Children’s National Medical Center Residency Guidebook

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**Assorted Useful Numbers**

Derrick Corley (RA): p1044  
Jackie Gafford (RA): p0046  
Spanish Interpreter: x5444, p0370  
IV Crisis RN: p8761  
Operating Room: x2015, x2861

**Radiology**

General: x5070, x5073  
X-ray: Attg (inpatient) p0543  
Attg (outpatient or ER) x3429  
X-ray tech x3429  
Body(U.S, CT, MR): Attg p0883 x3417  
US tech x3410; CT tech x5085  
MRI x2526, MRI charge RN x2927  
Interventional Rads: Attg p0965  
Fluoro: x3902, Nuc Med: x5091  
Neuroradiology: Attg p0292  
Wet desk (nite, wknd): p8643 x4687

**Lab**

General Lab: x5355, x5352, x2229  
Blood Bank: x5347, x5351  
Chem: x5354, Heme: x5676  
Micro: x5359, Virology: x2047  
Pathology: x2051, PCR: x2631  
Send Out: x2229, Special Rec: x5379

**Pharmacy**

General Pharmacy: x3307, x4080  
East Pharmacy: x7590, TPN: x5635  
Formula Lab: x6687, x3187, x3185

**Floors**

PICU: x2010, x2078, PICU Attg x8036  
PICU Fellow x8038, HKU: x5195  
Hem/Onc: x5180, Charge x5181  
Short Stay Unit: x5145  
Surgeon Care Unit: x5170  
Neuro Unit: x5150 (Charge x8276)  
NICU: x5040  
7 East: x5120

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**Contact Information**

**Emergency Department**

Main: x5203, Attending: x8198  
Charge RN: x8195  
Life Line/ECIC: x5433  
Respiratory therapy: x8789  
Hospitalist admits: x1427  
Short stay admits: x1428

**Consults**

ENT p8232, Dental x2160  
GI (Lindsay Cushen): p0164  
GI/IR (Krystal Artis): p4408  
GI/Nutrition (G.Gebus): x4125 p8793  
GI Procedure Room: x5317  
GI Transplant RN (P.Zovosky): p0093  
Pain: p1424, x8345, x7966  
PICC (Holli Hickey): p0965, x3791  
PM&R: p0410, Psych: p1622  
PT/OT: x3080, Surgery: p0673  
Urology: p8041, p8042  
Wound (June Amling): p5086

**Clinics**

Adams Mo.: x5580, Adoles: x4948  
Burgess Clinic: x2722, x5389  
Cards: x2090, (EKG Lab) x5495  
Comp: (202)745-5500  
Complex Care: x4664, Derm: x3440  
Dialysis Center: x5148, Endo: x2121  
ENT:x2159, (Marie) x3363  
GI: x3031, Genetics: x2187  
Hear/Speech (BAER): x5600, (Evoked Response) x5678, x5651, p6473  
GHR: x6900, (GHR Nurses) x6993  
Heme/Onc: x2140, x3940, x4615  
HSC Equipment Clin.: (202)635-4490  
ID:x5051, Imm:x3495, Sp Imm:x3508  
IMPACT DC: x3970  
MLK: x6575, (MLK Nurses) x6709  
Neuro: x2120, (Audrey) x2666, (EEG Lab) x5651, Opthe: x3015, x6115  
Ortho: x2110, PT/OT: x3094, x3434  
Plastics: x2157,  
Pulum: x2128 Sleep Lab: x3281  
Rheum: x7060  
THEARC: (202)436-3060  
Urology: x5042
Administrative
Abduction: x2222, Bomb: x2066, Disaster: x4444, Fire: x3473
AD: p0474, Admissions: x4068, x5005
Bed Control: x4068, Biomed: x2043
Dietary: x3185
Employee Health: x2035
Environmental Services: x2044, (Call Room Cleaning) x8301
Family Services: x3070
Hazardous Spill Reporting: x2044
Housekeeping: x6498
Human Resources: x2080
IT Help Desk: x4357
Medical Records: x5267
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Parking Office: x5457
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Walk-In Desk: x2902
CHC Team Room: x2953
CHC SW (Alison Page): x3556 p1059
Child Law Center: (202)467-4900
Child Protection: x4100
Parent Navigators: x2900
Family Help Desk: x3326
Referrals (Zoe Juarbe): x3241
Cristina Lomax: x2904
“Go To” RN: x3891
Generations: p0040

Newborn Metabolic Screen
DC NMS: (412) 220-2300
Maryland NMS: (410)767-6099
Fax (410)333-7112
VA NMS: (804)648-4480 x172, x174

Med Pre-Authorization
DC Med Auth: (800)272-9679
MD Pharm Program: (800)932-3918

Holy Cross Specific
Holy Cross Hospital: (301) 754-7000
Long Distance Code: 9-1-#-14950
HCH Pager Service: x7111
Nursery West: x7620 East: x7570
8th Floor Room: x7610 Fax: x7609
PL1: p1665 MS Call Room: x4815
PL2: p1181 PL2 Call Room: x4814
Attending: p20320 Med Ed: x7236
Kaiser: 888-989-1144, 703-359-7460
Pharmacy: x7310 Interpreter: p1128
Lab: x7320 Microbiology: x5232
RT: x4233 p1037 AV: x7920, x7766
SW: x7470 Trash: x4120
Home Care Bili: x7754 p8747
Home Care: x7740 p1351
Quest Hosp Ref: x21586
Library Copy Code: 2545

Early Interventions
DC EIP (0-3): (202) 727-3665
DC Early Stages (3-5): (202)698-8037
MontCo Infants/Toddlers: (English)
(240)777-3997, (Spanish) x-4454
MontCo Child Find (3-5): (301)947-6800
PG Infants/Toddlers (0-5): (301)265-8415
Labs

- **Phlebotomy to Collect**
  - Phlebotomists come to draw labs twice a day, at 6:00 AM and 16:00
  - In order to assure that the lab will see your order, 6:00 AM labs must be ordered by 2:00 AM and 16:00 labs by 14:00
  - To order labs for the phlebotomists to draw, your order should contain the following:
    - Date and time (either 6:00 or 16:00)
    - Lab Collect
    - Clinician to collect – NO
    - Specimen collected – NO
- **Nurse to Collect**: If you need labs drawn at any other time, you will need to draw it unless your patient as a Broviac, Port-a-cath, or PICC line; If your patient has a central line, the nurse can draw the labs for you
  - To order labs for nurse to collect, your order should contain the following:
    - Date and time
    - Routine Collect or Stat Collect (depending on how urgent)
    - Clinician to collect – YES
    - Specimen collected – NO
- **Resident to Collect**: If your patient does not have a central line, you will draw the labs; Before you go into the room gather the following supplies in either the med supply room or clean utilities room: Lab collection tubes (see below), Butterfly needle (23 gauge or 25 gauge – remember the smaller the number the larger the gauge), Tourniquet, Syringe (1 ml, 3 ml, or 5 ml depending on the volume of blood needed), Gauze, Alcohol/Chloraprep pads, Band-aid. If you are unsuccessful with the lab draw, you should first call your senior residents for help. Occasionally nursing will offer to draw labs for you depending on what service you are on. As a last resort, the nurse or you can page the IV Team or Crisis Nurses to help out with difficult patients
  - To order labs when you draw blood, your order should contain:
    - Date and time
    - Routine Collect or Stat Collect (depending on how urgent)
    - Clinician to collect – YES
    - Specimen collected – YES (this prints the labels for you and prevents having to ask the nurse to do so)

### Lab Collection Tube Colors

<table>
<thead>
<tr>
<th>CBC, Type and hold</th>
<th>Purple top tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMP, CMP, Mag, Phos, RFP, LFT</td>
<td>Green top tube</td>
</tr>
<tr>
<td>Aerobic Blood Culture</td>
<td>Blood Cx with Green label</td>
</tr>
<tr>
<td>Anaerobic Blood Culture</td>
<td>Blood Cx with Purple label</td>
</tr>
<tr>
<td>Fungal Blood Culture</td>
<td>Small Yellow top tube</td>
</tr>
<tr>
<td>Coags (must be transported on ice)</td>
<td>Blue top tube</td>
</tr>
</tbody>
</table>

For less common labs, go to Links tab at the top of Powerchart then select Lab Collection Information, type in lab you are searching for and scroll down to very bottom of the page and there will be a picture of the tube color that you need with the amount of blood that you will need for each lab
Orders for New Admissions

- **ED Admissions**: When a patient is admitted from the ED, an inpatient bed request is made placing the patient in the “ED Holding Unit” until assigned to a specific bed. Once patients are in ED Holding Unit, you can place orders on them and this is the best time to do so

- **Med Calc Weight**: Before starting to place orders, be sure that you have entered the Med Calc weight in Cerner by going to Adhoc tab, selecting Med Calc Weight, and entering weight

- **Admission Order Sets**: There are a number of order sets that are very helpful in placing orders such as Asthma and Bronchiolitis; If there is not an order set for your patient’s diagnosis, there is a general Hospitalist Admission Order Set that covers the basics

- **Locked Out**: While placing orders if you get a pop-up that says you have been locked out of profile by specific person, it is typically a pharmacist. You can call x3307 and kindly ask them to get out of profile until finished

- **NPO Guidelines**: “2-4-6-8” For a patient requiring a procedure, they have to be NPO for the following substances for the following duration:
  - 8 hours: Solids
  - 6 hours: Formula or Whole Milk
  - 4 hours: Breast milk
  - 2 hours: Clear liquids

<table>
<thead>
<tr>
<th>Contact</th>
<th>Diarrhea, Cellulitis, Abscess, Draining skin lesion, Local vesicular rash in an immunocompetent patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Droplet</td>
<td>Nonvesicular rashes including Meningococcemia, Parvovirus, Rubella, Scarlet Fever, and Toxic Shock Syn.</td>
</tr>
<tr>
<td>Contact/Droplet</td>
<td>Meningitis, Bronchiolitis, Croup, Influenza, Pneumonia, Tracheitis, Upper Respiratory Infection</td>
</tr>
<tr>
<td>Airborne/Contact</td>
<td>TB or Suspected TB, Measles, Vesicular rash that is disseminated AND/OR in an immunocompromised pt</td>
</tr>
</tbody>
</table>

**Fluids**

- **Maintenance Rate**: Use the 4-2-1 rule. For the first 10 kg of a patient you need to give 4 cc/h, for the next 10 kg a patient needs 2 cc/h and thereafter only 1 cc/h. Hence a 13 kg patient needs (4 cc/kg*10kg + 2cc/kg*3kg = 46 cc/hr) for maintenance rate.
  - **Increasing MIVF rate**: If patients are febrile, tachycardic, tachypneic, burned or have staph scalded skin, Stephens-Johnson, or basically any skin lesions to increase insensible losses they will need more IVF; Patients on IV acyclovir or patients in sickle cell pain crisis (but not acute chest) require 1.5x MIVF

- **Fluid Choice**: Most patients will be on D5+1/2NS (0.45%NS), however, for infants < 4 weeks or < 10 kg, consider using D5+1/3NS (0.33%NS)

- **Adding Potassium to fluids**: If your patient is going to be NPO for an extended period of time or is on continuous albuterol, KCL starting at 20meq/L should be added to fluids. Of course, if your patient is hypokalemic, KCl should be added to fluids
Complex Patients

- **Patients in Group Homes**: Many complex kids live in group homes and come to CNMC with an employee of the home; The employees often leave very quickly after the patients arrive on the floor, making it very important to see them in the ED or as soon as you hear the patient is on the floor; The employees often do not know the details of the HPI, but can call others at the home for you if needed; Many complex patients are followed by the Complex Care Team, and their notes are extremely helpful in gathering information on the patient’s medical history.

- **Medication History**: These patients are usually on a number of medications that are kept in a binder at the group home; It is very helpful to copy the list of medications before the caregiver leaves; These patients can be very overwhelming due to their extensive list of problems and medications, so it is often helpful to break them down by problem and think of the medications as they are used for each problem.

- **Dietary History**: Also, be sure that you know the feeding regimen as well as any free water given before the caregiver leaves. You’ll want to know:
  - What formula is the patient on? How many calories/oz is the formula?
  - Does the patient take anything by mouth? If so, what consistency?
  - Does the patient get bolus feeds? If so, how many ml’s, how often (when), and ran for how long?
  - Is the patient on continuous feeds? If so, how many ml’s/hour for how many hours?
  - Does patient have Gtube or GJTube? If GJ, where are meds given thru?
  - Does the patient get free water boluses? If so, how much and often?
  - Does the patient receive water flushes after meds? If so, how much?

- **Catheterization**: It is also important to ask if the patient is in-and-out cathed or not. If so, how frequently is this done?

- **Precautions**: Many of these patients have seizure disorders or trachs, and if so, you should order seizure precautions or airway precautions if needed

Transferring Patients to CNMC from HCH

- Stabilize the patient
- Update parents of child’s condition
- Contact the attending of record (PMD or hospitalist)
- Contact hospitalist on call
- Contact the accepting institution to facilitate transfer (202-476-LIFE)
- Fax the face sheet to the accepting institution
- Make the charge nurse aware of transfer
- Contact the PMD (if this is not the attending on record) to update them
- Write a transfer summary (documenting whom you spoke with including parent, PMD, etc.)
- Fax a copy of the written transfer summary to the PMD’s office
- Obtain a copy of any radiological studies for transfer (x7350)
- The attending must fill out an Acute Care Transfer Record (give a copy to the parent) and must be the one to write the Transfer Order
- Complete the medication reconciliation prior to discharge
### Empiric IV Antibiotics

<table>
<thead>
<tr>
<th>Syndrome</th>
<th>Common Bacteria</th>
<th>Gram Stain</th>
<th>Empiric IV Anti-Infectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Otitis Media</td>
<td>S.pneumo, M.catarrhalis, NT H.flu</td>
<td></td>
<td>3rd Gen Cephalosporin; Ampicillin</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>See AOM, MSSA, MRSA, Mycoplasma, Anaerobes</td>
<td></td>
<td>3rd Gen Cephalosporin</td>
</tr>
<tr>
<td>Sinusitis, Orbital Cellulitis (no cranial ext.)</td>
<td>See AOM, MSSA, Anaerobes</td>
<td></td>
<td>3rd Gen Cephalosporin</td>
</tr>
<tr>
<td>Orbital Cellulitis (with intracranial extension)</td>
<td>See AOM, MSSA, MRSA, Anaerobes, Metronidazole</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meningitis</td>
<td>S.pneumo, N.meningitis</td>
<td></td>
<td>3rd Gen Cephalosporin</td>
</tr>
<tr>
<td>Tracheitis</td>
<td>See PNA, Pseudomonas, MRSA</td>
<td></td>
<td>3rd Gen Cephalosporin</td>
</tr>
<tr>
<td>Pharyngitis</td>
<td>GAS, Clinda, Vanco</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dental</td>
<td>S.viridans, GAS, Anaerobes</td>
<td></td>
<td>3rd Gen Cephalosporin</td>
</tr>
<tr>
<td>Cellulitis, Abscess, Periorb. Cellul.</td>
<td>GAS, MSSA, MRSA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lymphadenitis</td>
<td>See Cellulitis/Abscess, Anaerobes</td>
<td></td>
<td>3rd Gen Cephalosporin</td>
</tr>
<tr>
<td>Osteomyelitis, Septic Arthritis</td>
<td>See Cellulitis/Abscess, Clinda, Vanco</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line Infection</td>
<td>See Cellulitis/Abscess, S.epidermidis, Pseudomonas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UTI</td>
<td>E.coli, Klebsiella, Proteus, Enterob.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neonatal SBI</td>
<td>HSV, Viral, E.coli, GBS, Listeria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Febrile Neutropenia</td>
<td>S.pneumonia, Pseudomonas, MRSA</td>
<td></td>
<td>3rd Gen Cephalosporin</td>
</tr>
<tr>
<td>Rickettsiae</td>
<td>RMSF, Ehrlichiosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Septic Appearing</td>
<td>MRSA, GNR, ESBL/ISBL, Toxic Shock Synd.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **O** = Gram positive cocci
- **R** = Gram positive rods
- **☐** = Gram negative cocci
- **□** = Gram negative rods

**Note:** Meningic dosing is not specified in the table provided.
### Musculoskeletal

#### Joint Fluid Analysis

<table>
<thead>
<tr>
<th>Condition</th>
<th>Cells (#/µL)</th>
<th>Glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Juvenile Idiopathic Arthritis</td>
<td>5,000 – 60,000 WBCs, most PMNs</td>
<td>Low to Normal</td>
</tr>
<tr>
<td>Septic Arthritis</td>
<td>OVER 60,000 WBCs, over 90% PMNs</td>
<td>Low to Normal</td>
</tr>
<tr>
<td>Reactive Arthritis</td>
<td>2,000 – 10,000 mononuclear WBCs</td>
<td>Normal</td>
</tr>
<tr>
<td>Trauma</td>
<td>RBCs &gt; WBCs; WBCs &lt; 2,000</td>
<td>Normal</td>
</tr>
</tbody>
</table>

#### Common Pediatric Orthopedic Injuries

<table>
<thead>
<tr>
<th>Injury</th>
<th>Mechanics</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clavicular Fracture</td>
<td>Most common fractured long bone in children; May be birth related (especially in large infants), and can be associated with <strong>brachial nerve palsies</strong></td>
<td>Figure 8 sling versus arm sling; Need for surgical repair depends on displacement and level of fxn</td>
</tr>
<tr>
<td>Greenstick Fracture</td>
<td>Incomplete fracture involving cortex on one side of the bone</td>
<td><strong>Reduction with casting</strong>; Order films at 7-10 days</td>
</tr>
<tr>
<td>Nursemaid’s Elbow</td>
<td><strong>Radial head subluxation</strong> that typically occurs as a result of being pulled or lifted by the hand; Child complains of pain and will not bend the elbow</td>
<td><strong>Manual reduction</strong> with gentle supination of the elbow at 90 degree</td>
</tr>
<tr>
<td>Osgood-Schlatter Disease</td>
<td>Overuse apophysitis of the <strong>tibial tubercle</strong>; Causes localized pain, especially with quadriceps contraction, in active young boys</td>
<td>Decrease activity for 1-2 years; Neoprene brace may provide symptomatic relief</td>
</tr>
</tbody>
</table>
| Salter-Harris Fractures | I: Physis (growth plate)  
II: Metaphysis and physis  
III: Epiphysis and physis  
IV: Epiphysis, metaphysic, physis  
V: Crush injury of the physis | Types I and II can generally be treated nonoperatively; Others, including unstable fractures, must be treated operatively |
Pulmonary

Asthma (Outpatient)
Place patients into severity category based on above chart. Patients should be stepped down if asthma is well controlled for 3 months and step up if needed, checking adherence, technique, environment, and co-morbidities. Step up at least one step if not well controlled and 1-2 steps often with a short course of oral corticosteroids if very poorly controlled.

Classification of Asthma Severity

<table>
<thead>
<tr>
<th></th>
<th>Intermittent</th>
<th>Mild Persistent</th>
<th>Moderate Persistent</th>
<th>Severe Persistent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daytime Sx</td>
<td>≤ 2 d/wk</td>
<td>&gt; 2 d/wk</td>
<td>Daily</td>
<td>Persistent</td>
</tr>
<tr>
<td>Night (&lt; 5 yr) Sx</td>
<td>0</td>
<td>1-2/mo</td>
<td>3-4/mo</td>
<td>&gt;1/wk</td>
</tr>
<tr>
<td>Daytime Sx</td>
<td>≤ 2/mo</td>
<td>3-4/mo</td>
<td>&gt;1/wk</td>
<td>Often (7/wk)</td>
</tr>
<tr>
<td>Interference with activities</td>
<td>None</td>
<td>Minor</td>
<td>Some</td>
<td>Extremely limited</td>
</tr>
<tr>
<td>SABA use</td>
<td>≤ 2 d/wk</td>
<td>&gt; 2 d/wk</td>
<td>Daily</td>
<td>Multiple x/d</td>
</tr>
<tr>
<td>FEV₁ % predict</td>
<td>&gt;80%</td>
<td>&gt;80%</td>
<td>60-80%</td>
<td>&lt;60%</td>
</tr>
<tr>
<td>Exacerbations req PO steroid</td>
<td>0-1/yr</td>
<td>(&lt;5 yr): ≥ 2 in 6 mo OR ≥ 4 wheezing in 1 yr lasting &gt; 1 d AND risk fx; (≥ 5 yr): 2/yr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3-5</td>
</tr>
</tbody>
</table>

Stepwise Approach to Managing Asthma

<table>
<thead>
<tr>
<th>Step</th>
<th>Beta Agonist</th>
<th>Inhaled Corticosteroid</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Short acting</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Short acting</td>
<td>Low dose</td>
</tr>
<tr>
<td>3</td>
<td>Short acting</td>
<td>Medium dose</td>
</tr>
<tr>
<td>4</td>
<td>Long acting</td>
<td>Medium dose</td>
</tr>
<tr>
<td>5</td>
<td>Long acting</td>
<td>High dose</td>
</tr>
<tr>
<td>6</td>
<td>Long acting</td>
<td>High dose PLUS oral</td>
</tr>
</tbody>
</table>

Common Daily Doses of Inhaled Corticosteroids

<table>
<thead>
<tr>
<th></th>
<th>&lt;5 yrs</th>
<th>5-11 yrs</th>
<th>12 yrs +</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluticasone MDI (mg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Flovent)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>176</td>
<td>88-176</td>
<td>88-264</td>
</tr>
<tr>
<td>Med</td>
<td>176-352</td>
<td>176-352</td>
<td>264-440</td>
</tr>
<tr>
<td>High</td>
<td>352+</td>
<td>352+</td>
<td>440+</td>
</tr>
<tr>
<td>Budesonide Respules (mg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Pulmicort)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.25-1</td>
<td>0.5</td>
<td>n/a</td>
</tr>
<tr>
<td>Med</td>
<td>0.5-1</td>
<td>1</td>
<td>n/a</td>
</tr>
<tr>
<td>High</td>
<td>1+</td>
<td>2</td>
<td>n/a</td>
</tr>
<tr>
<td>Beclomethasone MDI (mg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Qvar)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
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<td>80-160</td>
<td>80-240</td>
</tr>
<tr>
<td>Med</td>
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<td>160-320</td>
<td>240-480</td>
</tr>
<tr>
<td>High</td>
<td>n/a</td>
<td>320+</td>
<td>480+</td>
</tr>
<tr>
<td>Fluticasone / Salmeter DPI (Advair)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n/a</td>
<td>100/50 mcg 1 inhalation BID</td>
<td>Dose depends on patient</td>
<td></td>
</tr>
<tr>
<td>Budesonide / Formoterol MDI (Symbicort)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n/a</td>
<td>80/4.5 mcg 2 puffs BID</td>
<td>Dose depends on patient</td>
<td></td>
</tr>
</tbody>
</table>
Asthma (Inpatient)

- **New Admissions:** The following questions should be asked of all patients with a primary diagnosis of asthma:
  - Previous diagnosis of asthma? Age at diagnosis?
  - History of wheezing in the past?
  - In the last year how many times has your child had episodes of wheezing, exacerbations requiring steroids, or ER/urgent care visits?
  - Previous hospitalizations for asthma? Any in the last year?
  - How frequently does your child have daytime/nighttime symptoms?
  - Do these exacerbations interfere with normal activity?
  - What are your triggers? (e.g. smoke, colds, exercise, GERD, pollen, dust, animals, odors, mold, pests, weather changes, stress)
  - Are you followed by a Pulmonary specialist?
  - Have you been to IMPACT DC?
  - Do you have an Asthma Action Plan that you follow at home?
  - Do you use peak flow meters?

### Asthma Score (1-3 Mild, 4-6 Moderate, 7 or more Severe)

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dyspnea</strong></td>
<td>Speaks in sentences, playful, normal PO</td>
<td>Speaks in phrases, short cry, poor PO</td>
<td>Speaks in words, grunting, unable to PO</td>
</tr>
<tr>
<td><strong>Retractions</strong></td>
<td>0-1 accessory muscles</td>
<td>2 accessory muscles</td>
<td>3 or more accessory muscles</td>
</tr>
<tr>
<td><strong>Breath Sounds</strong></td>
<td>Normal breath sounds</td>
<td>Expiratory wheezing</td>
<td>I/E Wheezing or Diminished</td>
</tr>
<tr>
<td><strong>O2 Saturation</strong></td>
<td>94-100%</td>
<td>89-93%</td>
<td>88% or less</td>
</tr>
<tr>
<td><strong>RR for age (yrs)</strong></td>
<td>1-3: 34 or less</td>
<td>35-39</td>
<td>40 or more</td>
</tr>
<tr>
<td></td>
<td>4-5: 30 or less</td>
<td>31-35</td>
<td>36 or more</td>
</tr>
<tr>
<td></td>
<td>6-12: 26 or less</td>
<td>27-30</td>
<td>31 or more</td>
</tr>
<tr>
<td></td>
<td>13+: 23 or less</td>
<td>24-37</td>
<td>28 or more</td>
</tr>
</tbody>
</table>

- If patient required PICU admission consider Pulmonary consult.
- When patient able to tolerate, consider spirometry.
- Remember to use a spacer all the time when patients are on an inhaler
- Remember that Albuterol 2.5 mg NEB = 6 puffs with MDI
Chronic Lung Disease / Bronchopulmonary Dysplasia

- **General**: Weight, Height, Corrected Gestational Age, Formula
- **Oxygen**: Does the patient require home O2? Ok to go up but make sure you maintain them at least at their baseline.
- **Diuretics**: Is the patient on Diuretics? Check electrolytes if yes, May need to supplement. Patient shouldn’t be on Lasix for chronic mgmt.
- **Aerosols**: Are they on any bronchodilators (e.g. Albuterol? Atrovent?)? Are they on any steroids (e.g. Pulmicort?)

**Cystic Fibrosis**

- **Labs**:
  - **Admission**: IgE (only if not done w/in last 6-12 mo), HgbA1c (only if not done in last 3-6 mo), PT/PTT
  - **Admission & once per wk**: CBC, UA, BMP, Mag, Phos, AST, ALT (although if abnormal, would increase to twice per week)
  - **Admission & every 2 wks**: Sputum Cx, Repeating day 7 & 14 if new diagnosis Pseudomonas aeruginosa
  - **Pulmonary Function Testing**: On admission then qweekly
  - **Daily for CFRD**: Blood Glucoses Qac, Qhs, & 2 hr post prandial
  - **PRN**: Uhcg for females > 12, Utox if indicated

- **Imaging**
  - **CXR**: On admission for all, rechecking if sudden pain, hypoxemia, fever, or dyspnea
  - **CT Chest**: If indicated
  - **AXR**: If any GI complaints
  - **Gastrograftin Enema**: If obstructed
  - **Abdominal US**: If abdominal pain and elevated LFTs

- **Medications**: If cultures grew out from previous admits use this as empiric therapy; Use two different abx from two different families when treating Pseudomonas; Peak and trough after 3rd doses, repeat trough qwk. repeat peak qwk if concern for ototoxicity
  - **Tobramycin**: For first time using Rx start with 3 mg/kg/dose q8h otherwise use last dose (in mg/kg)
    - **Peak**: 10-12 mg/dL if steady state, 20-30 mg/dL if once daily
    - **Trough**: < 2 for both (for q24h dosing, obtain 12 h after dose)
  - **Aerosols**: All patient should be on Albuterol QID (or more frequently), Chest PT QID, and Pulmonzyme qdaily; Some patients will also be on Pulmicort, Atrovent, HT saline, etc.

- **Nutrition**: Nutrition consult on all patients
  - **Diet**: High protein – High calorie diet with snacks; Order no concentrated sweets if DM but do no t restrict diet, if hyperglycemic then they need insulin rather than restrict diet
  - **Supplements**: GT or NG supplements, Pancreatic enzyme supplements (e.g. Creon), Fat soluble vitamins (e.g. SourCF)

- **Access**: PICC If patient doesn’t already have a Port to access

- **Consults**: All patients → PT/SW/Nutrition, CFRD → Endo/Diabetes, High BUN/Cr → Renal, Pulm edema → Cardio, High LFTS → GI, may also need Pain or Surgery
**Tracheostomy**

- **Characteristics**: Size, Shiley or Bivona, Uncuffed or Cuffed (generally this is not used as it can lead to tracheomalacia and necrosis)
- **Tracheitis**: If concern for tracheitis, obtain respiratory culture and use WBC count on smear to determine whether to empirically treat
- **Air**: Do they receive Oxygen or Humidified Air?
- **Mechanism**: Do they get oxygen/air via trach nose, trach collar, etc.?
- **Speaking**: Do they use a Passe Muir valve to speak?
- **Changing**: What day do they usually change the trachs? Is it weekly?
- **For Emergencies**: Patients should have the trach of the same size and one half size smaller at bedside; If you are called for a code on a trach patient ALWAYS consider mucous plugging which might be resolved by closing the trach
Acid Base and Electrolytes

- **Oliguria** = UOP: <0.5 cc/kg/hr (child), <1.0 cc/kg/hr (infant)
- **Na deficit (to correct hyponat.)** = 0.6 x wt (kg) x (desired Na - initial Na)
- **Ca true value in setting of hypoalbuminemia**: ↑ serum Ca 1 mg/dL for each 1 g/dL of albumin below 4 g/dL (example: measured serum Ca= 7.5, albumin= 2.5 → true serum Ca= 9.0)
- **FeNa (fractional excretion of Na)** = (UNa/Ucr)/(PNa/PCr); LOW <1% (older child), < 2.5% (newborn)
- **Anion Gap** = [Na] - ([Cl] + [HCO3]); NORMAL=12-16; HIGH> 16
  - **High Anion Gap Metabolic Acidosis**: Methanol, Uremia, Diabetic Ketoadidosis, Paraldehyde, Inborn Errors of Metabolism, Lactic Acidosis, Ethanol, Ethylene Glycol, Salicylates, Sepsis
  - **Normal Anion Gap Metabolic Acidosis**: Diarrhea, RTA, CRF, Addison’s, Drugs (Carbonic Anyhdrase Inhibitors, Amphotericin, Toluene), Small Bowel or Pancreatic Fistula, Extra Chloride, TPN, Ureterosigmoidoscopy
- **Uncompensated Acid Base**
  - **pCO2 ON pH**: For every increase in pCO2 by 10, pH decreases by 0.08
  - **HCO3 ON pH**: For every increase in HCO3 by 10, pH increases by 0.15

<table>
<thead>
<tr>
<th>Compensated Acid Base</th>
<th>HCO3</th>
<th>pCO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metabolic Acidosis</td>
<td>For every ↓ by 1</td>
<td>Should ↓ by 1.3</td>
</tr>
<tr>
<td>Metabolic Alkalosis</td>
<td>For every ↑ by 1</td>
<td>Should ↑ by 0.6</td>
</tr>
<tr>
<td>Acute Resp Acidosis</td>
<td>Should ↑ by 0.1</td>
<td>For every ↑ by 1</td>
</tr>
<tr>
<td>Chronic Resp Acidosis</td>
<td>Should ↑ by 0.4</td>
<td>For every ↑ by 1</td>
</tr>
<tr>
<td>Acute Resp Alkalosis</td>
<td>Should ↓ by 0.2</td>
<td>For every ↓ by 1</td>
</tr>
<tr>
<td>Chronic Resp Alkalosis</td>
<td>Should ↓ by 0.4</td>
<td>For every ↓ by 1</td>
</tr>
</tbody>
</table>

- **Hyponatremia**: Often hypovolemic, requires hydration and NS boluses; Using hypertonic fluids or rapid correction may lead to cerebral edema.
- **Hypokalemia**: If asymptomatic and hypo or euvolemic, determine Na deficit and replacing at a rate no greater than 8 mEq per 24 hrs otherwise may lead to central pontine myelinolysis; If hypervolemic treat with water/Na restriction and diuretics; If symptomatic hyponatremia (seizures) use 1-2 mL/kg of 3% NaCl until no longer symptomatic
- **Hypokalemia**: May be due to ↓ intake (anorexia), extrarenal losses (vomiting, diarrhea, NG suction), renal losses (diuretic, amphotericin, gent, clinda, Bartter syndrome, RTA), or transcellular shifts (albuterol, insulin, alkalosis: for every 0.1 inc in serum pH, K may dec by 0.3-1.3); Causes weakness, cramping, constipation/ileus, urinary retention, arrhythmias: EKG shows flattened T waves, depressed ST, prominent U waves; Treat with oral supplements if mild, IV K if symptomatic or severe
- **Hyperkalemia**: Spurious due to hemolyzed labs or DKA (redistribution of intracellular K with actual total body deficit), however true hyperkalemia may be due to hemolysis, rhabdomyolysis, tumor lysis, drugs; Re-check BMP to confirm and then EKG to assess for peaked T waves, treat with:
  - **Ca gluconate** 60-100 mg/kg/dose of 10% [100 mg/mL] solution to stabilize the myocardium
  - **Glucose** (0.5-1.0 g/kg), **Insulin** (0.1 U/kg) and **NaHCO3** (1-2 mEq/kg over 30-60 minutes [1mEq/mL]) to drive K intracellularly
  - **Kayexalate** (1 g/kg) to exchange Na for K in colonic mucosa
Acute Kidney Injury

- **Prerenal Failure**: Hypoperfusion of the kidneys with a history indicating volume depletion (vomiting, hemorrhage, cardiac failure) and workup showing decreased UOP, increased serum Osm, low UrNa, low FeNa, and increased BUN:Cr ratio

- **Intrinsic Renal Failure**: Due to parenchymal injury to kidney from ischemic/toxic insult leading to cell necrosis often with a history of dehydration, hypoxia/ischemia, toxic ingestion, sepsis, hematuria, trauma, workup will reveal RBC casts, granular casts, low spec grav, high FeNa

- **Postrenal Failure**: Due to obstructed urine flow (renal calculi, bladder outlet obstruct, ureteral compression) with a history of gross hematuria, colicky pain (stones), distended bladder on exam

- **Managing AKI**: Maintain renal perfusion, fluid/electrolyte balance (may cause hyponatremia, hyperkalemia, hypocalcemia, hyperphosphatemia), control BP (may cause HTN), treat anemia, nutrition (low K and low phos diet), adjust meds for renal impairment, initiate dialysis when indicated

### Renal Tubular Acidosis

<table>
<thead>
<tr>
<th></th>
<th>Distal (Type I)</th>
<th>Proximal (Type 2)</th>
<th>Distal with ↑K (Type 3)</th>
<th>Type IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum HCO₃ untreated</td>
<td>10-15</td>
<td>15-20</td>
<td>10-15</td>
<td>15-20</td>
</tr>
<tr>
<td>Serum K</td>
<td>Normal/Low</td>
<td>Normal/Low</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Minimum Urine pH</td>
<td>Over 5.5</td>
<td>Under 5.5</td>
<td>Over 5.5</td>
<td>Under 5.5</td>
</tr>
<tr>
<td>Urine NH₄</td>
<td>Low</td>
<td>Normal</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Urine K</td>
<td>High</td>
<td>Normal/High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Urine Ca</td>
<td>High</td>
<td>Normal</td>
<td>High</td>
<td>Normal</td>
</tr>
<tr>
<td>Urine Citrate</td>
<td>Low</td>
<td>Normal/High</td>
<td>?</td>
<td>Normal</td>
</tr>
<tr>
<td>Kidney Stones</td>
<td>Yes</td>
<td>Maybe</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Rickets</td>
<td>Maybe</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Bicarb to fix (mmol/kg/d)</td>
<td>4-15 (Child)</td>
<td>4 -10</td>
<td>2-3</td>
<td>2-4</td>
</tr>
<tr>
<td></td>
<td>1-2 (Older)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response to Bicarb?</td>
<td>Good</td>
<td>Poor (2 mEq/kg)</td>
<td>Good</td>
<td>Variable</td>
</tr>
</tbody>
</table>

### Renal Transplantation

- **General**: Leave PICU a few days post-op. Your role will be to monitor fluid balance and electrolytes, control pain, and check levels of anti-rejection medications. Call fellow with these numbers before adjusting dose.

- **Drains**: If surgical drain is placed, keep track of output but do not remove. Surgery will do this when output decreased

- **Oliguria/Hematuria**: If poor UOP or blood in urine multiple days out from OR, will obtain a renal transplant US (ordered differently in computer orders than regular renal US) to assess flow to transplanted kidney.

- **Removing IJ**: IJ may be taken out close to day of discharge. Must be removed by resident, not nurse. To remove IJ, remove dressings and sutures. Place pt in trendelenberg, have them take deep breath and pull line as pt is exhaling. Hold pressure with gauze for at least 5 minutes.
General

- **Reporting Input/Output**: IMPORTANT! Report total volume I/O and cc/kg/hr of urine output. Daily weights are a good measure of fluid status and should always be included. You may find information on I/O’s of peritoneal dialysis in the paper chart next to the room.

- **Oliguric Patients**: Be very careful with fluid status in oliguric or anuric pt’s. Their total daily fluids should equal insensible losses + output every X hours. They do not need maintenance or boluses due to their low urine output if it is due to end stage kidney disease.

- **Ordering Enemas**: Be careful when giving enemas to renal pts. Fleets should not be used as they contain phosphorous and renal pts have difficulty regulating their lytes. May lead to seizures.

- **Replacing Electrolytes**: Very helpful website for blousing electrolytes when a pt is low. Tells you what levels at which to bolus and how much to bolus. Type “stemcell” into the intranet address bar and press enter. Go to “clinical reference information” Then click “hemeonc pocket reference book”. Then click “electrolytes”. Always try to PO bolus before IV if pt has a working gut and is not NPO. PO is always safer than IV.

- **Checking Hematuria**: For new blood in urine on dipstick, send to lab for UA. You want to evaluate for actual RBC’s vs + blood but no RBC’s

- **Dialysis Indications**: Kidney damage leading to CHF (fluid overload), anemia, hyperkalemia, acidosis, uremic pericarditis/enceph., malnutrition

- **Dialysis Caveats**: Attending/fellow will place dialysis-related orders; Must be careful which medications are given just prior to dialysis as the dialysis may remove them from blood stream (important for seizure medications)

- **Hypertension**: Indicated for treatment if >5% of 95th percentile systolic BP for height and age. Generally pharmacologic agents will be started on admission or during the day and ordered with parameters for use. You may hold for low BP’s or low HR’s (if using beta blockers) and give for BP’s over parameters. Always assess for blurred vision, headaches, neuro exam changes with new or increased HTN. Common medications include Hydralazine, Nifedipine, Amlodipine, and Labetolol

- **Nephrotic Syndrome**:
  - **Edema**: Can be mild and variable in distribution (periorbital in AM, generalized in PM). Severe edema includes ascites, pleural effusion, scrotal/vulvar edema, and causes skin breakdown.
  - **Electrolytes**: Total body Na usually elevated but usually presents as “hyponatremia” due to decreased GFR and free water retention secondary to increased ADH or as due to elevated cholesterolama. Also presents with false “hypocalcemia” due to hypoalbuminemia from urinary losses. CaCO3 may provide antacid effect while on steroids and Ca supplement

- **Immunosuppressed**: Due to steroid therapy and renal wasting of antibodies. Patient may present with:
  - **Varicella**: If susceptible child w/ NS is exposed, VZIg should be given within 72 hrs; Acyclovir/valacyclovir should be given if symptomatic
  - **Spontaneous bacterial peritonitis**: most commonly due to E.coli and S.pneumonia, thus pneumococal vaccine should be given to all children after NS in remission and off daily pred
- **Thromboembolism:** Due to reduced intravascular volume, reduced protein S/antithrombin concentrations

- **Glomerulonephritis:** Has a wide differential including FSGS, Goodpastures, membranoproliferative, IgA, Lupus, Henoch-Schonlein purpura, anti-GBM antibody, polyarteritis and other vasculites, amyloidosis; May present with vague symptoms of fatigue and malaise, anemia, HTN or UA + for blood; Salt restrict; Often we will use steroids to treat an “acute flare”; May need plasmaphoresis is process is thought to be related to antibodies.

- **Peritonitis:** Dialysis associated peritonitis is due to an infected hemodialysis catheter spreading infection to blood and then to peritoneum or from an irritation of peritoneal lining from infusion of fluid via a peritoneal dialysis catheter. May also be a result of nephrotic syndrome renal dz. 3rd spacing in the gut allows for collection and stasis of bacteria and fluids. Presents with severe abdominal pain, fevers, abdominal rigidity or distension. Obtain US to evaluate for fluid/acited. CT may be necessary to r/o abscess formation if resistant to treatment. You should obtain cell count and labs on actual fluid taken off during dialysis and infuse antibiotics straight into peritoneal dialysis fluid.

---

*Consider a functional diagram of the kidney*
Metabolism

In general you should think of metabolism patients based on their illness severity: There unstable/sick, known metabolic disorders susceptible to crisis, and chronic/stable patients. The treatment for MANY metabolic diseases is their unique feed, so NEVER change a feeding regimen/fluid unless you are sure this is what the child needs.

- **Metabolic Crisis**: For any new metabolic patient, double check your patient’s disease and select the appropriate metabolic pathway, ask the family for their emergency letter, find a recent clinic note, and ask the family for the diet the child receives at home (both when well and when sick, often different). It is helpful to know any emergency meds they use when sick (such as Carnitine or Arginine) and doses. When discussing their feeds it is helpful to know the glucose infusion rate (GIR) which is:
  - GIR (mg/kg/min)= Dextrose%* Rate (mL/hr) * 0.166 / Body weight (kg)

- **Call the Metabolist On Call**: Even if patient is in the ED call them to check the plan. They’ll want to know who will be the primary day person.
  - **Fluids**: Use NS boluses PRN for a child that is volume depleted and monitor blood sugar. For MOST patients, D10 +1/2NS+20K at 1.5x maintenance but if hypoglycemic use D10% (5ml/kg) or D25% (2ml/kg)
    - **Pyruvate dehydrogenase deficiency and children on ketogenic diets**: DO NOT follow routine pattern, call immediately for plan and DO NOT start Dextrose-containing fluids. Use NS instead initially.
  - **Labs**: I-stat (lytes, glucose, blood gas); stat BMP; CBC, stat UA, draw green top free flowing for ammonia on ice (may not be necessary, depending on disorder), urine dipstick POC for all voids (after first)
  - **Lipids**: If indicated, order intralipids 20% (available from pharmacy at all times for metabolic patients) (15ml/kg/day=3grams/kg/day divided over 24 hours=0.63ml/kg/hour) STAT order (dispense a 250ml bag)
  - **Feeds**: After discussion w/ metabolism, order feeds STAT and call the formula lab to confirm that they received the order. If after hours, you may need to call the pharmacy to have a formula made (x6687).

- **Imagine that the geneticist asks you to order....**
  - Sodium benzoate/sodium phenylacetate (100 mg ammonul=30.5 mg Na=1.33 mEq): for wt 1-25 kg, give 250mg/kg IV over 2 hours x 1 dose. For greater than 25 kg dose is 5500 mg/m2 over 2 hours. After this initial dose, see the pathway for continuing dose
  - Arginine HCl 10% (for OTC/CPS1 deficiency; NOT arginase deficiency): for 0-25 kg dose is 200 mg/kg over 2 hours: central line ONLY; greater than 25 kg 4000 mg/m2 over 2 hours via central line. After initial dose, see pathway for continuing dose
  - Arginine HCl for citrullinemia or argininosuccinic aciduria: 0-25 kg 600 mg/kg over 2 hours (central line only); over 25 kg 12,000 mg/m2 over 2 hours central line only. After this initial dose, see the pathway for continuing dose
• **Unstable/Sick:** Almost all Newborn are sick if “bad” metabolic disease (lethargy, vomiting, hypotension, liver failure), can appear like sepsis. To differentiate (metabolic/not metabolic): H&Ps, CMP, lactate, ammonia, urine ketones, newborn screen (if known), acidosis status via ABG/VBG

<table>
<thead>
<tr>
<th>Findings</th>
<th>Consider...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidotic (HCO3 &lt;16), Abnormal urine ketones</td>
<td>Organic academia (e.g. Propionic academia, Methylmalonic academia...)</td>
</tr>
<tr>
<td>Acidotic, High serum ketones and lactate</td>
<td>Primary lactic acidosis (e.g. Pyruvate dehydrogenase def.)</td>
</tr>
<tr>
<td>Non-Acidotic (HCO3 &gt; 16), High ammonia</td>
<td>Urea cycle defect (e.g. OTC def.)</td>
</tr>
<tr>
<td>Non-Acidotic, Normal ammonia</td>
<td>Galactosemia</td>
</tr>
<tr>
<td>Non-Acidotic, Abnormal acylcarnitine profile</td>
<td>Fatty acid oxidation disorders (e.g. Carnitine Palmitoyltransferase Def.)</td>
</tr>
<tr>
<td>Liver failure</td>
<td>Tyrosinemia</td>
</tr>
<tr>
<td>Cardiomyopathy, Hydrops</td>
<td>Storage disorders</td>
</tr>
<tr>
<td>Cardiomyopathy</td>
<td>Mitochondrial disorders</td>
</tr>
</tbody>
</table>

• **Known Metabolic Disorders:** Most of the kids we admit have diseases that make them get sick really fast (even after 2-3 episodes of vomiting)
  o **Branched chain AA metabolism disorders** (MSUD, methylmalonic acidemia, propionic acidemia, isovalericacidemia, etc.). Anion gap metabolic acidosis, +/- hypoglycemia, ketonuria, hyperammonemia. Usually presents in infancy. Admit most with minor childhood illnesses
  o **Fatty acid oxidation disorders** (e.g., MCAD deficiency). Hypoglycemia but absent or trace urine ketones; Often in association with minor illness or with fasting, including transition to decreased overnight feeds. May present at any age. Admit for IVF if cannot eat.
  o **Carbohydrate metabolism disorders** (e.g., galactosemia, glycogen storage diseases). Findings:-- hypoglycemia and/or ketonuria, hepatosplenomegaly, developmental delay; in galactosemic infants, there are reducing substances and galactitol in urine; LFTs/bili/coags may be elevated.—Admit if can’t maintain glucose(aka GSD) but galactosemausually doesn’t require additional response to acute illness if on treatment without difficulty
  o **Urea cycle disorders** (e.g., ornithine transcarbamylase deficiency)Findings: – normal or slightly elevated pH, markedly increased NH3. Important cause of lethargy/coma in newborns. Admit with childhood illnesses since NH3 goes up
  o **Primary lactic acidosis**.Findings:-- pH, anion gap, may have hypoglycemia, may have moderately elevated NH3, increased serum lactate, increased CSF lactate. May present in infancy. Admit with illness, as NH3 increases.
  o **Storage disorders** (e.g. Tay-Sachs, Hunter): Insidious onset as stored material builds up. Symptoms of brain accumulation (abnormal reflexes and development) or organ storage (respiratory distress). Often relatively stable with childhood illnesses.
  o **Primary Lactic acidosis:** Seen in mitochondrial disorders since their cells don’t have enough energy. Start D5 containing fluids immediately as these kids don’t tolerate much stress at all.
• **Chronic/Stable:** In general these patients you will be admitting for further evaluation. HPI should clarify FTT, vomiting, delayed milestones or loss of milestones, severe illness in conjunction with trivial concurrent infections such as gastro or URI, deafness, unusual odors on urine or breath, adverse reaction to ingestion of protein, avoidance of milk or sugar, symptoms of hypoglycemia, abdominal enlargement, recurrent constipation, seizures, evidence of rhabdomyolysis (muscle pain, weakness, dark urine), progressive change of facial appearance (particularly coarsening of the face), chronic anemia, or diabetes. Family history should include infant deaths, miscarriages, consanguinity, or mental retardation.

  o **Newborns:** positive newborn screen—stable child. They will ask for disease specific labs so talk to them. They will always ask you if you think the child “looks good”. Plan for CMP + urine organic acids + urine ketones +/- acylcarnitine profile or plasma aminoacids or galactosemia, or other specific tests.

  o **Older children with Failure to thrive:** Why do you think metabolic cause? Acidosis, hypoglycemia, large liver, large spleen, unusual vomiting history? Newborn screen normal? (If you can’t find this, ask Mother’s last name, date of birth, birth hospital name, city, state).

  o **Children with Suspected Child Abuse Neglect:** (Almost always r/o osteogenesis imperfecta). It is nice to know if family history of fractures, deafness, short stature, patient history of fractures and calcium, magnesium and phosphorus levels.

  o **Older children with Developmental Delay:** Why do you think metabolic? See FTT, but also does child have history of seizures, hepatomegaly, splenomegaly, hypoglycemia, funny odor, NBS results, history of rhabdomyolysis?

### Inborn Errors of Metabolism: All are AR unless specified

<table>
<thead>
<tr>
<th>Disease</th>
<th>Enzyme Deficiency</th>
<th>Distinctive Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lesch-Nyhan (XLR)</strong></td>
<td>Hypoxanthine-guanine phosphoribosyl transferase (HGPRT); <em>Uric Acid</em></td>
<td>Spastic CP, Motor retard., Self-injurious behavior, Gout, Renal Calculi, Tophi, Hyperuricemia</td>
</tr>
<tr>
<td><strong>Phenylketonuria</strong></td>
<td>Phenylalan. hydroxylase <em>Phenylalanine</em></td>
<td>Fair hair and skin, blue eyes, mousy odor</td>
</tr>
<tr>
<td><strong>Homocystinuria</strong></td>
<td>Cystathion. synthase <em>Homocystine, Methion.</em></td>
<td>Ectopic lentsis</td>
</tr>
<tr>
<td><strong>Maple Syrup Urine Disease</strong></td>
<td>Branch-chain KA DH <em>Leucine, Isoleucine, Val.</em></td>
<td>Maple syrup odor to urine, sweat, cerumen</td>
</tr>
<tr>
<td><strong>Hartnup’s Disease</strong></td>
<td>Na-dep AA transport sys <em>Deficiency of neutral AA</em></td>
<td>Most are asymptomatic</td>
</tr>
</tbody>
</table>

**Carbohydrate Storage Diseases**

<table>
<thead>
<tr>
<th>Disease</th>
<th>Enzyme Deficiency</th>
<th>Distinctive Features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Galactosemia</strong></td>
<td>Galactokinase, Galactos-1P-Uridyltransferase, Uridine Diphosphate Galactose-4-Epimerase <em>Galactose</em></td>
<td>Cataracts, HSM, Mental Retardation, E.coli sepsis, Vomiting, Seizures, FTT, Vitreous Hemorrhage, Cirrhosis</td>
</tr>
<tr>
<td>Fructosuria</td>
<td>Fructokinase</td>
<td>Fructose</td>
</tr>
<tr>
<td>------------</td>
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<td>----------</td>
</tr>
<tr>
<td>Hereditary Fructose Intol.</td>
<td>Aldolase B</td>
<td></td>
</tr>
</tbody>
</table>

**Glycogen Storage Diseases**

<table>
<thead>
<tr>
<th>Von Gierke’s (Type I)</th>
<th>Glucose-6-Phosphatase</th>
<th>Accumulates in the Liver, Kidney, Intestine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pompe’s (Type II)</td>
<td>α-1,4-glucosidase (acid maltase)</td>
<td>Accumulates in Cardiac and Skeletal muscle</td>
</tr>
<tr>
<td>McArdle’s (Type V)</td>
<td>Skeletal muscle glycogen phosphorylase</td>
<td>Accumulates in Skeletal muscle</td>
</tr>
</tbody>
</table>

**Lipid Storage Diseases**

<table>
<thead>
<tr>
<th>GM&lt;sub&gt;1&lt;/sub&gt; Gangliosidoses</th>
<th>β-galactosidase</th>
<th>GM&lt;sub&gt;1&lt;/sub&gt; ganglioside</th>
<th>Cherry red spot on macula (CRSM); HSM; slow motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tay Sachs</td>
<td>Hexosaminidase A (α)</td>
<td>GM&lt;sub&gt;2&lt;/sub&gt; ganglioside</td>
<td>CRSM; Hyperacusic; Froglike pose; No HSM!</td>
</tr>
<tr>
<td>Sandhoff</td>
<td>Hexosaminidase A (β)</td>
<td>GM&lt;sub&gt;2&lt;/sub&gt; ganglioside</td>
<td>CRSM; HSM; Hyperacusic; Froglike pose</td>
</tr>
<tr>
<td>Niemann-Pick</td>
<td>Sphingomyelinase</td>
<td>Sphingomyelin</td>
<td>CRSM; HSM; Neonatal jaundice</td>
</tr>
<tr>
<td>Gaucher’s</td>
<td>β-Glucosidase</td>
<td>Glucocerebrosid</td>
<td>Pancytopenia; Bone fractures; Crinkled paper cytoplasm</td>
</tr>
<tr>
<td>Fabry’s (XLR)</td>
<td>α-galactosidase or</td>
<td>Ceramide Trihexosidase Glycosphingolipid</td>
<td>Neuropathic limb pain; Angiokeratomas; Corneal deposit; Kidney/Cardiac dx</td>
</tr>
<tr>
<td>Krabbe’s</td>
<td>Galactocerebrosidase or</td>
<td>Ceramide β-galactosid. Ceramide Galactose</td>
<td>CNS degeneration; Optic atrophy, spastic; Globoid cells in areas of demyelin.</td>
</tr>
<tr>
<td>Farber’s</td>
<td>Ceramidase</td>
<td>Ceramide</td>
<td>Granulomas on joints, vocal cords; Mental and motor retard.</td>
</tr>
</tbody>
</table>

**Mucopolysaccharidoses**

<table>
<thead>
<tr>
<th>Hurler’s</th>
<th>α-L-iduronidase</th>
<th>MR; Dysostosis Multiplex; Organomegaly; Large tongue; Hearing loss Heart/Corneal Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheie’s (Mild Hurler’s)</td>
<td>α-L-iduronidase</td>
<td>Corneal clouding, Stiff joints, Aortic Regurg; Normal life and intellect</td>
</tr>
<tr>
<td>Hunter’s (XLR)</td>
<td>Iduronate 2-sulfate</td>
<td>MR; Dysostosis Multiplex; Organomeg.; Coarse Facies</td>
</tr>
</tbody>
</table>
Dysmorphology

• Genetic Tests
  o Karyotype: Checks the number of chromosomes and if any LARGE sections are added/missing
  o MicroArray: Always clarify with Genetics which one should be sent but it looks for duplications or deletions of areas of chromosomes. To order, Type “GenomeDX Oligonucleotide Microarray” in Cerner or lab will throw sample away and test credit.
  o Mutation analysis: Looks for point or common mutations in a gene
  o FISH: Fluorescence in-situ hybridization: whole chromosome picture with hybridization for the deleted/additional gene concerned about to confirm microarray results.

• Consult: Genetics consult/referral for non-metabolic patients if you have a patient with 2 or more seemingly un-related problems in different organ systems OR developmental delay/mental retardation/autism with dysmorphic features OR dysmorphic features and problems in an isolated organ system. Often, these children are hospitalized for an acute problem that may be exacerbated by an underlying genetic condition, so don’t be afraid to suggest the consult. Recognize that any child for whom you consult genetics should have growth parameters accurately measured and charted (know the percentiles, particularly for head circumference!)

• Head
  o Craniosynostosis: Premature fusing of one or more cranial sutures (makes misshapen head), can be confused with positional plagiocephaly which is when the head is misshapen due to lying in one position too long (especially in NICU or children that have limited movement)
  o Brachycephaly: Shortened front-to-back diameter of the skull: caused by coronal sutures closing early
  o Micro/Macro-cephaly: Large/small compared to growth charts. A child is not “normocephalic” because his head “looks normal”. You have to measure and compare to growth curves.

• Eyes
  o Hyper/Hypo-telorism: Pupils too close/too far apart
  o Telecanthus: Increased distance between the medial canthi of the eyes
  o Down/Up slanting palpebral fissures: From one corner of eye to other side of same eye, up-slanting if lateral side higher than medial side; down-slanting if opposite is true

• Ears: Anotia is no ears, Microtia is small ears


• Hands
  o Palmar creases: single, hockey stick (From below pinky ending between pointer/middle finger)
- **Dactyly**: polydactyly (extra finger, then state which finger and if bilateral: post axial polydactyly means on ulnar side/preaxial means on thumb side: postaxial polydactyl is VERY common finding in African American families), syndactyly (fused fingers), *clinodactyly* (5\textsuperscript{th} finger curves towards other fingers), brachydactyly (short fingers/toes)

- **GI**: Check for hepatosplenomegaly
- **GU**: Check for size of genitalia and anus location (i.e. anterior/posterior placement? absent with colostomy?)
- **Neuro**: Tone (hypo or hypertonia), muscle mass, strength, reflexes, clonus
Contact Information
Fellow: x8260
Residents: x8264, x8265, p1363
Dietician (Laura): p0335
Case Management (Emily): x8231, p4678
EEG (Tech): x8263, x5651 (Downstairs)
5 East Reading Room: x7105
MRI: x2927 (for sedation scheduling)
MRI Reading Room: x2988, x2989
Neurology Clinic: x2673
Appointment Line (for parents): x2610

Rotation Structure
• 4 interns and 1 senior total
  o 2 interns on wards (6a-6p)
  o 1 intern in clinic
  o 1 intern on nights (6p-6a)
• Includes Neuro and Endocrine
• Endocrine rounds before Neuro from 8-830 or in afternoon on Wed and Thu
• Interns cap at 10 patients to pre-round on (not including 23h vEEGs or priority D/Cs)

General Tips
• Equipment: You need a reflex hammer and penlight. Tuning fork recommended. Ophthalmoscopes are available on the floor.
• Admission Neuro Exam: Every new admission needs a complete neurologic exam. At a minimum this includes: mental status, CN II-XII, a thorough motor exam, tone, a reasonable screening sensory exam (age and cooperation-dependent), coordination, DTR (and primitive reflexes in infants) and gait (where possible).
• Daily Neuro Exam: Every patient needs a thorough, but not exhaustive, neurologic exam every day on pre-rounds (even if your med student already did it). Make sure to focus on any parts of the exam which were previously abnormal, or which could be abnormal based on their diagnosis. At a minimum, check mental status, cranial nerves, proximal and distal strength in all 4 extremities, tone and reflexes.
• AED Reporting: Report the anti-epileptics that seizure patients are on, both the milligram dose and, more importantly, mg/kg/day – which is how neurologists typically talk about dosage with these medications. Be careful with seizure medication doses – it is easy to make mistakes converting from ml/teaspoons to mg when entering orders and writing scripts.
• AEDs while NPO: Make sure patients are still getting their anti-epileptic medications when they are NPO. The pharmacy can help convert most meds from PO to IV. Some meds are only available PO – clarify a plan with the fellow for these medications. Do not leave a patient without any anti-epileptics while they are NPO unless the fellow explicitly tells you to.
• Daily Work: Neurology is a high-turnover service, you will be writing lots of H&P’s and D/C summaries. Use Cerner macros (for common parts of your note, like a normal neuro exam) and save common favorite orders (neuro admit orders, eeg, neurochecks, ativan, csf labs). Check your notes to keep them accurate and avoid copy-forward mistakes. Keep hospital summaries up to date on patients admitted for more than a few days.
• Dispo: Give Derrick names for follow-up appointments in advance, figure out things like prescriptions, outpatient imaging and seizure teaching as far before discharge time as you can, and keep in touch with case management. Derrick and the case manager can help figure out outpatient MRI’s.
Neurologic Examination

1. Mental Status
   a. Orientation to person, place, time, and situation – depending on age
      (Use familiar references like cartoons)
   b. Attention and concentration
   c. Memory
   d. Language (Body parts, numbers, colors, alphabet, reading, writing)

2. Cranial Nerves
   a. Olfactory (I) – rarely tested
   b. Optic (II) – visual fields, Snellen chart/Near card (if available),
      fundoscopic exam
   c. Oculomotor (III), Trochlear (IV), Abducens (VI) – eye movements
   d. Trigeminal (V) – facial sensation (three branches), corneal reflex e.
   e. Facial (VII) – facial movements
   f. Vestibulocochlear (VIII)– hearing, nystagmus
   g. Glossopharyngeal, Vagus (IX, X) – phonation and palate movement
   h. Accessory (XI) – SCM and shoulder shrug
   i. Hypoglossal (XII) – tongue movement

3. Muscle strength, tone, and bulk
   a. Strength (0-5)
      ▪ 0 – no movement
      ▪ 1 – trace movement
      ▪ 2 – movement with gravity eliminated
      ▪ 3 – movement against gravity with no resistance
      ▪ 4 – movement against slight resistance
      ▪ 5 - normal strong movement
   b. Abnormalities and cause:
      ▪ proximal weakness – myopathy
      ▪ distal weakness – neuropathy
      ▪ unilateral weakness - UMN lesion inclduing stroke
      ▪ spastic hypertonia (clasp knife)- CP, old stroke
      ▪ rigid hypertonia (lead pipe or cogwheeling) – Parkinsons
      ▪ paratonia (gegenhalten) - frontal lobe dementia
      ▪ hypotonia - myopathy

4. Sensation
   a. Spinothalamic (Light touch, pain, temperature)
   b. Dorsal Column (vibration, proprioception)

5. Coordination
   a. Finger nose finger, heel shin heel
   b. Rapid alternating movements

6. Reflexes
   a. Deep tendon reflexes (0-4)
      ▪ 0 – no reflexes
      ▪ 1 – trace reflex
      ▪ 2 – normal reflex
      ▪ 3 – increased reflex crossing two joints
      ▪ 4 – increased with clonus
   b. Primitive reflexes (normal duration in months in parenthesis)
      ▪ Moro (0-6) – mediated by vestibular nuclei brainstem
      ▪ Tonic neck (0-6) - mediated by vestibular nuclei brainstem
- **Grasp** (0-6) - mediated by vestibular nuclei brainstem
- **Rooting** (0-6) - mediated by trigeminal nuclei
- **Trunk incurvation** (0-9) – mediated by spinal cord level
- **Parachute** (after 6-8 mo) – mediated by vestibular nuclei brainstem
- **Babinski**: upgoing toe against noxious stimuli to plantar surface of foot indicating UMN process

7. **Gait**
   a. Normal
   b. Tandem
   c. Abnormal
      - **Circumductive**
      - **Shuffling** – basal ganglia
      - **Ataxic** - cerebellum
      - **Scissoring**
      - **Antalgic** - radiculopathy
      - **Waddling** - myelopathy
      - **Steppage** - neuropathy

**Localizing Lesions**

UMN lesions are characterized by:
- **Hypertonia** (Spasticity for corticospinal tracts; rigidity for extrapyramidal tracts)
- **Hyperreflexia**
- **Clonus**
- **Babinski**

LMN lesions are characterized by:
- **Hypotonia**
- **Weakness**
- **Hyporeflexia**
- **Fasciculations**

**Cortical lesions are associated with cortical type deficits:**
- **Dysphasia** for language cortex
- **Visual disturbances** for occipital cortex
- **Hemiparesis** for motor cortex

**Brainstem lesions**: Associated with CN signs in combination with long tract and crossed signs, i.e. weakness of ipsilateral face and contralateral body

**Spinal cord lesions are characterized by:**
- **Sensory level**
• Change in bowel or bladder function

**Neuroradiology Basics**

• **CT**
  o **Advantages:** Faster scan thus usually does not require sedation, Easier availability, Better imaging of bones, acute hemorrhage, calcifications
  o **Disadvantages:** Not as good as MRI for imaging brain anatomy, Worse visualization of structures near bones (posterior fossa), Rad exposure
  o **IV Contrast:** Helps with visualization of infection/abscess and tumors; Not needed to see acute hemorrhage, fracture

• **MRI**
  o **Advantages:** Better imaging of brain anatomy, nerves, soft tissues; Better assessment of white matter/myelination; No radiation exposure; Availability of advanced techniques (MRA/MRV, diffusion, spectroscopy)
  o **Disadvantages:** Slower scan thus young children often require sedation; Less rapidly available than CT
  o **IV Contrast:** Normal brain does not enhance because of the BBB thus useful for localizing tumors and abscesses

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2 (FLAIR is the same except CSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSF / Water</td>
<td>Dark</td>
<td>Bright (*Dark in FLAIR)</td>
</tr>
<tr>
<td>Myelin / Fat</td>
<td>Bright</td>
<td>Dark (Thus demyelination bright)</td>
</tr>
<tr>
<td>Tumors</td>
<td>Dark</td>
<td>Bright</td>
</tr>
</tbody>
</table>

• **MRA/MRV:** Allow for 3D imaging of vasculature without radiation or contrast injection (unlike CTA). MRA good for large/medium vessels. Not as good for small vessel disease

• **MRS:** Spectroscopy allows measurement of biochemistry of brain tissue in non-invasive way; Peaks for different brain metabolites/biochemical markers; Can assist with identification/evaluation of tumors, diagnosis of metabolic disease, prognostication in neonatal hypoxia

• **DWI:** Measures the mobility of water molecules in brain tissue; Diffusion of water inside cells more restricted than extracellular water; Good for Cytotoxic vs vasogenic edema, acute stroke, and tumors

**Common Admissions:**

• **Scheduled Video-EEG:** Pre-scheduled admits to better define an existing seizure disorder or help with diagnosis. They come with instructions from their neurologist (the fellow will have these) and a pre-set time limit for the admission from their insurance. Admissions can end early if patients have enough events on the EEG to give the neurologists what they need.
  o **HPI:** Be sure to read the last neuro clinic note in Cerner, which often gives a good idea of why the patient has been referred for video-EEG. Take a good seizure history as above
  o **Orders:** Seizure precautions, q4 neurochecks, CR monitor, Ativan (IV) or valium (PR) PRN for seizure > 5 minutes, Video-EEG (should be re-ordered each day for 24h), Labs – often none, but sometimes the primary neurologist requests some, Meds – continue the home meds, although clarify if primary neurologist wants to reduce dose for vEEG
  o **Discharge:** Often these patients just go home - without too much extra dispo planning - once enough EEG events are captured or once their insurance authorization runs out. Write Rx for any changes in meds. 25
• **New-onset seizures**: Children’s admits all potential new-onset seizure pts
  o **HPI**: Detailed description of event(s): What did it look like? Generalized or localized? Staring? Eye movements? Change in consciousness? Was the child alert during the event? Afterwards? Any post-ictal state? If so, how long? Duration of event(s)? If several events, do they happen more often at night/in the morning? While sleeping? Does something provoke them? Was there an aura or sensations prior to the event? Any Recent illnesses, fevers, changes in medications? Any recent trauma or other inciting event? Any family history, including any FH of seizures, neurologic or metabolic diseases, psychiatric diseases?
  o **Orders**: Use the general new onset seizure admission order careset plus safety seizure precautions, Q4h neurochecks, CR monitor, Ativan IV (if pt has access) or valium PR (if no access) PRN seizure > 5 minutes
    • **EEG** – most get a routine EEG, however some get a 24h video-EEG based on history. Clarify which you need at the time of admission.
    • **Labs** – BMP, glucose stick, and +/- CBC should have been ordered in the ER. If not, order them on admission
    • **Imaging** – Focal seizures/neuro findings or persistent AMS usually get a CT in the ER. Focal seizures or a focal neuro exam and younger than 2 y/o typically need a non-contrast MRI. Clarify if MRI is needed on admission, and make patients NPO the night before if they need to be sedated for it.
  o **Discharge**: Otherwise healthy children with a first seizure have a less than 50% chance of having another seizure, and are typically not started on AED’s after the first event. Exceptions include kids whose 1st seizure was status epilepticus, children with provoking trauma/insult, kids who have more than 1 seizure at presentation. If anything they often go home with Diastat, rectal valium gel. Ask if patients need this before the day of discharge (not all pharmacies have it on hand). It comes in a syringe with a dial that the pharmacist sets and locks when they fill it. For examples of how to write the prescription, see http://www.diastat.com/9-About/2.1-Supplied.html. Order Seizure and diastat teaching as a communication order prior to discharge.

• **Febrile seizures**: Simple febrile seizures (brief, generalized, fever at time of seizure) are common in children 6 months to 6 years and often are not admitted to the hospital. Children under 6 mo with fever and seizure may be admitted to work-up for meningitis. Complex febrile seizures (focal seizure, prolonged seizure, multiple seizures in 24h, persistent altered mental status) generally get admitted for a new onset seizure workup, same as above but ask about GI symptoms, continue fever W/U, and consider LP/CT if suspecting meningitis

• **Worsening of known seizure disorder**: When were they diagnosed with seizures, what do they usually look like, do the new events look the same or different? What meds are they on, have the doses changed, have they missed any doses? Recent illnesses, fevers, trauma?
  o **Orders**: Seizure precautions, neurochecks, monitor, Ativan/valium, often no EEG needed, Labs include BMP/Mg/Phos, AED levels – often ordered by the ER. Levels are most useful if obtained as a trough. Usually continue all home meds.
o **Discharge:** New prescriptions for meds that are changing. AED’s are usually tapered off instead of being stopped (in the case of switching a patient’s meds). Write out tapers specifically in discharge instructions.

- **Ketogenic Diet:** Helpful in controlling seizures in some children. Often these children are admitted to start the diet until they are in ketosis. Carbohydrate intake needs to be severely restricted to make this work. A pathway is available for new initiation of the diet. The dietician will help with admission orders, and will order the patient’s diet. Do not give the kids any other foods. Meds need to be re-ordered (most liquid meds have sugar in the syrup). The dietician has a helpful list of meds, and pharmacy can help convert over to appropriate formulations. Do this on admission when you are ordering their meds. For new initiation of the diet you will need to order serial UAs/labs per the pathway. Do NOT start ketogenic diet patients on dextrose-containing fluids.

**Common Emergencies**

At any time if vital signs are unstable, you need more help than you have, or think the patient may need PICU emergently, don’t hesitate to call a CAT.

- **Seizures:** Seizure disorders are a common reason for admission to the service. Some patients (VEEG admissions, for example) are being admitted with the expectation that they may have a seizure while admitted. Most seizures are brief and self-limited, requiring that patients be monitored for safety and vital sign stability. On the other hand, prolonged seizures (status epilepticus) are a life-threatening emergency. Patients with a series of multiple shorter seizures without regaining consciousness in between are also considered to be in status epilepticus. Benzos are the first line of treatment and are started at 5 minutes of seizures.

  - **If you are called for a seizure:**
    - Make sure the patient is safe from falling/injuring themselves
    - Monitor ABC’s, the patient should be on the pulse-ox/monitor
    - Especially in patients who do not have a known seizure disorder, consider other causes of seizure (fever/infection, trauma, toxins, tumors) and obtain a BMP and glucose stick STAT.

  - **At 5 minutes of seizure activity:**
    - **Ativan:** 0.05 to 0.1mg/kg IV, or rectal valium if no IV access. Send a nurse for the benzos BEFORE 5 minutes have passed, so that you have it on hand when needed. The patient should be on the CR monitor. Monitor ABC’s (respiratory particularly)
    - If they are not already present, call the senior resident

  - **If seizures continue**
    - A second dose of ativan can be given at 10 minutes
    - Obtain IV in patients without access
    - If seizure activity continues despite 2 doses of benzos, the next step is usually 20mg/kg (PE) of IV fosphenytoin.
    - If they are not already present, call the fellow

  - **If seizures continue**
    - Further treatment of refractory status epilepticus involves the PICU
    - If fosphenytoin fails, subsequent management of status epilepticus often includes Phenobarbital/other AEDs, versed drips, and pentobarbital coma. Versed drip/pentobarb will always be ICU.
o Once seizures stop
  - Touch base with the neuro fellow for patients who had a seizure requiring benzos, or if the patient is having very frequent shorter events. They may want to load the patient with an AED to prevent further seizures, particularly if the patient is having frequent/prolonged events.
  - In patients who do not have a history of seizures, continue workup for causes of seizure (infectious, trauma, electrolyte abnormalities, hypoglycemia, toxic ingestion, tumor, bleed, etc).

Altered Mental Status
  - **ABC’s:** Vitals, place pt on monitor, correct hypoxia, arrhythmia, shock, etc. Call for help STAT (seniors vs CAT) if vital sign instability.
  - **Physical exam:** Heart/lung exam, abdominal exam, neuro exam including mental status (determine baseline mental status from chart/nurse/family), cranial nerves, motor, tone, funduscopy. Call for help (seniors, fellow) for patients with change from baseline mental status or focal neurologic findings.
  - **Labs:** BMP vs CMP, glucose, +/- blood gas. Consider UA, uotox, CBC
  - **Imaging (usually head CT):** Particularly indicated in patients with new focal findings on neuro exam, findings of increased ICP, or patients with history of trauma, tumors, vascular problems/sickle cell, or stroke. EKG/CXR as indicated by exam.
  - Consider potential causes and direct further workup as appropriate. One mnemonic is AEIOU TIPS (Alcohol/drugs, Endocrine, Insulin, Opiates, Uremia, Toxins / trauma / tumour, Infections, Psychosis / Porphyria, Stroke / seizure / shock)

### Glasgow Coma Scale

<table>
<thead>
<tr>
<th>Eye</th>
<th>Verbal</th>
<th>Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Doesn’t open</td>
<td>No sounds</td>
<td>No movement</td>
</tr>
<tr>
<td>2 Opens to pain</td>
<td>Incomprehensible sounds</td>
<td>Decerebrate</td>
</tr>
<tr>
<td>3 Opens to voice</td>
<td>Inappropriate words</td>
<td>Decorticate</td>
</tr>
<tr>
<td>4 Spontaneous</td>
<td>Appropriate words, confused</td>
<td>Withdraws to pain</td>
</tr>
<tr>
<td>5 --</td>
<td>Appropriate words, oriented</td>
<td>Localizes pain</td>
</tr>
<tr>
<td>6 --</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Pupil Exam in Altered Mental Status

<table>
<thead>
<tr>
<th>Small Reactive</th>
<th>Dilated Reactive</th>
<th>Dilated Fixed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opiate/Benzos:</strong></td>
<td><strong>Amphetamine/Cocaine:</strong></td>
<td><strong>Ipsilateral:</strong> Uncal herniation (ipsilateral)</td>
</tr>
<tr>
<td>↓RR, ↓HR, ↓BP, ↓T</td>
<td>↑RR, ↑HR, ↑BP, ↑T, Seizures, Diaphoretic, and drug specific</td>
<td><strong>Midposition or wide &amp; unequal:</strong> Glutethimide</td>
</tr>
<tr>
<td><strong>Clonidine:</strong></td>
<td><strong>Anticholinergics:</strong></td>
<td><strong>Bilateral:</strong> Anoxia, CN3 compress, Atropine, or Scopolamine</td>
</tr>
<tr>
<td>↓RR, ↓HR, ↓or ↑ BP</td>
<td>↑HR, ↓BP, Hot/dry skin</td>
<td><strong>Midposition:</strong> Midbrain dx (transtentorial hernia or hemorrhage), Excess Barbiturates, ↓T, ↓BP</td>
</tr>
<tr>
<td><strong>PCP:</strong> Nystagmus, ↑HR, ↑BP, Warm, Seizures</td>
<td><strong>Carbamazepines:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Organophosphates:</strong></td>
<td><strong>Seafoam Green:</strong></td>
<td></td>
</tr>
<tr>
<td>DUMBELLS</td>
<td><strong>Midposition:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Phenothiazines:</strong></td>
<td><strong>Seafoam Green:</strong></td>
<td></td>
</tr>
<tr>
<td>↑HR, ↓BP, EPS</td>
<td><strong>Midposition:</strong></td>
<td></td>
</tr>
</tbody>
</table>

28
<table>
<thead>
<tr>
<th>Anticonvulsant</th>
<th>Dosage</th>
<th>Max: Child mg/k/d, Adult mg/d</th>
<th>Level (mcg per mL)</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbamazepine PO (Tegretol)</td>
<td>5 mg/kg div BID ↑ 5 mg/kg q3-5d to 15-20 mg/d div BID/TID/QID</td>
<td>35 2400</td>
<td>4-12</td>
<td>H, R, Diplopia, Ataxia, SIADH, Hepatitis, Cytopenias</td>
</tr>
<tr>
<td>Clobazam PO</td>
<td>0.25 mg/kg/d div BID, ↑ qwk to effect</td>
<td>1 30</td>
<td>NA</td>
<td>H, S, ↑ Secretions</td>
</tr>
<tr>
<td>Clonazepam PO (Klonopin)</td>
<td>0.01-0.03 mg/kg div daily/BID/TID</td>
<td>0.1-0.2 20</td>
<td>NA</td>
<td>H, S, ↑ Secretions Psychosis</td>
</tr>
<tr>
<td>Felbamate PO (Felbatol)</td>
<td>15 mg/kg/day div TID, ↑ q3-7d to 45 mg/kg/day</td>
<td>75-100 1800-4800</td>
<td>40-100</td>
<td>H, K, R, Anemia, Hepatic failure, Insomnia, ↓ PO</td>
</tr>
<tr>
<td>Ethosuximide PO (Zarontin)</td>
<td>10 mg/kg/d div daily or BID, ↑ 5 - 10 mg/kg/d q2wk to 15-30 mg/kg</td>
<td>30-40 2000</td>
<td>40-120</td>
<td>H, R, Lupus, Nausea, Psychosis</td>
</tr>
<tr>
<td>Gabapentin PO (Neurontin)</td>
<td>5 mg/kg/d div TID/QID ↑ 5 mg/k/d for 3 d to 15-20 mg/kg/d</td>
<td>45-60 3600</td>
<td>&lt;5</td>
<td>K, S, Irritability, Headache</td>
</tr>
<tr>
<td>Lamotrigine PO (Lamictal) *Different dosing on VPA</td>
<td>0.3 mg/kg/d x2 wks ↑ to 0.6 x2 wks, then to 1 x1 wk, 1.5 x1 wk, 2 x1 wk, then ↑ by 1 qwk to goal of 5-10 mg/kg/day</td>
<td>15-20 600</td>
<td>4-15</td>
<td>H, S and R (SJS), Hepatitis, Insomnia</td>
</tr>
<tr>
<td>Levetiracetam PO, IV (Keppra)</td>
<td>5-10 mg/kg/d div BID ↑ 5-10 mg/kg/d qweek to 20-30</td>
<td>100 3000-4000</td>
<td>Tr: 7-34 Pk: 36-70</td>
<td>K, Dizziness, Somnolence, Irritability, Psychosis</td>
</tr>
<tr>
<td>Lorazepam PO, IV, IM (Ativan)</td>
<td>0.025-0.10 mg/kg q8h</td>
<td>10</td>
<td>NA</td>
<td>H, Sedation, respiratory dep, Disinhib, Dizzy</td>
</tr>
<tr>
<td>Oxcarbazepine PO (Trileptal)</td>
<td>5 mg/kg/d div BID ↑ q5d to goal of 15-30 mg/kg/day</td>
<td>50-60 4400</td>
<td>8-35</td>
<td>H, Ataxia, Hyponatremia</td>
</tr>
<tr>
<td>Phenobarbital PO, IV, IM</td>
<td>4-6 (Neonate) or 3-5 (Child) mg/kg/d div BID</td>
<td>12 (&lt;Syr) 6 (5-18 yr) 240</td>
<td>15-40</td>
<td>H, R (SJS), Serum sickness, Depression, Rickets, Hyperactivity</td>
</tr>
<tr>
<td>Anticonvulsant Route of admin (Brand)</td>
<td>Dosage</td>
<td>Max: Child</td>
<td>Level</td>
<td>Side Effects</td>
</tr>
<tr>
<td>-------------------------------------</td>
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<td>--------------</td>
</tr>
<tr>
<td><strong>Phenytoin</strong>&lt;br&gt;PO, IV = Fosphenytoin (Dilantin)</td>
<td>8-12 mg/k/d div q8h (neonates, infants), 5 mg/k/d div BID (child, adolescents)</td>
<td>12 (neo) 8 (ch) 500</td>
<td>10-20; 0.1-2 (free)</td>
<td><strong>H, R</strong>, Hirsutism, Rickets, Gingiva hypertrophy, Coarse skin</td>
</tr>
<tr>
<td><strong>Pregabalin</strong>&lt;br&gt;PO (Lyrica)</td>
<td>2 mg/kg/d div TID ↑ to 4-5 mg/k/d</td>
<td>4-5 300</td>
<td>NA</td>
<td><strong>S, R</strong>, Myalgia, ↓ Plt, Wt gain, CHF exacerbation</td>
</tr>
<tr>
<td><strong>Primidone</strong>&lt;br&gt;PO (Mysoline)</td>
<td>50 mg x3 d, 50 BID x 3 d, 100 BID x 3 d to goal of 125-250 TID</td>
<td>25 1500</td>
<td>5-13</td>
<td><strong>H, R</strong> (SJS), Naus. Serum sickness, Hyperactivity</td>
</tr>
<tr>
<td><strong>Rufinamide</strong>&lt;br&gt;PO (Banzel)</td>
<td>10 mg/kg/d div BID ↑ 10 mg/kg/d q2d to goal of 45 (Max is 600 mg qd if VPA)</td>
<td>1800 (ch) 3200 (adult)</td>
<td>NA</td>
<td><strong>K, S, R</strong>, ↓ PO, Headaches, Dizzines, Nausea/Vomit</td>
</tr>
<tr>
<td><strong>Topiramate</strong>&lt;br&gt;PO (Topamax) *Max level is 25 mcg/mL for infantile spasm</td>
<td>1 mg/kg/d qdily/BID then ↑ by 0.5-1 mg/k/d q1-2 wks to goal 5-8mg/kg/d div BID</td>
<td>15-18 600</td>
<td>10-35</td>
<td><strong>K, ↓PO</strong>, Ataxia Encephalopat, Somnolence, Renal stone, Glaucoma, Anhidrosis</td>
</tr>
<tr>
<td><strong>Tiagabine</strong>&lt;br&gt;PO (Gabitril)</td>
<td>0.1 mg/kg/d ↑ 0.1 qweekly to 0.4 mg/kg/d div TID</td>
<td>32 (ch) 56 (ad)</td>
<td>NA</td>
<td><strong>H, R, S</strong>, Dizzy, Nausea, Non-convulsive status epilept</td>
</tr>
<tr>
<td><strong>Valproate</strong>&lt;br&gt;PO, IV (Depakote)</td>
<td>10 mg/kg/d ↑ by 5-10 mg/kg/d qweek to 20-30 mg/kg/d div BID/TID</td>
<td>60-70 4000-5000</td>
<td>50-110</td>
<td><strong>H</strong>, Pancreatitis, ↓Plts, Alopecia Wt gain, Nausea, PCOS</td>
</tr>
<tr>
<td><strong>Vigabatrin</strong>&lt;br&gt;PO (Sabril)</td>
<td>25mg/k/d div d/BID ↑ 25 mg/kg/d qwk to 50-100 mg/kg/d div daily/BID</td>
<td>100</td>
<td>NA</td>
<td><strong>K, S</strong>, Visual field loss, Wt gain, Dizzy, Agitation</td>
</tr>
<tr>
<td><strong>Zosinamide</strong>&lt;br&gt;PO (Zonegran)</td>
<td>2 mg/k/d ↑2 q2wk to 8-10 mg/kg/d div qdaily/BID</td>
<td>12 400</td>
<td>Max 40</td>
<td><strong>H, K, S, ↓PO</strong>, Anhidrosis, Hyperthermia, Sulfa-Allergy can cause SJS</td>
</tr>
</tbody>
</table>
Diabetes Mellitus: Inpatient Management

New Onset Type 1 Diabetes:

<table>
<thead>
<tr>
<th>Indications for floor admission:</th>
<th>Indications for PICU admission:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidosis with pH &gt; 7.3, Bicarb&gt;15</td>
<td>pH &lt; 7.3, Bicarb&lt;15</td>
</tr>
<tr>
<td>Ketosis</td>
<td>Need for insulin drip</td>
</tr>
<tr>
<td>Dehydration</td>
<td>Altered mental status</td>
</tr>
<tr>
<td>Significant electrolyte or renal fxn abnormalities</td>
<td></td>
</tr>
</tbody>
</table>

- **Acute Management on the floor**: Follow the pathway! Here’s the basic:
  - **LABS**
    - **In the ED**: BG q1h, UA, BMP, phos, blood gas, serum acetone, CBC, osmol, Hgb A1c stat and prn
    - **For new diagnosis**: GAD65 +/- thyroid screen
    - **Once on floor**: BG QIDACHS, urine dips void until ketones are cleared (small, trace or negative), +/- daily BMP
  - **IVF**: Rehydrating is most important part of mgmt!
    - **In the ED**: Bolus NS 10-20cc/kg x1hr
    - **Once on floor**: ½ NS + 20mEq KCl + 20mEq(13.6mmol)KPO4 @ 1.5xM
    - **If Na > 145**: Use NS instead of ½ NS to avoid correcting too rapidly
    - **If IVF with KPO4 not available**: Use 40mEq KCl
    - **Dextrose**: Once off insulin drip and tolerating PO, should NOT be on dextrose-containing IVF
  - **Duration**: Most attendings will continue IVF until ketones have cleared (small, trace, negative); others will stop when taking good PO, sugars controlled and otherwise meeting discharge criteria.
  - **INSULIN**: Insulin drip ONLY in PICU. Should always begin SQ insulin before stopping insulin drip (in PICU); SQ insulin tx options include basal/bolus with lantus/short acting or NPH/short acting
    - **Total Daily Dose (TDD)**: 0.5-1 unit/kg day (½ long acting (basal), ½ short acting(bolus))
    - **NPH and regular/analog**
      - 2/3 of TDD in a.m. (2/3 NPH, 1/3 short acting)
      - 1/3 of TDD in p.m. (2/3 NPH, 1/3 short acting)
    - **Basal/bolus (Lantus/Analog vs. pump)**
      - **Insulin to Carbohydrate Ration (rule of 500)**: Carbohydrate coverage ratio = 500 ÷ TDD= units of insulin per g of CHO
      - **Correction Factor (rule of 1800)**: Correction Factor = 1800 ÷ TDD = 1 unit of insulin will reduce the blood sugar so many mg/dl
GI
Erin Garth, NP, p0220 x8394, office: 3061
Ellen Clore, NP, p1226 x8394, office: 3297
Any Rozanova, Nutrition, p2290, office: 6141
JessicaMcGee, Nutrition p1691 office: 7811
Maria Kennickel, PA (consults), p0164 x8986
Catherine Walsh, p1966 office: 2492
IR TEAM
Krystal Artis, PA p4408, office: 6695
Roshnee Pennington, PA p1332, office: 6347
Karen H., Nutrition p1782, office: 5164

GI ATTENDINGS
Bader: p8199 office: 2415
Conklin: p0550
Darbari: p1423, office: 4459
Kerzner: p8200, office: 3058
Snyder: p0132, office: 2415
Wolfe: p0918, office:3058
IR ATTENDINGS
Mohan: p8201, office: 3058
Torres: p4259, office: 6649
Sehgal: p0556, office: 3058

Equations

- **Body Surface Area**: BSA=([Height(cm) x Weight(kg)]/ 3600 )½
- **Insensible Losses**
  - Neonates: 35ml/kg/day
  - 3-10 months: 40ml/kg/day
  - >10 months: 400-600 x BSA
  - **Unknown ht/length and <10 kg**: wt x 0.03 +0.2 x (400- 600)
  - **Unknown ht/length and >10 kg**: wt x 0.02 +0.4 x (400-600)
- **Calories from Formula**: When you are calculating how many calories your formula gave you, just divide the number of cc’s by 30 cc/oz and multiply by the formula number (e.g. 22 for BM-22) which gives you the total calories. Regular breast milk is 20 cal/oz. Then divide this number by the weight to get cal/kg/day
- **Calories in TPN/PPN**: Glucose has 3.4 cal/g, protein has 4cal/g and lipids (20% only here) has 2cal/mL, so to calculate total calories you need to calculate the amount of calories of each component, total those and divide by weight.
  A. **Dextrose**: (D%/100) x (total cc of dextrose-containing fluid; ie, not IL) x 3.4 = gluc cal/d
  B. **Lipids**: (total cc of lipids) x 2 = lipid cal/d
  C. Then add (A) + (B) and divide this by the weight = cal/kg/d of gluc+lipid
  D. **Protein**: Protein g/kg x 4 = Protein cal/kg/d
  E. Add (C) + (D) to get total cal/kg/d
- **Glucose infusion rate (GIR)**: This refers to how fast glucose is infusing in to the veins or arteries. It is important because depending on the location of the infusion (peripheral vs central), you are limited to how high your GIR can go. If too high the osmolarity can damage the veins/ arteries
  \[ \text{GIR (mg/kg/min)} = \text{GIR is GIR = (% dextrose x rate)} / (6 \times \text{weight}) \]
Progress Notes

• **Nutrition:** Formula type, caloric density, route, quantity, duration of feeds; Goal Kcal (in kcal/kg/day) and Kcal actually received; % Kcal for each type of nutrition if more than one (i.e. cal/kg via NGT and via TPN); Note that most formulas are written as [formula name]-[calories per ounce] – for example, breast milk fortified to give 22 cals/oz is called BM-22

• **I/O:** Total intake, Total output, Balance minus insensible losses.

• **Output:** Urine (volume and cc/kg/hr), Stool (# and description), Urine + stool (# and volume), Ostomy output (cc/kg/24hr), gastric tube output (cc only), emesis (# and cc)

• **Fluid Goal:** Include in IR and fluid restricted patients

• **Insensible losses** (in cc), see calculations below

• **BMI vs Height/Weight Ratio:** Note that if the child is under the age of 2 then you should use a height to weight ratio instead of BMI

• **MS notes:** If a medical student writes a note, assigned intern needs to correct and addend saying “Agree with the plan as above with my changes, Your Name, PL1”

Parenteral Nutrition

• **TPN vs PPN:** There are two types of Parenteral Nutrition TPN (Total Parenteral Nutrition) and PPN (Peripheral Parenteral Nutrition). TPN is given through a central line and can provide a higher glucose amount, up to 30% dextrose. Whereas, PPN is given through a peripheral IV and can only provide dextrose up to 12.5%.

• **Starting TPN:** During the week, the Nutritionist will help you. Over the weekends you can either call the on-call dietician. Note even on weekends TPN must be ordered by 1:00.

• **Monitoring:** Typically patients on TPN get daily BMP, Mg, Phos until electrolytes are stable. Thereafter they will only need Mon Thu labs:
  o **TPN large set:** (Monday): CBC, CMP, Mg, Phos, Bilirubin and cholesterol
  o **TPN small set** (Thursday): BMP, Mg, Phos

• **TPN Pharmacy:** Helps for questions about a TPN order at x5635

• **Fluid Cocktails:** Typically ordered when a central line malfunctions on a patient with TPN, when this happens you need to obtain a list of the ingredients from the previous TPN and use that as your baseline. Call a senior prior to creating a cocktail to verify it is correct. Remember that you are now creating a peripheral cocktail thus the max dextrose is 12.5% and protein cannot be added; If patient presents from home with a broken central line and is on TPN, ask the charge nurse for a copy of the broken central line protocol by Dr. Torres
### Parenteral Nutrition Guidelines

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Premature Infant</th>
<th>Term Infant</th>
<th>Child (1-10 y, &lt; 50 kg)</th>
<th>Adolescent (10-18 yr, &gt; 50kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Calorie Goal in kcal/kg</strong></td>
<td>90-100</td>
<td>90-100</td>
<td>60-90</td>
<td>30-45</td>
</tr>
<tr>
<td><strong>Dextrose</strong> (3.4 kcal/gm) in mg/kg/min</td>
<td>Initial: 5-7 ↑ by 1-2 Goal: 8-12 Max: 14-18</td>
<td>Initial: 6-9 ↑ by 1-2 Goal: 10-12 Max: 14-18</td>
<td>Initial: 3.5 or 10% dex ↑ by 5%/d to GIR 8-10</td>
<td>Initial: 3.5 or 10% dex ↑ by 2-5%/d to GIR 5-6</td>
</tr>
<tr>
<td><strong>Protein</strong> (4 kcal/gm) in gm/kg</td>
<td>Initial: 2.5-3 ↑ by 1 Goal: 3-4</td>
<td>Initial: 2-3 ↑ by 1 Goal: 2-3</td>
<td>Initial: 1-2 ↑ by 1 Goal: 1.5-3</td>
<td>Initial: 1-2 ↑ by 1 Goal: 1.5-3</td>
</tr>
<tr>
<td><strong>Intralipid</strong> 20% (2 kcal/cc) in gm/kg</td>
<td>Initial: 1-2 ↑ by 0.5-1 Goal: 3-3.5 Max: 0.17/h</td>
<td>Initial: 1-2 ↑ by 0.5-1 Goal: 3 Max: 0.15/h</td>
<td>Initial: 1-2 ↑ by 0.5-1 Goal: 2-3</td>
<td>Initial: 1 ↑ by 1 Goal: 1-2.5</td>
</tr>
<tr>
<td><strong>Na</strong> in mEq/kg/day</td>
<td>2-5</td>
<td>2-5</td>
<td>2-5</td>
<td>1-2</td>
</tr>
<tr>
<td><strong>K</strong> in mEq/kg/day</td>
<td>2-4</td>
<td>2-4</td>
<td>2-4</td>
<td>1-2</td>
</tr>
<tr>
<td><strong>Mg</strong></td>
<td>0.3-0.5</td>
<td>0.3-0.5</td>
<td>0.3-0.5</td>
<td>10-30 mEq/day</td>
</tr>
<tr>
<td><strong>Ca</strong></td>
<td>40-80</td>
<td>10-80</td>
<td>10-80</td>
<td>200-400 mg/day</td>
</tr>
<tr>
<td><strong>PO4</strong> mMol/kg/d</td>
<td>1-2</td>
<td>0.5-2</td>
<td>0.5-2</td>
<td>10-40 mMol/day</td>
</tr>
<tr>
<td><strong>Chloride</strong></td>
<td>As needed to maintain acid/base balance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Multivitamin</strong></td>
<td>2 mL/kg to a max of 5 mL</td>
<td>5 mL/day</td>
<td>5 mL/day</td>
<td>10 mL/day</td>
</tr>
<tr>
<td><strong>Zinc</strong> mcg/k/d</td>
<td>400 mcg/k/d</td>
<td>50-250 mcg/k/d</td>
<td>50-125 mcg/k/d</td>
<td>2-5 mg</td>
</tr>
<tr>
<td><strong>Copper</strong> mcg/k/d</td>
<td>20 mcg/k/d</td>
<td>20 mcg/k/d</td>
<td>5-20 mcg/k/d</td>
<td>200-500 mg</td>
</tr>
<tr>
<td><strong>Chromium</strong> mcg/k/d</td>
<td>0.05-0.2</td>
<td>0.2 mcg/k/d</td>
<td>0.14-0.2</td>
<td>5-15 mcg</td>
</tr>
<tr>
<td><strong>Selenium</strong> mcg/k/d</td>
<td>2</td>
<td>2</td>
<td>1-2</td>
<td>40-60 mcg</td>
</tr>
<tr>
<td><strong>Manganese</strong> mcg/k/d</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>40-100 mcg</td>
</tr>
</tbody>
</table>
Disease Specific Tips

Failure to Thrive
- Check for daily caloric requirements by age
- Graph weight trend during admission
- Call PMD for prior growth charts
- Common labs to send for initial work up: CBC, CMP, Mg, Phos, Prealbumin, Celiac Panel, TSH, T4, 72 hour fecal fat, fecal elastase
- Monitor for re-feeding syndrome: BMP, Mg, Phos daily-BID. Concern for hypokalemia, hypomagnesia, hypophosphatemia
- Order Speech and Nutrition consult on admission

Constipation/Bowel clean out
- Start clean out from below. Don’t start NG/PO regimen until some output
- Fleets daily → Mineral oil enema → saline colonic washes → NG GoLyteLy
- Start Miralax right away (does not need to wait for stool output). Titrate dose up or down until patient has a soft BM daily (applesauce consistency)

IBD
- Diet order: Usually NPO, then advance to Low Residue Diet (a special diet that is low in fiber and stool forming substances).
- Pain control- Avoid narcotics if possible as they can lead to constipation. Instead se Nubain or Tylenol

Short Gut/Intestinal Rehab
- Advance feeds VERY slowly
- Know total fluid goal and report it on rounds
- Report all I/Os on rounds (including insensibles) and how far from TF goal it was
- Know baseline ostomy output
- Establish on rounds how/when to replace output. MAKE SURE this is part of your signout to the covering person (night float/clinic)

Fever with a central line
Fever with a central line is treated differently than on other services
1. Assume there is a positive line culture
2. Triple Culture (aerobic, anaerobic, and fungal) from each lumen
3. Start zosyn, vancomycin, and flucanazole
4. For patient who are not responding to treatment or have an established line infection consider locking the central line with Vancomycin or Ethanol
   a. Vancomycin Lock: Order Vancomycin 5 mg and then specify in the comments section that this is fo a central line lock
   b. Ethanol Lock: Order as a Non Formulary Medication. Ethanol 70% 8 ml, specify that this is for a central line lock
5. Reculture for fever every 24 hours
Gastrostomy Tube Falling Out Algorithm

1. Gastrostomy tube falls out
   - Determine type of feeding tube
     - PEG tube (Bolster, No balloon)
       - Placed 0-3 d ago
         - Don’t replace or use tube and call GI attending STAT
       - Placed 4 d ago or more
         - Keep stoma patent by inserting GT (same sized) into stoma but DO NOT use or inflate balloon, notify GI attending and get dye study
     - Gastrostomy Tube (With balloon) or Mickey Button
       - Placed 0-3 d ago
         - Don’t replace or use tube and call surgery attending STAT
       - Placed 4-90 d ago
         - Keep stoma patent by inserting GT (same sized) into stoma but DO NOT use or inflate balloon, notify surgery attending and get dye study
       - Placed 90 d ago or more
         - Keep stoma patent by inserting GT (same sized) into stoma but DO NOT use or inflate balloon, and notify the service that originally placed the tube (surgery or GI)

   - Is there an obvious defect?
     - Yes
       - Replace with same type and size tube. Ok to use.
     - No
• **Cheat Sheet:** [http://stemcell](http://stemcell) contains fever management, electrolyte imbalance, blood products, and admission workup for common things such as sickle cell pain crisis and febrile neutropenia

• **Sickle Cell:**
  - **New admissions:** Each sickle cell patient should be asked...
    - Where do you normally have pain crises?
    - Frequency of hospitalizations, and for what? Any ICU admissions?
    - History of splenectomy or cholecystectomy?
    - History of acute chest syndrome, intubations, or stroke?
    - Managed with chronic transfusions or hydroxyurea?
    - Any other medications (PCN, Folic acid, Iron chelators, etc.)?
    - Received pneumococcal vaccination (if patient is new to us)?
    - Do you have asthma or chronic lung disease? What is your sick plan?
  - **Fluids:** Use 1.5x MIVF if in pain but only MIVF if suspecting acute chest
  - **Acute Chest Syndrome:** Sickle cell disease with new infiltrate on CXR and fever or any chest symptoms (e.g. cough, chest pain, hypoxia, etc)
  - **Sickle cell with Fever:** Temperature of $\geq 38.5^\circ C$ oral or rectal in any sickle cell patient. Should be worked up with a CBC, retic, blood Cx, CXR, UA, and other labs as clinically indicated. Start patient on ceftriaxone 50 mg/kg (maximum 2 g) IV daily, add vancomycin if really sick (criteria in online guide).
  - **Sickle Cell with Pain:** Initial management usually with Toradol and Morphine PCA eventually weaning to oral pain meds before discharge
    - **NSAIDs:** Toradol (Ketorolac) 0.5 mg/kg IV load and 0.25 mg/kg IV q6h (maximum dose 30 mg), OK to use for more than 5 days/month if renal function (BUN and creatinine) is normal. Usually transition to motrin once 5 days passed or no longer needed.
    - **Opiates:** Usually start with a morphine PCA and then transition to oral agents such as oxycodone or Percocet
      - **Morphine PCA:** Usually ordered by overnight residents, if this is ordered pain team should be notified (p1424) in the morning; Any other PCA types (e.g. Dilaudid) or adjustments done by pain team
      - Usual morphine dose range as follows: age <5-8 years (depends on patient ability/maturity): morphine 0.1 mg/kg (usual max. 0.15 mg/kg) IV q6h; age >5-8 years): Morphine PCA 0.02 mg/kg/h basal rate, bolus 0.02-0.03 mg/kg, lockout 8 min
      - While on IV opiates, need monitor, incentive spirometry, bowel regimen (Colace and/or Miralax), naloxone PRN respiratory depression, and potentially antipruritic (i.e. antihistamine) and/or antietemic (usually Zofran)
  - **Blood Products:**
    - **Transfusion Criteria:** Each patient will have transfusion criteria determined by the team during rounds, most commonly for Onc patients it is Platelets <20 or active bleeding for Platelet transfusion or Hgb <7 or symptomatic for RBC transfusion
• **Ordering:** First make sure there is a consent on file. When ordering make sure to select both the blood product order and the nursing instructions in the transfusion order set. Make sure the volumes of blood product match in the blood product order and the nursing order (you have to calculate and type them in them manually). You also have to specify the rate, which is the volume to infuse per hour.
  - **Platelets:** Typically transfuse 1 unit per 5kg (up to 6 units) over 1 hr
  - **RBCs:** Typically you transfuse 10 cc/kg over 4 hrs. You need to make sure that there is a type and cross from the past 3 days otherwise a blood sample needs to be sent to the lab for type and cross. Note that this should not be done in preoperative optimization of sickle cell patients, in which case they should be transfused to a goal of a Hgb of 10.
  - **Premediation:** Note that some patients may have a history of reactions to blood products and need to be premedicated with Tylenol and/or Benadryl (and in rare case, steroids). It should be documented in the computer, but make sure to confirm with parents whether their child needs premedication.
  - **Post-Transfusion:** You usually want to check a post-transfusion CBC after a few hours (next morning may be OK, depending on urgency).

• **Oncologic Crises:**
  - **Shock:** If patient becomes tachycardic and hypotensive or any concern for septic shock, need to start a NS bolus (20 cc/kg) immediately, give as fast as possible and repeat if necessary. If getting third bolus you need to notify the PICU.
  - **Fever:** In onc patients who are neutropenic and/or have a central line
    - **Under 12 months:** ≥38.0°C PO (or ≥37.5°C axillary)
    - **12 months or older:** ≥38.3°C PO (or ≥37.8°C axillary)
  - **Workup:** If febrile patient needs immediate blood culture and CBC (unless one from less than 24 hrs ago), followed by antibiotics STAT
    - **Which blood cultures?** Everyone gets Aerobic also add anaerobic for patients who have GI symptoms such as mucositis, and fungal culture for those who have been febrile and on antibiotics for more than 5 days with no identified source. If patient’s central line has multiple lumens, culture each one.
    - **Which antibiotics?** In general ceftriaxone if not neutropenic, ceftazidime if neutropenic, consider adding gentamicin and/or vancomycin if really sick
  - **Vomiting:** First line antiemetic is usually Zofran (ondansetron), Benadryl, Ativan, or even steroids may help but don’t order steroids without asking fellow, because may interfere with chemo. Emend (aprepitant) works well prophylactically only but is expensive. Kytril (granisetron) may also be an option, but not together with Zofran, because it’s from the same drug class, and can cause QTc prolongation
<table>
<thead>
<tr>
<th>Chemo</th>
<th>Indication</th>
<th>Side Effect</th>
<th>Monitor</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparaginase</td>
<td>ALL, AML</td>
<td>Pancreatitis, DM, DVT/PE, Allergy</td>
<td>Lipase, BMP qd</td>
<td>--</td>
</tr>
<tr>
<td>Bleomycin (Blenoxane)</td>
<td>Hodgkin, NHL, Germ cell tumors</td>
<td>Pulmonary Toxicity</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Cisplatin (Platinol), Carboplatin (Paraplatin)</td>
<td>Germ cell, CNS tumors, Osteosarcoma, Neuroblastoma,</td>
<td>Ototoxic, Nephrotoxic (Mg wasting, Renal failure)</td>
<td>BAERS, BUN/Cr, UA, Mag</td>
<td>--</td>
</tr>
<tr>
<td>Cyclophosphamide (Cytoxan)</td>
<td>Hodgkin, NHL, ALL, Ewing/Soft tissue sarcoma</td>
<td>Hemorrhagic Cystitis, Infertility</td>
<td>UA qvoid</td>
<td>Fluids, Mesna</td>
</tr>
<tr>
<td>Cytarabine (Ara-C)</td>
<td>ALL, AML, Hodgkin, NHL</td>
<td>Neutropenia, Conjunctivitis</td>
<td>CBC</td>
<td>--</td>
</tr>
<tr>
<td>Doxorubicin (Adriamycin), Daunorubicin (Cerubidine)</td>
<td>ALL, AML, Ewing/Osteo Hodgkin, NHL, Neuroblastoma</td>
<td>Red Urine, Cardiotoxicity</td>
<td>Pre-chemo, interval Echos</td>
<td>---</td>
</tr>
<tr>
<td>Etoposide (VePesid)</td>
<td>ALL, NHL, Germ cell tumors</td>
<td>Allergy, Rash, Hypotension, 2° Leukemia</td>
<td>BP during infusion</td>
<td>Benadryl, Epi, Fluids, Pressors</td>
</tr>
<tr>
<td>Ifosfamide (Ifex)</td>
<td>NHL, Wilm’s, Sarcoma, Germ cell/testicular tumors</td>
<td>Neurotoxic, Fanconi syn., Hemorrhagic cystitis, Infertility</td>
<td>BMP, Mag, Phos</td>
<td>Methylene blue, Lyte replacement, Fluids, Mesna</td>
</tr>
<tr>
<td>Methotrexate (Trexall, Rheumatrex)</td>
<td>ALL, NHL, Hodgkin, Osteo, Medulloblast.</td>
<td>Mucositis, Rash, Nephrotoxic, Hepatotoxic, Neurotoxic</td>
<td>BMP, UA qvoid for pH, LFTs</td>
<td>Magic mouthwash, Alkaline urine</td>
</tr>
<tr>
<td>Vincristine (Oncovin), Vinblastine (Velban)</td>
<td>ALL, Hodgkin, NHL, Wilm’s, Ewing, LCH, NB, Rhabdomyosar.</td>
<td>Constipation, Peripheral neuropathy, SIADH</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>
Contact Information
Fellow: x8094
Residents: x8095 and x8096
Dietician: Amy p1362
Case Management: Jan Robison
Cardiology Clinic: x2090

Rotation Structure
• 2-3 PL-2s with q4 call (average)
• Generally have 2 residents on service and 1 resident doing outpatient cardiology clinic.
• Cover inpatient cardiology patients 24 hrs/day
• Cover NP/PA patients only on nights/weekends
• CICU kids are never covered by residents
• Rounds start at 9a on weekdays, 8a on weekends
• Lectures generally occur at 8 on tues, wed (if there’s no grand rounds), and thurs. Friday at 7:30 is cath conference.
• Last Thursday of the block the residents give an informal lecture on a cardiology topic of their choosing.

CV Surgery NP Service
• Most are post-op congenital repairs
• We cover them only at night and on weekends
  o Residents never round on these patients
• Sign-out occurs at 4:30pm on weekdays (12-1 pm on weekends)
• Do not sit silently during sign-out, ask lots of questions!
  o What do all the abbreviations mean?
  o What is the goal SpO2?
  o Can patient receive supplemental O2?
  o What is the fever plan?
  o What kind of access do they have?

Telemetry
• Access through “Phillips Monitors” icon
• User: BIOMED pass: BIOMED
• Can review monitored events for each patient
### Heart Sounds

<table>
<thead>
<tr>
<th>Sound</th>
<th>Timing</th>
<th>Best heard</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Start of Systole</td>
<td>Apex</td>
<td>Normal; Caused by closure of the mitral and tricuspid valves</td>
</tr>
<tr>
<td>S2</td>
<td>End of Systole</td>
<td>Base</td>
<td>Normal; Splitting with inspiration; Caused by the closure of the aortic and pulmonic valves</td>
</tr>
<tr>
<td>S3 (gallop)</td>
<td>Diastol. (Early)</td>
<td>Apex</td>
<td>Indicates dilated cardiomyopathy but may be normal in children</td>
</tr>
<tr>
<td>S4 (gallop)</td>
<td>Diastol. (Late)</td>
<td>Apex</td>
<td>“Atrial kick”, this indicates a thickened left ventricle</td>
</tr>
<tr>
<td>Innocent Murmur</td>
<td>Systole</td>
<td>2nd L ICS</td>
<td>Dx of exclusion; Often in adolescents</td>
</tr>
<tr>
<td>Aortic Stenosis</td>
<td>Systole</td>
<td>2nd R ICS</td>
<td>Harsh, crescendo-decrescendo; Radiates to carotids, apex; Often s4; CXR shows post-stenotic aortic dilation, LVH, +/- calcifications</td>
</tr>
<tr>
<td>Aortic Insuff.</td>
<td>Diastol. (Early)</td>
<td>3rd L ICS</td>
<td>Sound is blowing, decrescendo; Quincke pulsations in nails (large pulse pressure); CXR shows large ascending aorta and cardiomegaly</td>
</tr>
<tr>
<td>Mitral Stenosis</td>
<td>Diastol. (Early to Mid)</td>
<td>Apex</td>
<td>Sound is rumbling, decrescendo-crescendo; CXR shows LA double density; Often rheumatic heart dx</td>
</tr>
<tr>
<td>Mitral Insuff.</td>
<td>Holosys</td>
<td>Apex, LLSB</td>
<td>Radiates to axilla; CXR shows AV ring calcification and cardiomegaly</td>
</tr>
<tr>
<td>ASD</td>
<td>Systole</td>
<td>2nd L ICS</td>
<td>Fixed splitting of S2, CXR showing prominent RV and Pulm artery (PA)</td>
</tr>
<tr>
<td>VSD</td>
<td>Systole</td>
<td>LLSB</td>
<td>Sound is harsh; CXR shows large PA and left atrium</td>
</tr>
<tr>
<td>PDA</td>
<td>Cont.</td>
<td>2nd L ICS</td>
<td>Loudest during S2; CXR shows large aortic arch, convex PA, cardiomegaly</td>
</tr>
<tr>
<td>HOCM</td>
<td>Systole</td>
<td>LLSB</td>
<td>Sound is harsh, louder with decreased venous return (e.g. standing or Valsalva)</td>
</tr>
</tbody>
</table>

- **Respiration**: R sided murmurs, S₃, & S₄ tend to incr w inspiration, whereas L sided murmurs and sounds are louder during expiration, except HCM
- **Positional**: Most murmurs decrease in length and intensity with valsalva or standing and become louder with squatting or passive leg raise, two notable exceptions are hypertrophic cardiomyopathy and mitral valve prolapsed in which the opposite change occurs.
- **Exercise**: Murmurs due to blood flow across normal or stenotic valves become louder with both isotonic (i.e. walking) and submaximal isometric (e.g. handgrip) exercise; Murmurs of VSD as well as mitral and aortic regurgitation also increase with handgrip exercises; Murmurs of HCM often decreases with near maximum handgrip exercise; Left sided S₃ and S₄ are often accentuated by exercise, especially when due to ischemic heart disease.
EKGs

• Order anytime on any patient (no consult required); Access online with MUSE: **user: resuser pass: Cardio$ep**; All EKGs will be “overread” by a cardiology attending within 24 hours (will show up as blue text in Muse)

• Small square = 1 mm = 0.04 sec
• Large square = 5 mm = 0.2 sec
• Develop a systematic approach:
  o **RATE:** 300 – 150 – 100 – 75 – 60 rule
  o **RHYTHM:** sinus must have P before every QRS and QRS following every P; use rhythm strip); RR interval may vary with respiration
  o **AXIS:** Find most isoelectric QRS and ventricular axis will be 90° away
• **Complexes:**
  o **P wave** → atrial depolarization
  o **PR interval** → conduction delay through AV node
  o **QRS complex** → ventricular depolarization
  o **T wave** → ventricular repolarization
  o **U wave** → late ventricular repolarization
• **Corrected QT interval:** QTc = QT / √(R-R)
  o use R-R that precedes the QT
  o average 3 measurements on rhythm strip
  o see Harriet Lane for normal values by age/sex
  o **Long QT syndrome** → QTc >0.44–0.46 sec in absence of other underlying causes
• **R wave progression** → as you move from V1 to V6, the R wave generally becomes larger (more upright) as the S wave decreases (except in infants where there is RV domination)
• **ST segment changes:** Elevation/depression >1 mm in limb leads, or >2 mm in precordial leads suggests myocardial ischemia/injury
• **T wave abnormalities:**
  o **tall/peaked** → common in hyperkalemia
  o **low/flat** → hypokalemia, hypothyroid, normal newborn, myocardial or pericardial injury/ischemia
  o From about 7 days to 7 yrs T waves should be inverted in V1 and progress to upright in the lateral leads
• **Hypertrophy:**
  o **RAE:** P wave height >3 mm
  o **LAE:** P wave width >0.10 s (double hump) or “sine wave” P >0.10 s in V1
  o **Ventricular hypertrophy:** diagnosed by QRS voltage, axis, and R/S ratio (see Harriet)
Rhythm Abnormalities

- Sinus arrhythmia: Normal variation in rate during respiration

Supraventricular

- Sinus tachycardia: NSR with HR > 95th %ile for age; usually < 230 bpm
- Sinus bradycardia: NSR with HR < 5th %ile for age
  - May be normal (esp. in athletic patients and teenagers)
  - Generally only concerning when symptomatic
- Premature atrial contractions (PACs): Ectopic focus in atrium causes abnormal P wave morphology; QRS will be narrow
- Atrial flutter: Atrial rate is 250-350 bpm yielding “sawtooth” pattern; ventricular response variable; QRS is narrow
- Atrial fibrillation: Atrial rate 350-600 bpm; no distinct p waves (fibrillatory pattern); ventr response irregular but generally 110-150 bpm; QRS narrow
- Supraventricular tachycardia (SVT): 3 or more premature supraventricular beats >230 bpm; narrow QRS and abnormal P waves
  - Wolff-Parkinson-White: Short PR, wide QRS, delta

Junctional

- Junctional rhythm (AV nodal escape): Driven by AV node; QRS is still narrow but P wave is invisible (buried in QRS or T) or retrograde (negative in lead II, positive in aVR)

- Often causes asymptomatic bradycardia, no intervention if pt HDS

Ventricular

- Premature ventricular contractions (PVCs): Ectopic ventricular focus causes early depolarization; QRS is wide and abnormal; usually followed by compensatory pause
  - Bigeminy: Alternating normal/abnormal QRS complexes
  - Trigeminy: 2 normal QRS complexes followed by one abnormal QRS
  - Couplet: 2 consecutive PVCs
- Ventricular tachycardia: 3 or more PVCs at rapid rate (120-250 bpm)
- Ventricular fibrillation: Uncoordinated, asynchronous depolarization of ventricles; irregular, abn QRS complexes of varying size and morphology

Heart Block

- First degree: Asym delay in AV node conduction; prolonged PR interval
- Second degree
  - Mobitz I (Wenckebach): Progressive lengthening of PR interval until a QRS is not conducted (dropped beat)
  - Mobitz II: Loss of conduction to ventricle (dropped beat) without PR prolongation; may progress to complete heart block
- Third degree (complete): Complete dissociation of atrial beats and ventricular beats; P wave and PR interval will be regular; RR interval regular and much slower; QRS morphology depends on whether AV node or ventricular pacemaker is driving the contractions

Bundle Branch Block

- RBBB: Prolonged RV depolarization, causes wide QRS; Prolonged QRS with RSR’ in V1, V2, or aVR
- LBBB: Prolonged septal and LV depolarization, causes wide QRS and loss of usual septal signal (rare in children); Wide negative QS in V1 with loss of septal R wave; Entirely positive wide R or RR’ in V6, loss of septal Q
Congenital Heart Disease

Acyanotic Lesions
- **VSD:** ~25% of CHD, systolic murmur (see table), possible systolic thrill; S2 may be narrow with increased P2; EKG may be normal or show LVH +/- LAE with larger lesions; generally present at 4-6 wks when PVR drops and infants develop sx of CHF
- **ASD:** Wide, fixed split S2 with murmur (see table); hemodynamically significant defects may show R axis deviation with RVH +/- RBBB
- **PDA:** 5-10% of CHD in term infants, “machine-like” murmur; larger lesions may show LVH or BVH
- **AV septal defects:** 30-60% in T21; hyperactive precordium with systolic thrill and loud S2; gallop may be present
- **Pulmonary stenosis:** Ejection click at LUSB with valvular PS; intensity varies with respiration (↑ with exp., ↓ with insp.)
- **Aortic stenosis:** Systolic thrill at RUSB; suprasternal notch; ejection click which doesn’t vary with respiration (valvular); harsh SEM radiating to neck and apex; may have early diastolic decrescendo murmur if AR is present
- **Coarctation of aortic:** 8-10% of CHD; usually 2-3/6 SEM at LUSB with radiation to scapular area; often with bicuspid valve and systolic ejection click at apex and RUSB
  o Obtain 4 extr BPs (both arms due to possible abberant R subclavian)
  o SpO2 discrepancy >5% between upper and lower extremities is suggestive of coarctation

Cyanotic Lesions
- **Tetralogy of Fallot (ToF) →** narrowed RV outflow tract (PS) may cause shunting across VSD and cyanosis; Consisting of 1. large VSD, 2. RVOT obstruction, 3. RVH, 4. Overriding aorta
  o **Murmur:** Loud SEM at LMSB and a single loud S2
  o **Tet spell →** increased RVOT obstruction or decreased systemic resistance causes increased R→L shunting across VSD; patients are tachypneic, cyanotic, and have a decreased murmur
  o **Tx options for Tet spells** include oxygen, IVF, calming measures, knee-chest position, medications to relax child or increase SVR
- **D-Transposition of the great arteries (TGA):** Extreme cyanosis; hear a single, loud S2
- **Total anomalous pulmonary venous return (TAPVR):** Pulmonary veins drain into RA or other location besides LA; must have ASD or PFO for survival; several subtypes
- **Ebstein’s anomaly:** Downward displacement of tricuspid valve with “atrialization” of upper RV; associated PFO or ASD may cause cyanosis; previously suggested that lithium use during pregnancy may be a cause but this has not been proven to be true
- **Truncus arteriosus:** Failure of pulmonary trunk and aorta to divide during development (common arterial trunk); multiple subtypes
- **Double outlet right ventricle (DORV):** Both PA and aorta arise from R ventricle
• **Pulmonary Stenosis**: Ejection click at LUSB with valvular PS; intensity varies with respiration (increased with expiration and decreased with inspiration)

• **Hypoplastic left heart (HLH)**: LV is severely underdeveloped

### General staged surgical correction sequence for HLH:

• **Stage 1**:
  o **Norwood procedure**: Attach hypoplastic aorta to pulmonary artery (provide flow to body); create ASD to allow oxygenated blood to flow to RA (and to body via RV) and re-establish blood into lungs with either:
    ▪ **Sano modification**: RV to PA via conduit... OR
    ▪ **Modified Blalock-Taussig Shunt**: Connect R subclavian to R pulmonary artery
  
• **Stage 2**:
  o **Glenn procedure**: Anastomosis of SVC to right PA (provides passive blood flow from upper body into pulmonary bed, and
  o **Fontan procedure**: Anastomosis of R atrium and/or IVC to pulmonary arteries via conduits; completely separates pulmonary flow and systemic flow (passive flow into lungs!)

*Consider including a diagram of hypoplastic left heart or other congenital heart disorders*
Pericardial Disease

- Pericarditis, inflammation of the pericardium can result in a pericardial effusion. Pericarditis can be isolated inflammation or associated w/ a more diffuse myocarditis.
- Classically presents w/ chest pain described as worse w/ lying down and relieved by sitting up and leaning forward.
- Children usually develop an associated fever w/ chest pain.
- If a pericardial effusion has developed they may present w/ shortness of breath/dizziness/syncope.
- Most common etiologies:
  - **Infectious**: viral, bacterial (think of lyme and mycoplasma), tuberculous, fungal and protozoal
  - **Post-op complication**
  - **Rheumatological diseases**: SLE, RA, rheumatic fever, Sjogrens
  - **Drug induced**: most associated w/ hydralazine or procainamide
  - **End-stage renal disease**
  - **Oncologic**: leukemia/lymphoma, mediastinal tumors, or side effect of high dose radiation
- EKG and Echo should be performed. If a large amount of fluid is present they may require a pericardiocentesis for symptomatic treatment.
- Treatment is generally NSAIDs and/or steroids and treating the underlying etiology if found.

### Genetic Syndromes

<table>
<thead>
<tr>
<th>Syndrome</th>
<th>Cardiac Defects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CHARGE</strong> (coloboma, heart defects, choanal atresia, retardation, genital and ear abnormalities)</td>
<td>VSD, ASD, AV canal defects</td>
</tr>
<tr>
<td><strong>DiGeorge</strong> (22q11 deletion)</td>
<td>ToF, aortic arch anomalies</td>
</tr>
<tr>
<td><strong>Down</strong> (trisomy 21)</td>
<td>AV septal defects, VSD</td>
</tr>
<tr>
<td><strong>Marfan</strong> (FBN1)</td>
<td>aortic root dissection, MVP</td>
</tr>
<tr>
<td><strong>Noonan</strong> (NS genes)</td>
<td>supravalvular AS, ASD</td>
</tr>
<tr>
<td><strong>Turner</strong> (XO)</td>
<td>aortic coarctation, bicuspid aortic valve</td>
</tr>
<tr>
<td><strong>Williams</strong> (7q11 deletion)</td>
<td>supravalvular AS</td>
</tr>
<tr>
<td><strong>Loeys-Dietz</strong> (TGFBR)</td>
<td>aortic root dissection</td>
</tr>
</tbody>
</table>
Common Cardiac Medications

- **Diuretics:**
  o **Lasix** (loop diuretic): Used for CHF/fluid overload and HTN to decrease the workload of the heart and decrease fluid in the lungs; Risk Fluid and electrolyte (hypokalemia) imbalances
  o **Chlorothiazide** (thiazide diuretic): Used for CHF/fluid overload and HTN to decrease the workload of the heart and decrease fluid in the lungs; Risks are fluid and lyte (hypokalemia and hypomagnesemia) imbalances
  o **Spironolactone** (K sparing diuretic): Used for CHF/fluid overload, HTN, hypokalemia; also has anti-androgen effects; Risks are fluid and electrolyte (hyperkalemia) imbalance; may also cause gynecomastia and menstrual irregularities

- **Other Cardiac Medications:**
  o **Digoxin**: Used for Atrial fibrillation and atrial flutter by slowing conduction through the AV node; CHF to allow for increased time in diastole and increased filling to east work on the heart (not first line choice); Risks are Hypokalemia, increased GI motility (nausea/vomiting, diarrhea), visual disturbances; rare but possible paroxysmal atrial tachycardia w/ AV block, and ventricular dysrhythmias
  o **Adenosine**: Used for SVT – useful for AVRT/AVNRT but avoid with atrial flutter/fibrillation as it works by slowing conduction through the AV node so will only work on rhythms going through the AV node; Risks are that it can cause an atrial fibrillation to degenerate into ventricular tachycardia – avoid in pts w/ known A fib or WPW. Common side effects include flusing, sweating, dizziness, which are usually transient. Adenosine must be administered quickly and in a line closest to the heart as it has a very short fast life. Administer quickly through a 2-way stopcock and flush immediately.
  o **Propranolol**: Used for arrhythmias (particularly SVT and ventricular arrhythmias associated w/ long QT); also used in HTN; Risks are bradycardia, fatigue, dizziness, hypoglycemia, bronchoconstriction (caution in pts w/ asthma
  o **Lidocaine**: Uses are Ventricular arrhythmias (1mg/kg IV); Risk are Hypotension, dizziness, arrhythmia

- **Amiodorone**: Uses are ventricular arrhythmias or refractory atrial arrhythmias such as SVT or atrial flutter; Risks are Hypotension, elevated LFTs, photosensitivity, GI intolerance, thyroid toxicity. Can cause corneal changes or visual impairments so all pts should have a baseline ophth exam. In children 1mos-15yrs may cause serious hypotension, bradycardia, or AV block. Can also cause hepatotoxicity and pulmonary toxicity. Pt w/ refractory arrhythmias started on amiodorone should do so monitored on telemetry . Due to the wide side effect profile all pts should have baseline LFTs, thyroid function, and eye exam.
Eating Disorders

- **Indications for admission:** Severe electrolyte abnormalities, Cardiac arrhythmias including long QT, Hemodynamic instability (HR < 40, BP < 90/60, orthostatic changes), Renal or hepatic compromise, Severe malnutrition (< 75% IBW or BMI < 17), Patient eating < 500 cal/d x3d, Rapid weight loss of >5% body weight within 10 days, or Ketosis

- **Admission Orders:** Follow protocol on intranet! Remember that patient cannot view medical record, patient cannot know weight, cannot know # of calories consumed. In general the management is:
  - **Diet:** generally start with 1200kcal/d and advance per protocol, with overnight NG feeds of Nutren 1.5 @ advancing rates per protocol. Any meals not taken PO must be replaced w Nutren 1.0 via NG. Patient cannot refuse feeds!!! Try to avoid stopping feeds for any reason, including abdominal pain as constipation is a frequent complaint
  - **Activity:** bed rest, no walking in halls
  - **Consults:** psyh, SW, child life, nutrition

- **Refeeding syndrome:** Highest risk over first 2 weeks of refeeding; Directly relates to degree of weight loss and rapidity of refeeding; May cause ↓K, ↓Phos, ↓Mg, vitamin/ trace mineral deficiency, volume overload, edema
  - ↓Phos stores due to starvation. Restarting feeds causes ↑ insulin which pushes K, Phos, Mg into cells, depleting them further. As the body makes ↑ATP and 2,3BPG which it further depletes its Phos stores which can result in tissue hypoxia and cardiopulmonary failure
  - Volume overload results from ↑Insulin causing ↑ Na retention leading to edema and volume overload

- **Bradycardia:** Caused by increased vagal tone, as a compensatory response to caloric deprivation; Monitor with continuous cardiopulm monitoring; Evaluate with EKG to r/o prolonged QT (esp. if electrolyte disturbances) and heart block

- **Gastroparesis, constipation:** Encourage liquids earlier in meal; small, frequent meals; avoiding legumes/ bran/ excessive fiber (can cause cramping); good hydration; consider Reglan, PPI, low fiber diet, miralax

- **Respiratory Failure:** Secondary to weakness and wasting of resp muscles; improves with refeeding; Consider possibility of poor cardiac function, fluid overload, pleural/pericardial effusions, PTX or pneumomediastinum

- **Other non-acute complications:** Secondary amenorrhea secondary to loss of pulsatile GnRH secretion; Hypothermia; Osteoporosis (esp. trabecular bone, e.g. spine and hips); Anemia, thrombocytopenia, leucopenia
Congential HIV Infection

Patients must express readiness to begin. Poor adherence leads to resistance. Starting HAART is never an emergency. If co-infected with another illness, or not ready to begin therapy, generally better to wait to begin HAART.

**NNRTI** = Non-Nucleoside Reverse Transcriptase Inhibitors
**PI** = Protease Inhibitors

- **Common HAART Regimens**
  - **NNRTI + 2NRTIs**: Atripla = Sustiva (NNRTI) + Truvada (2 NRTIs)
    - Use with caution in teens at high risk for pregnancy
    - Side effects include GI and CNS
  - **PI (boosted) + 2NRTIs**: Boosted Reyataz (PI) + Truvada (2 NRTIs);
    Boosted Prezista (PI) + Truvada (2 NRTIs)
    - Side effects include GI, lipids, and drug interactions
  - **Integrase inhibitor + 2NRTIs**: Isentress + truvada
    - Side effects include GI
  - **Pregnant women**: Kaletra (boosted PI) + Combivir (2 NRTIs)

### Prophylaxis against Opportunistic Infections

<table>
<thead>
<tr>
<th>Infection</th>
<th>Preferred Drug</th>
<th>Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCP</td>
<td>Bactrim (DS tab qd)</td>
<td>CD4&lt;200 (or thrush, h/o PCP, or fever &gt; 2 wks)</td>
</tr>
<tr>
<td>Toxoplasmosis</td>
<td>Bactrim (DS tab qd)</td>
<td>CD4 &lt; 100 (and toxo sero-positive)</td>
</tr>
<tr>
<td>Histoplasmosis</td>
<td>Itraconazole (200 mg qd)</td>
<td>CD4 &lt; 100 (and in an endemic region)</td>
</tr>
<tr>
<td>Mycobacterium Avium Complex</td>
<td>Azithromycin (1200 mg weekly)</td>
<td>CD4 &lt; 50</td>
</tr>
</tbody>
</table>
Dysfunctional Uterine Bleeding

- **Pathophysiology**: 95% of DUB in adolescents secondary to anovulation from unopposed estrogen stimulation
- **Hormonal Therapy**: Estrogen (homeostasis) + Progesterone (stabilize endometrium) through the use of combination OCPs (e.g. Lo-ovral, Desogen, Orthocyclen, Logestril); Patients should start on iron supplement
  - **Administration**: Often we use 1 pill 4x per day x 4 days, 1 pill 3x per day x3 days, 1 pill 2x per day x2 weeks, then 1 pill daily x3-6 mo
  - Occasionally may require IV estrogen if severe bleeding

**Management of DUB based on Presenting Anemia**

<table>
<thead>
<tr>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hgb &gt; 12 and Asymptomatic</td>
<td>Hgb 10-12</td>
<td>Hgb &lt; 10 or Symptomatic</td>
</tr>
<tr>
<td>- Menstrual diary</td>
<td>- High dose hormonal therapy</td>
<td>- Adolescent Medicine consult regarding need for possible admission +/- estrogen IV</td>
</tr>
<tr>
<td>- Daily multivitamin with iron</td>
<td>- Antiemetic</td>
<td></td>
</tr>
<tr>
<td>- Follow up with PCP or Adolescent in 3 months</td>
<td>- Iron therapy</td>
<td></td>
</tr>
<tr>
<td>- Follow up with PCP or Adolescent in 1 month</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pelvic Inflammatory Disease (PID)**

**Diagnostic criteria**: 4 major criteria OR 3 major criteria + 2 minor criteria

<table>
<thead>
<tr>
<th>MAJOR</th>
<th>MINOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower abd pain</td>
<td>Fever &gt; 38.0</td>
</tr>
<tr>
<td>Lower abd tenderness on exam</td>
<td>WBC &gt; 10K</td>
</tr>
<tr>
<td>Cervical motion tenderness</td>
<td>ESR &gt; 15</td>
</tr>
<tr>
<td>Adnexal tenderness</td>
<td>Abnormal sonogram</td>
</tr>
<tr>
<td></td>
<td>Culdocentesis revealing bacteria</td>
</tr>
<tr>
<td></td>
<td>Vaginal discharge</td>
</tr>
</tbody>
</table>

- **Indications for admission**: Pregnancy, Severe pain, Complicated salpingitis or peritoneal signs, history of prior PID, inability to tolerate PO, poor compliance, failed outpatient management, WBC > 12.5, ESR > 40, Fever > 38.5, sepsis, or shock
- **Management**: Follow pathway on intranet, admission order basics are:
  - **Typical Antibiotic Regimens**: (A) Cefoxitin/cefotetan + doxycycline, (B) Amp-sulbactam + doxy, or (C) Clindamycin + Gentamicin
  - **Pain control**: NSAIDs such as ibuprofen or ketorolac
  - **Hydration**: MIVF
  - **Surgical consult**: Only if peritoneal signs / concern for acute abdomen
  - **Evaluation**: cervical specimen (swab vs. urine), trichomonas prep, CBC, ESR, RPR, preg test, +/- pelvic ultrasound

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Clinic

- **Continuity Clinic** is where you, particularly as an intern, will learn preventive care, proper screening, immunization schedules, and normal development. Additionally, you establish a great base of “normal” exams so that you become more astute at picking up the abnormal.

## Age Specific Guidelines

<table>
<thead>
<tr>
<th>Visit</th>
<th>History, PE</th>
<th>Development</th>
<th>Anticipatory Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4 wks</td>
<td>Seborrhea (cradle cap) common. Stooling less often</td>
<td>Lifts chin, eye contact.</td>
<td>If exclusively breastfed, give Vit D 400 IUs daily. Back to Sleep, no co-sleeping. Fever guidelines</td>
</tr>
<tr>
<td>2 mo</td>
<td>Frequent spit-ups, More interactive, Sleep for 3-4 hrs</td>
<td>Lifts head and upper chest, Coos, Smiles</td>
<td>Vit D, review carseat, Back to Sleep, No bottle to bed, Fever guidelines</td>
</tr>
<tr>
<td>4 mo</td>
<td>Feeding history, growth curves</td>
<td>Roll front to back, Laugh, self-soothing begins</td>
<td>May begin introducing solids (rice cereal) at 4-6 mos.</td>
</tr>
<tr>
<td>6 mo</td>
<td>Teething, feeding (BM/formula til 1 yr), solids (purees)</td>
<td>Sit with support, stranger anxiety, babbling, rake</td>
<td>Start Fe supplements if only breastfeeding. Encourage cup</td>
</tr>
<tr>
<td>9 mo</td>
<td>Growth curves, TID meals and snacks</td>
<td>Crawling, Dada, Mama, wave bye-bye, pull to stand,</td>
<td>Childproofing! Meds locked. Gates on stairs. No bottle in bed</td>
</tr>
<tr>
<td>12 mo</td>
<td>Juice intake? (&lt;4oz). Birth Wt should triple.</td>
<td>Cruise, stands alone, walking begins. 2-8 words, jabbering</td>
<td>Start whole milk, use cup. Cont VitD. Rearfacing carseat until 2 yo, brush teeth w/ soft brush, read to child</td>
</tr>
<tr>
<td>15 mo</td>
<td>Growth curves (weight may drop a few % due to increased activity).</td>
<td>Continued expansion of vocabulary, undresses</td>
<td>More independence, curiosity, and stranger anxiety</td>
</tr>
<tr>
<td>18 mo</td>
<td>Mouth care (bottle/cup caries)</td>
<td>Points to body parts, scribbles</td>
<td>Whole milk max 16 oz/day.</td>
</tr>
</tbody>
</table>
Age Specific Guidelines (continued...)

<table>
<thead>
<tr>
<th>Visit</th>
<th>History, PE</th>
<th>Development</th>
<th>Anticipatory Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 mo</td>
<td>“No behavior” can be frustrating for parents</td>
<td>20 words, follows 2-step commands, stacks 5-6 blocks</td>
<td>Move to BED when able to climb out of crib, may start toilet training</td>
</tr>
<tr>
<td>3 yrs</td>
<td>Child may not have big appetite; don’t’ force!</td>
<td>Tricycle, copies circle, jumps in place, counts to 5, knows name</td>
<td>Teach #s, colors, shapes, letters. Car seat in back, forward facing.</td>
</tr>
<tr>
<td>4 yrs</td>
<td></td>
<td>Runs, hops, dress/undress, pretend play</td>
<td>Vit D is only supplement needed. Dentist annually.</td>
</tr>
<tr>
<td>5 yrs</td>
<td>Permanent teeth start to appear</td>
<td>Toilets without help, enjoys games, name colors, count to 10</td>
<td>Encourage imagination, Play outside, talk and read to child often. Prep for kindergarten</td>
</tr>
<tr>
<td>6-7 yrs</td>
<td>Active play, counts to 10</td>
<td></td>
<td>Street safety, smoke alarms, gun safety, bike safety</td>
</tr>
<tr>
<td>8-10 yrs</td>
<td></td>
<td></td>
<td>Limit juice to 6oz/day, safety as above</td>
</tr>
<tr>
<td>Adolescent</td>
<td>Initial Hx w/ parent, but examine, talk w/ pt alone. Sexual, EtOH, drug history important at every visit. Tanner staging at every PE.</td>
<td>Remind of confidentiality policies.</td>
<td>Prepare family and patient for pubertal changes, Discuss menstruation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SEATBELTS. Safe sex, birth control.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Screen for cholesterol, DM as appropriate based on history, or prior to college.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>All menstruating women get annual CBCs 2 years after establishing regular menstruation.</td>
</tr>
</tbody>
</table>
### Immunizations and Screening Tests

<table>
<thead>
<tr>
<th>Age</th>
<th>Immunizations</th>
<th>Screening Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>HBV (enter in eCW as past immunization)</td>
<td>Newborn Metabolic Screen (NMS)</td>
</tr>
<tr>
<td>1-4 wks</td>
<td></td>
<td>Weight check and NMS if born in Maryland</td>
</tr>
<tr>
<td>2 mo</td>
<td>HBV, Pentacel (DTaP/HiB, IPV), Prevnar 13, Rota*</td>
<td></td>
</tr>
<tr>
<td>4 mo</td>
<td>Pentacel (DTaP/HiB, IPV), Prevnar 13, Rota*</td>
<td></td>
</tr>
<tr>
<td>6 mo</td>
<td>HBV, Pentacel (DTaP/HiB, IPV), Prevnar 13, Rota*</td>
<td></td>
</tr>
<tr>
<td>9 mo</td>
<td>Catch up on Immunizations if needed</td>
<td>Formal Developmental tool (e.g. Ages &amp; Stages)</td>
</tr>
<tr>
<td>12 mo</td>
<td>Pentacel (DTaP/HiB, IPV), Prevnar 13, HepA, MMR, Varicella (should be given as separate shots for the first one)</td>
<td>PPD (if high risk or daycare), Lead, Hgb/Hct, Sickledex (if NMS unknown), Dental referral</td>
</tr>
<tr>
<td>15 mo</td>
<td>Catch up on Immunizations if needed</td>
<td></td>
</tr>
<tr>
<td>18 mo</td>
<td>HepA (if 6 mo after first HepA); Prevnar 13 booster if needed</td>
<td>Autism Screen (M-CHAT), Formal Developmental tool (e.g. Ages &amp; Stages)</td>
</tr>
<tr>
<td>24 mo</td>
<td>Catch up on Immunizations if needed</td>
<td>Lead, Hgb/Hct, Dental Referral</td>
</tr>
<tr>
<td>30 mo</td>
<td></td>
<td>Formal Developmental tool (e.g. Ages &amp; Stages)</td>
</tr>
<tr>
<td>3 yrs</td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>4 yrs</td>
<td>Kinrix (DTap/IPV), Proquad (MMR/Varicella)</td>
<td>**</td>
</tr>
<tr>
<td>5-10 yrs</td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>11 yrs</td>
<td>Menactra, Tdap, HPV (may be given as early as 9 yrs old)***</td>
<td>**</td>
</tr>
</tbody>
</table>

*Rotateq (Merck) requires 3 doses whereas RotaRix (GSK) requires 2 doses. You cannot start a patient on Rota if they are 15 weeks old or older.

** Vision and Hearing (every 2 yrs starting at 6 y/o), Dental referral if not already, Verbal cholesterol screening yearly with lab if high risk, PPD/Lead if high risk (only needs 2 blood lead or one after 24 months for DC schools)

*** HPV series is initial, in 2 months, and then again in 6 months
eClinical Works

• **Login**: To turn on the computers at CHC the name is “lgpac2” password is “respgm”. Double click the eCW icon and your login and password are the same, usually your first name and first few letters of your last name, e.g. “michaelo”.

• **Office Visit**: Click the S Jelly Bean icon (➔) to view appointments for the day, patients that are checked in or not, room location, status, reason for visit, and duration or length of time patient has been in the clinic.

• **Message Inbox**: To access messages click the M jelly bean

• **New Telephone Encounter**: To create a new telephone encounter you can either click the T jelly bean icon (➔) and then click new OR through patient hub click on the patient lookup icon (➔), search for the patient then click the “New Tel Enc” button.

• **New Progress Note**: On the “Office Visits” screen double click the patient’s name. For most visits you can then load a template which will format your note and prompt you with questions.
  o **Templates**: Templates are located at the bottom of the main screen. Choose the appropriate template and then click merge. Note that on the right side you can select or deselect portions of a template that you want to merge. If you load a template and the patient has been seen before, a little yellow arrow will be posted after each section. Click that arrow then check the box of the particular visit you want to copy.

  ▪ **Generic templates**: Are useful if you know the general reason why a patient is here. The ones that say “Standard WCC” are already filled out with the normal findings. This can be helpful for your normal WCC but make sure you go through everything to prevent incorrect documentation.

  ▪ **Asthma and Obesity templates**: Should always be used for patients with these respective problems

  ▪ **Patient specific templates**: Allow you to copy all or portions of an old note into your new note. You can also copy sibling notes so this is very helpful with twins.

  ▪ **Oops I loaded the wrong template!** Don’t type anything into the new template or this won’t work. If you go to generic templates and then COPY (not merge) the blank template it will get rid of everything except for the vitals.

  o **Assessments**: Most common presentations will be in Goldberg Pediatric Favorites, type the assessment in the line “Starts With”. If atypical diagnosis may need to change assessment to “All Codes”.

  ![Image](image_url)
- **Immunizations**: Click on the Immunizations link, Click Add, Find and select vaccine, Select visit date, Enter dose and dose # if not automatically entered. Don’t forget to go back to the main Office Visit screen and select Imm for status so the RN knows it is ok to administer the vaccines now (or Imm/Pro if you want a procedure done like a PPD placed in addition to the vaccination)

- **Treatment**
  - **Medications**: Click on Treatment Link, on Rx section click Add, Select the diagnosis from the assessments section that corresponds to the particular medication, then search for the medication name using the Find field and fill in the appropriate parameters (dose, freq, etc.)
  - **Printing Rx**: Click print script button and select the Rx to Print. At CHC you need to select Printer 3 to print it on prescription paper.
  - **Lab/Imaging/Procedure**: Click on Treatment link, on the lab section Click Browse. Search for lab order on Lookup field which will move the lab to Today’s lab section. Click “S” for STAT and “F” for Fasting. Note that you can also order future labs this way. Diagnostic imaging and Procedures are ordered in the exact same way.
  - **Referral**: Click on Outgoing Referral button. Complete details including referral to (e.g. Dr. Bernier, Neurology), ICD9 code, reason, +/- attaching progress note if desired. On the assigned to field select the referral coordinator name then click OK.

- **Billing**: Be sure to add E&M codes (e.g. sick or preventative visits) and CPT codes (e.g. injections or nebulized treatment) if appropriate. Make sure you use the up/down arrows to change the order of the codes, especially for multi-component vaccinations. For E&M codes, any 99214 or 99215 needs to be seen by an attending.

- **Follow Up**: Don’t forget to include on the billing screen the follow up date (e.g. 3 months) and reason (e.g. Weight check, WCC, etc.)

- **Assign Provider**: Once you are completely done with your note, click the down arrow next to the Details button and select “Change Assigned To” option and choose the supervising provider.

<table>
<thead>
<tr>
<th>Common Billing Codes</th>
<th>Code</th>
<th>Modifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccine Administration (first component)</td>
<td>90460</td>
<td></td>
</tr>
<tr>
<td>Vaccine Administration (addtl’ components) *</td>
<td>90461</td>
<td></td>
</tr>
<tr>
<td>PPD Placement</td>
<td>86580</td>
<td></td>
</tr>
<tr>
<td>Vision Testing</td>
<td>99173</td>
<td>59</td>
</tr>
<tr>
<td>OAE (Hearing Test)</td>
<td>92587</td>
<td>59</td>
</tr>
<tr>
<td>Pure Tone (Hearing Test)</td>
<td>92551</td>
<td>59</td>
</tr>
<tr>
<td>ADHD (Vanderbilt) Interpretation</td>
<td>96110</td>
<td>59</td>
</tr>
<tr>
<td>Development (ASQ, M-CHAT)</td>
<td>96110</td>
<td>59</td>
</tr>
<tr>
<td>MDI Teaching</td>
<td>94664</td>
<td>59</td>
</tr>
<tr>
<td>Nebulizer Treatment **</td>
<td>94640</td>
<td>25</td>
</tr>
</tbody>
</table>

* TEACHING HAS A -59 MODIFIER whereas ADDITIONAL SERVICES and PROCEDURES (e.g. cerumen removal, cryotherapy) HAVE A -25 MODIFIER

* Modify the “Units” that corresponds to this vaccine so that the total number of components is correct. For example in Pentacel, which contains 5 parts. Correct vaccination would be 90460 [1 unit] and 90461 [4 units].

** Modify the “Units” to equal the number of nebulized treatments
• Development is a rotation where you’ll become very comfortable with the various developmental assessment tools which are used to detect and monitor any developmental abnormalities in children. It is a fantastic opportunity for specific training in this area. Even if you are not planning to pursue primary care or Development, this opportunity gives one more comfort with ADHD diagnosis and management, proper screening questions for autism, and how to empower a family to advocate for their children in the public school system and in our community. These are all invaluable skills.
• A typical Day in Development consists of two sessions, am and pm. In each session, you will be expected to be the primary history taker and/or perform assessment tools while an attending takes the history with a family. The best way to prepare for a session is to familiarize yourself with a patient’s history, review their past few visits and what testing they have received. Asking specific follow-up questions during your history taking shows interest and allows the families to feel known. You will typically document your history taking, PE, and assessment on a paper chart (which you will later use to dictate from). Remember to do a full neurologic exam on every patient, including a gait assessment, testing balance, and testing for dysdiadokineses. Also, during your PE, comment on the attentiveness and cooperation of the child. It can be very helpful to “debrief” with an attending after seeing a patient in order to review the developmental assessment tools. This is a way to ensure you have performed and will document all necessary testing and will include most pertinent results in your dictation.
• Dictations: Dial “000”, Dr.Batshaw’s password is “62691 #”, then child development is “632 #”, then new work note type is “1#”, and finally the encounter number is the patient’s account number followed by the # sign. To pause while dictating push “1” and then to unpause once in pause mode push “2”. Pushing “4” then “5” gives you a number that you can use to save your note and find it if it is lost. When dictating start with the patient’s name, MRN, DOB, etc. Then state the parent’s address and the primary care provider’s address as the dictation will be sent to both sites. The remainder of the note flows as any other note (CC, HPI, PMH, Rx, Allergies, Im, PE) but you then need to summarize the developmental testing that you did and your assessment of these tests. Finally you finish with your overall assessment and plan. Include in your note whether the parents are good historians. A recommendation for your first few dictations is to have a prior dictation from that patient’s chart in front of you. That way, you can use prior documentation as a guide for including all pertinent history, PE, and assessments.
• Individualized Education Plan: Important things to note in an IEP:
  o Student Information: What the school thinks is their primary disability
  o PLAF (Present Level of Academic Function): Tells you what tests the school has actually done on the patient (e.g. teacher’s comments, IQ testing, language testing)
  o Special Considerations and Accommodations: Will say whether patient gets speech therapy / OT / PT, preferential seating, and other services
  o Goals: Determined by educators but general long term plan

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• **Developmental Scales:** Depending on the patient’s developmental age you may need one or two of these. For patients under 2 use the Capute scale (IQ test), from 2 to 5 you use the Preschool Screening (Language test), and over that you use the JASTAK (Achievement test).

<table>
<thead>
<tr>
<th>IQ</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>55-70</td>
<td>Mild</td>
</tr>
<tr>
<td>40-55</td>
<td>Moderate</td>
</tr>
<tr>
<td>25-40</td>
<td>Severe</td>
</tr>
<tr>
<td>Under 25</td>
<td>Profound</td>
</tr>
</tbody>
</table>

• **Intellectual Disability:** An IQ less than 70 occurring before age 18, typically resultant from a genetic or perinatal insult, with adaptive behavioral dysfunction in at least 2 of 9 cognitive fields. Workup typically is a Microarray, Brain MRI, CGG triplet repeats, Lysosomal enzymes, PAA/UOA, and Carnitine panel.
  - K-BIT: Nonverbal/verbal IQ of patients developmentally at least 4 yrs

• **ADHD:** Symptoms began before 7 years of age, are of over 6 months duration and in more than one setting, and patients have an abnormal rating in one of the ADHD questionnaires (Conners or Vanderbilt)
  - Conners: This is the test Dr. Batshaw uses because of its simplicity; a 15-20 is suggestive of ADHD and over a 20 is diagnostic. When starting a new medication, Dr. Batshaw has the parents give the Conners scale to the patient and they fill it out every day for two weeks. One of those weeks the patient is on his new medication but the school is blinded. Dr. Batshaw then makes adjustments to Rx dosing based on results.
  - Vanderbilt: More comprehensive test of ADHD but more complicated for a lay person to complete. For reliable families, the Vanderbilt can be given for parents (one form) and also for teachers (give several copies of the Teacher form depending on number of teachers). Explain that parents and teachers should fill out these forms after spending consistent time with the patient. Parents can then mail back the forms or bring completed forms back to clinic in 1-2 months for a follow-up visit to discuss results. This is more labor intensive, but more accurate and comprehensive (breaking down ADHD diagnosis into ODD, Inattentive, etc).

• **Autism and ASD (Autistic Spectrum Disorders):** You will become very comfortable screening for autism, but the MCHAT can guide your history taking (and can be printed for screening at home by parents/teachers). Some high yield questions including asking about joint attention (Does your child point to something to get your interest?), eye contact, playing properly with toys, hand flapping or rocking behaviors.
**Down Syndrome**

- **Well Child Care:** At every visit you should perform regular well child care using a Down syndrome specific growth chart, nutrition assessment, and vaccinations. Additionally at every visit patients need routine reviewing of the need for SBE prophylaxis, thyroid function testing, support group referral, evaluation by a speech pathologist, and hearing tests (OAE or ABR initially and behavioral thereafter).

<table>
<thead>
<tr>
<th></th>
<th>0-1 mo</th>
<th>6 mo</th>
<th>1 yr</th>
<th>2 yr</th>
<th>3 yrs</th>
<th>4-12 yrs</th>
<th>12-18 yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review karyotype</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genetic counselor referral</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Echocardiogram</td>
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<tr>
<td>Red reflex (Eye exam)</td>
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<td>X</td>
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<tr>
<td>Pediatric Ophto exam</td>
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<td>X</td>
<td>X</td>
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<td>Early intervention referral</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Dental examination</td>
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<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Celiac disease screening</td>
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<td>OSA screening</td>
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<td>X</td>
<td>X</td>
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<tr>
<td>Behavioral problem screening</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td></td>
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<tr>
<td>Cervical spine x-ray</td>
<td></td>
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<td>X</td>
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<tr>
<td>Neuro exam for gait, DTR, changes in bowel/bladder</td>
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<td>X X</td>
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<table>
<thead>
<tr>
<th>Milestone</th>
<th>Down syndrome (mo.)</th>
<th>Typical Kids (mo.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Range</td>
</tr>
<tr>
<td>Smiling</td>
<td>2</td>
<td>1½ -3</td>
</tr>
<tr>
<td>Rolling over</td>
<td>6</td>
<td>2-12</td>
</tr>
<tr>
<td>Sitting</td>
<td>9</td>
<td>6-18</td>
</tr>
<tr>
<td>Crawling</td>
<td>11</td>
<td>7-21</td>
</tr>
<tr>
<td>Creeping</td>
<td>13</td>
<td>8-25</td>
</tr>
<tr>
<td>Standing</td>
<td>10</td>
<td>10-32</td>
</tr>
<tr>
<td>Walking</td>
<td>20</td>
<td>12-45</td>
</tr>
<tr>
<td>Talking, words</td>
<td>14</td>
<td>9-30</td>
</tr>
<tr>
<td>Talking, sentences</td>
<td>24</td>
<td>18-46</td>
</tr>
<tr>
<td>Eating, finger</td>
<td>12</td>
<td>8-28</td>
</tr>
<tr>
<td>Eating, spoon</td>
<td>20</td>
<td>12-40</td>
</tr>
<tr>
<td>Toilet training, bladder</td>
<td>48</td>
<td>20-95</td>
</tr>
<tr>
<td>Toilet training, bowel</td>
<td>42</td>
<td>28-90</td>
</tr>
<tr>
<td>Undressing</td>
<td>40</td>
<td>29-72</td>
</tr>
<tr>
<td>Dressing</td>
<td>58</td>
<td>38-98</td>
</tr>
</tbody>
</table>
Newborn Nursery

- **Address:** 1500 Forest Glen Road, Silver Spring, MD 20910, 301.754.7000
- **Parking:** Off Dameron Drive, the street perpendicular to hospital, prior to the entrance on the R. Turn R onto Dameron and then L at the entrance. Go to the garage on the R. You’ll need your ID to get in. The ground level is actually Level 3 in the garage. If you do not have your ID badge the 1st day, park in visitor’s parking and they will validate you in Med Ed Office.
- **ID:** You'll need your ID to do everything (get into the garage, doctors' lounge, the elevator, nurseries, etc) so don’t leave home without it. You should receive your ID badge at NICU resuscitation day, however if you did not, go to the Med Ed Office (office on your left as you enter the building from the doctor’s entrance), 1st floor across from the Medical Staff Lounge.
- **How do I get to the nursery?** To get to the West Wing Newborn Nursery: from the garage follow the hallway until you see an elevator bank on your left. These are the west wing elevators. These are the only elevators you will ever need to take (unless you’re going to the NICU). There are so many banks of elevators it can get confusing. Take these to the 4th floor.
- **Where do I pre-round first?** There are 2 nursery sides East wing and West wing. Start rounding on the babies in the West Wing as a group first before going over to the East Wing. This will prevent babies from being away from their parents for too long. The attending must see the babies after you; therefore the babies stay in the nursery until seen by the attending. The attending starts in the West Wing and thus you should too.
- **How to do I get babies to round on?** We round only on clinic babies, not on private patients. Call the clerk (x7620 for West, x7570 for East) and tell her the room numbers of all of the babies you have. The nurses or techs will gather the babies and bring them into the nursery for you to see. Sometimes the clerk may say the nurses are busy giving report. There is usually a tech that can bring the babies into the nursery. Residents can always pick up the babies themselves. If you do, you and the parent must sign the pink form with the baby that reports where they are at all times. Beware of the elevators — do not roll the babies past the elevator doors or else alarms will sound and you will have a code pink on your hands.
- **Note Writing:** Reference the orientation packet, sample notes are given. You will write an initial admission/birth note, progress note, and depart.
- **Rounding:** The packet says that the attending orients you at 8am. That may or may not happen. Arrive at 7am because medical students show up at that time, sometimes later. You have a different attending every day. You may see the attending at some point when you are pre-rounding on the babies. At that point, you can ask what time they want to round. This was usually around 11am. So that means you have plenty of time to see all of the babies. If you have time, start on your mommy talks.
- **Medical Students:** You get new medical students every Monday, so they will need an orientation. Their orientation packet was emailed to you and is also located in the bottom file cabinet in the west wing nursery.
• **Cerner:** Did you get an email about your password for Cerner? If not, you'll have to go to Medical Staff Office on first floor (across from Medical Staff Lounge) to get it from Arlene Grimes. There is now a physician coach who will help you set up your hospital lists and give you an overview of cerner (which is pretty similar to BearTracks).

• **Mommy Talks:** Grab a “Holy Cross Congratulations you on your baby” sheet from the bottom file cabinet for each new mom. When you talk to them, you basically give them the sheet and review some of the important things (back to sleep, feeding, car seats). One of the main reasons for these mommy talks is to get an appointment with a pediatrician.

• **Translator Phones:** Most of your patients will speak Spanish. If you are not proficient, grab a Blue interpreter phone (located in cabinets by the charge nurse). Very easy. Just unplug patient's phone and connect that cord into your blue phone. Pick up handset, click on those two buttons. Then dial 2 - 1 - 2 - 2 (2 for Spanish), 1 (yes for Spanish), 2 (you don’t have an MRN), 2 (you don't want to add another phone number).

• **Blood Draws:** You will be called by the nursery staff for lab draws, even on children who are not your patients. Attempt the draw (venous or art) but if you can’t get it call the 2nd years (or NICU if they’re too busy).

• **NICU On-Call:** Pick up the beeper from top drawer in the west wing nursery. During the weekday this means you go down to the NICU on the third floor, and hang out in their computer room until 9pm. You attend all NICU deliveries. This may mean zero on some days. Bring things to do or read. On the weekend you show up at 7am and round on all the babies like you would during the weekday. Then in the afternoon, after work on your newborns is complete, head over to the NICU from 2pm until 8pm.

• **Call rooms:** 2nd floor, suite 2414. Take the elevator to the 2nd floor, walk down the hallway away from the cafeteria, turn left at the end of that hallway (you should see the neuroscience suite in front of you), then turn right. Then another left and then right. The call room is the door at the end of that hallway (the door that is facing you not on the right). The code is written on the door next to the key pad. There are 2 call rooms for us, the peds med student room and the peds resident room. These are shared among the people on nursery and wards.

• **Call for Help:** 2nd year residents are a call away on the 8th floor. Resident work room is x5441 and on-call pager is 1181. To page, call X7111.

• **Bathroom Code:** On the floor is 2-4-3
• FREE FOOD! Located in the Medical Staff Lounge. From the garage, take the Doctors' Entrance and the lounge will be on your right. From the 4th Floor, use the West Wing elevators. If you are stepping out of the West Wing Newborn Nursery, take the hallway all the way to end and the elevators will be in the last hallway on your left. Take the elevators to the 1st floor. Take the door to the right, walk down the long hallway towards the Medical Education Office and the lounge will be the door on the left.
  o Breakfast 7 am: Bagels, muffins, pastries, and yogurt (in the fridge) in addition to coffee and orange juice (in the fridge).
  o Lunch 11am: A variety of sandwiches are provided (turkey, roast beef, vegetable, ham, pastrami, and sometimes tuna). There are also two types of soup and fruit. If you get there by 11:30 there will also be soda and chips. If you get there after 12:30, there will be some sandwiches and some soup left.
  o Cookie Break 2pm - Cookies and/or brownies are put out in the afternoon. They go pretty fast, so be sure to be there by 2pm for an afternoon snack.
  o Coffee is available 24 hrs a day.

Newborn Examination

• Skin: Assess color for Jaundice, Plethora (↑ Hct due to fetal hypoxia), Cyanosis (congenital heart and lung disease), Pallor (anemia, shock, PDA)
  o Erythema toxicum: White papules with an erythematous base on the trunk, face, extremities developing on DOL 2-3, resolving within a week
  o Milia: White papules on the nose and cheeks due to keratin retention
  o Pustular Melanosis: Eruption of superficial pustules overlying hyperpigmented macules in dark skinned patients with subsequent removal of pustules with first bath so that only macules remain
  o Slate Gray Patch (Mongolian Spots): Blue discoloration due to uneven melanocyte migration on the buttocks or back of dark skinned pts
  o Nevus Simplex (Salmon Patch, Stork Bite, Angel Kiss): Pink-red capillary malformations on the upper eyelids, forehead, or nape of the neck

• Head: Measure head circumference, check fontanelles, face shape, nose shape and patency, ear placement/size, jaw size, and an intact lip/palate
  o Caput Succedaneum: Edema over the presenting part of the head, present at birth, crosses suture lines, and resolves within a few days
  o Cephalohematoma: Subperiosteal blood collection which does NOT cross suture lines, may increase in size, and resolves in weeks
  o Fontanelles: Large in hypothyroidism and Osteogenesis Imperfecta, Bulging due to meningitis or hydrocephalus, or Sunken if dehydrated
  o Craniotabes: Soft area of the skull with a ping-pong ball sensation when depressed, may be normal but seen in preemies, syphils, and rickets

• Eyes: Assess conjunctivae for exudates, red reflex, pupil reactivity, interpupillary distance, epicanthal folds, and slanting of palpebral fissures
  o Hypertelorism: Wide interpupillary distance, seen in Down syndrome
  o Brushfield spots: Salt & pepper speckling of the iris, seen in Down syn.
  o Leukocoria: White pupil seen in Retinoblastoma (50%), persistent fetal vasculature, ROP, Cataracts, and Colobomas

• Neck: Assess for masses (see ➔) mobility (e.g. Torticollis), excess skin (seen in Turner and Down syn.), clavicle integrity
Consider diagram of key findings on a newborn examination

<table>
<thead>
<tr>
<th>Innocent Murmur</th>
<th>Murmur likely due to Congenital Heart Dx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murmur grade 2 or less</td>
<td>Murmur grade 3 or more</td>
</tr>
<tr>
<td>Normal 2nd Heart Sound</td>
<td>Abnormal 2nd Heart Sound</td>
</tr>
<tr>
<td>Normal pulses</td>
<td>Absent/diminished Femoral Pulses</td>
</tr>
<tr>
<td>No audible clicks</td>
<td>Harsh, pansystolic, loud at LUSB</td>
</tr>
</tbody>
</table>

- **Chest:** Inspect breasts (often enlarged due to maternal estrogens, check for presence of supernumerary nipples), size and shape of chest (such as for pectus excavatum [funnel] or carinatum [pigeon]), listen to lungs (effort, consolidation, rate is normally 40-60 bpm) and heart (rate, rhythm, quality, murmur). Palpate femoral and brachial pulses, and check cap refill.

- **Abdomen:** Assess for distention, masses (palpating the liver, spleen, and kidneys), umbilicus (# cord vessels, presence of erythema or discharge)
  - Diastasis Recti: Nonunion of the rectus muscles, frequency resulting in an umbilical hernia is a normal exam finding in newborns
  - Omphalocele: Abdominal content herniation thorough umbilical root, covered with peritoneum; 1/3rd have associated congenital lesions
  - Gastrochisis: Failure of intestines to return into abdominal cavity causes a full thickness abdominal wall defect, usually to the right
  - Single Umbilical Artery: Seen in 0.5% of live births, increased risk of renal abnormalities

- **Pelvis:** Check hips for clicks/clunks, anus for patency; in a female assess size/location of labia, clitoris, and vaginal opening, in a male assess for the presence of both testes, size of the penis, and location of urethral opening
  - Hypospadias: Ventral located urethral meatus
  - Epispadias: Dorsal located meatus, rare but seen in bladder extrophy

- **Extremities:** Check for syndactyly and polydactyly of the fingers and toes, check all extremities move equally especially following difficult deliveries

- **Neuro:** Check back for evidence of a neural tube defect which would require an ultrasound (e.g. sacral dimple without base or with discoloration/hypertrichosis) and check primitive neuro reflexes including suck, rooting, palmar/plantar grasp, moro, and babinski
  - Fencer’s Reflex (Tonic Neck Reflex): Turning child’s head to one side causes ipsilateral arm to straighten and contralateral arm to bend
  - Gallant Reflex: Stroking the back causes infant to swing hips towards it
• **Orientation**
  o **Facilities:** There are 4 pods designated as A, B, C, and D side. A white board located between A and B side with daily schedule and team assignments. Lockers are in room directly next to white board to leave bags, coats. Staff lounge with badge access located at the end of D side hallway has coffee machine, refrigerator, microwaves, and water. Nutrition room located in hallway between C and D side has snacks, sandwiches, formula, and pedialyte for patients.
  o **Schedules:** There are 3 possible shift schedules: “A shift” from 7a-7p, “B shift” from 11a-11p, and “C shift” from 7p-7a. When you arrive for your 7am or 7pm shift you will receive sign out from any residents that are leaving if they have unfinished issues with patients. Do not pick up any patients during the last half-hour of your shift (this is a general rule. If its 6:30 pm and you have no patients and a cc URI sx comes in you should see them). Try to have patients wrapped up by the end of shift
  o **Conferences:** During daytime shifts you are expected to attend noon conference. Please remind your attending about 15 min prior to conference. Try to have plans wrapped up for patients if possible. You are not expected to attend morning report or grand rounds. Thursdays are education days. There are typically educations sessions scheduled from 9am-noon. If you are scheduled for an A or B shift that day you are expected to attend.
  o **Sign Out:** At 7am, 3pm, and 7pm team sign out occurs. The attending, fellow, residents, and RNs for each team meet to give quick sign out on each patient. First everyone introduces themselves “name, resident, here or leaving”. When presenting your patient give a quick one liner, clinical status, and plan. For example “Johnny is a 7 yo known asthmatic. He initially came in with an asthma score of 6. He’s now received 2 rounds and has a score of 3. He’s getting his third round now. He’ll then be reassessed for admission vs D/C home.”

• **Computer**
  o **Login:** The log on is emtc and the password id Codeteam1. Open beartracks, then click on firstnet. Your firstnet password is the same as your cerner log on and password.
  o **Check In:** Click the provider check-in toolbar icon (person with check mark). Type in a display name, choose a color, and if you have an ascom add your ascom number to your display name (e.g. “Alice 1505”)
  o **Patient Chart:** To open a patients chart click on the patients name. Right click then scroll down to “open patient chart”. Labs, vital signs, and radiology is displayed the same way as in powerchart. Previous power notes, including inpatient admissions can be viewed through firstnet. Outpatient documents (for example clinic letters) can also be viewed by changing the search criteria in the notes section from “powernotes” to “All” or going into the documents section. When in the “All” view, you can also see the triage and assessment notes from this visit which have some very useful information. It is helpful to view these notes before seeing patients.
- **New Patients**
  - **Team:** To see which patients are already assigned to your team, you can click the “A, B, C, or D” side tabs on firstnet. When a new patient arrives their name and room assignment will be added to the team list.
  - **Paper Chart:** When a new patient arrives their paper chart will also be placed in the rack mounted to the wall (in A or B) or bins (in C or D). This will contain any info from the PMD or OSH (in the case of a transfer) and patient label stickers. Transfer these papers to the other racks (to the right for A, to the left for B) once you are seeing the patient.
  - **Assign Provider:** To assign yourself to a patient, click the resident column and hit the assign provider toolbar icon (profile of a person).
  - **Evaluation:** Now go and see the patient. Take a pertinent, focused H&P.
  - **New Note:** When adding a power note the type of note is “ED note provider”. You can add specific type of ED notes such as “Respiratory complaint”, “Fever”, etc. After selecting a note type rename the note from “Respiratory complaint” to something more specific, like “cough”.
  - **Precepting:** Each patient in the ED needs to be precepted with an attending or fellow. A fellow or attending will either sign up for your patient on firstnet or you can approach the one assigned to your team (this information is written on the white board in between A/B side).
  - **Workup:** All labs and medications should be ordered as one time and “STAT”. All blood draws in the ED are collected by RNs or techs. For labs collected by an MD in the ER (such as CSF from an LP) all specimens should be left in the patients exam room. 2 people need to validate the patients name and initial lab slips before sending to the lab.
  - **Medication:** All narcotic and sedation medications need to have a co-signature from an attending or fellow.

- **Admissions**
  - **ETU:** The ER has an extended observation unit called the “ETU”. If a patient needs to be observed for a few hours the ETU may be an option. Examples of ETU patients include extended PO trials or respiratory kids you want to observe sleeping. To transfer a patient to the ETU order “ED to ETU patient transfer”. Patients in the ETU need holding order such as vital signs, IVF, Tylenol, etc.
  - **Subspecialty Admission:** These are patients being admitted to teams such as heme/onc, pulmonary, GI, neurology, cardiology, renal, or Kaiser patients. To admit these patients page the fellow or attending on call for that service and discuss the admission with them. They will then contact the subspecialty admitting resident. You’re responsible for ordering the “ED to inpatient bed request”. If you are working and overnight C shift be sure to page the correct on call fellow! For example if you’re working Monday into tues you should page fellows from the Monday “on call schedule”, not Tues. You can also ask the secretaries located next to A/B side work stations to page for you.
  - **General Academic Team Admission:** To discuss an admission to an academic team you should page 1427. During the day this pager is covered by the on call hospitalist. After 5:30 it is covered by the on call Hospitalist admitting resident. To admit a patient order the “ED to inpatient bed request”. Holding orders are required. There is an order
set called “ED holding orders”. This includes vitals, diet, monitor, etc. Always check to ensure that these patients are not suitable for PHAST first and that they are not Kaiser patients.

- **PHAST Unit**: Please don’t forget to utilize the PHAST unit. This can save on call and night float residents unnecessary work overnight. To discuss and admission to the PHAST unit page 1428. The PHAST unit is a unit in the hospital where uncomplicated patients can be admitted and cared for by attendings without resident support. Criteria for admission for short stay unit includes uncomplicated kids that do not require multiple consulting services. Examples include bronchiolitis, asthma exacerbations, abscesses requiring IV antibiotics, etc.

## Common ER Presentations

The ER relies on certain pathways to provide optimal care for patients with certain common presentations, key features of some common pathways are:

- **Asthma**: Patient gets Albuterol/Atrovent neb and Dexamethasone PO to start. Depending on the asthma score, patient may need subsequent Albuterol but typically the patient goes home with MDI with spacer teaching and a second Dexamethasone PO dose to take at home. Patients need to continue to take Albuterol q4h until seen by the PCP.
- **Sickle Cell with Fever**: Obtain CBC, Retic, Blood Cx, Type and Hold. If UTI signs/symptoms, male <6 mo or female <24 months also obtain a UA/UCx. Start patient on antibiotics within 1 hr
  - **If over 1 yr**: Ceftriaxone 75 mg/kg/dose IV (max 2000 mg) STAT
  - **If under 1 yr**: Cefotaxime 50 mg/kg/dose IV (max 2000 mg) STAT
  - **If Ceph allergy**: Clindamycin 10 mg/kg/dose IV (max 900 mg) STAT

<table>
<thead>
<tr>
<th>Admit and start Clinda</th>
<th>Admit only</th>
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</thead>
<tbody>
<tr>
<td>WBC &gt; 30k or Platlets &lt; 100k</td>
<td>Under 1 yr old</td>
</tr>
<tr>
<td>Temperature &gt; 40 C</td>
<td>Under 2 yrs old if Prevnar incomplete</td>
</tr>
<tr>
<td>History of S.pneumo bacteremia</td>
<td>Non-compliance with PCN prophylaxis</td>
</tr>
<tr>
<td>Acute toxic syndrome</td>
<td>Enlarging spleen with decreasing Hgb (1-1.5 g/dL from baseline)</td>
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<tr>
<td>Toxic appearing, Abnormal VS, or Bacterial infection (not UTI)</td>
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</table>

- **All Overdoses**: Call Poison Control at 1-800-222-1222. They may have been called from triage, so check the triage note. They often have very helpful recommendations for how to manage patients.
- **Acetaminophen Overdose**: Use IV N-acetylcysteine (NAC) or Acetadote 150 mg/kg over 60 min, 50 mg/kg over 4 hrs, then 100 mg/kg over the next 16 hrs. Check liver enzymes and APAP level 2 hrs before ending final infusion. If liver enzymes are elevated or APAP present (> 10 ug/mL) continue NAC for another 16 hrs using the dose (100 mg/kg) until LFTs are decreasing (2 levels 12 hours apart) and APA level is (< 10 ug/mL).
- **Burns**: Use the Parkland formula: (4 mL x weight in kg x % BSA burned) + MIIV requirement = 24 hour total. Give Half of the 24 hr total volume in the first 8 hrs and the second half in the next 16 hrs.

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Trauma Evaluation

- **Primary Survey**
  - **Airway**: Ensure airway patency, maintain cervical spine immobilization.
  - **Breathing**: Expose chest, observe chest wall mvmt, auscultate
  - **Circulation**: Check for good central and peripheral pulses, Assess the capillary refill and mental status.
  - **Disability**: GCS, Eval for neurologic deficits, strength, and extr ROM
  - **Exposure**: Remove clothing or obstructing objects, giving attention to heat loss. Control blood loss from open wounds.

- **Secondary Survey**
  - **Head**: Examine skull and facila bones for trauma/instability
  - **EENT**: Check pupils, lids, globe, nose, and mouth for blood/obstruction
  - **Neck**: Look for trauma, JVD, tracheal shift/deviation
  - **Chest**: Observe/palpatate for trauma, tenderness, and chest wall mvmt
  - **Abdomen**: Look for contusions/lacerations. Palpate all quadrants.
  - **Pelvis**: Check if blood in urethral meatus, Palpate rim for creptius/mvmt
  - **Extr**: Look for contusions/lacerations. Check neurovascular status/ROM
  - **Back**: Logroll patient check for stepoffs, rectal tone, and guiac check.

Consider additional resources here useful in ER such as additional toxicology examples with antidotes, practical tips for repairs of lacerations, imaging for fractures, or common ER protocols (e.g. asthma, sickle cell, etc.)
### Rapid Sequence Intubation

<table>
<thead>
<tr>
<th>Drug</th>
<th>Properties</th>
<th>Indications</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1: Adjuncts</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atropine</td>
<td>Anticholinergic, Blocks reflex bradycardia</td>
<td>Infants &lt; 1 y, Bradycardia, or Succinylcholine use (1&lt;sup&gt;st&lt;/sup&gt; dose in kids, before 2&lt;sup&gt;nd&lt;/sup&gt; dose in patients &gt;8 yrs); Consider with ketamine</td>
<td>0.01 mg/kg IV MIN: 0.1 mg MAX: 0.5 mg</td>
</tr>
<tr>
<td>Lidocaine</td>
<td>Mitigates ↑ ICP and sympathetic response</td>
<td>Traumatic Brain Injury or other situations with ↑ICP, Cushing’s triad</td>
<td>1-1.5 mg/kg IV MAX: 50 mg</td>
</tr>
<tr>
<td><strong>Step 2: Sedatives</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ketamine</td>
<td>Hypertension, Tachycardia, ↑ICP/IOP</td>
<td>Asthma, Hypotension (without catecholamine depletion)</td>
<td>2 mg/kg IV push</td>
</tr>
<tr>
<td>Midazolam</td>
<td>Hypotension</td>
<td>Seizures</td>
<td>0.1 - 0.2 mg/kg IV push</td>
</tr>
<tr>
<td>Etomidate</td>
<td>Hemodynamically stable, Neuro-</td>
<td>Adrenal suppression so can’t use in septic shock / adrenal insufficiency</td>
<td>0.3 mg/kg IV push</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>Hemodynamically stable, Neuro-</td>
<td>Minimal bronchial Δ, but can cause Chest wall rigidity</td>
<td>2-10 mcg/kg IV slow push</td>
</tr>
<tr>
<td>Thiopental</td>
<td>Hypotension, Bradycardia,</td>
<td>Increased ICP or seizures</td>
<td>4-6 mg/kg IV push</td>
</tr>
<tr>
<td></td>
<td>Bronchospasm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Propofol</td>
<td>Easily titratable</td>
<td><em>Rarely used at CNMC</em></td>
<td>2 mg/kg IV push</td>
</tr>
<tr>
<td><strong>Step 3: Paralytics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Succinylchol.</td>
<td>Malignant hyperthermia, fasiculations,</td>
<td></td>
<td>1-2mg/kg IV push</td>
</tr>
<tr>
<td></td>
<td>hyperkalemia, rhabdomyolysis, bradycardia, ↑ICP; Don’t use for burns, hyperkalemia, renal failure, or ↑IOP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rocuronium</td>
<td>Non-depolarizing; Onset in 1 min,</td>
<td></td>
<td>1 mg/kg IV push</td>
</tr>
<tr>
<td></td>
<td>Lasts 30-60 min; Priming not useful</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vecuronium</td>
<td>Non-depolarizing; Onset in 2 min,</td>
<td></td>
<td>0.1 mg/kg IV push</td>
</tr>
<tr>
<td></td>
<td>Lasts 40-60 min; Can prime with Vec 0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>mg/kg IV push, wait 5 min, then give 0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>mg/kg IV push to reduce onset to &lt;1 min</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Preparation**: 10 minutes before intubation
- **Preoxygenation**: 5 minutes before intubation
- **Pretreatment**: 3 minutes before intubation
- **Paralysis with induction**: Induction
- **Protection**: 30 seconds after intubation
- **Intubation**: 45 seconds after intubation
- **Post-intubation management**: 60 seconds after intubation
Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOL</td>
<td>Day of life (birth day is DOL 0, not 1)</td>
</tr>
<tr>
<td>PMA</td>
<td>Post-menstrual age</td>
</tr>
<tr>
<td>NMS</td>
<td>Newborn metabolic screen</td>
</tr>
<tr>
<td>NIPPV</td>
<td>Non invasive positive pressure ventilation</td>
</tr>
<tr>
<td>OC</td>
<td>Open Crib (vs isollette. Has to do with ability to regulate temp. Need to be &gt;1800g)</td>
</tr>
<tr>
<td>HUS</td>
<td>Head ultrasound</td>
</tr>
<tr>
<td>HC</td>
<td>Head circumference</td>
</tr>
<tr>
<td>A/B/D</td>
<td>Apneas, Bradycardias, Desaturations</td>
</tr>
<tr>
<td>AOP</td>
<td>Apnea of prematurity</td>
</tr>
<tr>
<td>AnOP</td>
<td>Anemia of prematurity</td>
</tr>
<tr>
<td>TFG</td>
<td>Total fluid goal</td>
</tr>
<tr>
<td>R &amp; E</td>
<td>Residuals and emesis</td>
</tr>
<tr>
<td>PBM</td>
<td>Plain breast milk</td>
</tr>
<tr>
<td>E22</td>
<td>Enfacare 22 cal/oz (confused with Elecare or Enfamil)</td>
</tr>
<tr>
<td>PE24</td>
<td>Premature Enfamil 24 cal/oz (unlike Elecare 24, PE24 is specifically for preemies and has extra nutrients)</td>
</tr>
<tr>
<td>HMF</td>
<td>Human milk fortifier (specifically for preemies with extra nutrients)</td>
</tr>
<tr>
<td>TP tube</td>
<td>Transpyloric tube (either nasoduodenal or oroduodenal)</td>
</tr>
<tr>
<td>PPN</td>
<td>Peripheral parenteral nutrition, basically TPN via peripheral IV w/ D&lt;12.5 and w/o calcium/heparin</td>
</tr>
<tr>
<td>AG</td>
<td>Abdominal girth</td>
</tr>
<tr>
<td>ROP</td>
<td>Retinopathy of prematurity</td>
</tr>
</tbody>
</table>

General Tips for GW NICU

- **Location**: On day 1 come to GW’s NICU (3rd floor, go into the L&D waiting room to have them let you in, go to the right hand corner, the nicu is next to the nursery in the corner (door is unlocked) – behind the nurses station is the kitchen area, and the call room is in the back).

- **Computer**: The computer in the call room and at the nurses station have labs (OPUS) and you can log in with generic username kahn01 and pw: babies123. The computer on the LEFT at the nurses station is the only one with radiology, and the username is refdek, the password is david1 and is on the computer itself.

- **Prenatal Consults**: The fellow does these consults; this is not your job. It’s nice if you want to go with them so you’re involved with the patient from the beginning.

- **Nursery Coverage**: Officially we only cover the term nursery from 5pm to midnight, but that’s often not how it works out. Usually there’s no NP or MD in the nursery from 2pm until 9am M-F and you’re it on the weekends. If any well baby is admitted to the term nursery from the time the covering NP or MD leaves, until midnight, you need to do the paperwork and exam. And if you were at the delivery (e.g. for a C-section), you need to do the admission paperwork even if it’s after midnight. Sometimes it’s good to stop by the well nursery a bit before midnight to find out if there’s any babies that need seen before you try to get some sleep.
• **Deliveries:** The charge nurse will notify you that there’s a delivery. Your job is to obtain maternal info (look for her chart, either at the bedside or at the OB nursing station) and update the fellow (Mom is a G3P2 @ 37 and 3/7 admitted in active labor, pregnancy complicated by preeclampsia, prenatal labs negative, GBS+, s/p 4 doses of Ampicillin, now using vacuum for delivery), and fill out the triple-layered white sheet located in the top drawer of the code cart. Additionally, you document the Apgars, length, weight, temperature, glucose (if done), and annotate the resuscitation.

• **OSCILLATORS:** Basically the oscillator jiggles the baby around and allows you to get better airflow without blowing a lung. There are four things you can adjust: MAP, ΔP, Hz, and FiO2. As with a normal vent you can adjust the fraction of inspired O2 (FiO2) but unlike a normal vent it oscillates about a certain Mean Airway Pressure (MAP). The amplitude of those oscillations is expressed as the change in pressure (ΔP) and the frequency is expressed as the Hertz (Hz). Adjusting the MAP and FiO2 will affect your oxygenation and adjusting the ΔP and Hz will affect your ventilation. Generally we find a Hz and MAP that we’re ok with and adjust the ΔP and FiO2 to achieve the desired oxygen and carbon dioxide levels. Note that increasing the ΔP should result in a decrease in the CO2 level.

### CNMC NICU

<table>
<thead>
<tr>
<th>Rotation Structure</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 residents/rotation: 4 residents on days, 1 resident at night</td>
<td>Fellow: x8743, x7933</td>
</tr>
<tr>
<td>NNP Team: Covers 4 pts on the weekends for the resident who has their golden wknd</td>
<td>Residents: x8865, x7934, x7936, x8870</td>
</tr>
<tr>
<td>Resident cap: 9 patients/resident</td>
<td>Dietician (June): x7988</td>
</tr>
<tr>
<td>Pre-round from 5:30am-8am</td>
<td>Case Magmt: Kim-x8319, Linda- x8325</td>
</tr>
<tr>
<td>Radiology rounds 8-8:30am</td>
<td>BAERs: x5678</td>
</tr>
<tr>
<td>Lecture 8:30-9am</td>
<td>ROP: p1846</td>
</tr>
<tr>
<td></td>
<td>TPN: x8808</td>
</tr>
</tbody>
</table>

### General Tips

• **Equipment:** No stethoscope needed! All the babies have their own! No white coats in NICU.

• **Admission Exam:** All new admissions need a complete exam. See below for the most commonly needed admission orders.

• **Daily Exam:** All babies should have a focused exam every day. Be sure to talk to your nurse about when they are going to do dressing changes, etc. so that you have the best opportunity to examine your patient’s wounds.

• **Med Reporting:** Report all meds in mg/kg/dose or mg/kg/day.

• **Daily Work:** NICU is obviously not a very high turnover service. After rounds, make sure that your orders are up to date, notes are up to date, and TPNs are completed. Hospital summaries and progress notes can become lengthy with all the information about the baby. Make sure not to use words like “yesterday” or “tomorrow.” Rather, insert the date that a medication was started or discontinued so as to not cause confusion for someone else looking at your note.
• **Avoiding Random Phone Calls:** Make sure that after you round on each patient to ask the nurse what orders need to be cleaned off. There are lots of miscellaneous orders that become overwhelming to everyone involved. Save yourself the extra phone calls after rounds by just simply asking.

• **DISPO:** Kim and Linda (Case Management) or Clydette (Social Worker) are great resources for appts, prescriptions, outpatient imaging, hearing exams, etc. They are present on rounds nearly every day, so take advantage of having such a great resource!

• **Pre-Rounding in Cerner:** Orders, Labs/Microbiology, MAR
  o **I-view:** ICU Ongoing Assessment (Apneas, Bradys, Desats), Pain (Pain Scores, WAT scores), Lines, Tubes, Drains (Good place to find your patient’s current access (or go examine them!))
  o **Intake and Output:** Total Fluids (cc) /kg; Break up intake to reflect TPN, IVFs, Feeds (how much PO vs. Enteral); UOP: cc/kg/hr; Ostomy Output: cc/kg; Can use the TPN calculator Excel Sheet on every computer in the NICU resident room to calculate calories
  o **Important Things to Include By System**
    - ACCESS: must be included for all patients
    - Weight: keep up to date with the most recent weight
    - RESP: vent settings and the most recent blood gas, medications
    - CVS: medications
    - FEN: I/Os, TPN (D , P__ , IL ), Feeds--formula, calories/oz, volume/rate, how often, advance, goal (for example—Enfamil 20cal/oz 50 cc q 3 increasing by 5 cc q 6 to a goal of 65 cc q 3); medications
    - HEME: last transfusion
    - OPHTHO: last exam, the results, and when the next exam will be
    - GENETICS: NMS (when it was and if it was normal/abnormal)
    - ID: antibiotics (day of treatment and planned duration), most current blood/CSF/resp/urine cultures
    - NEURO: most recent HUS/MRI result

**Weekly Orders**

• **For All Admissions**
  o Consent within 24 hours
  o DC NMS
  o Vitamin K
  o Erythromycin Eye Drops
  o Hep B and HBIG by 12 hours of life if Mom’s status unknown/positive
  o BMP, Mg, Phos, Bilirubin at 12 HOL and 24 HOL
  o Protective isolation if < 1000 grams
  o MRSA (nares), Ceftaz (rectal), VRE (rectal) swabs ordered on all patients
  o Glucose q 4-6 hours, then PRN
  o Follow up Mom’s prenatal labs (GBS, HIV, Hep B, RPR )
  o All babies should have respiratory care plan so that RT can wean vent as tolerated

• **Every Monday**
  o MRSA nare and Ceftaz rectal swab screens unless previously positive
• Update Med Calc Weight (this should be discussed on rounds especially if the weight is an estimation or the baby is edematous, etc.)
• Adjust meds per current med calc weight
• Order CXR for central line check on Tuesdays
• **Every Wednesday**
  o Order CBC, BMP, Mg, Phos (TPN small set) for Thursdays
• **Every Friday**
  o Order CBC, CMP, Mg, Phos, Triglycerides (TPN large set) for Mondays
  o Order all XRs for weekend (order XRs for 5am)
• **Routine Orders**
  o Routine weights are MWF
  o Must have PIV for blood products unless patient has a broviac
  o Eye exam at 32 weeks corrected age then PRN per Ophtho
  o Normal immunization schedule except no live vaccines in NICU
  o Synagis per guidelines if not in isolette (15 mg/kg/dose)
• **Radiology**
  o CXR every day for intubated ordered for next at 0500
  o All other XRs ordered as STAT
  o Order XRs on Mondays for Tuesday central line check
• **Prior to Discharge**
  o Make sure Hep B when > 2000 grams
  o Hearing Screen/BAERs
  o Car Seat Test
  o Circumcision (inpatient vs. outpatient)
  o Prescriptions filled
  o PMD and Subspecialty Follow Up
  o Fax discharge summary to PMD

**History and Physicals** – the things we want to hear about!
• **Maternal History**
  o GBS (treated?!), HIV, Hep B, RPR, Rubella
  o Gestational DM, PIH (Magnesium?), other pregnancy complications
• **Delivery**: Vaginal vs. C-section, Resuscitation after birth, Apgars
• **Birth Measurements**
• **Standard Interventions thus far**: Vitamin K given? NMS sent? Hep B given? Hearing Screen done?
• **History of urination and stooling?**
• **NICU Course at OSH**: Include blood cultures and other labs pending

**Intraventricular Hemorrhage**
• **Grade I**: subependymal hemorrhage only
• **Grade II**: subependymal hemorrhage + intraventricular hemorrhage (filling < 50% of lateral ventricle)
• **Grade III**: IVH + ventriculomegaly
• **Grade IV**: parenchymal hemorrhage with or without IVH and ventriculomegaly
• **Head US**: All babies < 1500 grams should receive at least 3 head ultrasounds, at DOL 3-5, DOL 14, and 6 weeks of age or prior to discharge
FEN

- **Calculating Calories:** From the FEN information you can calculate total daily fluids and calories and cc/kg and cal/kg.
  - **Parenteral:** TPN calculator in excel sheet can help you calculate how many parenteral calories your baby is receiving.
  - **Enteral:** When calculating how many calories the formula gave your baby, just divide the volume (cc’s taken) by 30 cc/oz and multiple by the formula concentration (22 cal/oz) which gives you total calories. Then divide this number by the weight to get cal/kg/day.

### Total Fluid Goals (in cc/kg/day)

<table>
<thead>
<tr>
<th>Gestation</th>
<th>Day of Life</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>36 weeks</td>
<td>60 *</td>
</tr>
<tr>
<td>32-36 weeks</td>
<td>80</td>
</tr>
<tr>
<td>28-32 weeks</td>
<td>100</td>
</tr>
<tr>
<td>25-28 weeks</td>
<td>120</td>
</tr>
<tr>
<td>&lt; 25 weeks</td>
<td>140</td>
</tr>
</tbody>
</table>

- **Formula Choice**
  - **< 1500 grams:** Enfamil Premature 24 cal/oz
  - **1800-2200 grams:** Enfamil Premature 24 cal/oz
  - **1800-2200 grams:** Neosure 22 cal/oz or Enfacare 22 cal/oz
  - **Term Infants:** Enfamil 20 cal/oz

- **Advancing Feeds**
  - Trophic Feeds: provide 10-20 cc/kg/day x 4-7 days
  - Advance feeds by ~ 20 cc/kg/day
  - Can d/c TPN and hang D10 when feeds are ~ 100-110 cc/kg

- **Growth Expectations**
  - **< 2 kg:** 10-15 gm/kg/day
  - **> 2 kg:** 20-30 gm/kg/day

### Respiratory Care Plans

<table>
<thead>
<tr>
<th></th>
<th>Preemies</th>
<th>Term</th>
<th>CLD</th>
<th>PPHN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pH</strong></td>
<td>7.25-7.35</td>
<td>7.3-7.4</td>
<td>7.3-7.45</td>
<td>7.3-7.4</td>
</tr>
<tr>
<td><strong>PCO2</strong></td>
<td>45-55</td>
<td>40-50</td>
<td>50-60</td>
<td>40-50</td>
</tr>
<tr>
<td><strong>Sats</strong></td>
<td>&gt; 88-93%</td>
<td>&gt; 92%</td>
<td>&gt; 88-93%</td>
<td>&gt; 92%</td>
</tr>
</tbody>
</table>

### Immunizations

- **NO live virus vaccines are given in the NICU!**
- DTap, Hflu, PCV, IPV can be given to all infants at 2 mo chronological age
- **If Mom is Hep B +,** all infants admitted during the 1st week of life, regardless of BW or gestational age, will be given BOTH HBIG and Hep B vaccine before 12 hours of age or ASAP.
- **If Mom’s Hep B status is unknown:**

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Term or Preterm > 2000 gm: Give Hep B vaccine ASAP before 12 hours of life; Request that Mom be tested and if the mother is HBsAg +, give HBIG ASAP, but within 7 days
Preterm < 2000 gm: Hep B vaccine and HBIG within 12 hours of birth.

If Mom’s Hep B status is negative:
- For term infants or preterm infants with BW > 2 kg and born to HBsAg negative women, start vaccinations at birth.
- For preterm infants weighing < 2 kg and born to HBsAg negative women: Vaccination #1 at 30 days of age; however preterm infants who begin Hep B vaccination at < 30 days of age will require a 4th dose

Therapeutic Hypothermia (Cooling Patient)
- Criteria for Infants Eligible for Cooling
  - > 36 weeks completed gestation
  - Must arrive for treatment within 6 hours of birth
  - Premature neonates are excluded (hypothermia is associated with increased mortality)
  - Evidence of hypoxic ischemic insult: Requirement for resuscitation at delivery, Moderate to severe encephalopathy
- Hypothermia: Placed on water filled cooling mattress to reduce body temperature to 92 degrees x 3 days; Re-warmed after 3 days of cooling
- Post Cooling
  - Asphyxiated infants are at risk of NEC from transient intestinal ischemia
  - Most infant recover oromotor function by the time of discharge
  - MRI should be performed between 7-10 days of life

Persistent Pulmonary HTN
- Mechanism: Increased pulmonary vascular resistance post-delivery leads to continuation of fetal R→L shunts (foramen ovale & ductus arteriosus)
- Duration: Most infants resolve their PPHN by 5 days of age
- Treatment Protocol: Keep Hct > 40; Keep MAPs normal/slightly elevated (you don’t want to increase the right to left shunt!); Treat Hypotension in PPHN with 10 cc/kg NS, PRBCs, and Dopamine
- Respiratory Management: You want patient to be slightly alkaloinized so induce Hyperventilation (PC02s 35-45) and give Nitric Oxide starting with 20 ppm (Met Hb must be monitored closely)
- When to Consider ECMO: After maximal therapy has been achieved and Pa02 < 50 x 2-3 hours, patient should be considered for ECMO
- ECMO Criteria: > 2 kg, < 10-14 days of assisted ventilation, Reversible lung disease, No severe IVH (> Grade II), Failure of max medical management

Rule out Sepsis
- All babies should have a complete sepsis work up including CXR, blood, urine, and CSF
- Medication Levels
  - Vanc: obtain trough before the 3rd dose
  - Gent: obtain peak after the 2nd dose and trough before the 3rd dose
Include most updated NALS algorithm

## Endotracheal Intubation

<table>
<thead>
<tr>
<th>Gestational Age (weeks)</th>
<th>Weight (kg)</th>
<th>ETT Size (mm)</th>
<th>Insertion (cm from upper lip)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 28</td>
<td>&lt; 1.0</td>
<td>2.5</td>
<td>6-7</td>
</tr>
<tr>
<td>28-34</td>
<td>1.0-2.0</td>
<td>3</td>
<td>7-8</td>
</tr>
<tr>
<td>34-38</td>
<td>2.0-3.0</td>
<td>3.5</td>
<td>8-9</td>
</tr>
<tr>
<td>&gt; 38</td>
<td>&gt; 3.0</td>
<td>3.5-4.0</td>
<td>9-10</td>
</tr>
</tbody>
</table>

Depth of insertion (cm) = 6 + weight (in kg)
• **Epinephrine**: 1:10,000 concentration, Use 0.01-0.03 mg/kg (0.1-0.3 mL/kg) ET or IV. Give rapidly, flush catheter/ETT with 0.5-1 mL NS.
• **Normal Saline**: 10 mL/kg IV or UVC over 5-10 minutes to volume expand
• **Sodium Bicarbonate**: 0.5 mEq/mL (4.2% solution), Use 1-2 mEq/kg (2-4 mL/kg), administer slowly over at least 2 min and only if newborn is being effectively ventilated
• **Naloxone**: 0.1 mg/kg rapid IV or ET (can give SQ or IM too) for narcotic induced respiratory depression
• **Glucose**: For hypoglycemia give D10W 2 mg/kg IV over 1-2 min followed by continuous glucose infustion
• **Phenobarbital**: 20 mg/kg slowly IV (1 mg/kg/min) for seizures although recognize it may depress respiratory effort
• **Dopamine**: 2-20 mcg/kg/min via continuous IV for hypotension

**Umbilical Lines**

• **Low Umbilical Artery Catheter (UAC)**
  o **Location**: Tip between L3 and L4 to avoid injuring the renal (L1) and inferior mesenteric (L2) arteries but above the bifurcation of the aortic and iliac arteries around L4/L5
  o **UAC length** (in cm) = Birth weight (in kg) + 7
  o **Malpositions and what to do:**
    ▪ If catheter is between L2 and T10: Catheter needs to be repositioned to a low line at L3 and L4. Once the catheter has been repositioned, repeat an AXR to check the new cathete placement.
    ▪ If catheter is curved back on itself: Try to pull back on the catheter to see if it will straighten out. Repeat the AXR after the catheter has been repositioned. If the catheter is still curven upon itself further attempts to reposition will most likely be unsuccessful thererfore it should be removed and a new sterile catheter inserted.
    ▪ If catheter is down the leg: Remove it and replace with a new sterile catheter
    ▪ If catheter is too low (below L4): It may be in an iliac artery in the leg. Do not push it in! Once a sterile field has been disassembled a catheter should not be advanced. Remove the catheter and reinsert a new one using sterile technique.

• **High Umbilical Artery Catheter (UAC)**
  o **Location**: Tip between T6 and T9 in order to pass the celiac artery (T11), superior mesenteric artery (T11-T12), but not as high as the aortic arch and subclavian arteries (T5)
  o **UAC length** (in cm) = [3 * Birth weight (in kg)] + 9
  o **Malpositions and what to do:**
    ▪ If catheter is higher than T6: Pull it back until it is between T6 and T9, repeat CXR to verify correct position
    ▪ If catheter is curved back on itself, follow above instructions
    ▪ If catheter is below T9, pull it back until it is at the level fo L3 to L4 (i.e. convert the catheter from a high to a low line)

• **Umbilical Venous Catheter (UVC)**
  o **Location**: Tip between IVC and RA
  o **UVC length** (in cm) = [0.5 * High UAC length] + 1
• **Starting:** Your PICU Goals & Objectives will be sent to you for your review about a week before your month begins. Review them before you start so that you can have a sense of what you should be learning before you’re thrown in. You should receive sign-out on your kids prior to your first Monday, and arrive on the first day with enough time to get a quick update and pre-round on your patients. Usually, people show up around 5 or 5:30 on their first day.

• **Schedule:** 5:30-6am – Arrive and pre-round on your patients 7:30am – Rounds start 9:30am – Radiology Rounds 10:30am – Resident teaching session 11am – Post-call resident must be gone Noon-1pm – Residents going to clinic or REACH sign-out 5pm – Afternoon residents not on call sign-out and leave On Wednesday, there is Grand Rounds from 8-9am that everyone attends. This takes the place of resident teaching session that day.

• **Every new admission requires:** A MRSA nasal PCR order, PICU consent form signed, an H&P in the set up of a PICU systems based progress note. In Cerner add note, Search for PICU systems based progress note and click on it, Title it and select in the drop down menu “history and physical”, In the subjective/HPI region you must type in the HPI, PMH, Meds and allergies so that the attending can bill appropriately as an H&P, That way, the next day, you can just copy forward and just have to change the title and delete unnecessary info in the HPI

• If you’re done with your work and you are not on call, it is totally acceptable to sign out early

• Update your hospital summaries at least twice a week. This is so crucial since most afternoons one person is there by themselves.

• **Transferring patients out of the PICU:**
  - If going to a subspecialty covered by residents
    - Talk to the fellow/attending
    - Once given ok for transfer out, page senior to let them know about the transfer
  - If going to a subspecialty not covered by residents
    - Talk to fellow/attending
  - If going to hospitalist service
    - Page admitting hospitalist on days, PL3 on the weekend or nights
  - The accepting service has to write the transfer order
### Shock

<table>
<thead>
<tr>
<th></th>
<th>CO</th>
<th>SVR</th>
<th>MAP</th>
<th>Wedge</th>
<th>CVP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypovolemic</td>
<td>↑</td>
<td>↑</td>
<td>⇔ or ↓</td>
<td>↓↓↓</td>
<td>↓↓↓</td>
</tr>
<tr>
<td>Cardiogenic</td>
<td>↓↓</td>
<td>↑↑↑</td>
<td>⇔ or ↓</td>
<td>↑↑</td>
<td>↑↑</td>
</tr>
<tr>
<td>Obstructive</td>
<td>↓</td>
<td>↑</td>
<td>⇔ or ↓</td>
<td>↑↑</td>
<td>↑↑</td>
</tr>
<tr>
<td>Distributive</td>
<td>↑↑</td>
<td>↓↓↓</td>
<td>⇔ or ↓</td>
<td>⇔ or ↓</td>
<td>⇔ or ↓</td>
</tr>
<tr>
<td>Septic: Early</td>
<td>↑↑↑</td>
<td>↓↓↓</td>
<td>⇔ or ↓</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Septic: Late</td>
<td>↓↓</td>
<td>↑↑</td>
<td>↓</td>
<td>↑</td>
<td>↑ or ⇔</td>
</tr>
</tbody>
</table>

### Pressors

<table>
<thead>
<tr>
<th></th>
<th>α</th>
<th>β1</th>
<th>β2</th>
<th>CO</th>
<th>Cont</th>
<th>SVR</th>
<th>MAP</th>
<th>Wedge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epinephr.</td>
<td>+++</td>
<td>+</td>
<td>+</td>
<td>↑↑</td>
<td>↑</td>
<td>Any</td>
<td>↑</td>
<td>⇔ or</td>
</tr>
<tr>
<td>Norepine.</td>
<td>+++</td>
<td>+</td>
<td></td>
<td>Any</td>
<td>↑</td>
<td>↑↑↑</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>Dopamine</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>↑↑</td>
<td>↑</td>
<td>Any</td>
<td>↑</td>
<td>⇔ or</td>
</tr>
<tr>
<td>Dobutam.</td>
<td>+</td>
<td>+++</td>
<td>+</td>
<td>↑↑</td>
<td>↑</td>
<td>Any</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Isoproter</td>
<td>+++</td>
<td>+++</td>
<td></td>
<td>↑↑</td>
<td></td>
<td>Any</td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Amrinone</td>
<td>↑↑</td>
<td>Any</td>
<td>↓</td>
<td></td>
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<td></td>
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<tr>
<td>Milrinone</td>
<td>↑↑</td>
<td>↑</td>
<td>↓↓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Enoximone</td>
<td>↑↑</td>
<td>Any</td>
<td>↓↓</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Nitropruss.</td>
<td>↑</td>
<td></td>
<td>↓↓</td>
<td></td>
<td></td>
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<tr>
<td>Nitroglyce.</td>
<td>↑</td>
<td></td>
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<tr>
<td>Captopril</td>
<td>↑</td>
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</table>

### Acid Base Disorders

<table>
<thead>
<tr>
<th></th>
<th>pH</th>
<th>HCO3</th>
<th>CO2</th>
<th>Compensation</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metabolic Acidosis</td>
<td>↓</td>
<td>↓</td>
<td></td>
<td>CO2 ↓ by 1.2 mmHg for every 1 mEq ↓ in HCO3</td>
<td>MUDPILES, TPN, RTA, Diarrhea</td>
</tr>
<tr>
<td>Respiratory Acidosis</td>
<td>↓</td>
<td>↑</td>
<td></td>
<td>HCO3 ↑ by 1 (acute) or 3.5 (chronic) for every 10 mmHg ↑ in CO2</td>
<td>CNS Δ, ARDS, Pleural dx</td>
</tr>
<tr>
<td>Metabolic Alkalosis</td>
<td>↑</td>
<td>↑</td>
<td></td>
<td>CO2 ↑ by 0.7 mmHg for every 1 mEq ↑ in HCO3</td>
<td>Vomiting, Diuretics, Diarrhea</td>
</tr>
<tr>
<td>Respiratory Alkalosis</td>
<td>↑</td>
<td>↓</td>
<td></td>
<td>HCO3 ↓ by 2 (acute) or 4 (chronic) for every 10 mmHg ↓ in CO2</td>
<td>Salicylates, Sepsis, CNS bleed</td>
</tr>
</tbody>
</table>

### Diabetic Ketoacidosis

- **Diagnosis:** Ketonuria, Blood glucose >250, Anion gap, pH<7.3, bicarb <18
- **Management:** KEEP DEXTROSE OUT OF IVF UNTIL BG<300
  - NS bolus of 20 cc/kg
  - Insulin gtt (0.1 units/kg/hr) NOTE: Insulin drives K and Phos into cells
  - Fluid Correction: assume 7-10% dehydrated – use 1/2NS or NS and run at 1.5-2xMIVF
  - Check BG and BMP q1h until bicarb >15
  - Once bicarb>15 and patient tolerating PO, can transition to interval insulin dosing → transfer to endocrine

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Traumatic Brain Injury

- **CPP** (cerebral perfusion pressure) = MAP – ICP
  - <1 year: >50
  - 1-12 years: => 55
  - >12 years: => 60
- **ICP monitoring:** With ventriculostomy vs. intraparenchymal bolt if
  - Initial GCS <8
  - Head CT is abnormal
  - Inability to serially assess clinical exam
- **ICP normal values 5-15 in adults and trends down for infants**
- **ICP Management**
  - Elevate HOB to 30 degrees
  - Sedate/control pain (versed, morphine, fentanyl)
  - CSF drainage
  - **Saline:**
    - Continuous infusion starting at 1 cc/kg/hr
    - Bolus dosing of 5 cc/kg for acute ICP spikes
    - Goal Na 150-160 (check q8h), osmol <360
  - **Mannitol** (osmotic diuretic)
    - Decreases CSF production
    - Dose: 0.25-1 gm/kg q4-6 hours PRN ICP>20
    - See effect in 1-5 minutes, peak 20-60 minutes
    - Limit: serum osmolality >320 mOsm/kg
  - **Paralytics**
    - More controversial/patient specific: mild hyperventilation (CO2 25-35),
      pentobarb coma, steroids (NEVER with intracranial hemorrhage), craniotomy
  - **Cooling:**
    - **Theoretical benefits:** decreases metabolism, cytokines, apoptotic
      enzymes, edema
    - T: 32.5-37 degrees Celsius
    - Not every patient meets criteria for cooling – the fellows will let you
      know which patients should be cooled

Status Asthmaticus

- **PICU admits:** All children on continuous albuterol <= 3 yo or those in
  severe distress w/: O2 requirement >50%, On continuous for >18 hours, or
  about to tire out
- **Magnesium Sulfate:** Children: 25-75 mg magnesium sulfate/kg/dose (max
  dose: 2 g) IV; Adults: 2 g magnesium sulfate as a single dose
- **Epinephrine:** Data only available for adult dosing: SubQ: 0.3-0.5 mg every
  20 minutes PRN for 3 doses
- **Terbutiline Sulfate**
  - **SubQ:** Kids - 0.005-0.01 mg/kg/dose to a maximum of 0.4 mg/dose
    every 15-20 minutes for 3 doses; may repeat every 2-6 hours as needed
    Adults: 0.25 mg/dose repeated in 20 minutes for 3 doses; a total dose
    of 0.75 mg should not be exceeded
  - **IV gtt:** 2-10 mcg/kg loading dose followed by an 0.08-0.4 mcg/kg/minute
    continuous infusion – room to go up but data is not sufficient on max
dose
Status Epilepticus

- **Differential:** Fever, medication change/error, metabolic, congenital, anoxic, trauma, vascular, infection, drugs, unknown
- **Reversible causes:** Consider electrolytes, glucose, ammonia, tox screen

  ***Remember you must correct hypomag before you can correct other electrolyte abnormalities***

- **Stop the Seizure:**
  - **Benzodiazepines:** Lorazepam is first line in ICU: 0.1 mg/kg IV/IM over 2 minutes (lasts 5-12 hours)
  - **Barbiturates:**
    - **Phenobarbital:** 20 mg/kg IV loading dose
    - **Fosphenytoin:** 20 mg/kg IV over 5-7 minutes
    - **Pentobarbital:** 5-12 mg/kg IV loading dose (lasts 25 hours!)
  - For anything lasting >1 hour, goal is burst suppression on EEG using: Pentobarb gtt, phenobarb gtt, midazolam gtt, propofol gtt, anesthetic drugs, ketamine, pyridoxine
  - Last resort: cut out the seizing brain, vagal nerve stimulator
  - Remember: Always have low threshold for nonconvulsive status (in 20% of pts after convulsions stop)

**Intubations**

- **Indications:** respiratory failure, CV failure, neurological compromise, airway protection
- **Premeds:** atropine (prevents bradycardia during DL), glycopyrolate (↓ secretions), lidocaine (blunts ICP spike with DL, but negative inotrope)
- **Sedatives/Analgesics:** Different options have different advantages

<table>
<thead>
<tr>
<th>Sedative</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzodiazepines</td>
<td>Amnesia, Sedation</td>
<td>Danger in low CO states</td>
</tr>
<tr>
<td>Opiates</td>
<td>Analgesia</td>
<td></td>
</tr>
<tr>
<td>Ketamine</td>
<td>Minimal Resp Depression, Bronchodilation, Amnesia</td>
<td>Lowers seizure threshold, ↑ secretions, Dissociative</td>
</tr>
<tr>
<td>Etomidate</td>
<td>Short acting, No Myocardial depression</td>
<td>Adrenal suppression</td>
</tr>
<tr>
<td>Thiopental</td>
<td>Short acting, Good for head trauma</td>
<td>Hypotension</td>
</tr>
<tr>
<td>Propofol</td>
<td>Short acting, Rapid onset, rapid recovery, No nausea</td>
<td>No analgesia, Long infusions (MA, renal failure)</td>
</tr>
</tbody>
</table>

**Dexmedetomidine** (NOT FOR INTUBATION): Helps with extubation; Benefits are sedation, and minimal resp depression; Downsides are bradycardia, sinus arrhythmias, and hypotension

- **NM Blockade:** Depolarizing meds such as Succinylcholine are quick onset (30-60 sec), short effect (3-5 min) but have the downsides of inc K, inc ICP, malignant hyperthermia, muscle fasciculations Non-Depolarizing meds include Rocuronium and Vecuronium

- **Rapid Sequence Intubation:** Often in cases where the patient is presumed to have recently eaten, first preoxygenate but no BMV!! Then +/- pre meds: lidocaine, atropine, +/- defasciculating med, Sedative, Paralytic, Laryngoscopy with Cricoid pressure, then Intubate.
Ventilators

- **Indications**: ventilation failure (apnea, pCO2>55, impending resp failure), oxygenation failure (pO2<60 at FiO2>0.6, to decrease WOB, NM disease (loss of protective reflexes)
- **Ventilation**: Goal is to facilitate CO2 release and maintain normal PaCO2
  - Increased CO2 production (fever, sepsis, injury)
  - Increased V0 (atelectasis, lung injury, ARDS, PE)
  - Adjust RR and TV
    - Efficiency of ventilation decreases with increasing RR
    - Goal TV = 10ml/kg
- **Oxygenation**: Goal is to maximize O2 delivery to blood (PaO2)
  - V/Q mismatching (supine position, airway pressure, asthma)
  - Adjust FiO2 and PEEP (in tandem)
    - FiO2 is the simplest maneuver to quickly increase PaO2, however, long term toxicity when > 69%; Inadequate oxygenation despite 100% FiO2 usually due to pulmonary shunting, i.e. collapse (atelectasis), pus-filled alveoli (PNA), water/protein (ARDS), water (CHF), blood (hemorrhage)
    - PEEP increases FRC, recruits collapsed alveoli and improves V/Q mismatching, enables maintenance of adequate PaO2 at a safe FiO2 level; However, increases intrathoracic pressure, may lead to ARDS and rupture (PTX, pulm edema)
- Goal of PPV is to inc end-exp volume toward FRC, inc mean lung volume, and recruit atelectatic lung segments/poorly ventilated alveoli

- **Control vs SIMV**
  - **Assist control**: patient initiates all breaths and vent delivers full TV for each initiation
  - **IMV**: patient receives set # of ventilator breaths, but can also initiate own (spont) breaths with fixed TV, that are NOT supported by machine, BUT...ventilator ALWAYS delivers breath, even if patient exhaling
  - **SIMV**: synchronized! Spont breaths and mandatory breaths, so if patient has resp drive, the mandatory breaths are synchronized with the patient’s inspiratory effort

- **Pressure vs Volume**
  - **Pressure Vent**: avoids excessive inflating pressure→dec barotraumas for better oxygenation, BUT has variable volume and changes in compliance/resistance not noticed as easily
  - **Volume Vent**: has constant volume and changes in pressure are associated with pt mechanics (i.e. P increases= need for suction), BUT can get very high pressures→increased barotraumas

- **PRVC**
  - Set tidal volume
  - Set inspiratory time
  - Constant pressure applied → decelerating flow pattern
  - Vent regulate the achieved TV and adjusts pressure accordingly

- **Where to start?**
  - **TV or PIP**: Want to achieve ~6-8ml/kg
  - **IMV**: Set a physiological norm for age, then adjust based on pCO2
  - **I time**: Want I:E ratio of ~1-2; Infants-0.4-0.5, small kids-0.6-0.8, big kids-0.8-1.2
Electrolyte Emergencies

- **Hyponatremia:**
  - **Loss of Na:** adrenal insufficiency, Salt wasting nephropathy, cerebral salt wasting, meds/diuretics (thiazides, loop)
  - **Too much H2O:**
    - **Too much H2O taken IN:** water intoxication, dilutional
    - **Too little H2O let OUT:** SIADH, appropriate ADH (dehydration, shock, hypoproteinemia, CHF)
  - **Other:** hyperglycemia, pseudohyponatremia (hyperTG, nephritic syn.)

- **SIADH:** Syndrome of Inappropriate ADH; Excludes normal reasons for release of ADH (i.e. hypertonicity, life threatening hypotension)
  - **Features:** Hyponatremia, Oliguria, Concentrated urine (elev urine spec gravity and inappropriately high urine osmolality in the face of hyponatremia), Normal to high urine sodium excretion
  - **Causes:** Any CNS disease (TBI, meningitis/encephalitis, stroke, head bleed), Drugs (tegretol, cytoxan, SSRIs, anti-psychotics), Any LUNG disease (tumors, TB, infections), Infections, Stress
  - **Symptoms:** Anorexia, nausea, vomiting, muscle cramps, weakness, confusion, HA, seizures, resp failure, coma, death
  - **Treatment** (if asymptomatic): Fluid restriction (25-75% of maintenance requirements, including oral intake), Daily wts, Frequent lyte monitor
  - **Treatment** (if symptomatic): Hypertonic saline (3% NaCl) with volume depending on on Na deficit = (0.6)(weight in kg)(125-measured Na), with a goal to increase at least 5mEq/L in the first hour

- **Cerebral Salt Wasting:** Dx of exclusion, seen with any brain lesion
  - **Features:** Low serum Na, High urine Na (>40), Elevated urine osmoles (>100), Volume depletion
  - **Treatment:** Fluids for hypovolemia! Replace urinary sodium losses until resolution of disease process, and keep CLOSE monitoring

- **Diabetes Insipidus:** Excess urinary excretion of free H2O (CENTRAL) from destruction of neurons that originate in the supraoptic and paraventricular nuclei of hypothalamus (TBI, Brain tumors, LCH) or (PERIPHERAL) due to failure of the nephron to respond to ADH
  - **Features:** Serum with Hyponatremia, Hyperosmolality (>300); Urine with polyuria, urine osm <300, urine spec grav <1.010
Treatment (Central): Vasopressin infusion: 0.5mu/kg/hr, adjusting to UOP; Sodium correction: correct Na by no more than 1mEq/hr or 15mEq/day

• Hypernatremia: Na > 145?
  o Water losses
    ▪ Renal: Central DI, Nephrogenic DI, diuretics, Hyperglycemia
    ▪ Insensible: Fever, exercise, burns, respiratory illness
    ▪ GI: Gastro, osmotic diarrhea, colostomy, malabsorption
  o Decreased fluid intake: Neurologic impairment; Restricted access to fluids; Fluid restriction
  o Excess Na administration: Hypertonic NaCl/IVF; High solute feeding; Na ingestion

• Hyperkalemia:
  o Causes: Excessive intake; Not enough out (renal failure, hypoaldosteronism); Redistribution (Acidosis), Cell breakdown
  o EKG changes: Peaked T waves, Absent P waves, Wide QRS → Vtach
  o Treatment: Ca Gluconate (100mg/kg), Ca Bicarb (10-20mg/kg), Bicarb (1mEq/kg), Insulin (0.1unit/kg) and Glucose (1gm/kg), Albuterol, Kayexalate (1gm/kg PO or PR), Loop/Thiazide Diuretics, Dialysis

• Hypokalemia:
  o Causes: Poor intake (anorexia), Losses (GI: v/d, Renal: diuretics), Alkalosis
  o Symptoms: Weakness; Paralysis; Constipation; Ileus
  o EKG changes: Flattened T waves; ST depression; PVCs; U waves
  o Treatment: PO/IV: peripheral: no more than 40-50mEq/L; central: 0.5-1 mEq/kg bolus; Remember to replace Mg if low (25-50mg/kg IV)
<table>
<thead>
<tr>
<th>Drug</th>
<th>Onset</th>
<th>Indications</th>
<th>Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dose</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dose: 0.02 mg/kg/dose IV</td>
<td>Rapid</td>
<td>Pts &lt; 2 yrs or those getting ketamine</td>
<td>Causes tachycardia and dries secretions</td>
</tr>
<tr>
<td>Min/Max dose: 0.1/1 mg</td>
<td></td>
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<tr>
<td><strong>Glycopyrolate</strong></td>
<td>1-10 min</td>
<td>Similar to atropine</td>
<td>Similar to atropine</td>
</tr>
<tr>
<td>Dose: 4-10 mcg/kg IV/IM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dose: 1 mg/kg IV/ET</td>
<td>45-90 s</td>
<td>Good for asthma, May blunt ICP spike during laryngoscopy</td>
<td>Negative inotrope, don’t use if patient is hypotensive</td>
</tr>
<tr>
<td>Max dose: 100 mg</td>
<td></td>
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<tr>
<td><strong>Midazolam</strong></td>
<td>1-5 min</td>
<td>Decreases anxiety, best used w narcotic</td>
<td>Vasodilation and hypotension. Avoid in shock pts</td>
</tr>
<tr>
<td>Dose: 0.1 mg/kg/dose IV</td>
<td></td>
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<tr>
<td><strong>Fentanyl</strong></td>
<td>Rapid</td>
<td>Good analgesic</td>
<td>Bradycardia, Chest wall rigid in ↑ dose</td>
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<tr>
<td>Dose: 1-5 mcg/kg/dose IV</td>
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<tr>
<td><strong>Etomidate</strong></td>
<td>30-60 s</td>
<td>Deep sedation, CNS protectant, Min hemody. Effects</td>
<td>Potential for adrenal suppression</td>
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<tr>
<td>Dose: 0.3 mg/kg IV</td>
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<tr>
<td>Max dose: 30 mg</td>
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<tr>
<td><strong>Sodium Thiopental</strong></td>
<td>30-60 s</td>
<td>↓cerebral metab rate, ↓brain vol, ↓ ICP, Good for sz</td>
<td>Myocardial depression, hypotension</td>
</tr>
<tr>
<td>Dose: 2-4 mg/kg IV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ketamine</strong></td>
<td>30 s</td>
<td>Dissoc amnesia, Bronchodilation, Positive Inotrope</td>
<td>Increased ICP, ↓ seizure threshold, Bronchorrhea</td>
</tr>
<tr>
<td>Dose: 1-2 mg/kg IV/IM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dexmedetomidine</strong></td>
<td>3-5 min</td>
<td>Sedation, analgesia</td>
<td>↓HR, Arrythmia, Hypotension</td>
</tr>
<tr>
<td>Dose: 1 mcg/kg/dose IV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Propofol</strong></td>
<td>Rapid</td>
<td>Rapid onset, short duration, titratable</td>
<td>Myocardial depression w hypotension</td>
</tr>
<tr>
<td>Dose: 1 mg/kg IV</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rocuronium</strong></td>
<td>30-60 s</td>
<td>Rapid onset</td>
<td>Duration 45-70 min, urine and bile excretion</td>
</tr>
<tr>
<td>Dose: 0.6-1 mg/kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Vecuronium</strong></td>
<td>1-3 min</td>
<td></td>
<td>Duration 20-30 min, renal and hepatic excretion</td>
</tr>
<tr>
<td>Dose: 0.1 mg/kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cisatracurium</strong></td>
<td>1-4 min</td>
<td></td>
<td>Duration 20-30 min</td>
</tr>
<tr>
<td>Dose: 0.4-0.5 mg/kg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Succinylcholine</strong></td>
<td>30-60 s</td>
<td></td>
<td>Raises ICP, causes sinus bradycardia</td>
</tr>
<tr>
<td>Dose: 1 mg/kg</td>
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<td></td>
</tr>
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</table>
### Resuscitation and Dysrhythmias

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose/Route</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adenosine</strong></td>
<td>(First dose) 0.1 mg/kg (Max = 6 mg) IV/IO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Subsequent doses) 0.2 mg/kg (Max = 12 mg each)</td>
<td></td>
</tr>
<tr>
<td><strong>Amiodarone</strong></td>
<td>5 mg/kg (Max = 15 mg/kg/day) IV/IO</td>
<td></td>
</tr>
<tr>
<td><strong>Atropine</strong></td>
<td>0.02 mg/kg IV/IO/ET</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Min single dose) 0.1 mg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Max single dose) Child 0.5 mg, Adult 1 mg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Max total dose) Child 1 mg, Adult 2 mg</td>
<td></td>
</tr>
<tr>
<td><strong>Calcium Chloride</strong></td>
<td>20 mg/kg IV/IO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Max dose) 500 mg – 1 gm</td>
<td></td>
</tr>
<tr>
<td><strong>Dextrose</strong></td>
<td>(&lt; 3 mo) D10% 2-6 mg/kg IV/IO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(&gt; 3 mo) D25% 2-4 mg/kg IV/IO</td>
<td></td>
</tr>
<tr>
<td><strong>Epinephrine</strong></td>
<td>(IV/IO) 0.01 mg/kg of 1:10,000 (0.1 mg/kg) Can repeat q3 min</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(ET) 0.1 mg/kg of 1:1,000 (0.1 mg/kg)</td>
<td></td>
</tr>
<tr>
<td><strong>Lidocaine</strong></td>
<td>(Loading dose) 1 mg/kg of 2% IV/IO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Max dose) 100 mg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Infusion) 20-50 mcg/kg/min</td>
<td></td>
</tr>
<tr>
<td><strong>Magnesium Sulfate</strong></td>
<td>25-50 mg/kg (Max = 2 gm) IV/IO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Administer over 20 minutes</td>
<td></td>
</tr>
<tr>
<td><strong>Sodium Bicarbonate</strong></td>
<td>1 mEq/kg IV/IO Use 4.2% (0.5 mEq/mL) for neonates</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use 8.4% (1 mEq/mL) for infants and children</td>
<td></td>
</tr>
</tbody>
</table>

### Vasoactive Medications and Insulin

<table>
<thead>
<tr>
<th>Medication</th>
<th>Dose/Route</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alprostadil (PGE1)</strong></td>
<td>0.05-0.1 mcg/kg/min</td>
<td></td>
</tr>
<tr>
<td><strong>Dobutamine</strong></td>
<td>5-20 mcg/kg/min</td>
<td></td>
</tr>
<tr>
<td><strong>Dopamine</strong></td>
<td>5-20 mcg/kg/min</td>
<td></td>
</tr>
<tr>
<td><strong>Epinephrine</strong></td>
<td>0.1-1 mcg/kg/min</td>
<td></td>
</tr>
<tr>
<td><strong>Isoproterenol</strong></td>
<td>0.05-2 mcg/kg/min</td>
<td></td>
</tr>
<tr>
<td><strong>Nitroprusside</strong></td>
<td>0.3-10 mcg/kg/min</td>
<td></td>
</tr>
<tr>
<td><strong>Norepinephrine</strong></td>
<td>0.05-2 mcg/kg/min</td>
<td></td>
</tr>
<tr>
<td><strong>Phenylephrine</strong></td>
<td>(Initial bolus) 5-20 mcg/kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Subsequent) 0.1-0.5 mcg/kg/min</td>
<td></td>
</tr>
<tr>
<td><strong>Insulin</strong></td>
<td>(100 U/100 mL NS) 0.1 U (=0.1 mL)/kg/hr (no bolus)</td>
<td></td>
</tr>
</tbody>
</table>
### Anticonvulsants and Increased ICP

<table>
<thead>
<tr>
<th>Medicine</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diazepam</td>
<td>0.1-0.3 mg/kg IV/IO&lt;br&gt;(Max dose &lt; 5 yrs) 5 mg&lt;br&gt;(Max dose &gt; 5 yrs) 10 mg</td>
</tr>
<tr>
<td>Diastat (rectal diazepam gel)</td>
<td>(2-5 yrs) 0.5 mg/kg&lt;br&gt;(6-11 yrs) 0.3 mg/kg&lt;br&gt;(12 yrs +) 0.2 mg/kg</td>
</tr>
<tr>
<td>Fosphenytoin</td>
<td>(Loading dose) 18 mg PE/kg IV/IO over 20 min&lt;br&gt;(Max dose) 1 gm PE</td>
</tr>
<tr>
<td>Lorazepam</td>
<td>0.1 mg/kg IV/IO&lt;br&gt;(Max dose) 4 mg</td>
</tr>
<tr>
<td>Midazolam</td>
<td>0.1-0.2 mg/kg (Max dose = 5 mg) IV/IM/IO</td>
</tr>
<tr>
<td>Mannitol 25%</td>
<td>(0.25 gm/mL) 0.25-1 gm/kg IV/IO</td>
</tr>
<tr>
<td>Phenobarbital</td>
<td>(Loading dose) 10-20 mg/kg IV/IO over 20 min&lt;br&gt;(Adult dose) 300-800 mg&lt;br&gt;Administer dose at a rate not to exceed 1 mg/kg/min</td>
</tr>
</tbody>
</table>

### Respiratory Distress Medications

<table>
<thead>
<tr>
<th>Medicine</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albuterol</td>
<td>0.083% = 2.5 mg/3 mL&lt;br&gt;(&lt; 5 kg) 0.15 mg/kg&lt;br&gt;(5-10 kg) 1.25 mg (1.5 mL of 0.083% neb solution)&lt;br&gt;(10-20 kg) 2.5 mg (3 mL of 0.083% neb solution)&lt;br&gt;(&gt; 20 kg) 5 mg (6 mL of 0.083% neb solution)&lt;br&gt;(Continuous neb) 0.4-0.6 mg/kg/hr (Max = 20 mg/hr)</td>
</tr>
<tr>
<td>Dexamethasone</td>
<td>(For croup) 0.6 mg/kg (Max 10 mg) PO/IV/IM</td>
</tr>
<tr>
<td>Epinephrine</td>
<td>0.01 mg/kg of 1:1,000 SQ (Max 0.3 mg = 0.3 mL)</td>
</tr>
<tr>
<td>Ipratropium</td>
<td>(&lt; 12 yrs) 250 mcg + NS = 3 mL Aerosol&lt;br&gt;(&gt; 12 yrs) 250-500 mcg + NS = 3 mL Aerosol</td>
</tr>
<tr>
<td>Magnesium Sulfate</td>
<td>25-75 mg/kg (Max = 2 gm) IV/IO over 20 min</td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td>2 mg/kg then 0.5-1 mg/kg q6h (for status asthmaticus)</td>
</tr>
<tr>
<td>Racemic Epinephrine</td>
<td>(&lt; 5 kg) 0.25 mL&lt;br&gt;(&gt; 5 kg) 0.5 mL</td>
</tr>
<tr>
<td>Terbutaline (SQ)</td>
<td>(&lt; 12 yrs) 0.005-0.01 mg/kg SQ; Can repeat q15-20 min x 3&lt;br&gt;(&gt; 12 yrs) 0.25 mg SQ every 20 min; Can repeat q15-20 min x 3</td>
</tr>
<tr>
<td>Terbutaline (IV)</td>
<td>2-10 mcg/kg (initial bolus), then 0.1-0.4 mcg/kg/min&lt;br&gt;(Max dose) Doses up to 10 mcg/kg/min have been used</td>
</tr>
</tbody>
</table>
Consider including the most updated Pediatric Cardiac Arrest algorithm

**Reversible Causes**
- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypoglycemia
- Hypothermia
- Tension Pneumothorax
- Tamponade (cardiac)
- Toxins
- Thrombosis (coronary, PE)

- **CPR:** If no advanced airway 15:2 ratio of compressions:ventilation; if airway in place 8-10 bpm with continuous compressions. Push fast (at least 100 bpm), deep (1/3 AP diameter), and allow full recoil
- **Shock:** 1\(^{\text{st}}\) shock 2 J/kg, 2\(^{\text{nd}}\) shock 4J/kg, maximum 10J/kg or adult dose
- **Epinephrine:** 0.01 mg/kg IV/IO (0.1 mL/kg of a 1:10,000 concentration) or if no access may give 0.1 mg/kg ETT (0.1 mL/kg of a 1:1,000 concentration)
- **Amiodarone:** 5 mg/kg bolus, may repeat x2 for refractory VF/pulseless VT
Consider including the most updated Pediatric Bradycardia algorithm

- **Cardiopulmonary Compromise**: Hypotension, Acutely altered mental status, signs of shock
- **Epinephrine**: IV/IO dose is 0.01 mg/kg (0.1 mL/kg of 1:10,000 concentration). Repeat every 3-5 minutes. If IO/IV access not available but endotracheal (ET) tube in place, may give ET dose: 0.1 mg/kg (0.1 mL/kg of 1:1,000 concentration)
- **Atropine**: IV/IO dose: 0.02 mg/kg. May repeat once. Minimum dose 0.1 mg and maximum single dose 0.5 mg.
Consider including the most updated Pediatric Tachycardia algorithm

- **Synchronized Cardioversion**: Begin with 0.5-1 J/kg; If not effective, increase to 2 J/kg. Sedate if needed, but don’t delay cardioversion.
- **Adenosine**: IV/IO dose 1st is 0.1 mg/kg rapid bolus (max 6 mg), 2nd is 0.2 mg/kg rapid bolus (max 12 mg)
- **Amiodarone OR Procainamide**: Both can be given IV/IO but do not routinely administer together. Amiodarone dosing is 15 mg/kg over 20-60 minutes. Procainamide dosing is 15 mg/kg over 30-60 minutes
### Normal Pediatric Vital Signs

<table>
<thead>
<tr>
<th>Age</th>
<th>Weight (kg)</th>
<th>Heart Rate</th>
<th>Resp. Rate</th>
<th>Systolic BP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>3.5</td>
<td>100-160</td>
<td>30-60</td>
<td>50-70</td>
</tr>
<tr>
<td>3 mo.</td>
<td>6</td>
<td>100-160</td>
<td>30-60</td>
<td>70-95</td>
</tr>
<tr>
<td>6 mo.</td>
<td>8</td>
<td>90-120</td>
<td>25-40</td>
<td>80-100</td>
</tr>
<tr>
<td>1 yr.</td>
<td>10</td>
<td>90-120</td>
<td>20-30</td>
<td>80-100</td>
</tr>
<tr>
<td>2 yr.</td>
<td>12</td>
<td>85-120</td>
<td>20-30</td>
<td>80-105</td>
</tr>
<tr>
<td>3 yr.</td>
<td>15</td>
<td>80-120</td>
<td>20-30</td>
<td>80-110</td>
</tr>
<tr>
<td>4 yr.</td>
<td>17</td>
<td>80-120</td>
<td>20-30</td>
<td>80-110</td>
</tr>
<tr>
<td>6 yr.</td>
<td>20</td>
<td>70-110</td>
<td>18-25</td>
<td>80-110</td>
</tr>
<tr>
<td>8 yr.</td>
<td>25</td>
<td>70-110</td>
<td>18-25</td>
<td>80-110</td>
</tr>
<tr>
<td>10 yr.</td>
<td>30</td>
<td>60-90</td>
<td>15-20</td>
<td>90-120</td>
</tr>
<tr>
<td>12 yr.</td>
<td>40</td>
<td>60-90</td>
<td>15-20</td>
<td>95-135</td>
</tr>
<tr>
<td>14 yr.</td>
<td>50</td>
<td>55-85</td>
<td>14-20</td>
<td>100-140</td>
</tr>
</tbody>
</table>

Hypotension = SBP < 70 + (2x age in years) or < 60 if neonate

### Pediatric Equipment

<table>
<thead>
<tr>
<th>Age</th>
<th>Blade</th>
<th>ET Tube</th>
<th>IV Cath</th>
<th>Central line (Fr)</th>
<th>Chest tube (Fr)</th>
<th>NGT (Fr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth</td>
<td>0-1</td>
<td>2.5-3.5</td>
<td>22-24</td>
<td>UVC 5</td>
<td>10-12</td>
<td>5-8</td>
</tr>
<tr>
<td>3 mo.</td>
<td>1</td>
<td>3.5-4.0</td>
<td>22-24</td>
<td>3</td>
<td>10-12</td>
<td>5-8</td>
</tr>
<tr>
<td>6 mo.</td>
<td>1</td>
<td>3.5-4.0</td>
<td>20-24</td>
<td>3-4</td>
<td>10-14</td>
<td>8-10</td>
</tr>
<tr>
<td>1 yr.</td>
<td>1</td>
<td>4.0-4.5</td>
<td>20-24</td>
<td>3-4</td>
<td>16-20</td>
<td>8-10</td>
</tr>
<tr>
<td>2 yr.</td>
<td>2</td>
<td>4.0-4.5</td>
<td>18-22</td>
<td>3-4</td>
<td>20-24</td>
<td>10</td>
</tr>
<tr>
<td>3 yr.</td>
<td>2</td>
<td>4.0-4.5</td>
<td>18-22</td>
<td>3-4</td>
<td>20-24</td>
<td>10</td>
</tr>
<tr>
<td>4 yr.</td>
<td>2</td>
<td>4.0-5.0</td>
<td>18-22</td>
<td>3-4</td>
<td>20-24</td>
<td>10-12</td>
</tr>
<tr>
<td>6 yr.</td>
<td>2</td>
<td>4.5-5.0</td>
<td>18-20</td>
<td>4</td>
<td>24-32</td>
<td>10-14</td>
</tr>
<tr>
<td>8 yr.</td>
<td>2-3</td>
<td>4.5-5.5</td>
<td>18-20</td>
<td>4-5</td>
<td>24-32</td>
<td>14</td>
</tr>
<tr>
<td>10 yr.</td>
<td>3</td>
<td>6.0-7.0</td>
<td>18-20</td>
<td>4-5</td>
<td>28-32</td>
<td>14</td>
</tr>
<tr>
<td>12 yr.</td>
<td>3</td>
<td>6.5-7.5</td>
<td>16-20</td>
<td>5+</td>
<td>32-40</td>
<td>14-18</td>
</tr>
<tr>
<td>14 yr.</td>
<td>3</td>
<td>6.5-7.5</td>
<td>16-20</td>
<td>5+</td>
<td>32-40</td>
<td>16-18</td>
</tr>
</tbody>
</table>

ET Tube size > 2 years = (16 + age in years) / 4
ET Tube depth at lips = 3 x normal tube size
ET Tube > 6 mm or patient > 8 years = cuffed tube
• **Book Author and Editor**: Mike Ortiz
• **Senior Book Editor**: April Troy
• **Hospitalist**: Mary Scott Ramnitz, Padma Pavuluri
• **Pulmonary**: Geovanny Perez, Tina Catanzaro
• **Renal**: Lindsey Rasmussen, Tom Weiler
• **Genetics/Metabolism**: Jamie Fraser, Deb Regier
• **Neurology**: Jonathan Kurz
• **Endocrine**: Heidi Schumacher, Daniel DeSalvo
• **Gastroenterology**: Jacob Edwards
• **Hematology/Oncology**: Yevgenia Nusinovich
• **Cardiology**: Alicia Tucker, Bob Kavanaugh
• **Adolescent**: Heidi Schumacher
• **Clinic**: Kristen Reese, Ruth Hollo
• **Development**: Kristen Reese, Karen Summar
• **Newborn Nursery**: Deb Bear, Emily Yee
• **Emergency Department**: Alice Rusica, Dewesh Agrawal
• **NICU**: Soraya Diblassio, Melissa House
• **PICU**: Brenda Mendizabal, Stacey Tryzinski