utilize based on previous training and validation. License verification is part of the process of credentialing and onboarding typically refers to all activities involved when a new employee begins their job.

A5-Correct-A- Continue home medications, explain carefully what is being done and why
In the hospital setting, providers are focused on the reason for the admission and their attempts to heal or cure symptoms. In this case, the child had two problems; the primary concern is complicated pneumonia, but the secondary mental health issue should still be addressed. A patient who is being treated with medication should continue this therapy as prescribed. Some medications also have risks associated with stopping them abruptly. A teen should also have expectations that she will participate in therapy that will improve her health status. Continuing her depression medications and explaining treatment is most important.

A6-Correct D- cohort study

The evidence pyramid is an illustration of best levels of information to guide a practice change. Systematic reviews and meta-analyses are the highest level of evidence, followed by randomized controlled trials. Cohort studies, which are designed to follow matched samples prospectively fall in the middle of the pyramid, which would then include other less rigorous research designs, such as quasi-experimental studies. Case studies are below cohort studies and expert opinion does occupy the lowest position on the pyramid.

A7-Correct C- The advanced practice nurse consensus model requires that education match certification and practice, so dermatology would not match acute care practice

The APRN Consensus model also known as LACE model (Licensure, Accreditation, Certification and Education) was published initially in 2008 and outlines recommendations for uniformity of practice expectations in the regulation of APRN roles. Despite the presence of an independent practice clause within a state for nurse practitioners, the consensus model dictates the recommendations for which population an APRN can care for, what certification is acceptable for that population-based role and baseline education for the same. In this situation, the consensus model would not approve an acute care PNP practicing in a dermatology practice, which is a specialty, but not acute or critical care in nature.

A8-Correct B- Nonmaleficence

This patient has a risk of increased complications with another surgical procedure. The stem of the question does not offer the current option of palliative care or an end of life plan but taking the child back to the operating room may not be in the best interest of the child at present, which represents doing no harm, the definition of nonmaleficence.

A9-Correct C- Advocating to use a community fund for a child to receive ADHD medications who has a large prescription co-pay which is not affordable for the family.

The concept of beneficence is to have the welfare of the patient as the goal. The best answer for this question is advocating to use a community fund for a child to receive ADHD medications who has a large prescription co-pay which is not affordable for the family. Encouraging administration of flu vaccination for a child who was hospitalized the year prior with influenza is important, however, in that example, beneficence would be providing antiviral therapies to the child to treat the influenza. Resuscitating a child that is thought to be brain dead would not be in the best interest of the child as it may prolong suffering. Offering palliative care services for a child who has been diagnosed with spinal muscular atrophy (SMA), type I is appropriate, however, not the best example of beneficence when considering the options.

A10-Correct D- consult diabetic educator to review diabetes care with both parents and child
An adolescent patient with diabetes cannot be expected to manage her own care independently. Frequent admissions for DKA most likely indicate poor control of diabetes, so if the child is spending more time with her father at this point, the father has to be included in learning diabetes management. It would be appropriate to make sure that the patient has supplies, but not the first priority in this case.

A11-Correct A- Situation

In the SBAR method, providing the caller's name and institution, and the patient's reason for transfer provides the 'situation.' Additional information about the child's history and presentation provides the 'background,' information about the child's physical examination and differential diagnosis provides the 'assessment,' and information on the plan for the patient provides the 'recommendation.'

A12-Correct B- Privileging

Determining certification, and licensure and verifying education will be performed in a professional practice role for the purpose of credentialing, which is the process of establishing the qualifications of a health care provider. Privileging is the process which lists specific procedures or skills that a nurse practitioner can perform in the role and licensure is granted by the specific

state where the provider is practicing. Certification is granted by certifying bodies (e.g., PNCB, ANCC) after demonstration of successful examination completion demonstrating competence.

A13-Correct B- Introduce the topic of palliative care and call the palliative care team
Early involvement of palliative care services provides patients and families with tools and support to optimize the child's life. When prognosis for a child is grim, it may be easy to 'soften the blow' by using nebulous terms or skirting around the truth, however, the family and child deserve truthful and accurate information on the disease and prognosis. Connecting the family with resources to facilitate caring for their child at home is an important piece of discharge planning. Introducing allow natural death (AND) is appropriate for this patient and family, however, introducing palliative care and discussing goals of therapy prior to introducing discussion of AND is more appropriate.

A14-Correct D- Evaluate the patient and situation, discuss quality of life and anticipated recovery with parents

This patient has chronic disease and quality of life may be questioned in the need for a tracheostomy and continued ventilation to support breathing in this patient. Evaluating the patient and situation, discussing quality of life and anticipated recovery with parents and the family is most important in making decisions for resuscitation or this surgical procedure. It may be routine procedure to place a tracheostomy tube after a period of intubation and ventilation, but parents are not accepting of this procedure, so it warrants continued discussion.

A15-Correct B- If the admission was after midnight, only one of the providers can bill for the admission

Two providers from the same team/subspecialty may not bill for the same services in the same-24-hour period. If the admission was after midnight, only one of the providers can bill for the admission. If there are procedures completed for this patient, these can be coded and billed, but nothing else can be billed if completed by both providers. It is best to discuss the appropriate billing plan with the biller to ensure that billing is maximized without resulting in double billing/fraud.

A16-Correct B- Discussing with the family the opportunity to transition the young man to an adult based medical home provider

This patient with multiple medical problems is well established with subspecialty services, however, is now 25 years of age and ready to transition to adult providers that can better meet adult medical needs. A discussion of DNR may be indicated depending on his overall quality of life, however, more information is needed.

A17- Correct C - Reinforce that the illness may have contributed to the child's delay and refer to a developmental program for continued support

It is common for children to have regression in milestones after experiencing significant medical illness and receiving aggressive medical therapies. Reassuring the family that regression is common in children experiencing a major-medical illness is common and referral for intervention is helpful.

A18-Correct C- The LACE model reflects that education, certification and position match, so she should seek an educational program where she can obtain the missing coursework.

The APRN Consensus model also known as the (LACE) Licensure, Accreditation, Certification and Education model was published initially in 2008 and outlines recommendations for uniformity of practice expectations in the regulation for APRN roles. Despite the fact that this NP

was able to practice in her original state without the appropriate education and certification, this ability does not go across state lines. The best option is for her to complete a post-master program in acute care and acute care certification to be able to practice in that population in any state. Individual state boards can determine rules for their state without utilizing the national guidelines. The PNP must abide by the governing state board rulings.

A19-Correct B- Introducing the topic of palliative care and asking the family to consider completing an AND plan

Palliative care is a process which offers patients and families many benefits to support continued quality of life care during chronic or life-limiting illness, so referral to this team is appropriate even early in the diagnosis. In the setting of this progressive neurologic illness, the child will most likely not be able to live a normal life and will require advanced respiratory support, so it is helpful for the parents to determine what emergent therapies they want to pursue prior to the time that this happens. The child may not live a long life, but it is important to support parents' wishes while also allowing them to make decisions with the best possible explanations and planning. Long term care may be a needed option but asking the parents to make this decision along with a DNR order is not appropriate. Respiratory failure may precede cardiac dysfunction so the AND offers parents the ability to make decisions about each option within resuscitation.

Part B: Respiratory

B1-Correct C- Pneumothorax

In this **acute** presentation of chest pain, tachypnea, and respiratory distress, a spontaneous pneumothorax is the most likely etiology. An asthma exacerbation is also possible, however, there is no mention of a history of asthma or other illness in this teenager. Asthma is also associated with wheezing and cough. Pneumonia and bronchitis generally have a slower onset and may be accompanied by fever or other signs of infection.

B2-Correct C- Assess his previous stooling patterns

Investigating previous feeding and elimination patterns is always important in the assessment of appropriate or "normal" body function. Stooling patterns can vary among infants and children and do not have to follow a specific, daily process. NPO status and hospitalization may affect the normal stool pattern, but important to address previous history.

B3-Correct C- Involve child life services to provide a puzzle, crayons and coloring book for distraction

Providing therapy and treatment for young children can be challenging. In this case, keeping the oxygen in use is very important. Involving child life therapists to provide age-appropriate toys, crayons, etc. to occupy this child is typically recommended and will assist in distracting him from the nasal cannula.

B4-Correct B- Does the infant roll over and try to sit up?

It is always important at any health care encounter to evaluate growth and development. Even in the hospital environment, asking questions and observing activity and behaviors assists in identifying developmental delays. Illness can also contribute to regression.

B5-Correct A- Initiation of noninvasive ventilation with BIPAP

This child is experiencing increased hypoxia rather than ventilation issues, making non-invasive ventilation or intubation more solid choices than escalation of albuterol or addition of magnesium which would enhance smooth muscle relaxation and assist in improving ventilation. This child's

clinical status allows for an attempt at non-invasive ventilation prior to escalating to invasive mechanical ventilation. It is best to avoid invasive ventilation for children with asthma, if possible, due to their increased risk for air trapping and air leak syndromes once intubated.

B6-Correct C- Do not change the tracheostomy tube or ties

Fresh tracheostomy tubes (e.g., $\sim < 7$ days) do not have well established tracts. If a tracheostomy tube is intentionally or unintentionally removed or dislodged there is significant risk for losing the airway and an emergency may arise. Some children will require oxygen administration after placement of the tracheostomy tube, however, this will depend on the indication for the tracheostomy tube placement. Intravenous antibiotics may be administered based on surgeon preference, but the risk of surgical site infection is not as significant as the risk for losing the airway if the tracheostomy tube is dislodged. Head position with the head of bed up can be helpful to improve the risk of facial swelling and may be beneficial if the child is at risk for aspiration, however, this also is not as important as the risk for losing a secure airway.

B7-Correct B- Pneumonia caused by chlamydia pneumoniae

Rationale: This 5-day old infant is unlikely to have streptococcus pneumoniae, especially without fever or significant respiratory distress. Chlamydia pneumoniae is much more likely at this time frame and age of infant. Transient tachypnea of the newborn usually presents with symptoms not long after birth and bronchopulmonary dysplasia is typical for infants who were born preterm, with immediate findings. *Streptococcus pneumoniae* will generally present with a fever while *Chlamydia* is generally an afebrile infection.

B8-Correct A- Obtain a blood gas

This child is demonstrating signs of respiratory decompensation/failure. The next best step is to obtain a blood gas to assess oxygenation and ventilation. An arterial blood gas would provide the best results, but often is painful and could cause additional distress, so obtaining a capillary or venous sample would also be appropriate. This child may require intubation and ventilation, however, the information from the blood gas can help with that decision. High flow nasal cannula or BiPap would be other options after assessing the blood gas results. A complete blood count and cold agglutinins may provide some information about whether the asthma exacerbation was incited or accompanied by an infection, but will not aid in his treatment during acute decompensation.

B9-Correct C- Azithromycin

Atypical pneumonia, like *mycoplasma*, is common in school aged children and is well covered by azithromycin, a macrolide antibiotic. Clindamycin is a very good selection for aspiration pneumonitis, many *staphylococcus* and *streptococcus* infections (and, in some cases, MRSA). Linezolid has broad spectrum antimicrobial coverage and is generally reserved for severe and resistant infections. Amoxicillin (particularly high dose) is often a good choice for community acquired pneumonia, however, does not provide good coverage for *Mycoplasma pneumoniae* which this question is targeting.

B10-Correct D- Apply heated high flow nasal cannula system

Applying heated high flow nasal cannula would be the appropriate next step in the management of this infant. It allows higher flow by nasal cannula without drying out the nasal passage as similar flows in standard nasal cannula. High flow nasal cannula has been shown to increase tidal volume and increase bronchiolar gas exchange. The increased level of flow will also likely stimulate the baby to breathe more consistently. Albuterol is not indicated in this child who is not wheezing. Using nasal CPAP is also a good choice, though, using a step-wise approach, attempting high flow nasal cannula first is most appropriate.

B11-Correct D- Lateral Decubitus

A decubitus x ray, an x-ray obtained with the child lying on their side, will allow that fluid to layer out (form a meniscus) due to the dependent position. This will allow better evaluation of the size/layering out of the effusion. Anterior-posterior (AP) and posterior-anterior (PA) chest x-rays may demonstrate effusions, but improved evaluation is provided using the decubitus position. A lateral x-ray or taking the x-ray through the side of the child while sitting up (without laying the child on their side), will likely not provide much information about an effusion and should not be used.

B12-Correct A- Hyperinflation with peribronchial cuffing

The most common chest x-ray finding in a child with an asthma exacerbation is hyperinflation/hyper-expansion due to air trapping. The diaphragms are pushed down and lose their convex appearance. Atelectasis, infiltrate, or effusion may result in the inability to decipher the diaphragm on the chest x-ray. The heart border can be obscured when atelectasis is present. Infiltrates in the lower lobes along with hyperinflation are not commonly seen in status asthmaticus, however, hyperinflation along with peribronchial cuffing suggestive of bronchial wall thickening due to mucus build up is common in asthma exacerbation.

B13-Correct B- Magnesium sulfate bolus

This child has received back-to-back albuterol treatments, was hypoxic which is now improving, but still meets criteria for a diagnosis of status asthmaticus. Magnesium sulfate assists in promoting smooth muscle relaxation which will help to eliminate wheezing after albuterol and steroids. If magnesium bolus is not effective, beginning continuous albuterol treatments for this child would follow. CPAP or high flow nasal cannula may be helpful, especially if the child remained hypoxic and was not moving air well; however, they will not treat the underlying pathology of bronchoconstriction, inflammation, or mucus production. Administration of terbutaline would be another option after the use of magnesium and continuous albuterol.

B14-Correct C- Assess the endotracheal tube for placement

The best first step anytime there is an acute decompensation of a child that is intubated is to hand ventilate with a bag and assessment of appropriate endotracheal tube placement. If the tube is deemed not to be in the trachea, the endotracheal tube should immediately be removed. A chest x-ray may be indicated if there are unequal breath sounds and there is concern for appropriate placement (e.g., migration into the right main stem bronchus) or a pneumothorax. Increasing the ventilator rate will increase ventilation but is not the best ventilator adjustment to improve oxygenation.

B15-Correct B- Pertussis PCR and culture

Pertussis begins with a catarrhal stage, then progresses to a spasmodic cough. In the spasmodic phase, children have severe episodes of coughing, often associated with post-tussive emesis and cyanosis. RSV is often associated with cough, rhinorrhea, and fever, though less commonly with severe cough and post-tussive emesis. A CBC and electrolytes can be helpful to evaluate the white blood cell count which in the case of pertussis may indicate lymphocytosis, and electrolytes can assist in determining hydration status. These lab results will not provide conclusive data to base treatment, though. A chest-Xray may be warranted but will not provide diagnosis unless the infant has an accompanying pneumonia or pneumothorax.

B16-Correct A- Increase the pressure support until the spontaneous breaths are synchronous Synchronized intermittent ventilation (SIMV) with volume control allows the patient to initiate a breath and then provides the set volume to maintain inspiration. The patient situation/illness

controls the amount of pressure required to generate the set volume; for example, sedation may lower the pressure requirement, but asthma, an obstructive process will increase the needed pressure to generate the same amount of volume to the lungs. A ventilator set rate of 15 and less sedation will allow the patient to breathe more frequently than breaths provided by the ventilator. In this situation, pressure support allows the patient to initiate a breath and the ventilator then provides the airflow to support the spontaneous breath. Increasing pressure support, increases the pressure generated when a patient takes a spontaneous breath, which will prolong the inspiratory phase and slow down overall respiratory rate. Decreasing the ventilator rate will not slow spontaneous respirations.

B17-Correct A- decrease or stop sedation, trial on CPAP on the ventilator and if he breaths spontaneously and maintains oxygenation, he is ready to extubate

There are several methods to extubate an infant or child with the most significant and successful way to include giving the child an opportunity to breathe on his own with minimal pressure support, like the use of CPAP within the ventilator mode. Some ventilator settings should also be decreased in preparation for extubation, such as the rate and PEEP, if both are high. A child who has been on sedation and analgesia for 3 days should not experience tolerance to those medications in that much time, so the sedation/analgesia can be turned off shortly before the child is expected to breathe independently. Having oxygen and breathing support is necessary any time a patient is extubated, but in an otherwise healthy child, the expectation is that the child will continue to breathe without support.

Part C: EENT

C1-Correct A- orbital cellulitis can cause vision impairment and pain, restricted movement in the affected eye

Differentiating between a child with a peri-orbital cellulitis and orbital cellulitis is extremely important as orbital cellulitis can result in blindness. Orbital cellulitis can cause vision impairment and eye pain, restricted movement in the affected eye. Periorbital cellulitis involves the area around the orbit of the eye, primarily the eyelid and it is less toxic and does not cause significant pain or any visual impairment.

C2-Correct A- BAER evaluation

A BAER, or brain stem auditory evoked response, test determines electrical activity in the cochlea and auditory pathway in the brain. This is a good test for an individual receiving ototoxic chemotherapy that is experiencing hearing loss. Tympanometry is a test of the inner ear and mobility of the tympanic membrane. This is best for children with recurrent otitis media and fluid in the middle ear. Preliminary testing with a BAER is best prior to making referrals to specialists.

C3-Correct B- *Staphylococcus aureus*/ Clindamycin + amoxicillin clavulanic acid

The symptoms and findings in this child most likely represent periorbital cellulitis. The most common causative organisms are *Staphylococcus* and *Streptococcus species*. It can less commonly be caused by other bacteria, viruses or fungal infections. The AAP Redbook offers guidelines for treatment which include clindamycin and augmentin.

C4-Correct A- Renal

Pits or tags in the preauricular area may be associated with branchio-oto-renal syndrome. Children should be screened for hearing loss and renal abnormalities.

C5-Correct A- *Streptococcus pyogenes*, *Staphylococcus aureus* and *Haemophilus influenzae*

Staphylococcus, *streptococcus*, *Haemophilus*, and *Neisseria* are the most common pathogens cultured in peritonsillar abscess, which is found more commonly in older children and teens as compared to retropharyngeal abscess which are more common in children between the ages of 2 and 4. Both types of abscess may require drainage and/or treatment with antibiotics.

C6-Correct B- If OM is present, treatment with Ceftriaxone if unable to take PO fluids or Amoxicillin PO

A young patient with status asthmaticus with fever may indicate an infectious process along with asthma or RAD. In a child with a history of prolonged cold symptoms and fever, along with frequent episodes of OM, it is very likely that he has an ear infection, incidental to the wheezing episode. First line treatment for OM is Amoxicillin or Ceftriaxone if the child cannot tolerate oral intake. Hyperinflation and atelectasis are common radiologic findings in a child with status asthmaticus, but do not indicate pneumonia.

Part D: Cardiac

D1-Correct C- Administer IV hydralazine PRN

Acute hypertension can be managed with anti-hypertensive therapies, like hydralazine which can be titrated and administered PRN to manage high blood pressure in different situations. Diuretics can be used for hypertension, but caution needs to be taken to assess fluid status and, in this situation, may not be appropriate for treatment, as this BP is most likely secondary to chemotherapy and steroid therapy, which hopefully will not last long term. Other work up may include an echocardiogram but obtaining an ECHO prior to the start of chemotherapy is standard. Most important is to control blood pressure to prevent other complications.

D2-Correct D- Abdominal radiograph

The greatest concern for an infant with hypoplastic left heart syndrome and abdominal distention is necrotizing enterocolitis (NEC). The best initial way to evaluate for NEC is an abdominal x-ray which can demonstrate pneumatosis or free air in the abdomen if the bowel lumen has perforated. An abdominal US is not a first line test for this infant, though is a good study to evaluate for ascites which can be associated with low cardiac output. However, ascites is rarely a medical emergency. Liver function tests would not be indicated in this infant. An ECHO is very helpful in evaluating cardiac anatomy, function, and pericardial effusion; however, the abdomen is the targeted concern in this question and an abdominal x-ray is the most appropriate first diagnostic test for this infant.

D3-Correct A- Aldactone

Spiro lactone (Aldactone) is a potassium sparing diuretic. It is a weak diuretic and primarily is helpful in retaining potassium when the patient is concomitantly on a loop diuretic, like lasix which is commonly associated with potassium loss. Children with a VSD do not require anticoagulation when VSD alone is present. Typically, an additional potent diuretic agent such as Butamide is not required. Clopidogrel is not needed in a child with a VSD.

D4-Correct B- Coronary artery aneurysm

The most concerning cardiac risk for children with Kawasaki disease is the development of coronary artery aneurysm. Appropriate diagnosis and therapy of Kawasaki disease can reduce the risk for aneurysm development. Serial ECHOs are required to evaluate for aneurysm. Cardiac ischemia, congestive heart failure, and arrhythmia are generally not noted with Kawasaki disease.

D5-Correct B- Avoid other medications which can prolong QT interval

Additional medications that can prolong the QT interval can increase risk for life threatening arrhythmia, so should not be given when beta blockers are the treatment. No change in diet is needed with beta blockers. Administering the medication prior to sport activities can be helpful as these activities can increase the heart rate.

D6-Correct D- snowman sign

The snowman sign is the most common description of the cardiac silhouette on Xray in infants with TAPVR. The 'egg on a string' cardiac silhouette description is associated with transposition of the great arteries (TGA), and the boot shaped cardiac silhouette is associated with tetralogy of fallot. Hyper expansion of the lungs is seen in diseases associated with air trapping (e.g., asthma, reactive airways disease).

D7-Correct A- Nitric oxide inhalation through ventilator circuit

The best methods for reducing pulmonary hypertension include nitric oxide, oxygen, alkalosis, and sildenafil. Digoxin may slow the heart rate and increase function; however, it does not affect pulmonary pressures. Low intravascular volume is not directly associated with pulmonary hypertension.

D8-Correct A- documenting rhythm on EKG

Narrow complex tachycardia with heart rates greater than 220 beats for minute (in infants; may be lower in older children) and no variability fits the description of supraventricular tachycardia (SVT). This child has a pulse and if accompanied by a normal blood pressure and perfusion would be considered 'stable' SVT and treated per the "PALS" protocol. Ventricular tachycardia is commonly associated with wide complex QRS and lower rhythm. Ventricular fibrillation is associated with quivering of the heart and is associated with a disorganized rhythm with no discernable pattern and no pulse. Sinus tachycardia has a discernable p wave and rates are generally < 220 beats per minute. Without an EKG strip, it is difficult to discern the appropriate treatment, so this would be the first intervention.

D9-Correct C- Echocardiogram

The best test for suspected myocarditis is an echocardiogram (ECHO). This child has clinical decompensation, and an exercise stress test is not appropriate at this time. Cardiac CT or MRI may be indicated when the patient is more stable, depending on the evaluation/etiology of the myocarditis, however, is not needed in the acute phase of illness.

D10-Correct A- Brachial-femoral lag as both pulses are palpated simultaneously

A brachial-femoral lag is an indication of coarctation of the aorta. The other physical finding choices in the list to include heart sounds heard loudest on the left side of the chest, PMI noted at the midclavicular line and a split S2 auscultated on inspiration do not indicate pathologic conditions.

D11-Correct A- Maintaining alkalosis and administration of nitric oxide

The best measures to reduce pulmonary artery pressure include maintaining alkalosis and administration of inhaled nitric oxide. Acidosis and administration of sub ambient oxygen worsen pulmonary artery hypertension.

D12-Correct B - Muffled heart sounds, hypotension and jugular venous distention

Common signs of post-cardiotomy syndrome include muffled heart sounds, hypotension and jugular venous distention. This syndrome involves inflammation of the pleura and pericardium

and is characterized by fever, friction rub, pleuritic pain, pleural effusion, and sometimes cardiac tamponade.

Part E: Toxicology

E1-Correct B- Evaluate the child for a mental health disorder, as this age is unusual for accidental ingestion

It would be highly unlikely for an 8-year-old to take medications without direction of parents or knowledge of what they were taking. This child is mature enough to make that decision purposefully, so should be evaluated for a mental health diagnosis such as depression, prior to being discharged from the hospital. Although it is still important to include social work for evaluation of the child's home/supervision and education for the family to include the child about storage and safety of medications.

E2-Correct A- Notify poison control, administer activated charcoal and order IV N-acetylcysteine (NAC)

Poison control should be involved in all patients with suspected ingestion, both inpatient and outpatient. The antidote for acetaminophen ingestion is N-acetylcysteine (NAC). It is best if it is administered as soon after the ingestion as possible, however, it should still be administered if the timing of the ingestion is not known. It restores levels of glutathione to reduce the toxic metabolite caused by overloading the liver with acetaminophen. Activated charcoal is also indicated and can be useful if the ingestion occurred in the prior couple of hours.

E3-Correct C- Benzodiazepines

Treatment of camphor ingestion from ingestion of Vicks Vaporub is largely supportive. Depending on the amount that was actually ingested, there is a risk for seizures and the first line treatment is benzodiazepines, if this occurs.

E4-Correct C- acetaminophen

Activated charcoal can be very useful in many toxic ingestions, particularly if administered in the first couple of hours after ingestion. However, it is not recommended for all toxic ingestions, especially for anything that can cause irritation or burning with emesis, like lye or bleach. Iron is not absorbed by charcoal, so if the iron levels are high, treatment would be with chelation. Charcoal is indicated after acetaminophen ingestion. It is not recommended for lye, iron, or bleach ingestion.

E5-Correct D- Babysitter takes Metformin for Type 2 diabetes mellitus

Metformin is classified as a biguanide or anti-diabetic medication which lowers blood glucose levels. It has a long half-life and ingestion of a small amount can cause prolonged low blood sugar levels, especially in a young child. This child may have suffered a seizure as a result of hypoglycemia, which can also have other neurologic effects. Drinking juice likely increased his blood glucose level, therefore improving symptoms. Labetalol is classified as a beta-blocker and is just as concerning of an ingestion in a young child due to the half-life of 5-8 hours but would cause hypotension, bradycardia and arrhythmias and other findings.

Part F: Infectious Disease

F1-Correct C- Positive culture, continue treatment with antibiotics to cover gram negative infection and follow organism identification.

Urosepsis occurs as a result of urinary tract infection when bacteria invade the circulatory system causing an inflammatory response which can present as septic shock and result in multisystem organ failure. Urine culture results that are considered positive have $\geq 100,000$ CFU/ml of bacteria. Typical organisms include gram negative bacteria such as *Escherichia coli*, *klebsiella* species, *pseudomonas aeriginosa* and some gram-positive organisms including *staphylococcus aureus*. This is a positive culture and will require a bacterial organism identification with sensitivities to be sure the correct antibiotic is being used.

F2-Correct-C- Maternal history of positive group B strep culture

Young infants are at high risk for developing meningitis with significant morbidity and mortality. In the first several weeks of life, neonates can also develop symptoms from a maternally- derived infection, like group B strep. The information about the mother's group B status is very important in determining which antibiotics would be most effective.

F3-Correct A- Obtain lumbar puncture, urine culture and hospital admission for IV antibiotics
The child in this scenario has high fever and irritability which can be the only notable presenting symptoms in meningitis. Meningitis can have devastating long term effects if not treated early and appropriately. Despite recent guidelines regarding provider decisions in completing a full sepsis work up in a young infant, in this case a lumbar puncture is essential to evaluate the cerebrospinal fluid cell count, glucose, protein and to obtain a culture in this newborn.

F4-Correct B- Ampicillin, cefotaxime and acyclovir

Infants with concern for meningitis that are < 2 month of age have unique pathogen risks compared to older infants and children. Coverage in this age group must include *Listeria monocytogenes* (covered by ampicillin) and *Herpes Simplex Virus* (covered by acyclovir). Presence of fever and RBC's in the CSF may indicate *HSV*. Untreated herpes simplex virus can have significant neurologic sequelae and is often associated with elevated red blood cells and xanthochromia in the cerebrospinal fluid.

F5-Correct B- Ceftriaxone, acyclovir and doxycycline

Coverage for common meningitis pathogens for this age group and clinical history must be initiated swiftly. Ceftriaxone or cefotaxime are first line empiric options in the treatment of community acquired meningitis to provide coverage for common pathogens of *Neisseria meningitidis*, *Streptococcus pneumoniae*. In addition, coverage for herpes simplex virus (acyclovir) for the history of focal seizure activity is needed, and doxycycline for coverage for Lyme disease is needed due to the history of camping. Always review the child's allergies and make treatment adjustments based on allergy history.

F6-Correct D- Dehydration with Septic shock

This child has a history of several days of fever suggesting inflammation or infection and is now demonstrating alterations in perfusion, tachycardia, and hypotension reflecting a shock state. The best answer is septic shock.

F7-Correct B- Fungal sputum culture

This 5-year-old with immunodeficiency has already been treated with antibiotics for several days without clinical improvement. Now, it is time to think about other etiologies for this child's illness. Due to the history of immunodeficiency, this child is at risk for a fungal respiratory infection and the next step is to evaluate for fungal infection with a fungal sputum culture. Lack of neurologic symptoms makes meningitis less likely on the differential diagnosis.

F8-Correct A- Viral meningitis

This child's presenting symptoms are consistent with meningitis. The next challenge is to determine which is the most likely category of illness; in the case, most likely viral. CSF findings common in viral meningitis include clear CSF, normal white blood cell count, normal or slightly elevated opening pressure, normal or elevated glucose, and a high protein level. An elevated white blood cell count, low glucose, and high protein suggest bacterial meningitis. CSF of fungal meningitis is often clear or cloudy with an elevated opening pressure, low glucose, elevated protein, and normal or elevated white blood cell count. Meningococemia is dissemination of *Neisseria meningitidis* in the blood, which can spread to the CSF and cause *meningococcal meningitis*.

F9-Correct B- Clindamycin and incision and drainage after evaluation

The first step in managing this fluctuant abscess is to perform an incision and drainage to release the bacteria in the lesion. Antibiotics targeting community-acquired *methicillin resistant Staphylococcus Aureus* include Clindamycin and sometimes Bactrim. Generally, these children do well and can follow-up with their primary care provider. If signs of systemic infection are present, further monitoring/admission may be warranted.

F10-Correct A- Obtain blood and fungal cultures

Due to recent interventions/procedures and congenital heart disease, this child is at risk for bacterial and fungal infections and a complete infection work up is needed to evaluate for surgical infection or mediastinitis. Evaluation with a blood and fungal culture are indicated and will allow for targeted therapy of the infection. Additional studies (e.g., CT scan) may be needed depending on the clinical presentation and response to therapy. It is appropriate to send urine studies on this child also, however, blood cultures are priority.

F11-Correct C- Incise and drain the lesion, and obtain a wound culture

Incision and drainage are the most appropriate first step management of this child to drain the pocket of bacteria. Obtaining a wound culture will provide information to direct antibiotic therapy. The perineal area is a common site for abscess in children and is usually not suggestive of a sexually transmitted disease. Initiating antibiotic therapy with MRSA coverage is important, however, the lesion must be drained in conjunction with antibiotic therapy to effectively treat the abscess.

F12-Correct A- Neisseria meningitis

Older teens and young adults are most susceptible to developing Neisseria meningitis which presents with fever, severe headache and nuchal rigidity. Children receive two doses of both type A and type B meningococcal vaccines which are intended to assist in prevention of illness. Without vaccination, there is a greater chance of becoming seriously ill or dying from Neisseria meningitis.

Part G: Dermatology

G1-Correct D- Erythema Multiforme

This child has erythema multiforme (EM) which is an acute, self-limited skin condition that is thought to be a hypersensitivity reaction. Usually, EM involves a localized skin eruption without mucus membrane involvement. Stevens Johnson Syndrome (SJS) and Toxic epidermal necrolysis (TEN) may be on the same spectrum of EM, however, are much more severe. SJS includes widespread blisters predominant on the face and trunk and involve mucus membranes. Epidermal

detachment is < 10% in SJS and > 30% in TEN. The classic triad of Rocky Mountain spotted fever is fever, rash, and history of a tick bite.

G2-Correct B- vancomycin infusing too quickly

Redman syndrome is an adverse reaction to vancomycin and it can be associated with infusing this medication too quickly. This syndrome results from a histamine release and includes a pruritic, erythematous rash of the face, neck and upper torso primarily. Other symptoms can include hypotension, tachycardia, weakness, angioedema and generalized pain or discomfort. Treatment includes stopping the antibiotic and providing supportive care. Diphenhydramine can be useful for rash and itching and an H2 blocker such as famotidine is typically utilized for treatment.

Part H: Oncology and Hematology

H1-Correct B- referral to ophthalmologist

These findings are classic for retinoblastoma. This is a rare form of cancer that develops in the light detecting tissue of the eye. It is almost exclusive to young children. Most children will survive this form of cancer, but often lose vision in the affected eye or require the affected eye to be removed.

H2-Correct C- Admit to the pediatric floor, transfuse with PRBC's, and consult with hematology
This child has profound anemia associated with tachycardia and pale mucous membranes. The best therapy is to admit this child to the floor, transfuse with PRBCs (slowly), and consult the hematology service. The child may have a common cause of anemia, such as iron deficiency, however, the hematologists can assist in appropriate evaluation of type of anemia and appropriate therapy. The anemia is too severe to initiate iron therapy alone. This is most likely a chronic form of anemia since there are no reports of acute losses of blood/bleeding and the child is hemodynamically stable and admission to the general ward is appropriate.

H3-Correct C- Hyperphosphatemia, hyperkalemia and hyperuricemia

Tumor lysis syndrome is characterized by hyperphosphatemia, hyperkalemia and hyperuricemia. An elevated BUN may also be noted. It occurs most commonly as a complication during cancer treatment when large amounts of tumor cells are killed/lysed. Most commonly, after the treatment of leukemia and lymphoma. Children with a high risk for tumor lysis syndrome are pretreated with allopurinol or rasburicase and hydration therapy.

H4-Correct C- Exchange transfusion

The best management for a child with sickle cell disease and an ischemic stroke is an exchange transfusion, which replaces sickled red cells with healthy ones, providing easier access through small vasculature. Aspirin, thrombolytic therapy, and anticoagulation therapy will not treat ischemic stroke, but can be helpful in stroke secondary to thrombosis.

H5-Correct B- Vancomycin, Cefepime, and Gentamycin

This child is at risk for serious infection due to his immunosuppressed state and due to presence of his intravascular catheter. The best antibiotic choice to provide broad spectrum coverage for the most likely pathogens include vancomycin for MRSA and other gram positive organisms, cefepime for gram positive and gram negative infections, and gentamicin for gram negative organisms, including pseudomonas. Once an organism is identified, antibiotics are tailored appropriately.

H6-Correct B- Osteosarcoma

Prolonged bone pain with confirmation of lesion on Xray, followed by biopsy typically indicates osteosarcoma in an adolescent or teen aged child. Osteosarcoma usually affects the metaphysis of the long bones in the arms and legs and is often found after ruling out other entities, including sprain/strain and perhaps arthritis, but this picture is classic for this diagnosis.

H7-Correct A- referral to oncology specialty, continued work up for blood cell cancer and hospital admission

Findings of multiple bruises and petechiae with persistent fever, lethargy or irritability and pancytopenia are typical with the presentation of leukemia. This child should be referred to the oncology service, had additional work up for leukemia and admitted to the hospital for potential induction chemotherapy and management of hematologic findings.

Part I: Gastroenterology

I1-Correct D- Na⁺ 143 meq/dL, K⁺ 4.3 meq/dL, Cl⁻ 108 meq/dL, HCO₃⁻ 26.3 meq/dL

Frequent and persistent emesis as that seen in Pyloric stenosis results in metabolic alkalosis, often hyperchloremic alkalosis from loss of stomach acid within the emesis. Infants who present with alkalosis or other alterations in electrolytes, should have the electrolytes stabilized prior to going to the OR for repair.

I2-Correct B- Metabolic alkalosis

Pyloric stenosis is associated with enlargement of the pylorus muscle, causing gastric outflow obstruction and repeated emesis. Infants are generally hungry again soon after they have emesis. The emesis is often described as projectile. Due to the high losses of gastric fluid, which is acidic, the infant has a resultant metabolic alkalosis.

I3-Correct C- Abdominal x-ray

Bilious emesis, distended abdomen, and irritability are signs of intestinal obstruction. A quick and non-invasive test to evaluate for potential abdominal emergencies of perforation or obstruction is an abdominal x-ray. If this diagnostic test is normal, additional imaging studies will be needed.

I4-Correct C- Meckel's nuclear medicine scan

The most common cause of painless rectal bleeding in children is a Meckel's diverticulum. The best way to diagnosis this condition is with a Meckel's nuclear medicine scan. A Meckel's diverticulum is a congenital diverticulum in the small intestine that is a remnant of the omphalomesenteric duct. Treatment is surgical resection of the diverticulum.

I5-Correct A- Right lower quadrant pain, pain at McBurney point and + Psoas sign

Acute appendicitis can cause significant abdominal pain, primarily located on the right lower quadrant, but located near McBurney point on the abdomen. The typical prodrome of fever, abdominal pain, nausea, vomiting and sometimes diarrhea is usually initial features of appendicitis, but the severity of abdominal pain with many positive abdominal exam tests indicate the presence of appendicitis.

I6-Correct B- Toxic megacolon

Toxic megacolon is a complication of Crohn disease and is associated with laxative use. The symptoms include fever, acute abdominal pain, distention, hypokalemia and leukocytosis. This problem usually requires surgical intervention.

I7-Correct C- Abdominal radiograph

Acidosis in the presence of an abdominal process, is quite likely to be a bowel perforation, so surgical intervention is required as soon as possible. An abdominal x-ray is easy and quick with good possibility of identifying an obstruction or perforation, based on air-gas patterns. An abdominal CT provides better diagnostic worth, but usually requires contrast and can take longer than an Xray, when time to the OR is most important.

I8-Correct A- Colectomy

Ulcerative colitis is a progressive, recurrent bowel disease which is characterized by diffuse mucosal inflammation of the colon and can be present in any areas of the bowel or rectum. The onset of illness is usually between ages 15 – 30 but can occur in any age group. Medical regimens to prevent symptoms are the therapy goal, but if not possible, with failed therapy, surgical resection is the next treatment. A colectomy is the procedure surgeons use for this population.

I9-Correct A- Ultrasound and pyloric stenosis

Projectile vomiting in the first weeks of life, is often associated with pyloric stenosis. The first line test to diagnose pyloric stenosis is an abdominal ultrasound to evaluate the pyloric muscle size; evidence of obstruction. When checking electrolytes, these infants demonstrate metabolic alkalosis from the high amount of acidic gastric acid losses through emesis.

I10-Correct B- Obtain a CBC with differential, complete metabolic panel and CRP

Gastrointestinal bleeding is not uncommon in children, but usually represents easily identified etiology. Although esophageal varices can contribute to upper GI bleeding which can be acute and excessive, this diagnosis is rare. Most children have gastritis, gastro-esophageal reflux, infectious diarrhea or stress-related bleeding. Initial work-up will include a CBC to check hemoglobin and hematocrit, complete metabolic panel and inflammatory markers, CRP and/or ESR. Once these basics are resulted, specialty services can be consulted.

I11-Correct A- proton pump inhibitor, clarithromycin and amoxicillin

Helicobacter pylori is a common cause of gastric ulcers in all age patients, even though gastric ulcers are uncommon in children. Evidence-based treatment includes a triple-therapy approach with a proton-pump inhibitor, and clarithromycin with either amoxicillin or metronidazole. There are other antibiotics that can be used if allergies are present.

I12-Correct A- bowel obstruction, appendicitis, constipation

Based on the location of pain, the most likely differential diagnoses include bowel obstruction, appendicitis and constipation. Appendicitis typically presents with peri-umbilical pain which migrates to the right lower quadrant and fever, but initially could be afebrile. A bowel obstruction would be a surgical emergency so should be listed first on the list, followed by appendicitis and then constipation which is much more common than the other two diagnoses.

Part J: Nephrology and Genitourinary

J1-Correct C- Renal function testing

This blood pressure measurement is very elevated for a pre-school child, so she should have evaluation of renal function immediately. The history of frequent urinary tract infections indicates that there may be an underlying kidney disease. A 4-extremity blood pressure should also be checked to evaluate for coarctation of the aorta. The BP will need to be followed over the next weeks and months, however, the evaluation of needs to begin immediately.

J2-Correct B- Pre-renal failure

This child has sustained multiple trauma and required fluid resuscitation, developing capillary leak syndrome and edema. A fractional excretion of sodium of $< 1\%$, high urine specific gravity and elevated BUN suggest pre-renal failure.

J3-Correct B - Begin antibiotics with doxycycline

This child has developed post-streptococcal glomerular nephritis (PSGN) which is characterized by sudden appearance of hematuria, proteinuria, red blood cell casts in the urine, edema, and hypertension. Oliguria may or may not be present. Treatment for PSGN includes treatment of blood pressure, management of edema. Antibiotics should be started first to eradicate the infection with the use of penicillin or erythromycin.

J4-Correct A- Interstitial nephritis

Interstitial nephritis is a disease process characterized by inflammation and edema, caused by a viral process, or drug and presents with rigors, fever, flank pain and skin rash.

J5-Correct C- Hypervolemia, hyperkalemia and acidosis

Dialysis is necessary in some cases of acute and chronic renal failure. Indications for dialysis include hypervolemia, hyperkalemia, and acidosis. Hypovolemia would be treated prior to initiating dialysis in a child with renal failure due to fluid shifting and risk for hypotension during a dialysis session. Hypocalcemia is not an indication for dialysis and can be treated to calcium supplementation.

J6-Correct -C - Obtain a surgical consult

Testicular torsion is a surgical emergency to maintain viable testes. It occurs acutely and causes severe pain. Surgical consultation is required immediately and testicular ultrasound will be needed for imaging.

Part K: Trauma

K1-Correct A- Serial hemoglobin and hematocrit monitoring

A child with a liver laceration is at risk for bleeding, so should have serial hemoglobin monitoring. A stable hemoglobin is reassuring that ongoing bleeding is minimal. Serial abdominal CT scans are not necessary and would result in unnecessary and perhaps harmful levels of high radiation. Requirement for surgical intervention will be made by serial hemoglobin evaluations and the hemodynamic status of the patient. Coagulation therapy is not needed as the cause of bleeding is due to a laceration rather than coagulopathy. Surgical intervention is needed in severe cases; however, most children can be managed non-operatively.

K2-Correct B- Arrange to remove the cast

This child is demonstrating reduced perfusion to the distal extremity and signs of compartment syndrome with pain, pallor, altered perfusion. The most important intervention for this child is to arrange for the hip spica cast to be removed to improve perfusion/blood flow to the extremity.

K3-Correct C- Slipped Capital Femoral Epiphysis

This obese adolescent without report of injury is most likely to have a slipped capital femoral epiphysis (SCFE), which is typical of overweight adolescent boys with symptoms that can be progressive or acute. Osteomyelitis is unlikely without a febrile prodrome. Femur fracture is

unlikely without a history of a trauma/injury. With SCFE, the hip will most likely require fixation.

K4-Correct A- Septic arthritis and osteomyelitis

Septic arthritis and osteomyelitis both result from an infectious process, typically bacterial infection is responsible. They should both be considered in young patients who presents with acute pain, fever and swelling/tenderness in one joint or extremity.

K5-Correct A- Administer normal saline fluid bolus

Children undergoing spinal fusion surgery often experience long surgical times and have significant fluid shifting. They are prone to developing SIADH. The best management choice for this child with low urine output, hyponatremia, and normal specific gravity is a fluid bolus with normal saline. Her level of hyponatremia does not warrant treatment with 3% saline. If she meets criteria for SIADH during her post-operative course, fluid restriction will become appropriate.

K6-Correct A- If pain, pallor, decreased perfusion and sensation, return immediately to ED

A child with a significant fracture is at risk for developing compartment syndrome. Some targeted questions can help determine the next steps in this child's management. If pain, pallor, decreased perfusion and sensation, are noted, this child needs to return immediately to ED for removal of the cast and prevention of compartment syndrome.

K7-Correct A- Transient synovitis of the hip

Transient synovitis of the hip is common in young children, occurs often following a viral illness. It is a self-limiting condition and can be managed with rest and analgesics as needed.

K8-Correct A- Injury resulting in widening of growth plate

Any time fractures are near a growth plate in a child, there is risk for limb length discrepancy if the fracture is not treated appropriately. Referral to an orthopedic surgeon is needed to ensure the most appropriate therapy for the child.

K9-Correct B- Abdominal CT with IV contrast

An abdominal CT with IV contrast will best assess the abdominal vessels to evaluate the flow and bleeding in the abdomen. An abdominal CT with oral contrast will provide better images of the intestinal lumen. An abdominal X-ray will likely yield little assistance when evaluating for splenic laceration.

K10-Correct B- Gun shot at close range

A gunshot at close range would most likely result in a comminuted fracture. This is because considerable force is needed to cause bone to crush and result in fragments. The other injury options on this list do not involve high energy force.

Part L: Metabolic and Endocrinology

L1-Correct B- Due to excessive weight loss, assess intake and output and evaluate breastfeeding

A newborn infant should not lose 10% or more of his birthweight in the first week of life and his weight should return to what it was at birth by age 2 weeks. This one-week-old, has lost 17% of his birth weight, so this is concerning. Breastfeeding should be evaluated, and supported, with the possibility of supplementation, along with continued assessment of daily weight monitoring.

L2-Correct B- Encourage the teen to have a discussion with the school nurse with his plans and her support

The developmental milestones of a teen include having more interest in peer relationships, and spending more time with friends, then with parents. Most teens want to make decisions for themselves and can be responsible for some of their own health care needs. Teens want to have independence and privacy. In this situation, it may be difficult for the teen to totally manage his diabetes without help from an adult. Engaging the school nurse to work with him and her knowledge to support his self-care is important.

L3-Correct D- Congenital adrenal hyperplasia

Congenital adrenal hyperplasia should always be high on the differential diagnosis in any infant presenting with hyperkalemia and hyponatremia, so electrolytes should always be evaluated in this situation. Infants can also present with significant dehydration when CAH is diagnosed.

L4-Correct D- 735 mL

This 4.9 kg infant has a fluid deficit of 735mL based on the clinical signs and symptoms of severe dehydration. Fluid deficit in a child with severe dehydration is 150mL per kg of body weight. For this 4.9 kg infant that equals $150\text{mL} \times 4.9\text{ kg} = 735\text{ mL}$. Moderate dehydration would be 100 mL per kg, and mild dehydration would be 50 mL per kg.

L5-Correct B-72

This 2-month-old infant is receiving 72 kcals/kg. The volume is 15 mL/hour for 24 hours per day which = 360mL per day. Next, determine how many ounces per day she is receiving - 360mL divided by 30 mL = 12 ounces per day. 12 ounces x 24 cal/ounce = 288kcal/day. 288 kcal divided by 4 kg = 72 kcal/kg/day.

L6-Correct B- NS 50 mL, and start D5 NS @ 20 mL/hr

The best choice for this dehydrated, hyponatremic 4.9 kg infant would be to administer a fluid bolus of 10 mL/kg (50mL) and start D5 0.9NS for hyponatremia at maintenance rate (4mL x 5kg = 20 mL/hour). She would be re-assessed frequently to evaluate her fluid status and determine if additional fluid boluses are needed.

L7-Correct D-43 mL/hr

Calculating 2/3 maintenance fluids for this 24 kg child would be 43 mL/hour. "Full" maintenance rate for this child for 24 hours is 100mL/kg for the first 10 kg (1000 mL), 50mL/kg for the next 10 kg (500 mL), plus 80mL or 20ml/kg (for the last 4 kg) for a total of 1580 ml in 24 hours, or 68 mL/hour. 2/3 of 68mL/hour is approximately 43mL/hour.

L8-Correct A- pH, HCO₃, BUN and creatinine

A child with a history of diabetes presents with diabetic ketoacidosis, with a high blood glucose, acidosis and ketonuria. The most important assessment in a child with DKA is neurological status. The most important laboratory tests in the acute phase of the illness are pH to evaluate her acid-base status, bicarbonate to assess acid-base and fluid status, and BUN/creatinine to assist in evaluating her fluid status. Hemoglobin A1C is an important indicator of how well her blood sugar has been controlled recently, however, that information will not impact the acute management for this child. A CBC may indicate signs of infection that may have triggered this episode of DKA, yet will not likely be helpful in the acute management of her DKA.

L9-Correct A- Blood glucose is < 300 or dropping faster than 100 per hour

The most appropriate time to add dextrose to the IVF of a child with diabetes ketoacidosis is when the blood glucose is < 300 mg/dL or dropping faster than 100 mg/dL per hour. Allowing the blood sugar to drop too fast can lead to central pontine myelinolysis.

L10-Correct B-1000 mg of calcium gluconate IV

Emergent management of hyperkalemia includes 100mg/kg of calcium gluconate administered IV. Calcium chloride may be used instead of calcium gluconate and has the benefit that it does not need to be metabolized in the liver; dose is 20mg/kg. Calcium, insulin, sodium bicarbonate, insulin, and glucose are all temporizing measures to move the potassium into the intracellular space and stabilize the cardiac membrane until potassium can be excreted from the body with resin exchanging medication, diuretics, or dialysis.

L11-Correct C- Cerebral salt wasting

These laboratory findings are most consistent with cerebral salt wasting. SIADH is characterized by excess circulating blood volume which will result in a low serum sodium value, high urine sodium, and low urine output. Diabetes insipidus results in massive dilute urine output, reduced intravascular volume, and increased serum sodium value.

L12-Correct B- Less active than usual, sticky oral mucosa, slightly diminished skin turgor and tachycardia.

Symptoms consistent with 10% dehydration include oliguria, reduced activity level, sticky oral mucosa, and normal or slightly diminished skin turgor.

Part M: Immunology and Rheumatology

M1-Correct D- CRP, ESR, ANA and CBC with differential

The best studies to evaluate for juvenile arthritis include CRP (marker of inflammation), ESR (sedimentation rate), ANA (anti-nuclear antibodies), and a CBC with differential. Electrolytes are generally not needed in the evaluation of arthritis.

Part N: Neurology

N1-Correct B- Ptosis

Infant botulism is a rare illness, which has been associated with botulinum spores often found in honey and in soil. It causes progressive neurologic deterioration which can begin as constipation or mild muscle weakness and progress to respiratory failure, so very important to include in the differential diagnosis of an infant with progressive weakness. Along with the history, physical exam can provide excellent clues to the diagnosis. On exam, Ptosis or drooping of the upper eyelids is often noted when evaluating the face of an infant.

N2-Correct C- Attention deficit hyperactivity disorder (ADHD)

Children with attention deficit hyperactivity disorder can manifest other findings or symptoms. In this case, it appeared that he was having absence seizures in the classroom, but was most likely “zoned out” as a result of ADHD, which has not yet been formally evaluated or diagnosed. It is very important to differentiate between physiologic and behavioral processes to be sure you are treating the appropriate diagnosis.

N3-Correct B- There is a risk of subsequent seizures but the risk of epilepsy is extremely low
Febrile seizures typically present between the ages of 6 months and 6 years. When a child has a febrile seizure, complex or not, there is risk for another febrile seizure in the future. Febrile seizures, even if occurring on more than one occasion, rarely place a child at risk for epilepsy. No

chronic anticonvulsant therapy or prescription for rectal valium is needed for children with a febrile seizure. Administering antipyretics is usually not effective as the seizure is more likely to occur when the temperature is rising, not after the child is noted to be febrile.

N4-Correct C- Administer a 5 mg dose of rectal valium and attempt IV placement
This child has evidence of ongoing seizure activity (status epilepticus) and additional anticonvulsant therapy is needed. Rectal valium should be administered immediately while attempting IV placement for additional anticonvulsants, if needed. Administration of an additional anticonvulsant should not be delayed until after an IV is secured as this can take several minutes or longer. An IO is not needed to administer anticonvulsant therapy. An EEG and head CT are indicated, but the immediate priority is controlling the seizure.

N5-Correct A - Obtain Keppra and Tegretol levels
To evaluate if the long-term anticonvulsant therapy medications are at therapeutic levels in the blood, sending serum levels of keppra and tegretol is needed. This can help determine if medication changes/adjustments will be needed and if low levels may have contributed to his presentation. He is not currently having continuous seizure and does not require an additional dose of an antiepileptic at this time. A phenytoin (Dilantin) level will be needed if this medication is continued long term, but is not helpful to obtain prior to one hour following the dose. Clonazepam is a benzodiazepine which does not require monitoring of levels.

N6-Correct C- Video EEG
These abnormal movements are not associated with other neurologic symptoms, however, it is important to evaluate for seizure activity with a video EEG to assist in determining the etiology of these movements and to appropriately treat them, if present. An MRI and CT of the brain are not indicated at this time, though may be helpful if other testing is inconclusive. Electromyography can be helpful to determine the etiology of these movements; however, EEG monitoring will take precedence.

N7-Correct A- Has the child ingested honey or been exposed to soil?
Infants exposed to honey or contaminated soil are at risk for botulism. The toxins associated with clostridium botulinum attack nerves and can lead to respiratory and muscular paralysis. Typical presenting signs/symptoms of botulism include progressive generalized weakness, tiredness, and weak cry/voice. It is not common in children > 6 months of age due to the natural defenses that develop in the intestine over time.

N8-Correct B - Administration of hypertonic saline
Treatment for increased intracranial pressure (ICP) requires immediate intervention and includes decreasing the pressure within the brain. Reducing ICP can be achieved with hyperventilation to induce mild hypocarbia and the use of hypertonic saline or mannitol for their osmotic effects, and important while preparing for a head CT to determine etiology. Cerebral blood flow is largely dependent on PaCO₂. Hyperventilation reduces PaCO₂, subsequently results in vasoconstriction and lower cerebral blood flow. Isotonic saline will not change ICP. Hypoventilation will increase cerebral vasodilation and blood flow, worsening ICP. Mannitol and hypertonic saline are both osmotic agents that lower ICP, by drawing fluid out of the injured brain.

N9- Correct C- Obtaining a stat head CT
The most appropriate study for this child with past medical history and new neurologic findings including unequal pupils is a stat Head CT. This quick diagnostic test can identify acute intracranial processes that require immediate intervention (e.g., mass, hydrocephalus,

hemorrhage). Acute pupillary changes require neuroimaging and monitoring neurologic examination is not sufficient. An EEG may also be indicated, and an MRI may be ordered to follow up, however, CT is needed first to evaluate for etiologies requiring acute neurosurgical intervention.

N10-Correct B- discussing his previous baseline activities with family

This infant was intubated soon after arrival to the hospital due to a prolonged seizure. His baseline neurologic status is unknown, other than what history was initially obtained. From a developmental standpoint, it is important to ask again whether he is holding his head up and does he normally have normal flexion before deciding that the flaccid extremities resulted from the seizure.

Part O: Sedation and Analgesia

O1-Correct A- Ketamine infusion

Ketamine is a centrally acting non-opioid anesthetic that is useful for sedation. It has properties that cause bronchial smooth muscle relaxation, which makes it useful for patients with asthma or other respiratory illness.

O2-Correct C- Continuous infusion of fentanyl 1mcg/kg/hr and Midazolam 0.3mg/kg/hr

Of the offered options in this questions, sedation and analgesia for a 3-month-old include a continuous infusion of fentanyl 1mcg/kg/hr. and Midazolam 0.3mg/kg/hr., with opportunities to increase dosing as needed. The dexmetomidine and fentanyl dosing in option A are too high for starting therapy and intermittent medications do not work as well for sedation, as well as the meds, with dosing are not appropriate in options B and D. The length of sedation is not mentioned in this question and for shorter periods of time, intermittent dosing may be appropriate, but with the correct medications and dosing.

O3- Correct B- Dexmedetomidine and fentanyl

Chest tube placement is a painful procedure and will require that the child lie very still. Local anesthetic with child life therapy is not appropriate for this invasive procedure. Ketamine and midazolam will not provide adequate pain control. Etomidate is general anesthetic with limited analgesic effects. Dexmedetomidine and fentanyl will provide the best combination of sedation and pain control and dexmedetomidine is short acting which also makes it a good choice for this clinical scenario.

O4-Correct D- Local anesthetic with child life therapist support during procedure

Sedation of a child with a difficult airway can be a challenge, although, this school age child will undergo a short procedure associated with short term localized pain, so there is no need for a long acting sedative. Using a local anesthetic agent with child life therapy support is the best choice to facilitate pain control and keep the child safe. Use of the other agents listed may result in need for a secure airway which is difficult in this child; ultimately placing this child at high risk for airway compromise.

O5-Correct B- Fentanyl and midazolam

Acute changes in neurologic status can indicate the need for a lumbar puncture which would require sedation. Fentanyl and midazolam are a good choice for this child. Ketamine can increase intracranial pressure and is contraindicated in this child with neurologic changes. Lorazepam is longer acting than midazolam making midazolam a better choice for a short procedure. Etomidate is a general anesthetic agent than can be associated with adrenal suppression.

O6-Correct B- Administer small amounts of narcotic analgesic until the pain is controlled
This child has had several prior surgeries and is demonstrating signs of pain. Additional analgesic medication is indicated and can best be administered using small amounts of a narcotic until the pain is well controlled. The epidural catheter will continue to provide pain relief for the child in the post-operative phase and should not be removed. A sedative is not appropriate for this post-operative child that is experiencing pain symptoms. Post-operatively, this child may not be ready to tolerate oral agents and they do not provide immediate pain relief as an IV agent, however, can be considered later in the post-operative phase.

Part P: Technical Skills/Procedures

P1-Correct D- using the Seldinger technique, at the 4th to 5th intercostal space along the mid-axillary line

Chest tubes are inserted for the drainage of either fluid or air. In the majority of situations, the ideal placement for the tube is at the 4 – 5th intercostal space along the mid-axillary line. The Seldinger technique is the correct method for insertion which involves inserting a guide wire into the pleural space through an introducer needle, then removing the needle and through the use of dilators, increase the size of the opening and then thread the catheter into the pleural space. The Seldinger technique is not associated with the actual location of the insertion site. Placing a chest tube along the mid-axillary line decreases the potential for an obvious, visible scar.

P2-Correct B-Obtain a chest xray to evaluate placement of tube and presence of air in the pleural space

Crepitus around the site of the chest tube could indicate that the tube has been misplaced and air is leaking into the subcutaneous tissue. If the patient is also experiencing respiratory distress, it is very possible that the tube is not functioning to evacuate air, so a chest Xray would be indicated to evaluate tube placement. The chest tube may need to be repositioned or removed and a new one placed, but that determination cannot be made without an Xray. Increasing the suction would not necessarily decrease the air leak and even though the patient may need an escalation in respiratory support, the Xray is most important in this situation.

P3-Correct C- and identify the presence of kinks in the catheter or a pneumothorax from insertion process

A central line inserted through the internal jugular vein extends through the superior vena cava to the right atrium, with catheter placement documented with a chest Xray to demonstrate correct placement. A chest radiograph or fluoroscopy can also identify the presence of a pneumothorax occurring from the needle or kinking of the catheter which can obstruct fluid flow and blood withdrawal. Intravenous fluids should not be started until placement is confirmed.

P4-Correct A- opening pressure, fluid for culture, cell count and HSV

A young infant who presents with fever should have a full sepsis work-up completed, to include a CBC with differential, blood culture, urine culture, chest radiograph and cerebrospinal fluid (CSF) obtained from a lumbar puncture to test for possible meningitis. The CSF fluid should be sent to the lab to identify cell count, protein, glucose, bacterial culture and culture for HSV to rule out herpes simplex meningitis and encephalitis. Obtaining an opening pressure assists in identifying the presence of increased intracranial pressure, which is indicated if the measurement is high and can contribute to determination of the final diagnosis.