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1 PEDIATRIC CARDIOLOGY

- Acyanotic = left-to-right
- Cyanotic = right-to-left

NOTE: All left-to-right shunts have the potential to revert to right-to-left shunts due to increasing pulmonary congestion (Eisenmenger’s syndrome).

Investigation of suspected heart defect
- Most cases are diagnosed prenatally by US screening @ 16-20 weeks
- Some defects don’t emerge until several days or weeks have passed since birth due to transition of circulation → adult levels of pulmonary vascular resistance
- Neonate will usually have symptoms within 24 hours

1.1 Atrial Septal Defect

- Acyanotic

Signs & symptoms
- May be asymptomatic unless there are other defects
- R heart failure
- Pulmonary edema
- Increased pulmonary vasculature
- Midsystolic pulmonary flow or ejection murmur accompanied by a fixed split S2

Management
- Refer to pediatric cards for echo
- Surgical repair at age 2-3 for most
- Small defects in boys don’t need closure if RV size is normal.

1.2 Coarctation of the Aorta

- Obstructive

Signs & symptoms
- Poor perfusion to LEs → diminished femoral pulses, cyanosis, cardiogenic shock, cold extremities, claudication
- Association with Turner’s syndrome, Shone’s syndrome, and bicuspid aortic valve

Workup
- Measure BPs on all 4 extremities → HTN in UEs with low or unattainable BP in LEs
- Refer for echo

Management
- Reopen truncus arteriosus within 4 days of birth with prostaglandins
1.3 Patent Ductus Arteriosus

- Acyanotic

**Signs & symptoms**
- Harsh continuous machine murmur
- Usually asymptomatic
- May have exertional dyspnea or heart failure

**Management**
- Refer to pediatric cards for echo and for meds to make ductal tissue regress or surgical repair

1.4 Tetralogy of Fallot

- The most common cyanotic heart defect
- Pulmonary stenosis \(\rightarrow\) RV hypertrophy, overriding aorta, VSD
- VSD may be right-to-left or left-to-right

**Signs & symptoms**
- Progressive
- May appear healthy and pink at birth
- Cyanotic “tet spells” where child turns blue, squats to valsalva
- Harsh systolic ejection murmur
- May also have right aortic arch, Down’s or DeGeorge’s syndrome

**Management**
- Surgical correction in early infancy

**Complications**
- Brain abscess
- Stroke
- CNS injury

1.5 Transposition of the Great Vessels

- Cyanotic
- Aorta and pulmonary trunk are switched so that deoxygenated blood gets pumped through the aorta to systemic circulation while the oxygenated blood gets pumped through the pulmonary artery back through the lungs
- Coexisting left-to-right shunt must also be present for life ex utero

**Signs & symptoms**
- Severe cyanosis at birth
- Loud S2

**Management**
- Requires arterial switch for long-term survival
1.6 **Ventricular Septal Defect**

- The most commonly diagnosed congenital heart defect
- May be single or multiple
- May be associated with other lesions

**Signs & symptoms**
- Holosystolic murmur
- May have thrill or diastolic rumble
- Heart failure
- Down’s syndrome association

**Management**
- Most will get smaller and disappear on their own
- Surgical repair indicated for intractable CHF, failure to thrive
2 PEDIATRIC PULMONOLOGY

2.1 Acute Bronchiolitis

- Research definition = first episode of wheezing in a child younger than 12 to 24 months who has physical findings of a viral respiratory infection and has no other explanation for the wheezing, such as pneumonia or atopy
- Broader definition = an illness in children <2 years of age characterized by wheezing and airway obstruction due to primary infection or reinfection with a viral or bacterial pathogen, resulting in inflammation of the small airways/bronchioles
- Mostly in infants < 2 months
- Prophylaxis with Synagis given to high risk infants during first RSV season

Agents
- Usually RSV
- Rhinovirus
- Human metapneumovirus
- Influenza
- Parainfluenza
- Adenovirus

Signs & symptoms
- Concomitant URI
- Conjunctivitis or OM
- Wheezing, tachypnea, retractions, crackles

Differential
- Asthma
- Foreign body

Workup
- Diagnosis is usually clinical
- CXR showing hyperinflation, interstitial pneumonitis, infiltrates
- ELISA for RSV available

Management
- Supportive
- Humidifier
- Oxygen if needed for severe disease
- Bronchodilators or steroids for select patients

2.2 Acute Epiglottitis
Agents
- H. flu
- Strep pneumo or Strep pyogenes
- Staph aureus
- Trauma

Signs & symptoms
- Abrupt onset of high fever, sore throat, stridor, dysphagia, drooling, trismus
- Sitting child that won’t lie down, head leaning forward (sniffing or tripod position)

Differential
- Croup
- Peritonsillar abscess
- Foreign body
- Diptheria

Workup
- Lateral x-ray for “thumb sign”

Management
- Send to ED for inpatient management and antibiotics as any manipulation of glottis could result in airway obstruction

2.3 Croup

Agents
- Usually parainfluenza virus
- RSV
- Human metapneumovirus

Signs & symptoms
- Average child is 18 months of age
- Stridor, hoarseness, barking seal cough, low-grade fever
- Rales, rhonchi, wheezing
- Symptoms worse at night

Differential
- Epiglottitis
- Neoplasm
- Bacterial tracheitis
- Pharyngeal abscess
- Foreign body

Workup
- CXR showing “steeple sign”

Management
- Supportive: cool mist humidifier
- Send to ED for inhaled epinephrine if severe or if there is stridor at rest
- Steroids

2.4 Pneumonia
Agents
- Kids under 5: mostly viruses, also Strep pneumo, Staph aureus, and Strep pyogenes
- Kids over 5: Strep pneumo, Mycosplasma, Chlamydophila

Signs & symptoms
- Fever
- Cough
- Tachypnea
- Increased work of breathing: retractions, nasal flaring, grunting, accessory muscle use
- Hypoxia
- Adventitious lung sounds

Severity of community acquired pneumonia in infants and children

<table>
<thead>
<tr>
<th>Clinical features of mild pneumonia</th>
<th>Clinical features of severe pneumonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature &lt;38.5°C (101.3°F)</td>
<td>Temperature&gt;=38.5°C (101.3°F)</td>
</tr>
<tr>
<td>Mild or absent respiratory distress:</td>
<td>Moderate to severe respiratory distress:</td>
</tr>
<tr>
<td>Increased RR, but less than the age-specific RR</td>
<td>RR &gt;70 breaths/minute for infants; RR &gt;50 breaths/minute for older children</td>
</tr>
<tr>
<td>that defines moderate to severe respiratory distress</td>
<td>Moderate/severe suprasternal, intercostal, or subcostal retractions (&lt;12 months)</td>
</tr>
<tr>
<td>Mild or absent retractions</td>
<td>Severe difficulty breathing (&gt;=12 months)</td>
</tr>
<tr>
<td>No grunting</td>
<td>Grunting Nasal flaring Apnea</td>
</tr>
<tr>
<td>No nasal flaring</td>
<td>Significant shortness of breath</td>
</tr>
<tr>
<td>No apnea</td>
<td></td>
</tr>
<tr>
<td>Mild shortness of breath</td>
<td></td>
</tr>
<tr>
<td>Normal color</td>
<td>Cyanosis</td>
</tr>
<tr>
<td>Normal mental status</td>
<td>Altered mental status</td>
</tr>
<tr>
<td>Normoxemia (oxygen saturation&gt;=92 percent in room air)</td>
<td>Hypoxemia (sustained oxygen saturation &lt;90 percent in room air at sea level)</td>
</tr>
<tr>
<td>Normal feeding (infants); no vomiting</td>
<td>Not feeding (infants) or signs of dehydration (older children)</td>
</tr>
<tr>
<td>Normal heart rate</td>
<td>Tachycardia</td>
</tr>
<tr>
<td>Capillary refill &lt;2 seconds</td>
<td>Capillary refill &gt;=2 seconds</td>
</tr>
</tbody>
</table>

Workup
- No clinic or radiologic features can reliably distinguish between bacterial, atypical bacterial, and viral pneumonia
- CXR if disease is severe

Management
- Send to ED for admission with severe disease, failure of outpatient antibiotics, toxic appearance, dehydration, or younger than 3-6 months
- Empiric antibiotics for 6 months-5 years → amoxicillin, cefdinir, or macrolide
- Empiric antibiotics for > 5 years → macrolide, doxycycline
- F/u outpatient treatment in 24-48 hours

Sequelea
- Postinfectious cough for up to 4 months
• Moderate DOE for 2-3 months

2.5 Respiratory Syncytial Virus

Highly contagious, transmitted via aerosols or fomites
• The most common cause of fatal acute respiratory infections in infants and young children
• Causes a spectrum of disease from URTs, LRTs, pneumonia
• Most serious disease is in preemies, chronic lung disease, heart defects, asthma, immunocompromised, and the elderly.

Management
• Supportive
• May need hospitalization with fluid and respiratory support
• Albuterol trial
• Steroids only in older kids, not infants
• Ribavirin for select infants

2.6 Asthma

Signs & symptoms
• Coughing
• Wheezing
• Chest tightness or pain
• SOB
• Eczema
• Allergies

Differential
• Anatomic abnormality
• Infection
• Foreign body
• Cystic fibrosis: more likely to see digital clubbing
• GERD
• Pulmonary edema
• Laryngeal dysfunction
• Bronchopulmonary dysplasia

Workup
• PFTs are most useful but can’t usually get good data until age 7-8, and may look normal despite having asthma

Management
• Patient education: use of spacer, shaking canister, home monitoring, prevention or environment control
• SaμAs: albuterol, levalbuterol
• LaμAs: salmeterol, formoterol
• Inhaled steroids: beclomethasone (required trial for Medicaid), fluticasone, budesonide, mometasone, ciclesonide, triamcinolone, flunisolide
• Anticholinergics aren’t as helpful in kids
- Mast cell stabilizers: cromolyn, nedocromil
- Leukotriene inhibitors: montelukast, zileuton, zafirlukast
- Refer for acute life-threatening attack, mod-severe asthma, steroid-dependent asthma, complicated asthma, poor response to optimal therapy

**PCP treatment for pediatric acute exacerbation**
- Assess severity using Pulmonary Index Score
- Mild: SaSÅ neb up to 3 doses, with oral steroids given after 1st dose if no improvement.
- Moderate oxygen if needed, SaSÅ + ipratropium neb up to 3 doses, with oral steroids after 1st dose
- Systemic steroids: 3-5 days for mild-mod flare, 5 days with taper for mod-severe flare.

**Follow-up visits**
- Inquire about missed days of school, # urgent
care or ER visits, # of hospitalizations, days per week with symptoms
- Ask about triggers

**Pediatric Meds: Ages 0-4**

**Pediatric Meds: Ages 5-11**
2.7 Cystic Fibrosis

- Autosomal recessive inherited defect of protein regulating chloride channels, bicarb, and other ions (CFTR protein) → defective mucociliary clearance → mucus obstruction, inflammation, infection, and fibrosis
- Also affects the pancreas and vas deferens
- Most commonly affects Caucasians

Signs & symptoms

- Will be on a continuum depending on % of normal CFTR functioning
- No known abnormalities until there is < 10% normally functioning CFTR proteins; < 10% → absence of vas deferens, < 5% → sweat abnormality, < 4.5% → progressive pulmonary infections, < 1% → pancreatic deficiency
- Recurrent pulmonary infections with atypical bacteria (Staph aureus in infancy and Pseudomonas in adulthood), poorly controlled asthma, failure to thrive, meconium ileus, pancreatitis, vitamin deficiencies, nasal polyps, sinusitis, fatty liver, liver fibrosis, portal HTN, gallstones, jaundice, osteoporosis or frequent fractures from vit D deficiency, rectal prolapse from thick stools, intestinal strictures, appendicitis, GERD, infertility, delayed puberty, smooth muscle growth around bronchioles, respiratory symptoms, diabetes, enlarged or deficient spleen
- Acute exacerbation (will be bronchial rather than pneumonia): increased cough of sputum, sputum color change, dyspnea, fatigue, decreased exercise tolerance, poor appetite, new tachypnea, retractions, wheezing, rhonchi, weight loss, fever, new findings on CXR, PFTs, hypoxia.

Workup
Newborn screens detect only severe disease
Genetic screens of 23 most common mutations only identify CF in Caucasians
Buccal DNA swab for other mutations
Sweat chloride test is confirmatory

Management
- Dietary support: higher BMI associated with better lung functioning, need high caloric intake to combat malabsorption, salt supplements, pancreatic lipase supplements, fat-soluble vitamin supplements
- Promote mucus clearance: percussion and chest compression vests, upside-down coughing, huff breathing, oral oscillators, exercise, CPAP, saline mist, albuterol
- Infection control: cyclic use of antibiotics against *Pseudomonas*, intermittent IV antibiotics, oral antibiotics for 2-3 weeks after exacerbation
- Frequent office visits with PFTs, sputum culture, diabetes screens, bone densitometry, CBC, PT/PTT, UA, vitamin levels, LFTs, albumin, immunizations

Prognosis
- Lung function declines at about 2% per year, but this will speed up with increasing exacerbations
- Patients are unable to return to previous baseline with each exacerbation
- Median survival age is 38

2.8 Neonatal Respiratory Distress Syndrome (Hyaline Membrane Disease)
- A result of surfactant deficiency $\rightarrow$ alveolar collapse and diffuse atelectasis
- Typically occurs in preterm infants

Prevention
- Antenatal glucocorticoid treatment for women at risk for preterm delivery prior to 34 weeks of gestation
- If gestation is greater than 30 weeks, the fetal lung maturity may be tested by sampling the amount of surfactant in the amniotic fluid by amniocentesis

Signs & symptoms
- Respiratory distress and cyanosis soon after birth
- Tachypnea
- Tachycardia
- Chest wall retractions
- Abdominal breathing

Workup
- CXR showing diffuse ground glass appearance with air bronchogram

Management
- Inpatient with fluid balance, CPAP, exogenous surfactant

2.9 Foreign Body Aspiration
Most common site is the right lung, followed by left lung, trachea/carina, and larynx

**Signs & symptoms**
- Choking episode followed by symptom-free period
- Respiratory distress
- Cyanosis
- AMS
- Generalized wheezing
- Coughing
- Recurrent pneumonia
- Diminished breath sounds

**Workup**
- Send to ED for bronchoscopy if severe symptoms
- CXR is problematic because most swallowed objects are radiolucent.
3 PEDIATRIC ENDOCRINOLOGY

3.1 Dwarfism

Etiologies
- Achondroplasia: most common, genetic
- Growth hormone deficiency: will see delayed puberty
- Others: congenital dysplasias, Noonan syndrome, Turner syndrome, osteogenesis imperfecta, hypothyroidism

Workup
- Bone x-rays
- Referral to endocrinology

Management
- Growth or thyroid hormone supplementation
- Distraction osteogenesis

3.2 Type I Diabetes Mellitus

- Accounts for most cases of diabetes in kids under 19
- Genetic and environmental influences

Signs and symptoms
- Polyuria
- Polydipsia
- Weight loss
- Lethargy
- DKA is often the initial presentation

Workup
- Differentiate from DM2 by islet autoantibody screen

Management
- Formal training and education using a diabetes team
- Intensive insulin regimen
- Address depression and anxiety
- Annual urine microalbumin
- Ophtho visits at age 10 or after 3-5 years of diagnosis
- Lipid screens
- Periodic autoimmune thyroid and celiac screening
3.3 Type II Diabetes Mellitus

Screening
- Universal not recommended by AAP nor ADA
- Screen at risk children with BMI > 85th percentile and 2+ additional risk factors; screen every 3 years

Signs & symptoms
- DKA
- Hyperglycemia without ketonuria
- Polyuria
- Polydipsia
- Lethargy
- Often occurs at onset of puberty as this causes increased insulin resistance

Workup
- Differentiate from DM1 by presence of excess weight, acanthosis nigricans, HTN, dyslipidemia, PCOS, FH, ethnic group risk factors

Management
- Treat comorbidities
- If asymptomatic → lifestyle changes only with weight loss and increased activity; if no improvement → metformin
- If symptomatic with mild hyperglycemia → metformin and lifestyle changes; if no improvement → add basal insulin
- If severe → begin insulin then wean off to metformin
- Screen for HTN, dyslipidemia, NAFLD
- Annual ophtho visits
- Annual microalbumin screens
- Annual diabetic neuropathy screens

3.4 Obesity

- Overweight = BMI 85-95th percentile
- Obese = BMI > 95th percentile
- Severe obesity = BMI > 120th percentile or BMI > 35
- Genetic factors account for 30-50% of variation in adiposity
- Endocrine causes account for < 1% of cases

Environmental risk factors
- High glycemic index foods
- Sugar-contained beverages
- Large portion sizes
- Fast food
- Diminished family presence at meals
- Decreasing structured physical activity
- Shortened sleep duration
- Television viewing

Screening
• BMI should be calculated annually for children older than 2, with plotting to track changes
• Overweight children additionally should be screened for dyslipidemia, NAFLD (ALT); utility of insulin resistance screen or vitamin D deficiency screen has not been established

Workup
• Obesity ROS: delayed development, short stature, headaches, snoring, daytime sleepiness, abdominal pain, hip pain, knee pain, limp, oligomenorrhea or amenorrhea, urinary frequency, nocturia, polydipsia, polyuria, binge eating or purging, insomnia, anhedonia

Management
• Refer all obese children under 2 to a specialist
• Treatment for underlying eating disorders
• Firm limits on screen time
• Establish habitual physical activity
• Educational handouts

Sequelae
• Pseudotumor cerebri
• Sleep apnea
• Obesity hypoventilation syndrome
• Liver disease
• DM
• PCOS
• Slipped capital femoral epiphysis
• Tibia vara
4 PEDIATRIC EENT

4.1 Conjunctivitis

Etiologies
- Kids & adults: adenovirus, Strep pneumo, Haemophilus, Moraxella,

Pseudomonas
- Infant: think Neisseria gonorrhoeae or Chlamydia trachomatis
- Allergic = conjunctivitis verno
- Conjunctivitis sicca is chronic dry eye related to rheumatic disease
- Hard to distinguish bacterial from viral, all etiologies can cause eyes to be stuck together in the morning
- Bacterial tends to be consistently purulent throughout the day and is usually unilateral
- Viral tends to feel more gritty and usually affects the 2nd eye 24-48 hours later
- Allergic will be ITCHY = pathognomonic

Workup
- Culture if extremely purulent

Treatment
- All etiologies are usually self-limiting
- Throw out contact lenses, wash sheets and hands, will be contagious for 2 weeks
- Antibiotics → erythromycin ointment, sulfacetamide drops, FQ drops in contact lens wearers (Pseudomonas)
- OTC antihistamine drops for viral causes → Ocuhist, Naphcon-A, Visine AC
- Acute allergy → short-term antihistamine/vasoconstrictor drops like Naphcon-A, Opcon-A, Visine-A
- Chronic allergy → antihistamine + mast cell stabilizer drops like Patanol or Pataday, Optivar, Alocril, Ketotifen, Alamast, Elestat
- Severe allergy: Iodoxamide or cromolyn drops
- If no response in 2 days or need for steroid drops refer to ophtho

4.2 Dacryoadenitis

- Blocked lacrimal glands

Etiologies
- Viral: EBV
- Bacterial: mumps, Staph, gonorrhea
- Chronic: sarcoidosis, thyroid eye disease, orbital pseudotumor

Signs & symptoms
- Swelling of upper lid
- Lid redness & erythema
- Lid pain
- Excess tearing or discharge
- Swelling of preauricular nodes
Management
• Warm compresses
• Think malignancy if no improvement

4.3 Strabismus (Tropia)

Etiologies
• Congenital: pseudostrabismus, prenatal drug exposure, nerve palsy, familial external ophthalmoplegia
• Acquired: accommodative strabismus, intermittent exotropia, cataracts, tumors, increased ICP, orbital injury, head trauma, vascular disorders, botulism, myasthenia gravis, nerve palsy, Guillain- Barre, ocular myopathy, multiple sclerosis, infection, drug or toxin, DM, hypoglycemia, thyrotoxicosis

Differential
• Pseudostrabismus
• Ocular instability of infancy (normal in first few months of life)

Workup
• Affected eye will drift when covered, then moves quickly back if cover is removed
• Differentiate congenital from acquired (may be vision-threatening or life-threatening)

Management
• Refer to ophtho for consistent strabismus at any age, persistent strabismus after 4 months of age, altered light reflex, deviation with cover test, deviation that changes depending on position of gaze, torticollis, parental concern

Sequelae
• If untreated may lead to amblyopia (vision reduction) or diplopia

4.4 Otitis Media

Acute OM
• Agents: Strep, H. flu, M. cat, or viral (can’t distinguish)
• Signs & symptoms: hearing loss is hallmark, ear pain, ear fullness, drainage with relief if ear drum is perforated, prior URI, pulling at ears, fever, irritability

Chronic suppurative OM = frequent AOM with otorrhea as a result of TM perforation or tube placement

OM with effusion = fluid behind TM without presence of infection, a result of chronic eustachian tube dysfunction, previous AOM, or barotrauma

Management
If mild, can watchfully wait with NSAIDs for pain relief as long as patient is > 2 years
If infection is obvious or there is a fever, treat with 10-14 d of high dose amoxicillin, erythromycin, Augmentin, Septra, ceftriaxone
Refer for surgical management if there is bilateral effusion > 3 months and bilateral hearing deficiency
Chronic → tx with 10 d of FQ, consider chronic therapy with daily amoxicillin during winter and spring with monthly f/u.

4.5 Otitis Externa

Etiology
• Bacterial 90% of the time: Pseudomonas, Strep, Staph
• Fungal: Aspergillus, Actinomyces, Candida
• Eczema if chronic
• Malignant otitis externa = osteomyelitis of temporal bone as a result of chronic infection in DM, not cancerous!

Signs & symptoms: pain with manipulation of tragus, hearing loss, otorrhea, fullness, itching, recent exposure to water.

Management
• Bacterial → neo/poly/HC only if TM intact, FQ (use a wick if canal is swollen), systemic therapy if canal is swollen shut or pt is immunocompromised
• Fungal → acetic acid/HC drops, clotrimazole drops
• Bacterial vs fungal? → CASH powder covers both
• Chronic → treat eczema with steroid cream, then use vinegar/water washes and avoid Q-tips
• Malignant → emergent referral to ENT

4.6 Oral Candidiasis

Risk factors: inhaled steroid use, AIDS, antibiotic use, radiation therapy

Signs & symptoms
• Pseudomembranous form is most common: white plaques
• Angular cheilitis with chronic lip-lickers
• Glossitis with broad spectrum antibiotic use
• Cottony feeling in mouth
• Loss of taste
• Pain with eating and swallowing
• May be asymptomatic

Workup
• KOH prep of mouth scrapings

Treatment
• Infants: oral nystatin swabs for 7-14 days, boiling of bottle nipples and pacifiers
• Older children: oral nystatin rinses or systemic fluconazole if severe

Allergic Rhinitis
• Typically does not occur in infants under 6 mos
• Seasonal or perennial
Samter's triad = syndrome of aspirin sensitivity, nasal polyposis, and asthma often seen with allergic rhinitis, frequently leading to severe pansinusitis

**Signs & symptoms:** repetitive sneezing, pruritus of nose, eyes, palate, ears, clear rhinorrhea, nasal congestion, postnasal drip, epistaxis, allergic shiners, Dennie's lines, allergic salute, retracted TMs, serous effusions, swollen or boggy turbinates, hyperplasia of palate or posterior pharynx

**Differentiation:** sinusitis, rhinitis medicamentosa (Afrin!), polyps, deviated septum, adenoid hypertrophy, FB, vasomotor rhinitis

**Management**
- Instruct patients in allergen avoidance: closed windows, bed cases, washing linens weekly, removing stuffed animals, cockroach poison, mold precautions, HEPA filters
- Nasal saline sprays or rinses
- Oral decongestants
- Nasal steroids: fluticasone, flunisolide
- 1st or 2nd gen antihistamines: cetirizine and fexofenadine ok for infants > 6 mo
- Leukotriene inhibitor
- Refer to allergist for kids with mod-severe disease, prolonged rhinitis despite intervention, coexisting asthma or nasal polyps, recurrent otitis media or sinusitis

### 4.7 Nasal Polyps

**Etiologies**
- Usually a reaction to bacterial infection in kids
- Allergies
- Chronic sinusitis

**Signs & symptoms**
- Stuffiness
- Feelings of pressure or fullness in the face
- Trouble smelling

**Management**
- Steroid nasal spray
- Saline rinses
- Refer for surgical excision but may recur

### 4.8 Pharyngitis & Tonsillitis
4.8.1 Viral Pharyngitis
Agents
- Adenovirus, coronavirus, rhinovirus, influenza, parainfluenza, Coxsackie

Signs & symptoms
- Concurrent rhinorrhea
- Erythema, edema, dysphagia, pain, fever, lymphadenopathy, diffusely pink throat, cough, fever

Treatment
- Salt water gargles
- Lozenges or hard candy for kids over 4
- Acetaminophen or ibuprofen
- Oral rinse with equal parts lidocaine, diphenhydramine, and Maalox
- Benzydamine HCl mouth rinse

4.8.2 Strep Pharyngitis

Agents
- GAS

Signs & symptoms
- Uncommon in kids under 2-3
- Sore throat, dysphagia, odynophagia, erythema, airway obstruction, bright beefy red demarcated splotches
- Centor criteria: tender cervical adenopathy, fever > 100.4, no cough, tonsillar exudate
- Abdominal pain and vomiting in ped

Workup
- Distinguish from viral by rapid Strep test ± culture

Treatment
- Penicillin VK
- Cefalosporin
- Erythromycin: increasing macrolide resistance

4.8.3 Acute Tonsillitis

Agents
- Viral (can be mono) or bacterial (usually GAS)

Signs & symptoms
- Swollen tonsils with white plaques

Workup
- Rapid Strep
- Monospot

Treatment
- Antibiotics

4.8.4 Peritonsillar Abscess
Signs & symptoms
- May follow tonsillitis
- Bulging, asymmetrical soft palate, hot potato voice, severe throat pain, dysphagia, trismus, deviated uvula, salivation, fever, severe malaise

Treatment
- Urgent referral to ENT for I&D

4.8.5 Mononucleosis

Agents
- EBV or CMV

Signs & symptoms
- Fatigue, malaise, sore throat with tonsillar edema, erythema, and shaggy white-purple tonsillar exudate, lymphadenopathy, hepatosplenomegaly
- Many will have 2° Strep tonsillitis

Workup
- Monospot (not + early in disease)
- CBC to look for atypical lymphocytes

Treatment
- OTC pain control
- ? steroids
- Splenic precautions
- Treat tonsillitis but avoid ampicillin due to rxn with mono → rash

4.8.6 Fusobacterium Pharyngitis

Agents
- Fusobacterium necrophorum

Signs & symptoms
- Adolescents
- Severe pharyngitis
- Cervical adenopathy
- Headache
- May have fever
- Unilateral neck pain or swollen neck

Workup
- Very high CRP
- ↑ WBCs with leukocytosis

Treatment
- Treat to avoid Lemierre’s syndrome (septic emboli thrown from internal jugular) with penicillin + clindamycin

4.9 Dental Caries
Prevention
- Early referral to dentist for kids with breast or bottle feeding > 12 months, frequent consumption of sugary beverages and snacks, prolonged use of sippy cups, use of bedtime bottles, use of liquid meds > 3 weeks, insufficient fluoride exposure, visible plaque on upper front teeth, enamel pits or defects, exposure to second-hand smoke
- AAP recommends referral to dentist at age 1, Medicaid begins at age 3
- Screen for plaque, white spots, and cavities as soon as first teeth erupt
- Instruct parents to clean infant’s gums with soft cloth starting at birth, and to begin brushing teeth when they first appear twice per day
- Fluoride varnish: providers in NC may apply from eruption of first teeth up to age 3
- Stop pacifiers by age 3, thumb sucking by age 6

Signs & symptoms
- Initial presentation is a white spot
5 Pediatric GI

5.1 Gastritis

Differential
- H. pylori
- Stress, severe illness, or major surgery
- Caustic ingestion
- Celiac disease
- Drugs
- Ethanol
- Milk sensitivity
- Eosinophilic gastroenteritis
- Crohn’s disease
- Other infection
- GERD

5.2 Pyloric Stenosis

- Typically in 3-6 week olds, usually firstborn males
- Rare after 12 weeks

Signs & symptoms
- Projectile nonbilious vomiting
- Ravenous hunger
- Palpable pyloric olive
- Poor weight gain
- Visible peristaltic waves

Workup
- KUB showing “caterpillar sign” of distended, hypertrophic stomach
- US showing thickened stomach muscle (preferred imaging)

Management
- Refer for surgical pyloromyotomy

5.3 Constipation

***Encopresis is managed similarly, only without the use of laxatives as long as constipation has been excluded as a cause
- Usually begins with an acute episode of constipation then is self-perpetuating as kids may hold stool to avoid painful BMs or going at school → chronic rectal distension → increased threshold for conscious need to defecate

Signs & symptoms
- Encopresis
- UTIs
- Chronic abdominal pain
- Poor appetite
- Lethargy
- Rectal skin tags

**Differential**
- Imperforate anus
- Hirschsprung disease repair
- Crohn’s perianal disease
- Psychogenic
- Hypothyroidism
- Tethered cord
- Spina bifida
- Anterior displacement of the anus
- Intestinal pseudo-obstruction
- Cystic fibrosis
- Celiac
- Lead intoxication
- Botulism
- Cow’s milk constipation

**Workup**
- Criteria: symptoms must be present for 1 month in toddlers and infants and 2 months in older children
- Labs only for kids not responding to an intervention program

**Management**
- Initial disimpaction with enema or Golytely (or lactulose or sorbitol-containing juices in infants) followed by maintenance with Miralax (if > 2 years old, but safety has also been demonstrated in infants)
- Adjust maintenance therapy to goal of 1 soft stool per day
- “Rescue plan” to use stimulant laxative, enema, or suppository if there are signs of constipation recurrence
- Behavioral modification with toileting regimen and bowel training → sit on toilet for 5-10 min after each meal, give sticker or game reward for each effort, record BMs and symptoms with log

**Rome III criteria for the diagnosis of functional constipation in children**

<table>
<thead>
<tr>
<th>Infants and toddlers</th>
<th>Children with development age 4 to 18 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least two of the following present for at least one month</td>
<td>At least two of the following present for at least two months</td>
</tr>
<tr>
<td>Two or fewer defecations per week</td>
<td>Two or fewer defecations per week</td>
</tr>
<tr>
<td>At least one episode of incontinence after the acquisition of toileting skills</td>
<td>At least one episode of fecal incontinence per week</td>
</tr>
<tr>
<td>History of excessive stool retention</td>
<td>History of retentive posturing or excessive volitional stool retention</td>
</tr>
<tr>
<td>History of painful or hard bowel movements</td>
<td>History of painful or hard bowel movements</td>
</tr>
<tr>
<td>Presence of a large fecal mass in the rectum</td>
<td>Presence of a large fecal mass in the rectum</td>
</tr>
<tr>
<td>History of large-diameter stools that may obstruct the toilet</td>
<td>History of large-diameter stools that may obstruct the toilet</td>
</tr>
</tbody>
</table>

**Pediatric Laxative Dosing**

<table>
<thead>
<tr>
<th>Osmotic and lubricant laxatives</th>
<th>Laxative</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Polyethylene glycol 3350 powder (Miralax®)</strong></td>
<td>Children</td>
<td>0.4 to 0.8 gm/kg/day (up to 1.5 gm/kg per day has been useful in some cases*)</td>
</tr>
<tr>
<td></td>
<td>Adults</td>
<td>17 gm of powder per day, in 8 ounces of water</td>
</tr>
</tbody>
</table>

**Current clinical practice:**

<table>
<thead>
<tr>
<th>Younger than:</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 months</td>
<td>0.5 to 1 teaspoon once daily</td>
</tr>
<tr>
<td>18 months to 3 years</td>
<td>2 to 3 teaspoons once daily</td>
</tr>
<tr>
<td>Older than 3 years</td>
<td>2 to 4 teaspoons once daily</td>
</tr>
</tbody>
</table>

**Lactulose**

<table>
<thead>
<tr>
<th>Lactulose</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children</td>
<td>1 mL/kg (up to adult dose), once or twice daily</td>
</tr>
<tr>
<td>Adults</td>
<td>15 to 30 mL, once daily (maximum 60 mL/day)</td>
</tr>
</tbody>
</table>

**Sorbitol (syrup, 70 percent solution)**

<table>
<thead>
<tr>
<th>Sorbitol</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 11 years old</td>
<td>1 mL/kg, once or twice daily</td>
</tr>
<tr>
<td>12 years to adults</td>
<td>15 to 30 mL, once or twice daily</td>
</tr>
</tbody>
</table>

**Mineral oil**

<table>
<thead>
<tr>
<th>Mineral oil</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 3 mL/kg, once daily (Caution: Should not be used in individuals at risk for aspiration, including infants, neurologically impaired children, or patients with marked gastroesophageal reflux)</td>
<td></td>
</tr>
</tbody>
</table>

**Magnesium hydroxide**

<table>
<thead>
<tr>
<th>Magnesium hydroxide</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 2 mL/kg, once daily</td>
<td></td>
</tr>
</tbody>
</table>
**Stimulant laxatives**

<table>
<thead>
<tr>
<th>Laxative</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Senna (syrup, 8.8 mg sennosides/5 mL OR Tablets 8.6 mg sennosides/tab)</strong></td>
<td></td>
</tr>
<tr>
<td>1 to 2 years old</td>
<td>1.25 to 2.5 mL, once or twice daily</td>
</tr>
<tr>
<td>2 to 6 years old</td>
<td>2.5 to 3.75 mL, once or twice daily</td>
</tr>
<tr>
<td>6 to 12 years old</td>
<td>5 to 7.5 mL (or 1 to 2 tabs), once or twice daily</td>
</tr>
<tr>
<td>12 years and older</td>
<td>1 to 2 tabs, once or twice daily</td>
</tr>
<tr>
<td><strong>Bisacodyl (10 mg suppositories OR 5 mg tablets)</strong></td>
<td></td>
</tr>
<tr>
<td>2 to 12 years old</td>
<td>1/2 to 1 suppository (OR 1 to 2 tablets), once daily</td>
</tr>
<tr>
<td>12 years to adult</td>
<td>1 to 3 tablets (OR 1 suppository), once daily</td>
</tr>
</tbody>
</table>

### 5.4 Intussusception

- The most common cause of intestinal obstruction in infants < 1 year
- Most cases are between 6 months and 3 years of age
- Can occur multiple times

**Etiologies**
- Idiopathic: most cases
- Viral
- Underlying condition: Meckel diverticulum

**Sings & symptoms**
- Periodic colicky abdominal pain
- Vomiting
- Bloody “currant jelly” stools
- Palpable mass or “sausage” in RUQ
- Lethargy

**Differential**
- Malignancy if child is over 3

**Workup**
• Plain films showing SBO
• US showing “pseudokidney sign” or “lasagna sign” (test of choice)

**Management**
• Refer for emergent reduction via enema or surgical repair

5.5 Umbilical Hernia

• Caused by open umbilical ring, which usually closes in all kids by 5 years but may be slower to close in black children
• May interfere with feeding if it contains bowel
• Rarely become incarcerated or strangulated in kids

**Management**
• Referral for surgical repair indicated when hernia is incarcerated, extremely large, or symptomatic

5.6 Childhood Nutritional Deficiencies

-Supplements indicated for children from neglected or deprived environments, anorexia, inadequate appetite, lead poisoning, failure to thrive, limited sunlight exposure, with chronic disease affecting absorption and utilization of nutrients, who are trying to lose weight, or are on restrictive diets.

5.6.1 Vitamin Iron

**Screening**
• Hb routinely checked at 12 months, 3 years, annually in teen females, once in teen males
• Screen at 15-18 months for high risk infants

**Signs of deficiency**
• Anemia
• Impaired psychomotor or mental development
• Susceptibility to infection
• Decreased exercise capacity
• Thrombosis

**Workup**
• Hb or CBC
• Ferritin, Hb electrophoresis, B12, folate
• FOBT
• Celiac workup
• IBD workup

**Recommendations**
• Iron supplements for preterm infants until 12 months
• Iron-fortified infant formulas
• No cow’s milk until 12 months
• Supplement as needed with oral iron
• Recheck CBC every 4 weeks during therapy

5.6.2 Vitamin D

**Screening**
• Screen kids with risk factors (premature, exclusively breast fed, vegetarian diet, high altitude, malabsorption)

**Signs of deficiency**
Rickets

• Osteomalacia

**Workup**
• 25-OH vitamin D level

**Recommendations**
• At least 400-600 IU daily
• Follow supplementation with laboratory testing

5.6.3 Calcium

**Screening**
• Ask about milk consumption at well child visits

**Signs of deficiency**
• Rickets
• Susceptibility to fracture

**Workup**
• DEXA scan

**Recommendations**
• Whole milk from 1-2 years of age
• Kids 1-3 need 700 mg of Ca (~2 cups of milk)
• Kids 4-8 need 1000 mg of Ca (~2-3 cups of milk)
• Kids 9-18 need 1300 mg of Ca (~3+ cups of milk)
• Decrease soda intake (P in it associated with bone fx)
• Other sources: white beans, broccoli, fortified OJ, salmon, sweet potatoes
• Calcium in spinach is not bioavailable!

5.7 Phenylketonuria

• Autosomal recessive disorder
• Screened for in newborn metabolic screening
• From defective conversion of phenylalanine to tyrosine
• Phenylalanine is found in breast milk and standard formulas

**Signs & symptoms**
• Intellectual disability
• Epilepsy
• Abnormal gait, posture, or stance
• “Mousy” urine or body odor
• Eczematous rash

**Differential**
• BH4 deficiency
Workup
• Elevated serum phenylalanine

Management
• Dietary restriction
• Frequent phenylalanine and tyrosine monitoring

5.8 Lactose Intolerance
• May be primary or secondary due to bacterial overgrowth, enteritis, Celiac disease, IBD, etc.
• High prevalence among Native Americans, patients of African descent, and Hispanics

Signs & symptoms
• Abdominal pain, bloating, farts, diarrhea, and possibly vomiting after ingestion of lactose
• Avoid milk and ice cream as they have the highest amount of lactose
• Lactase supplementation (variable results)
• Add Lactaid to milk and let sit overnight before drinking
• Utilize yogurt or cheese for dietary calcium needs, or supplement

5.9 Abdominal Pain

5.9.1 Chronic Abdominal Pain = greater than 1-2 months duration
• Most digestive tract pain is perceived in the midline, so any lateralizing is usually the gallbladder, kidney, ureter, ascending/descending colon, or ovary.

Organic Etiologies

<table>
<thead>
<tr>
<th>Clinical clues</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadrant pain</td>
<td>The further the pain from the umbilicus, the greater the likelihood of organic disease</td>
</tr>
<tr>
<td>Early morning pain, pain awakens at night</td>
<td>Peptic origin</td>
</tr>
<tr>
<td>Early satiety, nausea, sour breath, belching</td>
<td>Peptic origin</td>
</tr>
<tr>
<td>Crampy pain and/or bloating and/or intestinal gas related to meals, dairy products and foods containing dairy products</td>
<td>Lactose intolerance, giardiasis</td>
</tr>
<tr>
<td>Respiratory symptoms, such a chronic cough, wheezing, laryngitis</td>
<td>Gastroesophageal reflux</td>
</tr>
<tr>
<td>Infrequent stoolsing, incomplete evacuation, encopresis, mass in the left lower abdominal quadrant and hard stool in rectal vault, diet low in fiber and high in starches, abdominal distension</td>
<td>Constipation</td>
</tr>
<tr>
<td>Blood in stool</td>
<td>Peptic origin or inflammatory bowel disease</td>
</tr>
<tr>
<td>Fever, weight loss, no increase in height, joint complaints and rash</td>
<td>Inflammation or an infectious disease process</td>
</tr>
<tr>
<td>Self-induced purging behavior with or without weight loss</td>
<td>Gastroesophageal reflux from an eating disorder</td>
</tr>
</tbody>
</table>
Weight loss, restrictive eating behavior, and fecal mass in left lower abdominal quadrant | Constipation from an eating disorder
---|---
Medications such as antibiotics for acne | Esophagitis
Pain with specific physical activity and primarily muscle tenderness on examination | Muscle strain
Cervical motion tenderness, adnexal tenderness, or adnexal mass on pelvic | Pelvic inflammatory disease, ovarian cyst, ectopic pregnancy

**Functional Etiologies**

**Functional dyspepsia** (must include all of the following):
- Within the preceding two months, at least weekly occurrence of:
- Persistent or recurring pain or discomfort in the upper abdomen, and
- No evidence of inflammatory, anatomic, metabolic, or neoplastic process to explain the symptoms, and
- Pain or discomfort not relieved by defecation or associated with the onset of a change in stool frequency or form

**Irritable bowel syndrome** (must include all of the following):
- Abdominal discomfort or pain with >+2 of the following
- Relieved with defecation, and/or
- Onset associated with a change in frequency of stool, and/or
- Onset associated with a change in form (appearance) of stool, and
- No evidence of inflammatory, anatomic, metabolic, or neoplastic process to explain the symptoms

**Functional abdominal pain** (must include all of the following):
- Within the preceding two months, at least weekly occurrence of:
- Episodic or continuous abdominal pain, and
- Insufficient criteria for other functional gastrointestinal disorders, and
- No evidence of inflammatory, anatomic, metabolic, or neoplastic process to explain the symptoms

**Childhood functional abdominal pain syndrome**
- Within the preceding two months, at least weekly occurrence of:
  - Childhood functional abdominal pain at least 25 percent of the time and >=1 of the following:
    - Some loss of daily functioning, and/or
    - Additional somatic symptoms such as headache, limb pain, or difficulty sleeping

**Abdominal migraine pain** (must include all of the following):
- Within the preceding 12 months, >=2 episodes of:
  - Paroxysmal episodes of intense, acute, periumbilical pain that lasts for >=1 hour, and
  - Intervening periods of usual health lasting weeks to months, and
  - The pain interferes with normal activities, and
  - The pain is associated with >=2 of the following: anorexia, nausea, headache, photophobia, pallor, and no evidence of inflammatory, anatomic, metabolic, or neoplastic process to explain the symptoms

**Management**
- Goal is to return to normal function vs. complete elimination of pain
- Pain diaries
- Biopsychosocial model of care receives higher satisfaction in this setting
- Relaxation techniques
- Dietary changes: removing lactose or increasing fiber
- Set plan for return to school (may begin part-time but homeschooling is discouraged)
- Medications for pain triggers: acid, constipation, altered motility
- Refer to GI for alarm symptoms of active or persistent bleeding, weight loss, early satiety with peptic symptoms, loss of appetite, persistent chest pain, persistent vomiting, or failure to improve with medical therapy.

5.10 **Acute Abdominal Pain**

<table>
<thead>
<tr>
<th>Differential</th>
<th>Neonate</th>
<th>3 months - 2 years</th>
<th>2-5 years</th>
<th>&gt;5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colic</td>
<td>Gastroenteritis</td>
<td>Gastroenteritis</td>
<td>Gastroenteritis</td>
<td></td>
</tr>
<tr>
<td>Dietary protein allergy</td>
<td>Viral illness</td>
<td>Viral illness</td>
<td>Viral illness</td>
<td></td>
</tr>
<tr>
<td>Volvulus</td>
<td>Trauma (including inflicted injury)</td>
<td>Trauma (including inflicted injury)</td>
<td>Appendicitis</td>
<td></td>
</tr>
<tr>
<td>Necrotizing enterocolitis</td>
<td>Incarcerated hernia</td>
<td>Appendicitis</td>
<td>Trauma</td>
<td></td>
</tr>
<tr>
<td>Testicular torsion</td>
<td>Intussusception</td>
<td>Pharyngitis</td>
<td>Constipation</td>
<td></td>
</tr>
<tr>
<td>Adhesions</td>
<td>Urinary tract infection</td>
<td>Constipation</td>
<td>Pharyngitis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Foreign body ingestion</td>
<td>Urinary tract infection</td>
<td>Pneumonia (lower lobe → diaphragm irritation)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sickle cell syndrome vasoocclusive crisis</td>
<td>Pneumonia</td>
<td>Urinary tract infection: may also cause diarrhea</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dietary protein allergy</td>
<td>Intussusception</td>
<td>Diabetic ketoacidosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tumor</td>
<td>Foreign body ingestion</td>
<td>Sickle cell syndrome vasoocclusive crisis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hirschsprung disease</td>
<td>Sickle cell syndrome vasoocclusive crisis</td>
<td>Henoch Schönlein purpura</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adhesions</td>
<td>Henoch Schönlein purpura</td>
<td>Ovarian torsion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hemolytic uremic syndrome</td>
<td>Ovarian torsion</td>
<td>Testicular torsion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Toxin</td>
<td>Intraabdominal abscess</td>
<td>Inflammatory bowel disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meckel's diverticulum</td>
<td>Tumor</td>
<td>Intraabdominal abscess</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hepatitis</td>
<td>Adhesions</td>
<td>Ruptured ovarian cyst</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hemolytic uremic syndrome</td>
<td>Cholecystitis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hepatitis</td>
<td>Pancreatitis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meckel's diverticulum</td>
<td>Urolithiasis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Toxin</td>
<td>Hepatitis</td>
<td></td>
</tr>
</tbody>
</table>
### Acute abdominal pain: males and premenarchal females

<table>
<thead>
<tr>
<th>Primary bacterial peritonitis</th>
<th>Meckel's diverticulum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perforated ulcer</td>
<td></td>
</tr>
<tr>
<td>Adhesions</td>
<td></td>
</tr>
<tr>
<td>Hemolytic uremic syndrome</td>
<td></td>
</tr>
<tr>
<td>Myocarditis, pericarditis</td>
<td></td>
</tr>
<tr>
<td>Primary bacterial peritonitis</td>
<td></td>
</tr>
<tr>
<td>Familial Mediterranean fever</td>
<td></td>
</tr>
<tr>
<td>Abdominal migraine</td>
<td></td>
</tr>
</tbody>
</table>

**PE**
- Should be complete for CC of abdominal pain, including bimanual pelvic exam for sexually active females with lower abdominal pain
- Tenderness to percussion, rebound tenderness, and involuntary guarding are often signs of peritoneal irritation

**Workup**
- Unnecessary for kids that are otherwise healthy, well-appearing, and have normal Pes
- CBC with smear for infection and red cell morphology
- Hct for bleeding
- Liver enzymes and amylase for suspected hepatitis, cholecystitis, or pancreatitis
- BMP for DKA
- Urinalysis
- Urine HCG for all menstruating females
- Rapid Strep test
- Imaging for kids with hx of trauma, peritoneal irritation signs, obstructive signs, masses, distension, or focal tenderness or pain (for pediatric appendicitis, consult with pediatric surgeon before ordering imaging) → abdominal film for obstruction, upper GI series with contrast for volvulus, US or contrast enema for intussusception, CT with contrast when a wide variety of dx are being considered, US or non-contrast helical CT for urolithiasis
Acute abdominal pain in postmenarchal girls
Management

- Pain control with morphine is shown to not affect exam results
- Rule out life-threatening etiologies

5.11 Diarrhea
5.11.1 Chronic = persistent loose or watery stools at least 3x per day for > 2 weeks

- In developing countries this is more likely to be due to serial enteric infections and malnutrition
- In developed countries this is more likely to be due to underlying disease causing malabsorption or maldigestion

**Etiologies**

- **Functional diarrhea** (aka toddler’s diarrhea) = painless passage of 3+ large unformed stools during waking hours for > 4 weeks without failure to thrive or a definable cause
- **Postenteritis syndrome**: an uncommon sequelae of acute infectious diarrhea
- **Bacterial**: occurs chronically in the immunocompromised as a result of Campylobacter or Salmonella infection, or from C. diff
- **Parasites**: uncommon in developed countries
- **Immunodeficiency with subsequent opportunistic infection**: chronic diarrhea with Crypto, Isospora, Cyclospora, rotavirus
- **Celiac**
- **IBD**
- **Allergic enteropathy**: diarrhea as a result of cow’s milk proteins
- **Eosinophilic gastroenteritis**: sometimes associated with an identifiable dietary antigen
- **Fat maldigestion**: cystic fibrosis or pancreatic insufficiency
- **Bowel obstruction or dysmotility**: Hirschsprung’s or intestinal pseudoobstruction
- **Congenital diarrhea**
- **Neuroendocrine tumor**: ZE syndrome, VIPoma, mastocytosis
- **Factitious diarrhea**

**Red**: life-threatening cause.

**Green**: common cause.

* Symptoms typically >1 month in duration.
- More likely in older children and adolescents.
- Only in infants
- More likely in infants and young children

**Workup & Management**

- Self-limiting
- Eliminate sorbitol and juice as the cause
- Increase dietary fat
- Probiotics
- Bacterial cultures
- Gluten avoidance

5.11.2 Acute

**Etiologies**
- Viral gastroenteritis: the most common cause of acute diarrhea
- Extraintestinal infection (OM, UTI, pneumonia)
- Antibiotics: amoxicillin
- Overfeeding: causes osmotic diarrhea
- Lactase deficiency: primary or secondary
- Cryptosporidium: from contaminated drinking water
- Toxin ingestion: from food bacteria or organophosphate poisoning

**Not Seriously Ill**

![Flowchart diagram showing the evaluation of diarrhea symptoms](image)

**Seriously Ill** = bloody diarrhea or abdominal tenderness
Red: life-threatening conditions.

* More likely in older children and adolescents.

• More likely in infants and young children.

Presentation
- Dysenteric symptoms = fever, tenesmus, blood and/or pus in the stool
- Mild dehydration = increased thirst, moist or slightly dry mucous membranes, normal tear and urine production
- Moderate dehydration = irritability, lethargy, postural hypotension, sunken eyes and anterior fontanelle, decreased tear and urine production, decreased capillary refill
- Severe dehydration = lethargy, rapid/weak pulse, marked hypotension with poor peripheral perfusion, dry mucous membranes, anuria or oliguria, absent tear production

Workup
- Ask about travel to a developing area, day care, pets and petting zoos, unsafe foods, swimming in or drinking fresh untreated surface water, knowing other ill people, medications, underlying medical conditions, and contact with reptiles
- Stool culture: only order when results would affect treatment (recent travel, h/o blood or mucus in stool, systemically unwell, severe or prolonged diarrhea or with high suspicion of disease outbreak due to low yield

Management
- Admit for IVF resuscitation with mod-severe dehydration, circulatory compromise, significant electrolyte abnormalities, continuous copious diarrhea, or inability to drink
- Oral rehydration solution: 50-100 mL/kg over 3-4 hours (starting with 1 tsp/hour and working up), then maintain as 10 mL for each loose stool, 2 mL for each emesis
- Avoid antibiotics unless specific organism has been detected due to risk of HUS
- Avoid antimotility agents in kids
- May take 10-20 mg zinc for 10-14 days (can reduce severity and incidence of diarrheal episodes)
- May have single dose ondansetron for emesis
• Back to normal diet ASAP or non-diluted formula

5.12 Hyperbilirubinemia

• Jaundice is common in newborns since it is formed at high levels during this time and not cleared as well as in adults
• Appearance of jaundice begins in the face and progresses to the chest, abdomen, arms, and then legs
• Jaundice within first 24 hours of life is worrisome
• Jaundice developing in 72-96 hours is physiologic and resolves in 1-2 weeks
• "Breast milk jaundice" begins in the first week after birth, peaks at 2 weeks, and then declines; it is not dangerous and is probably due to the infant’s immature liver and intestines
• Hyperbilirubinemia puts infant at increased risk for encephalopathy and kernicterus
• Total bili values are compared in percentiles (Bhutani nomogram)
• Major risk factors for infants >= 35 weeks’ gestation: predischarge total bili in the high risk zone, jaundice in first 24 hours, positive DAT or known hemolysis, gestational age 35-36 weeks, previous sibling received phototherapy, cephalohematoma or significant bruising, exclusive breastfeeding, East Asian race
• Minor risk factors: predischarge total bili in the high intermediate risk zone, gestational age 37-38 weeks, jaundice observed before discharge, previous sibling with jaundice, macrosomic infant of diabetic mother, maternal age > 25 years, male gender
• Decreased risk factors: total bili in low risk zone, gestational age > 41 weeks, exclusive bottle feeding, black race, hospital d/c after 72 hours

Screening
• Usually done routinely at time of metabolic screening prior to discharge (USPSTF grade I); infants with total bili > 95th percentile are at increased risk
• Routine follow-up appointments after discharge are timed to assess developing jaundice, with f/u in 3 days for infants d/c before 24 hours (or sooner if high-risk), and later for infants d/c after 48 hours or beyond

Management
• Calculate risk zone of infant based on risk factors and total bili values
• Admit for phototherapy if needed
• Admit for exchange transfusion if needed: initiated when phototherapy has failed or infant has signs of neuro dysfunction
• Home measures for low-risk infants: increasing frequency and efficacy of breastfeeding, supplementing inadequate breastfeeding with formula
6 PEDIATRIC GU

6.1 Cryptorchidism

- Most undescended testes will descend spontaneously by the time an infant is several months old but will rarely occur after 6 months
- Ectopic testes are descended but are in an aberrant position such as the inguinal pouch, suprapubic region, or perineum
- Occasionally descended testes can ascend as child grows
- Retractile testes and located suprascrotally but can descend to the scrotum and remain there as long as the cremasteric reflex is overcome

Management
- Refer for testes not descended by 6 months for surgical orchiopexy due to risk of malignant degeneration, subfertility, torsion, or inguinal hernia

Enuresis
- Not clinically significant until child is > 5 years of age
- Contributing factors: nocturnal polyuria, detrusor overactivity, disturbed sleep, maturational delay, genetics, abnormal ADH secretion

Differential
- Kidney disease
- Daytime incontinence
- Constipation
- Pinworms
- Spinal dysraphism or abnormality
- Urologic anatomic abnormality

Workup
- Voiding diary
- UA

Management
- High rate of spontaneous resolution by 15 years of age
- Behavioral changes: regular voiding and emptying bladder before bedtime, no fluids after 6pm
- Rewards for voiding before bedtime, working up to rewards for staying dry overnight
- More active interventions needed as child gets older, social pressures increase, and self-esteem is affected
- Enuresis alarms for wetting > twice per week
- Desmopressin for children with nocturnal polyuria and normal bladder capacity who have failed alarm trials
6.2 Cystitis

- Agents: 90% are E. coli, also Staph saprophyticus, Enterococcus, enterics
- Uncomplicated = limited to lower urinary tract, child > 2 years, no underlying medical problems, no underlying anatomic or physiologic abnormalities
- Complicated = upper tract disease, MDR pathogen, host with malignancy, DM, or anatomic or physiologic abnormality, indwelling catheter
- Risk factors: female, sexual activity, vesicoureteral reflux, polycystic kidneys, dysfunctional elimination syndrome, fecal impaction, paraplegia, sickle cell anemia, kidney transplant, DM, bladder stones, immunodeficiency, recent instrumentation

**Signs & symptoms**
- Infants < 1 month: may only have fever
- Older kids: dysuria, frequency, urgency, enuresis, abdominal or suprapubic pain, hematuria (fever, chills, flank pain suggest upper tract infection)

**Differential**
- Chemical cystitis
- Autoimmune cystitis
- Drugs
- Bladder dysfunction
- Vulvovaginitis, cervicitis, or urethritis
- Prostatitis or epididymo-orchitis
- Nephrolithiasis
- Urethral stricture
- Neoplasm
- Vaginal foreign body

**Workup**
- UA with microscopy (catheterized specimen for non-toilet trained children), culture if negative (sensitivity only 88%)

**Treatment**
- Admit for infants < 2 months, immunocompromised, vomiting, inability to tolerate orals, lack of outpatient f/u, and failure of outpatient therapy
- Ages 2-13 years: 2nd or 3rd generation cephalosporin, add amoxicillin if suspecting enterococcal infection
- Age > 13: Septra or cephalosporin
- First episode in uncomplicated female should be treated 5-7 days
- Young children, male adolescents, and children with recurrent, febrile, or complicated cystitis should be treated for 7-14 days
- Renal bladder US indicated for first febrile UTI in kids under 2 who did not have normal prenatal screening US, for kids of any age with recurrent UTIs, and kids of any age with UTI, poor growth, HTN, or FH of renal disease
- VCUG indicated for evaluation of possible reflux in kids of any age with > 2 febrile UTIs
6.3 Orchitis

- Usually viral: mumps, rubella, coxsackie, echovirus, parvovirus
- May be STI if sexually active

**Signs & symptoms**
- Scrotal swelling
- Pain and tenderness with erythema and shininess of the overlying scrotal skin
- May also have epididymis involvement with STI orchitis

**Differential**
- Epididymitis
- Testicular torsion: absent cremasteric reflex
- Appendix testis or appendix epididymis torsion
- Trauma
- Incarcerated inguinal hernia

**Management**
- NSAIDs
- ABs if suspecting STI cause
- Scrotal support
- Ice packs

6.4 Wilms Tumor

- A renal cancer that is the 4th most common childhood cancer
- Most diagnosed before age 10

**Signs & symptoms**
- Abdominal mass or swelling
- Abdominal pain
- Hematuria
- HTN

**Management**
- Refer to surgery and pediatric cancer center
- Abdominal US or contrasted CT to differentiate from other masses

**Prognosis**
- Good with early disease
- Lung is most frequent first site of recurrence

6.5 Male Circumcision

- Currently promoted as the health benefits outweigh the risks: reduced UTIs, reduced STI transmission, reduced penile inflammatory and retractile disorders, easier hygiene
- Procedural risks are rare
- Not covered by Medicaid and typically costs $200 out of pocket
- Uncircumcised infants will need parent education on how to care for and clean the penis regularly to prevent phimosis
6.6 Vesicoureteral Reflux

- Currently this is treated as it is thought to promote renal scarring and recurrent pyelonephritis
- Can occur prenatally and may be seen on prenatal US as hydronephrosis
- Graded I-V based on severity

Workup

- Renal US for infants diagnosed with prenatal hydronephrosis
- Contrasted voiding cystourethrogram
- Radionuclide cystogram
- Serum creatinine
- UA
- Screen siblings for reflux

Management

- Grades I and II can be managed with observation
- Kids with > grade III reflux are treated
- Antibiotic prophylaxis: Septra, trimethoprim, nitrofurantoin
- Surgical correction
- Annual imaging for medical or observational therapy
- Annual growth checks, BP, and UA

6.7 Vaginitis

Etiologies

- STI
- Vaginal polyp or tumor
- Atrophic prepubertal tissue (more susceptible to irritants)
- Strep pyogenes and other respiratory pathogens
- Foreign body
- Pinworms
- Urethral prolapse: treat with topical estrogen cream for 2 weeks
- Lichen sclerosus: treat with topical steroids
- Labial adhesions: treat with topical estrogen cream
- Systemic illness: measles, varicella, scarlet fever, EBV, Crohn’s, Kawasaki disease
- Nonsexually transmitted vulvar ulcers
- Urethral prolapse
- Ectopic ureter

Management

- Treat underlying cause
- Wear nightgowns to allow air circulation
- Cotton underwear
- Avoid tights, leotards, and leggings
- Bathe in water only for 15 minutes and limit soap to non-genital areas
- Dry genital area well after bathes, can use a cool hair dryer
- No bubble baths or perfumed soaps
- Cool compresses
- Use wet wipes instead of toilet paper
• Avoid sitting around in wet swim suits
• Antibiotic therapy for purulent discharge that does not respond to hygiene measures

6.8 Dysmenorrhea

6.8.1 Primary = painful menses with normal anatomy
• Cause is usually prostaglandins and uterine vasoconstriction
• Leading cause of school absences
• Incidence decreases after age 20
• Cramping pain radiating to back or inner thighs
• Associated with heavy flow
• Management: NSAIDs beginning 1-2 days before expected menses, OCPs, progesterone, Mirena IUD, acupuncture, thiamine supplementation

6.8.2 Secondary = a result of disease or pathology
• Causes: endometriosis, uterine fibroids, adenomyosis, STIs, endometrial polyps
• Usually begins well after menarche
• Causes pelvic pain unrelated to menses
• May have history of pelvic pain beginning at menarche vs. several months or years later
• Workup: refer for laparoscopy to differentiate endometriosis from PID
• Management: NSAIDs, OCPs, IUD, refer to OB-GYN for uterine artery embolization and evaluation for hysterectomy

6.9 Amenorrhea

6.9.1 Primary Amenorrhea = failure of any menses

Differential
• Hypothalamic or pituitary dysfunction
• Hyperandrogenism
• Ovarian causes
• Pseudohermaphroditism
• Uterine causes
• Pregnancy

Workup
• Begins at 14 if neither menarche or breast development has occurred, or otherwise at age 16
• Pelvic and rectal exam
• hCG test
• FSH, LH, PRL, testosterone, TSH, FT4 (may refer to endocrine for these)

6.9.2 Secondary amenorrhea = absence of menses for 3 consecutive months in women who have passed menarche
Differential

- Pregnancy
- Hypothalamic-pituitary causes: stress, strict diet or exercise
- Hyperandrogenism
- Uterine causes
- Premature ovarian failure (before age 40)
- Normal physiologic variation shortly after menarche
- PCOS
- Meds
- Calorie deprivation

Workup

- bHCG, PRL, FSH, LH, TSH, CMP
- Testosterone levels if evidence of virilization
- Refer for dexamethasone suppression test if suspecting hypercortisolism
- 10 day progestin withdrawal trial

Treatment

- Usually estrogen replacement therapy
7  **PEDIATRIC MSK**

7.1  **Nursemaid’s Elbow (Radial Head Subluxation)**

- MOI: being pulled up too hard by hand or wrist → radial head slipping out of annular ligament
- **Signs & symptoms**
  - Crying, screaming, holding arm flexed against belly, refusal to use arm

- **Workup**
  - X-ray
  - Assess neurovascular involvement

- **Treatment**
  - Reduce with flexion and supination of the arm (usually occurs during x-ray positioning)

7.2  **Slipped Capital Femoral Epiphysis**

- MOI: occurs when femoral head is displaced from the femoral neck

- **Signs & symptoms**
  - Obese, hypogonadal adolescent males are at increased risk
• Unilateral or bilateral, with many uni cases progressing to bi Limp
• Affected leg turns out and appears shorter
• Loss of hip flexion, internal rotation, and abduction

**Workup**
• X-ray

![image](image1.png)

**Management**
• An orthopedic emergency, requires surgical repair

### 7.3 Osteosarcoma

• Arises from primitive bone-forming mesenchymal stem cells
• Overall the most common malignant bone tumor
• Most occur in the metaphysis region
• Peak incidence in 12-25 year olds

**Signs & symptoms**
• Pain
• Swelling
• Palpable mass

**Differential**
• Trauma
• Infection

**Management**
• Biopsy for definitive diagnosis
• Bone MRI, chest CT, radionuclide bone scan, and/or PET scan for staging

### 7.4 Juvenile Rheumatoid Arthritis
• Classification of subtypes is still a work in progress
• Most commonly used classification is ILAR, with further classification of each group based on age at onset, duration and pattern, and presence of ANA or rheumatoid factor

**ILAR Classification of Idiopathic Arthritis of Childhood**

7.4.1 **Systemic arthritis**
• An autoimmune condition probably unrelated to other forms of childhood arthritis, requiring different therapy
• Accounts for 10-20% of cases
• Can present in kids as young as 1

**Signs & symptoms**
• High fever
• Macular, salmon pink rash related to fever spikes
• Hepatomegaly
• Lymphadenopathy
• Arthralgias typically in the wrists, knees, and Differential
• Postinfectious arthritis
• Reactive arthritis
• SLE and other connective tissue diseases
• Malignancy
• Malaria ankles

**Workup**
- Diagnosis is clinical, based on presence of intermittent fever for at least 2 weeks and arthritis
- Labs will show increased WBCs, thrombocytosis, anemia, high ESR

**Management**
• NSAIDs for 6-12 weeks for mild and nondisabling symptoms
• Add steroid taper or biologics for severe cases or for those unresponsive to NSAID trial, followed by DMARD
• Anticytokine therapy for refractory disease

**Prognosis**
• Follows one of three patterns: systemic symptoms and no progressive arthritis, persistent systemic symptoms and progressive arthritis, or resolution of systemic symptoms with progressive destructive arthritis

7.4.2 **Polyarthritis**
• Involves at least 4 joints during first 6 months of illness

**Signs & symptoms**
• Younger kids: begins with 1-2 affected joints then spreads
• Older kids: rapid onset in multiple joints - Usually symmetric
• Sausage fingers
• Uveitis

**Differential**
- Reactive arthritis
- Psoriatic arthritis
- Spondyloarthritis
- SLE
- Systemic vasculitis
- Sarcoidosis
- IBD
- Epiphyseal dysplasia
- Minocycline-induced autoimmunity

**Workup**
- No characteristic labs, may have elevated ESR, anemia

**Management**
- NSAID trial for 3 weeks, followed by a different NSAID if no response
- Methotrexate or biologic

**Prognosis**
- Will be chronic and progressive without treatment

### 7.4.3 Pauciartihritis (oligoarthritis)
- Involvement of < 5 joints during the first 6 months of disease onset
- May involve more joints over time ( = extended pauciartihritis)

**Signs & symptoms**
- Limping without complaint
- Usually large joints are affected but not the hips
- Swollen, tender joints

**Differential**
- Psoriatic arthritis
- Enthesitis-related arthritis
- Infection
- Malignancy

**Workup**
- Diagnosis is clinical based elimination of other causes and on presence of arthritis in a single joint for at least 3 months or 2+ joints for at least 6 weeks
- ANA is usually +
- No rheumatoid factor
- Management
- NSAIDs
- Intraarticular steroids
- Methotrexate or biologics rarely required

**Prognosis**
- Many cases resolve within 6 months
- May recur
- Uveitis is the most serious complication and occurs in 20% of cases
7.4.4 **Enthesitis-related arthritis**
- Includes childhood spondyloarthopathies
- Arthritis + enthesitis
- Arthritis + 2 or more of the following: SI joint tenderness, inflammatory spinal pain, FH, uveitis, + HLA-B27
- Gradual onset that may first be recognized following fever or musk trauma

**Management**
- NSAIDs for 3-6 months: frequently diclofenac or piroxicam are used
- Sulfasalazine, biologics, or DMARDs if no improvement

**Prognosis**
- May progress to psoriatic arthritis

7.4.5 **Psoriatic arthritis**
- Psoriasis + arthritis

**Signs & symptoms**
- May need to search for hidden psoriasis lesions
- Joints tend to be less tender than other inflammatory arthritides
- Nail pitting or onycholysis
- Pitting edema
- Uveitis
- Dactylitis

**Differential**
- Reactive arthritis
- Ankylosing spondylitis

**Workup**
- Usually seronegative
- No specific tests

**Management**
- NSAIDs: typically don’t induce remission
- Steroid injections into joints
- DMARDs
- Add second DMARD or biologic if needed
- Monitor for uveitis

**Prognosis**
- Clinical remission achieved in most patients after 5 years of treatment
7.5 Osgood-Schlatter Disease

- MOI: anterior tibial tuberosity avulsion due to overuse
- Most common in males age 10-14

**Signs & symptoms**

- Anterior knee pain that increases gradually over time
- Worse with kneeling, running, jumping, squatting, or stairs
- Relieved by rest
- Recent growth spurt
- Recent increased activity
- Localized pain and swelling
- Step-offs

**Workup**

- X-ray to rule out fracture

**Management**

- Self-limiting, pain typically subsides after closure of the tibial growth plate at 14-18 years of age
- Activity as tolerated
- Stretching, strengthening, and icing
- Patellar brace

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7.6 Scoliosis

- Defined as Cobb angle > 10°

**Etiologies**

- Congenital
- Neuromuscular
- Idiopathic: most common kind

**Screening**

- Many schools provide screening but efficacy is not proven
- UpToDate recommends routine screening at well-child visits, especially before growth spurts
- USPSTF grade D
- Bright Futures: begin after age 8

**Signs & symptoms**

- May be detected incidentally
- Severe curves may result in restrictive pulmonary disease
- Pain or rapid progression of curve suggests non-idiopathic etiology
- Workup
- Arm span measurement to detect Marfan’s
- Skin examination for neurofibromatosis, spinal dysraphism, tumor, or Marfan’s or Ehlers- Danlos
- Leg length examination to detect compensatory scoliosis
- Foot examination and full neuro exam (esp abdominal reflex) to detect neuromuscular disease
- Adams forward bend test
- MRI for associated neuro signs, associated pain, early onset with rapid progression, or abnormalities on x-ray
- Calculate Cobb angle
- Assess skeletal maturity to determine risk for progression of curvature

Management
- Adolescents with curves at low risk for progression may be followed by primary care
- Refer to orthopedic surgery for increased rotation or Cobb angle, or progression of Cobb angle by more than 5°
- Refer to specialist for severe pain or neuro symptoms
- Efficacy of bracing is disputed

Prognosis
- Most patients with untreated idiopathic scoliosis have little functional limitation or pain in adulthood

Cobb angle calculation

7.7 Pediatric Fractures

- Bowing and greenstick fx are unique to kids due to their skeletal immaturity
- Growth plate fx are classified by Salter-Harris
- Most fx only require closed reduction
- Kids heal faster due to more active periosteum and higher % cartilage

Fractures Associated with Child Abuse
- Metaphyseal corner fx: child abuse until proven otherwise
- Posterior rib fx: child abuse until proven otherwise
- Any fracture in a child under 1
- LE fracture in a non-ambulatory child
- Multiple fractures in various stages of healing
- Sternal or scapular fx: high impact mechanism such as MVC required or else it may be child abuse
- Spinous process fracture
- Lower specificity: clavicular fx, long bone fx, linear skull fx
7.7.1 Toddler fracture

- Spiral fx of distal tibia
- Typically in 1-3 year olds
- Salter-Harris classification

**Signs & symptoms**

- Limp
- Refusal to bear weight
- May not be painful

**Workup**

- X-ray: may show subtle fracture only on 1 view

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**Management**

- Long-leg casting

7.7.2 Supracondylar fracture

**Workup**

- X-ray showing posterior sail sign, anterior humeral line drawn will not bisect the capitate
- X-ray showing posterior sail sign, anterior humeral line drawn will not bisect the capitate

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**Management**

- Assess neurovascular involvement
7.7.3 Lateral condylar fx

- MOI: FOOSH with extended elbow, traction forces, or acute varus stress

Workup

Management
- Casting if displacement is minimal
- Closed or ORIF if displaced

7.7.4 Medial epicondyle fx

- MOI: acute valgus stress during FOOSH, posterior stress, chronic muscular traction (throwing)

Signs & symptoms
- Associated with elbow dislocation or subluxation

Workup

Management
- Casting with forearm and wrist in flexion

7.7.5 Scaphoid fx

- MOI: FOOSH

Workup
- 4 view x-ray
- Repeat imaging in 10-14 days if negative

Management
- Immobilize in thumb spica
7.7.6  Colles fx
- MOI: FOOSH

**Workup**

**Management**
- ORIF & short arm cast

7.7.7  Smith fx
- MOI: opposite Colles = fall on back of hand

**Workup**

**Management**
- ORIF & short arm cast

7.7.8  Spondylolysis
- Stress fx of pars interarticularis, usually L5
- Seen in gymnasts, football players, weight lifters

**Signs & symptoms**
- Pain adjacent to midline and aggravated with extension and rotation
- May be asymptomatic

**Workup**
- X-ray showing scotty dog with collar
Management

- Modification of activities
- Core strengthening
8  PEDIATRIC NEUROLOGY

8.1  Febrile Seizures

- Typically occur in the setting of systemic bacterial or viral infection, but patient/family may not be aware of infection until sudden fever
- Genetic component

8.1.1  Simple febrile seizures

- Less than 15 min (or total duration < 30 min if they occur in a series)
- No focal features
- Usually generalized tonic clonic seizures but may be atonic

Workup

- LP only indicated with meningeal signs or suspected intracranial infection, with infants 6-12 months not immunized with HIB and PCV, when patient is on antibiotics (masking of meningeal signs), and with seizures occurring after 2nd day of illness
- Imaging for abnormal neuro exam

Management

- Treat any febrile seizure longer than 5 minutes: lorazepam
- Intubation if breathing becomes compromised
- Electrolytes and glucose if > 5 minutes
- Parents may be taught how to give rectal lorazepam once for recurrent febrile seizures
- Generally preventative antiepileptic drug therapy is not indicated in this population

Prognosis

- Recurrence rate is 30% or more
- Neurologic sequelae are rare
- Preventative acetaminophen administered at the first sign of fever may or may not prevent a febrile seizure
- Greater risk of later epilepsy, although prevention of febrile seizures using antiepileptics does not appear to reduce this risk

8.1.2  Complex febrile seizures

- Greater than 15 minutes (or total duration > 30 min if they occur in a series)
- Focal features
- Postictal paresis

Workup

- LP only indicated with meningeal signs or suspected intracranial infection, with infants 6-12 months not immunized with HIB and PCV, when patient is on antibiotics (masking of meningeal signs), and with seizures occurring after 2nd day of illness
- -Imaging for abnormal neuro exam

Management
• Treat any febrile seizure longer than 5 minutes: lorazepam
• Intubation if breathing becomes compromised
• Electrolytes and glucose if > 5 minutes
• Parents may be taught how to give rectal lorazepam once for recurrent febrile seizures
• Generally preventative antiepileptic drug therapy is not indicated in this population

Prospects
• Recurrence rate is 30% or more
• Neurologic sequelae are rare
• Preventative acetaminophen administered at the first sign of fever may or may not prevent a febrile seizure
• Greater risk of later epilepsy, although prevention of febrile seizures using antiepileptics does not appear to reduce this risk

8.1.3 Febrile status epilepticus
• Lasts 30 minutes or longer
• Unlikely to stop if not treated with antiepileptics

Workup
• May need LP

Management
• Emergency management with antiepileptics and lorazepam to end seizure, cooling blanket, antipyretics

8.2 Cerebral Palsy
• A group of nonprogressive clinical syndromes characterized by motor and postural dysfunction

Etiologies
• Most cases are prenatal due to prematurity, intrauterine growth restriction, intrauterine infection, antepartum hemorrhage, placental pathology, or multiple pregnancy
• Perinatal hypoxia or ischemia
• Perinatal stroke
• Low birth weight

Presentations
• Spastic CP: an UMN syndrome with slow effortful voluntary movements, impaired fine-motor function, difficulty in isolating individual movements, and fatigability
• Dyskinetic CP: usually a result of severe perinatal asphyxia; encephalopathy characterized by lethargy, decreased spontaneous movement, hypotonia, suppressed primitive reflexes, later athetosis, chorea, and dystonia
• Ataxic CP: ataxic movements and speech, widespread disordered motor function; a diagnosis of exclusion → Frequently accompanied by other disorders of cerebral function such as intellectual disability or learning disability, behavioral and emotional disorders, seizures, impaired vision or speech
• → Also may have secondary consequences such as poor growth and nutrition, orthopedic problems, osteopenia, and urinary disorders

Signs & symptoms
- FH of the disease
- Loss of developmental milestones
- Ataxia, involuntary movements, oculomotor abnormalities, muscle atrophy, or sensory loss
- Hypotonia associated with weakness
- Rapid deterioration of neuro signs

**Workup**

- Glucose, ammonia, lactate, pyruvate, ABG, and other studies are needed to exclude a metabolic disorder
- Requires a constellation of findings including motor delay, neurologic signs, persistence of primitive reflexes, and abnormal postural reactions
- Diagnosis may require serial exams and is not possible until later infancy; CP is a diagnosis of exclusion
- Brain MRI to determine site of lesion

**Management**

- Multidisciplinary team needed
- Botox for joint contractures
- Regular x-ray screenings for hip dysplasia
- Physical therapy to reduce muscle tone
- May need gastrostomy tube

**Prognosis**

- CP lesion will be static but clinical signs may evolve as the nervous system matures

### 8.3 Headache

**Etiologies**

- Acute & localized: URI, other viral infection, post-traumatic, dental abscess, TMJ dysfunction, brain abscess, first migraine
- Acute & generalized: fever, systemic infection, CNS infection, HTN, CH, exertional, first migraine, trauma, toxins, meds
- Acute & recurrent: migraine, cluster headache
- Chronic & nonprogressive: tension headache, psychiatric issue, post-traumatic, postconcussive, medication overuse
- Chronic & progressive: idiopathic intracranial HTN, space-occupying lesion, post-traumatic, postconcussive

**Workup**

- CT without contrast or MRI indicated for kids with headaches and neuro signs or symptoms suggestive of intracranial pathology = headache that awakens child during night or occurs upon waking, sudden severe headache, persistent nausea or vomiting, AMS, ataxia, headache worsened by cough, urination, or defecation, absence of aura, chronic and progressive headaches, change in headache quality, severity, or frequency, occipital headache, recurrent localized headache, lack of response to medical therapy, cranial bruits, growth abnormalities, papilledema or retinal hemorrhages, age < 3

**Management of chronic headaches**

- Provide realistic expectations for medical interventions
• Plan for return to school
• Avoid triggers: lack of sleep, dehydration
• Address comorbid problems: insomnia, mood problems, anxiety

**When to refer**
• Headaches associated with mood disturbance or anxiety
• Uncertain diagnosis
• Headaches refractory to primary care management
• Chronic daily headaches

## 8.4 Migraine Headaches

### Signs & symptoms
• May be shorter in kids, as short as 1 hour
• Toddlers: pallor, decreased activity, vomiting, sensitivity to light and noise
• Nausea, vomiting, abdominal pain, desire to sleep
• Complicated migraine symptoms: hemiplegia, ophthalmoplegia, tinnitus, vertigo, ataxia, weakness, confusion, paresthesias

### Workup
• Imaging to rule out more serious causes is indicated for complicated-type symptoms and for occipital location

### Management
• Initial abortive therapy with acetaminophen or ibuprofen
• Antiemetic like promethazine for nausea & vomiting
• 2nd line is abortive therapy with triptans
• Begin prophylactic treatment if > 4-5 migraines per week → cyproheptadine for kids under 6, propranolol for older kids, amitriptyline for concomitant depression
• For menstrual migraines, naproxen BID just before beginning period has been shown to be beneficial

## 8.5 Tension Headaches

### Signs & symptoms
• Bilateral pressing tightness
• Non-throbbing
• Lasts hours to days
• May have sensitivity to light and noise
• Daily activities typically not affected
• Not aggravated by walking stairs or similar routine activity

### Differential
• -Migraine without aura
• -Increased ICP
• -Rumor
• -Infection

### Workup
 Imaging has a low yield but may be needed to relieve parental apprehension or with sleep-related headache, no FH of migraine, presence of vomiting, absence of visual symptoms, headache of < 6 months duration, confusion, or abnormal neuro exam

**Management**

- Minimize stress
- Acetaminophen or NSAIDs for infrequent use
- If prophylactic therapy is needed, can use amitriptyline
- Psychotherapy, relaxation techniques, and biofeedback techniques about as successful as amitriptyline

8.6  **Cluster Headaches**

- May occur in kids as young as 3 but are generally rare in kids under 10

**Signs & symptoms**

- Unilateral, excruciating, steady pain in the eye, periorbital region, or temple
- Increased swelling on ipsilateral side of face and eyelid
- Ipsilateral miosis or ptosis
- Ipsilateral nasal congestion or rhinorrhea
- Lasts 15-180 minutes untreated
- Occurs in bouts up to every other day or up to 8 attacks daily for weeks at a time followed by remission for months or years
- Can be precipitated by sleep, occurring 90 minutes after falling asleep
- Patient may complain of “worst headache of life”

**Management**

- Abortive therapy: 100% O2 on a non-rebreather @ 6-12 L/min for 15 min, SQ or nasal sumatriptan, octreotide, nasal lidocaine
- Prophylaxis: DOC is verapamil (takes 8 weeks to work), Li, ergotamine, prednisone taper, nerve block
9  PEDIATRIC PSYCHIATRY

9.1  ADHD

Signs & symptoms
- Peak severity at 7-8 years
- Hyperactivity: excessive fidgetiness, talking, difficulty remaining seated, difficulty playing quietly, frequent restlessness
- Impulsivity: difficulty waiting turns, blurting out answers, disruptive classroom behavior, intruding or interrupting other’s activities, peer rejection, unintentional injury
- Inattention: forgetfulness, easily distracted, losing or misplacing things, disorganization, academic underachievement, poor follow-through with assignments or tasks, poor concentration, poor attention to details
- Teacher-reported symptoms should have a duration of at least 4-6 months!

Differential
- Learning disability
- Language or communication disorder
- Autism spectrum disorder
- Anxiety disorder
- Mood disorder
- Oppositional defiant disorder
- Conduct disorder
- OCD
- PTSD
- Adjustment disorder
- Stressful home environment
- Inappropriate educational setting
- Hearing or vision impairment

Workup
- Schools are federally mandated to perform appropriate evaluations at no cost to the family if a child is suspected of having a disability that impairs functioning, but the waiting period can be months
- Primary care toolkit available online via the NICHQ
- Psychometric testing is not necessary for routine evaluation for ADHD and does not distinguish children with ADHD from those without ADHD but can be valuable in excluding other disorders and pinpointing specific ADHD problem areas
- Specialist evaluation indicated for suspected intellectual disability, developmental disorder, learning disability, hearing or vision impairment, history of abuse, severe aggression, seizure disorder, continued dysfunction despite treatment
- Additional evaluations in speech and language, occupational therapy, and mental health as needed

Diagnostic criteria
- Symptoms must be present and impair function in more than one setting (school, home, work)
- Symptoms must persist for at least 6 months
- Symptoms must present before the age of 7
- Symptoms must be excessive for the developmental level of the child (i.e. beyond normal hyperactivity for a child’s age)
Management
- Reevaluation whenever symptoms change or worsen
- Treat comorbid anxiety, depression, and learning disorders

9.2 Autism
- Now considered to be a biologic rather than psychologic disorder, more related to mental retardation
- Highly genetic basis with possible environmental factors

Screening
- MCHAT administered between 16-30 months (usually at 18 mo WCC as required by NC Medicaid)

Signs & symptoms
- Markedly impaired eye contact (red flag: lack of joint attention)
- Failure to develop peer relationships
- Not seeking to share enjoyment or interests (red flag: doesn’t look up for approval by 2-3 years)
- Lack of social or emotional reciprocity
- Delayed or absent spoken language without attempt to compensate with gestures or mime (red flag: no words by 18 mo, no strings of words by 2 years)
- Repetitive language
- Inability to initiate and sustain conversation
- Lack of spontaneous make-believe play appropriate for developmental level
- Repetitive motor mannerisms (rocking, spinning)
- Preoccupation with parts of objects
- Strong fixations to objects or restricted interests (“little professor”)
- Inflexible adherence to rigid routines
- May also exhibit sensory seeking or avoidant behavior
- Tantrums set off by noise or changes in routine

Diagnostic criteria
- Onset before age 3
- Impairments in 3 domains: social interaction, language, interests and repetition

Differential (many of these can co-exist with autism)
- Rett syndrome
- Fragile X syndrome
- Angelman syndrome
- Turner syndrome
- William syndrome

Workup
- Send for comprehensive medical evaluation after failed MCHAT or parental concern: basic language and developmental testing via a developmental pediatrician, psychologist, and speech therapist, audiology screen, genetic microarray testing
Management
- Applied behavioral analysis is the best tested method of autism treatment
- Language therapy: focuses on pictures and visual communication
- Social skills groups
- Occupational therapy to aid stimuli sensitivity
- Gluten and casein-free diet

9.3 Eating Disorders
- Anorexia and bulimia are more common in middle and upper-class families

Etiology: combination of psychological, social, and biologic factors
- Psych: perfectionism, high expectations, need for control, people pleasing, hypersensitivity to real or perceived rejection
- Social: over-valuing thinness, sexualization of women, restricted expression of emotion, familial emphasis on weight control, high amount of life stressors
- Biologic: genetic influences, serotonin imbalance in bulimia, comorbid major depression or bipolar disorder in bulimia

Screening
- SCOFF screen useful in primary care, considered to be 100% sensitive: sick, control, “one stone”, fat, food → 2+ points suggest eating disorder

Workup
- EKG
- BMP, TSH, vitamin levels
- DEXA

Management
- Intervention designed to decrease shame, validate patient feelings, assess social supports, encouragement of patient honesty and openness, inform about available resources, and affirm provider willingness to provide ongoing support
- Psychotherapy: individual and family
- Regular medical visits
- Admit for: weight loss > 35% ideal, unresponsiveness to outpatient therapy, rapid weight loss, hypovolemia, electrolyte abnormalities, malnutrition, severe depression or suicidality

Prognosis
- Complication of refeeding syndrome, when shift from fat to CHO metabolism causes ↓ P → depletion of intracellular ATP and tissue hypoxia → impairment of myocardial contractility → CV collapse, seizures, delirium, or rhabdomyolysis
- Complication of Wernicke’s encephalopathy, prevented with thiamine supplementation

9.3.1 Anorexia Nervosa
- Average duration of illness is 5.9 years

Signs & symptoms
- Restrictive type: self-starvation
- Binge purge type: use of laxatives, vomiting, diuretics, or enemas to purge after binging
- Preoccupation with food
- Social withdrawal
- Obsessive exercise
• Frequent weighing
• Fatigue
• Hair loss
• Cessation of menses
• Sensitivity to cold
• Serious: arrhythmia, dehydration, malnutrition, hypotension, bradycardia, reduced bone density, heart failure, dental problems, hypothermia, fainting, lanugo

**Diagnostic criteria**
• Weight loss to 15% below ideal
• Distorted body image
• Amenorrhea
• Intense fear of being overweight

**Management**
• Refer for psychotherapy: family therapy
• Meds only after weight is restored: atypical antipsychotics, tricyclics, SSRIs, Li, anxiolytics before eating

**Prognosis**
• Mortality of 5-20%
• 50% will have good results, 25% intermediate, 25% poor

### 9.4 Adjustment Disorder

• An excessive, prolonged reaction to a stressful event or situation or combination of situations serious enough to impair social and occupational functioning
• Ex. relationship problems, financial difficulties, family conflict, school or work changes, major life changes, health problems, divorce, death, moving, sexuality issues

**Signs & symptoms**
• Common comorbidities: depression, anxiety, disturbance of conduct, eating disorder

**Management**
• Referral for psychotherapy

### 9.5 Child Abuse

• Suspected child abuse or neglect in NC is required to be reported by providers to Child Protective Services
• A report made in good faith can’t be held legally liable while failure to report could result in the provider being legally liable
• Risk factors for child abuse: disabled child, domestic violence, substance abuse, prior abuse in the home, multiple caretakers, mental illness of caretaker, premature child, lack of family support or social isolation, inexperienced parents
• Yellow flags: multiple ER or clinic visits for trivial complaints in an apparently well child, question of apnea, failure to thrive, multiple injuries in the past, doctor-shopping, families in crisis
• Red flags: injuries where history does not fit, little knowledge as to how an injury occurred, little desire to know how the injury occurred, blaming the child for being accident prone, unreasonable expectations for developmental age, delay in seeking care, dead on arrival
• Sexual abuse: occurs gradually and progressively over time and is rarely an isolated incident

**Signs & symptoms**
• Bruising in neonate or young infant or extensive bruising at any age
• Railroad track signs from switching
• Burn injuries: 10-25% of all burns are child abuse
• Fractures
• Head injury: retinal hemorrhages seen with shaken baby syndrome, subdural hematomas can be intentional
• Sexual abuse: sexual acting out, excessive masturbation, self-injurious behavior, eating or sleeping changes, promiscuity, substance abuse, fears, depression, aggression, anxiety, school issues, suicide attempt, chronic medical complaints, stomachaches, anal pain, constipation, encopresis, bleeding, anal discharge, dysuria, hematuria, frequency, enuresis

**Workup**
• Child will be unlikely to disclose any abuse, it is usually uncovered after disclosure to friend, teacher, or family member, or by accidental discovery
• Requires complete medical exam guided by child’s choice, which typically takes hours
10 PEDIATRIC DERMATOLOGY

10.1 Dermatitis

- Substances are either irritants (not immunologically mediated) or allergens (type IV hypersensitivity)
- May require sunlight acting on substance to cause the dermatitis
- Inflammation may be acute, subacute, or chronic
- Distinguish irritant from allergic dermatitis by provocation testing: apply substance to AC fossa twice daily for a week; contact urticaria 15-30 min after application suggest allergic etiology
- Patch testing is only indicated when dermatitis is chronic, recurrent, or deters work or life activities (this tests for type IV hypersensitivities rather than type I, which is what skin scratch tests check)
- Does NOT include latex hypersensitivity as this is a type I reaction

Management

- Trigger avoidance
- Topical or systemic steroids
- Emollients or other barriers
- Oral antihistamines

10.1.1 Allergic Contact Dermatitis

- Causes a killer T-cell response
- Common allergens: metallic salts, plants (poison ivy), fragrances, nickel, preservatives, formaldehyde, propylene glycol, oxybenzone, bacitracin, neomycin, bleached rubber, chrome, sorbic acid

Signs & symptoms

- Acute with macules, papules, vesicles, and bullae
- Chronic with lichenification, scaling, fissures
- Uncommon on scalp, palms, soles, or other thick-skinned areas that allergens can’t get through

10.1.2 Irritant Contact Dermatitis

- Accounts for most cases of dermatitis
- Common irritants: water, soaps, detergents, wet work, solvents, greases, acids, alkalis, fiberglass, dusts, humidity, chrome, lip licking or other trauma

Signs & symptoms

- Acute with bullae, erythema, and sharp borders
- Chronic with poorly-demarcated erythema, scales, and pruritus
- Fissured, thickened, dry skin
- Usually palmar

Workup

- Negative patch test
- Healing proceeds without plateau on removal of the offending agent

10.1.3 Atopic Dermatitis (Eczema)
Inflammatory, acute or chronically relapsing, not contagious

**Etiology**
- Genetic predisposition
- Defects in skin barrier function
- Immune dysregulation

**Signs & symptoms**
- May have concomitant food allergy, asthma, or allergic rhinitis
- Infantile phase: affects cheeks, forehead, scalp, and extensor surfaces of limbs; lesions are vesicular, edematous, weepy, and crusty
- Childhood phase: affected areas are less vesicular, more papules and plaques that become lichenified
- Post-pubertal phase: skin becomes thickened, dry, and lichenified, may affect dorsal surfaces as well as flexural skin, dyshidrotic changes maybe present on the palms and soles

**Workup**
- Patch test to look for pustular reactions

**10.2 Childhood Exanthems**

**10.2.1 Measles (Rubeola or First Disease)**
- Agent is measles virus
- Prevent with MMR vaccination (indicated to prevent death)

**Signs & symptoms**
- Cough
- Coryza
- Conjunctivitis
- Koplik’s spots
- Maculopapular rash starting at hairline and spreading down to confluence

**Treatment**
- Self-resolution in 7-10 days
- Supportive care
- Complication: subacute sclerosing panencephalitis, a rare fatal infection years after initial infection

**10.2.2 Scarlet Fever (Second Disease)**
• Agent is GAS

**Signs & symptoms**
- Pharyngitis
- Strawberry tongue
- Sandpapery rash that is worse in the groin and axilla with desquamation of palms and soles

**Treatment**
- Penicillin VK or amoxicillin administered to prevent sequelae of rheumatic fever

**10.2.3 Rubella (German Measles, 3 Day Measles, Third Disease)**
- Agent is rubella virus
- Prevent with vaccination (indicated to prevent congenital rubella syndrome)

**Signs & symptoms**
- Mild fever
- Conjunctivitis
- Arthralgias
- Postauricular and occipital adenopathy
- Maculopapular rash on face that spreads

**Treatment**
- Resolves in 3 days
- Sequelae of arthralgias

**10.2.4 Erythema Infectiosum (Fifth Disease)**
- Agent is human parvovirus B19

**Signs & symptoms**
- Mild flulike illness
- Rash at days 10-17: initially appears as flushed cheeks, then encompasses whole body as a maculopapular rash, becoming lacy in the arms and legs
- Low grade fever
- Migratory arthritis in older patients that can last 6-8 weeks
- “Papular purpuric glove & sock syndrome” in older adolescents, lasts 1-2 weeks

**Treatment**
- Treatment is supportive with NSAIDs for arthralgias and fever

**10.2.5 Roseola (Sixth Disease)**
- Agent is HHV-6 or HHV-7
- Affects young children, 6 mo to 3 years

**Signs & symptoms**
High fevers to 104 for 3-7 days with no rash
Rash after fever goes away

**Treatment**
- Antipyretics and hydration

### 10.2.6 Varicella
- Caused by HHV-3 (VZV)
- Child will be contagious for 1 week

**Signs & symptoms**
- Intensely pruritic lesions on the trunk first, then face, head, extremities, possibly mucous membranes
- Lesions come in crops over 3-4 days and crust over in 3-5 days

**Treatment**
- Symptomatic only
- Consider acyclovir in teens

### 10.2.7 Hand-Foot-Mouth Disease (Herpangina)
- Agent: Coxsackie A16 virus
- Highly contagious

**Signs & symptoms**
- Vesicles on tongue, oral mucosa, hands, possibly feet
- May have generalized scarlatiniform rash
- Low-grade fever
- Overall child feels well

**Treatment**
• Symptomatic
• Sequelae of myocarditis, substernal chest pain, dyspnea
• Gianotti-Crosti

10.2.8 Gianotti-Crosti Syndrome (Papular Acrodermatitis of Childhood)
• Usually caused by EBV, Hep B, or HHV-4
• Affects 6-14 month olds

Signs & symptoms
• Symmetric red-purple papules and papulovesicles on the face, buttocks, and extremities
• Lymphadenopathy
• Low-grade fever

Treatment
• Self-limiting over 3-4 weeks

10.2.9 Enterovirus Exanthems

Signs & symptoms
• Varied rash; may be maculopapular, vesicular, petechial, or urticarial
• May involve other organ systems

10.3 Dermatophytoses

• Caused by Microsporum, Trichophyton, or Epidermophyton spp
• May be transmitted person-to-person, soil-to-person, or zoonotically
• Risk factors: atopy, immunosuppression, existing skin condition, DM, sweating, humidity
• AKA “tinea” or “ringworm”

Differential
• Atopic dermatitis
• Dyshidrotic dermatitis
• Lichen simplex chronicus
• Psoriasis
• Trichotillomania
• Alopecia areata
• Erythema chronicum migrans
• Pityriasis versicolor
- Pseudofolliculitis barbae
- Seborrheic dermatitis
- Acne rosacea
- Discoid lupus erythematosus
- Contact dermatitis
- Candidal intertrigo
- Erythrasma
- Friction blister
- Onychogryphosis
- Traction alopecia

10.3.1 Tinea capitis: head

**Signs & symptoms & Workup**
- Black dot hair loss
- Scalp erythema and scaling
- May see kerions

**Treatment**
- Oral antifungal: griseofulvin, terbinafine, or itraconazole
- ± Antifungal shampoo: selenium sulfide, ketoconazole

10.3.2 Tinea barbae: beard

- Majocchi (trichophytic) granuloma

**Treatment**
- Oral antifungal: griseofulvin, terbinafine, or itraconazole
- Air exposure
- Topical antifungal: terbinafine, naftifine, butenafine
- ± Soaks with aluminum acetate
- 2nd line: topical azole

10.3.3 Majocchi (trichophytic) granuloma
Signs & symptoms & Workup
- Deep cutaneous infection

Treatment
- Oral antifungal: griseofulvin, terbinafine, or itraconazole
- Air exposure
- Topical antifungal: terbinafine, naftifine, butenafine
- ± Soaks with aluminum acetate
- 2nd line: topical azole

10.3.4 Tinea manuum: hand

Signs & symptoms & Workup
- Similar to tinea pedis but on the hand
- May be more aggressive

Treatment
- Oral antifungal: griseofulvin, terbinafine, or itraconazole
- Air exposure
- Topical antifungal: terbinafine, naftifine, butenafine
- ± Soaks with aluminum acetate
- 2nd line: topical azole

10.3.5 Tinea corporis: infection of neck, trunk, or extremities
Signs & symptoms & Workup
- Sharp-bordered erythematous plaques of varying sizes
- May have pustules or vesicles within the border
- Lesions will enlarge peripherally and may have an area of central clearing

Treatment
- Oral antifungal: griseofulvin, terbinafine, or itraconazole
- Air exposure
- Topical antifungal: terbinafine, naftifine, butenafine
- ± Soaks with aluminum acetate
- 2nd line: topicalazole

10.3.6 Tinea cruris: “jock itch”; groin and thighs
Signs & symptoms & Workup
- Erythematous, well-demarcated scaling plaques
- Must differentiate from erythrasma or candidiasis (will fluoresce differently under Wood’s lamp)

Treatment
- Oral antifungal: griseofulvin, terbinafine, or itraconazole
- Air exposure
- Topical antifungal: terbinafine, naftifine, butenafine
- ± Soaks with aluminum acetate
- 2nd line: topicalazole

10.3.7 Tinea faciale
**Pediatric Quick Notes**

**Signs & symptoms & Workup**
- Located on the non-bearded face
- Children often acquire from cats or dogs
- May be brought on by sunlight exposure

**Treatment**
- Oral antifungal: griseofulvin, terbinafine, or itraconazole
- Air exposure
- Topical antifungal: terbinafine, naftifine, butenafine
- ± Soaks with aluminum acetate
- 2nd line: topical azole

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**10.3.8 Tina pedis**

**Signs & symptoms & Workup**
- Erythema, scaling, vesicles
- Maceration of web spaces
- May have toenail involvement or bacterial 2° infection
- "Moccasin" pattern with involvement of heels, soles, and lateral feet
- May be inflammatory with bullae

**Treatment**
- Oral antifungal: griseofulvin, terbinafine, or itraconazole
- Air exposure
- Topical antifungal: terbinafine, naftifine, butenafine
- ± Soaks with aluminum acetate
- 2nd line: topical azole
10.3.9 Tinea unguium (onychomycosis)

**Signs & symptoms & Workup**
- 3 forms: distal subungual, proximal subungual, and white superficial
- Most pts will also have tinea pedis
- Infection may be yeast or nail dystrophy = must to KOH scrape to be sure before starting therapy as terbinafine won’t cover candidiasis

**Treatment**
- 1st line is oral terbinafine
- 2nd line is oral azole or ciclopirox topical lacquer
- 3rd line is repeat therapy or nail removal

10.3.10 Tinea versicolor: caused by Malassezia furfur = not really a tinea

**Signs & symptoms & Workup**
- Hypo or hyperpigmented macular lesions
- Especially on trunk
- Fine rim of scale
- KOH prep for spaghetti and meatballs

**Treatment**
- Topical selenium sulfide, pyrithione zinc, propylene glycol, ciclopirox, azole, or terbinafine
- ± UV light therapy
- Systemic ketoconazole if recurrent or refractory
10.4 Acne Vulgaris

Etiology
- Multifactorial, involving hormones, keratin, sebum, and bacteria
- Proliferation of P. acnes in this environment → foreign body reaction

Types
- Comedonal
- Inflammatory
- Cystic: characterized by cysts, fissures, abscess formation, deep scarring

Differential
- Hydradenitis suppurativa (acne inversa): usually occurs in the axillae, inguinal folds, and perianal area; hallmark is double comedones
- Steroid acne
- Meds: Li, tetracyclines (paradox), phenytoin, OCPs, isoniazid
- Infectious folliculitis
- Cutting oils and other occlusives
- Rosacea
- Perioral dermatitis

Management
1. Behavioral modification: no picking, mild cleanser BID, oil-free non-comedogenic products
2. Topical comedolytics (allow 4-6 weeks to work): retinoid (pregnancy D), azelaic acid (better for pregnancy), glycolic acid, salicylic acid
3. Topical antibacterials: benzoyl peroxide (DOC, no bacterial resistance), clindamycin, erythromycin (lots of resistance), sulfur-containing preparations, metronidazole, dapsone (for inflammatory acne)
4. Oral therapies: antibiotics (minocycline, doxycycline, tetracycline, erythromycin; need 2-4 weeks to work), 5 mo course of isotretinoin (regulated by FDA iPledge due to pregnancy X), OCPs (for adult acne, hirsutism, PCOS, premenstrual flares), spironolactone (for poor OCP candidates, pregnancy X)

Prognosis
- Usually ends by age 25

10.5 Molluscum Contagiosum

- Agent is a poxvirus
- Spread by autoinoculation

Signs & symptoms
- Flesh-colored dome-shaped lesions with umbilicated central core

Management
- Self-limiting after about 1 year
- Cryotherapy
10.6  Verrucae

- Agent is HPV, which infects the skin keratinocytes to cause warts
- Occur in areas of skin trauma
- 100 serotypes = many infections possible over a lifetime
- Don't have "roots", rather they are confined to the epidermis
- Cause necrosis of capillaries
- Have oncogenic potential

Subtypes
- Verruca vulgaris: the common wart; verrucous surface, thrombosed capillaries, loss of dermatoglyphics, may have fingerlike projections
- Verruca plana: the flat wart; flat-topped pink to brown papules, usually in linear formation, with predilection for the face, dorsal hands, wrists, and knees, commonly spread by shaving
- Verruca plantaris: the plantar wart; verrucous surface, thrombosed capillaries, often coalesce into a “mosaic”, with predilection for pressure points of the feet

Differential
- Callus: won't interrupt skin lines

Management
- Wait for regression via cell-mediated immunity
- Destruction: cryotherapy, laser, cautery, duct tape occlusion, excision, beetle juice, podophyllin gel, retinoids, salicylic acid, 5-fluorouracil
- Immunomodulating agents

10.7  Impetigo

Etiologies
- Usually Staph aureus
- Also Strep
- If deep and extending into the dermis with ulceration and a tender yellow-gray crust, it is called ecthyma (agents are Strep, Pseudomonas, Staph)
- Risk factors: trauma, underlying eczema or HSV, poor hygiene, previous antibiotics, warm temps, high humidity
- Lesions are spread by auto-inoculation

Signs & symptoms
- Oozing lesions
- May be pruritic
Management
- Topical mupirocin for small number of non-bullous lesions
- Oral therapy for anything else: dicloxacillin, cephalexin, or clindamycin
- Suspect MRSA → clindamycin or linezolid

Sequelae
- May be followed by poststreptococcal glomerulonephritis or rheumatic fever

10.8 Lice

Signs & symptoms
- Scalp or neck pruritus
- May be asymptomatic
- Cervical and nuchal lymphadenopathy
- Secondary infection

Workup
- Diagnosis is with visualization of the nits on hair shaft as well as crawling nymphs and adults

Management
- Resistance has been reported and varies geographically
- First-line treatments are pyrethroids, malathion, benzyl alcohol, or spinosad
- Mechanical wet combing is an alternative therapy for kids too young for medical therapy (< 2 months)
- Lindane is restricted due to neurologic effects
- Treat bedmates prophylactically and examine all housemates and close contacts for nits
- Wash all clothing and bedding used in last 2 days in hot water
- Store non-washable items in a plastic bag for 2 weeks
- 2nd treatment with insecticide 7-10 days after first treatment to kill any surviving nits
- Kids may return to school after first application of insecticide
11  PEDIATRIC HEMATOLOGY

11.1  Sickle Cell Anemia

- Caused by recessive inherited mutation in Hb → HbS
- Genotypes SS, SC, SB, SA (trait) → severity is on a spectrum
- Onset occurs early in life, after HbF levels fall and HbS prevails
- Lifelong hemolytic anemia with acute and chronic tissue damage as sickled RBCs get stuck in small blood vessels → infarctions
- Episodes may be triggered by infection, folate deficiency, hypoxia, or dehydration

Screening
- Routinely done on all newborns, as 8% of black babies will carry the sickle cell trait

Signs & symptoms
- Pallor, jaundice
- Splenomegaly
- Leg ulcers
- Priapism
- Delayed puberty
- Infection
- Acute pain crisis from infarctions of the lung, kidney, spleen, or femoral head, will also have fever
- Blindness
- Stroke
- Malnutrition

Workup
- CBC with smear showing sickled cells, target cells,
- Howell-Jolly bodies, and nucleated RBCs; may have leukocytosis, thrombocytosis, and reticulocytosis
- Confirmation of positive Sickledex screen is done via Hb electrophoresis (can’t do until 3 mo of age due to HbF predominance)

Management
- Increased susceptibility to encapsulated organisms → vaccinate all pediatric sickle cell patients with adult
- Pneumovax
- Transfusions as needed
- Folate supplementation
- Pain crisis: fluids, O2, narcotics, and antibiotics
- Hydroxyurea to increase HbF (risks)
11.2 Acute Lymphocytic Leukemia

- Cancer of the lymphoid progenitor, affecting B or T cells
- Most common leukemia in kids 3-7

**Signs & symptoms**
- Malaise and fatigue
- Fever
- Bleeding gums
- Lymphadenopathy
- Splenomegaly
- Petechiae
- Weight loss
- Meningitis
- Anorexia
- Dyspnea

**Workup**
- Send for bone marrow biopsy; indicative of leukemia if > 30% blasts
- CBC showing pancytopenia

**Management**
- Refer to oncology for aggressive chemo (~2 years) and possible bone marrow transplant

**Prognosis**
- 80% cure rate for kids with chemo
12 PEDIATRIC INFECTIOUS DISEASE

12.1 Diphtheria

- Agent is Corynebacterium diphtheriae
- Transmission is direct or droplet
- Humans are the only reservoir and immunization does not prevent carriage
- Some strains produce respiratory toxin → heart and nervous system damage (why we vaccinate)

**Signs & symptoms**

- May be asymptomatic
- Sore throat
- Low grade fever
- Malaise
- Cervical lymphadenopathy
- Diphtheria membrane
- Cutaneous diphtheria

**Workup**

- Throat and membrane cultures

**Treatment**

- Erythromycin or penicillin
- Airway management
- Prophylax close contacts

12.2 Pinworms

- Parasite is Enterobius vermicularis
- The most common parasitic intestinal infection
- Transmission is fecal-oral or by inhalation

**Signs & symptoms**

- Severe rectal itching
- UTI
- Vaginitis

**Workup**

- Diagnosis is usually clinical
- Tape test with microscopy

**Management**

- Albendazole, with repetition in 2 weeks
12.3 Mumps

- Agent is paramyxovirus
- Prevent with MMR vaccine (indicated to prevent severe pain)

Signs & symptoms

- Parotitis
- Stenson’s duct inflammation with yellow discharge
- Orchitis 7-10 days later, with abrupt fever, testicular swelling and tenderness
- Possible CNS involvement

Management

- Scrotal support and ice packs
- NSAIDs

Prognosis

- Rare chance of sterility with orchitis

12.4 Pertussis

Prevention

- Dtap vaccine series for kids
- Tdap vaccination for adults to protect kids

Signs & symptoms

- Initial: cold-like; rhinorrhea, lacrimation, dry cough with episodes of severe cough, low-grade fever; post-tussive emesis
- Paroxysmal stage: coughing becomes more severe and may persist up to 10 weeks at this stage; paroxysmal whooping may be heard
- Convalescent stage: coughing diminishes as patient recovers and disappears over 2-3 weeks but may recur with subsequent URIs

Workup

- Bordetella culture or PCR from nasopharyngeal swab

Management

- Macrolides are DOC
- Septra is an alternative

Prognosis

- May be infectious for several weeks if untreated
13 Pediatrics Exam Notes

13.1 The Newborn Infant

13.1.1 Background

- Terms:
  - **newborn**: from birth until 28th day of life
  - **neonatology**: care given until discharge from nursery
  - **pediatrics**: care given from discharge until college physical
  - **gestational age**:
    - **small for gestational age**: babies less than 10th percentile for head circumference, weight, and/or length
      - **symmetrical**: all measures are < 10th percentile
        - occurs early in gestation
        - usually due to smoking, drugs, chromosomal abnormalities, intrauterine infections, or metabolic disorders
        - brain is symmetrically smaller
      - **asymmetrical**: usually only weight is < 10th percentile
        - occurs late in gestation
        - caused by placental or uterine insufficiency □ chronic hypoxia
        - associated with risk of hypoglycemia, perinatal asphyxia, polycythemia
        - little to no effect on brain size
    - **large for gestational age**: babies > 90th percentile for weight
      - most common reason is diabetic mothers
      - associated with increased risk of perinatal asphyxia and birth injuries, RDS, hypoglycemia

- **perinatal mortality**: death from 20th week gestation up to 7 days after birth
- **neonatal mortality**: death from birth until 28th day
- **postnatal period**: from 28th day to end of 1st year
- **infant mortality**: neonatal + perinatal mortality

13.1.2 Evaluation of the Newborn at Birth

- **APGAR SCORING SYSTEM**

- Quick assessment at moment of birth
• **Apgar score:** physiologic indicator of baby's response to birth process  
  o measured at 1 and 5 minutes  
  o many newborns have acrocyanosis, and this is considered normal and usually resolves within a few hours  
• skeletal survey for obvious deformity  
• umbilical cord: 2 arteries and 1 vein  
• placental inspection  
• Detailed exam at nursery  
  • vital signs  
    o normal HR 120-160  
    o normal RR 30-60  
    o normal BP 50-70 systolic  
    o recorded and plotted height, weight, and head circumference  
      ▪ body weight will decrease by 8-10% in 1st 24 hours then regain within 2 weeks  
  • skin:  
    o bruising or petechiae: common as a result of the birth process  
    o meconium staining of nails and skin may be a sign of fetal distress  
    o acrocyanosis: pink trunk but blue hands and feet  
    o pallor: sign of anemia  
    o may see *vernix caseosa* (smooth white covering of fetus that is normally lost close to term)  
      ▪ may still be present in babies born before 34 weeks  
    o lanugo: mostly lost in full term infants but present in preterm  
    o peeling skin common in postterm infants  
    o hemangiomas  
    o nevus simplex (aka salmon patch or stork bite)  
      ▪ usually goes away  
    o may see *Mongolian spots*: dark color on buttocks common in African American, Native American, and Asian babies, usually fades with time  
    o lumbar spine hair tufts may represent spinal defects  
    o may see *milia*: erythematous papules secondary to blocked sebaceous glands  
    o may see *erythema toxicum*: diffuse erythematous papulovesicular eruption  
    o seborrhea (aka cradle cap)  
      ▪ treat by massaging scalp with warm mineral oil  
      ▪ resolves within a couple of months  
    o neonatal acne: due to excess maternal estrogens  
      ▪ resolves on its own  
  • heart:  
    o murmurs are commonly present in first few days of life due to closure of ductus, pulmonary artery stenosis, or small VSD  
    o congenital heart defects: cyanotic vs acyanotic  
    o irregular HR is not unusual in first few days of life  
• lungs:  
  o transient rales common in first few hours of life but should disappear  
  o signs of respiratory distress: RR > 60, retractions, grunting  
    ▪ causes:  
    ▪ aspiration syndromes: meconium or blood  
    ▪ transient tachypnea of the newborn: from retained secretions  
      • usually resolves within first few days of life  
  o babies normally are periodic breathing (crescendo followed by brief apneic period)  
• abdomen:  
  o kidneys and liver are usually palpable  
  o spleen may be palpable  
  o abdomen should be soft with normal bowel sounds
common abnormalities:
- esophageal atresia
- tracheoesophageal fistula:
  - excessive drooling and choking and aspiration with first attempted feed
  - confirmed by NGT placement with CXR
  - surgical repair within first few days of life
- obstruction:
  - volvulus
  - Hirschsprung disease: congenital absence of intramural colonic ganglion cells in sigmoid colon = no innervation = babies can’t pass stool, abdominal distension, bilious vomiting
- abdominal wall defects are usually diagnosed before birth
  - omphalocele: abdominal contents are herniating into base of umbilicus
  - gastroschisis: same as omphalocele except contents are not contained by membrane
- umbilical hernia from incomplete closure of fascial umbilical ring
  - more common in black babies
  - taping a quarter to the navel does not help
  - make sure it is easily reducible
  - usually close by age 5 or can be surgically closed
- GERD
- head:
  - abnormalities:
    - cephalohematoma: rupture of small vessels that cross skull to periosteum that is contained within suture lines
      - less frequently seen, a result of prolonged labor or instrumentation
      - can cause ↑bili and ICH
      - resolves more slowly, requires close monitoring for skull fx
    - caput succedaneum: accumulation of blood above the periosteum that crosses sutures
      - frequently seen after prolonged labor
      - self-resolves within a few days
    - craniosynostosis: premature fusion of the sutures
      - always need neurosurgery consultation
  - facial nerve palsies
  - fontanelles: posterior should close in 2-4 months, anterior in 4-24 months
- nose:
  - infants are obligate nose breathers, need to make sure they can breathe easily
    - choanal atresia: blockage of both nasal passages
  - seasonal allergies are extremely unusual in children under 2, so any sneezing is a result of trying to clear congestion
- eyes:
  - normally neonate can see light, shapes, and movement at 8-15 inches
  - subconjunctival hemorrhage may be due to labor and should go away
  - red reflex present symmetrically
  - leukocoria is white reflex that may be due to cataracts or glaucoma
    - need ophthalmology referral
  - nasolacrimal duct stenosis: usually presents as constant unilateral conjunctivitis
    - should self-resolve by 18 months
• treat until them with massage around lacrimal duct
  • differentiate from *Chlamydia* conjunctivitis, which appears ~2 weeks after birth
    • alignment: check for strabismus and tracking
      • intermittent strabismus normal up to 6 months

• ears:
  • check for malformed or malpositioned ears (a sign of chromosomal abnormality)
  • hearing should be fully developed by 1 month

• mouth:
  • small white vesicles on roof of mouth are called Epstein’s pearls and are normal
  • natal teeth occur occasionally
  • abnormalities:
    • thrush: treat with nystatin
    • cleft lip or palate
    • signs of hereditary chromosomal syndromes:
      • micrognathia: small mandible sometimes seen in infants with fetal alcohol syndrome
      • macrognathia: large tongue

• neck:
  • common masses: branchial cleft cyst, thyroglossal duct cyst, cystic hygroma
  • congenital torticollis seen with forceps delivery

• genitalia
  • ambiguous genitalia is a medical emergency requiring further testing
  • make sure testes are descended in males
    • however, they may go up and down up to age 1
  • hydrocele
  • hypospadias
  • circumcision
    • not covered by Medicaid
  • labial adhesion can be fixed with estrogen cream
  • vaginal discharge or blood may be present due to maternal hormones

• musculoskeletal
  • clavicular fx from birth trauma
    • *Erb’s palsy*: internally abducted and rotated arm due to brachial plexus injury
    • painless but needs orthopedic referral
    • talipes equinovarus: clubfoot
    • metatarsus adductus: deformity causing foot bones to bend inward
    • check for hip dysplasia: repeated throughout infancy
      • Barlow maneuver attempts to dislocate an unstable hip
      • + Ortlani = hearing or feeling a clunk as femur goes back into acetabulum
        • with reduction of a dislocated hip
    • syndactyly and polydactyly can be just soft tissue or with bone involvement

• neuro
  • check primitive infant reflexes: rooting, suckling, palmar grasp, startle reflex (Moro), + Babinski
13.1.3 Common Problems in the Term Newborn

- Birth anomalies
- Birth trauma
- Neonatal jaundice:
  - presentation: kernicterus, bili > 5 mg/dL, lethargy, hypotonia, poor suck, high pitched cry
  - jaundice in first 24 hours is abnormal
    - treat with phototherapy
  - jaundice appearing on days 2-3 and disappearing by day 5 is physiologic
- Hypoglycemia: in newborns this means < 35 mg/dL
  - risks: infants of diabetic mothers, intrauterine growth restriction, infection, prematurity
  - presentation: lethargy, poor feeding, irritability, seizures
  - treat with IV glucose
- Respiratory distress
- Infections: transplacental, ascending, or from passage through birth canal
  - bacterial: sepsis, pneumonia, meningitis, UTIs, omphalitis
  - congenital: CMV, rubella, toxo, varicella, syphilis, TB
  - perinatal: HSV, hep B, hep C

13.1.4 Initial Care of the Newborn

- Eye prophylaxis to prevent gonococcal infection
  - erythromycin ointment will cover both gonorrhea and Chlamydia infection
- Give vitamin K
- Check blood glucose
- Hep B vaccine
- Hearing screen
- Cord blood: type and Coomb’s test to look for hemolytic anemias
- Newborn screen: most states mandate this happen within first 24 hours of life

13.1.5 Discharge, Follow-Up and Clinic Visits

- Must have newborn lab screen for metabolic and genetic disease before leaving hospital:
  - panel varies by state but all include PKU, hypothyroidism
  - NC: amino acid disorders, fatty acid disorders, organic acid disorders, biotinidase deficiency, hypothyroidism, congenital adrenal hyperplasia, sickle cell disease
- Discharge from hospital after 24-36 hours is safe for normal newborns
  - normal feeding and voiding, yellow stool, < 10% weight loss, stable bili
- Infants born to GBS+ moms need to stay for 48 hours
- Follow-up visit at 48-72 hours
- Fevers in young babies (≤ 3 months) should be considered life-threatening illness until proven otherwise
  - the younger the infant, the larger the worry
- First visit @ 6 weeks? unless not gaining weight
- Milestones
  - most babies double weight by 6 months, triple by a year, and quadruple by 2 years

13.2 Pediatric Oral Health

13.2.1 Background

- Dental development begins in utero at 6 weeks
- Tooth anatomy:
  - enamel
Pediatric Quick Notes

- dentin
- pulp
- cementum: collagenous matrix

13.2.2 Pediatric Oral Exam

- Oral mucosa
- Labial and lingual frenulum
- Hard and soft palate: look for bony growths
- Tongue
- Erupted teeth
  - eruption: process by which teeth emerge into the oral cavity
    - eruption is usually bilateral and symmetric
    - primary dentition fully erupted by 30 months
      - some variation, with girls sooner than boys
    - mandibular central incisors first and then maxillary central incisors
    - symptoms: excessive drooling, irritability, gingival swelling, eruption cysts
      - not associated with fever
    - can give acetaminophen, cool objects to suck on
      - issue with oral analgesics is that they suppress the gag reflex → risk of aspiration
  - exfoliation: process of losing primary dentition with eruption of permanent teeth
    - usually begins at age 6 but may be earlier
- Gingiva

13.2.3 When to Refer to a Pediatric Dentist

- Delayed eruption (> 6 months) of primary or permanent teeth
  - could be genetic, hypothyroidism, hypopituitarism, rickets
- Complete failure of eruption: associated with a variety of rare congenital pediatric syndromes
- Variations in number of teeth or missing teeth
- Early exfoliation

13.2.4 Dental Caries

- Background:
  - caries are the most common chronic disease of childhood
  - a significant public health problem
  - caused by formation of biofilms from dietary carbs and oral flora
    - bacteria ferment carbs → decreased pH and demineralization of tooth enamel
    - initiated by Streptococcus mutans (transmitted from mother to child) and Streptococcus sobrinus
    - continued by Lactobacillus acidophilus and L. casei
  - At risk: active decay or multiple fillings in mothers, maternal dietary habits, SES, diet high in sugar, bedtime bottles, prolonged use of sippy cups, enamel defects, insufficient cleaning, liquid medications, exposure to passive tobacco smoke
    - caries in primary teeth incur 3x greater risk of developing caries in permanent teeth
    - protective: good salivary flow, good oral hygiene, balanced diet, adequate fluoride
- Prevention:
  - clean gums with soft cloth starting at birth
  - cleaning teeth with soft brush at least twice a day
    - parental supervision up to age 6
  - visual screening at health maintenance visits as soon as primary dentition comes in
  - avoiding foods with increased cariogenic risk: sugary snacks, grazing on high-carb foods, fruit juices, sleeping with bottles
  - fluoride:
supplementation if tap water does not have adequate concentrations
- fluoridated toothpaste for children over 6 months with caries or at increased risk for caries
  - fluoride increases resistance to demineralization, enhances mineralization, and inhibits bacterial colonization
- fluoride varnish
  - medical providers are trained in NC to apply this on children at risk of caries from time of first tooth eruption up to age 3
- dental visits:
  - start encouraging families to see one starting when child is one year old
  - first visit should ideally occur by age 1, must occur by age 3?

- Presentation:
  - initial lesion is a white spot
  - brown or black lesions are stages of decay

13.2.5 Gingivitis & Periodontal Disease

- More common than previously believed in pediatric population
- Gingivitis progresses to periodontitis = loss of attachment and destruction of bone
  - “juvenile periodontitis” is a more severe form around permanent first molars and incisors
  - polymicrobial
- Treatment:
  - gingivitis should improve with better oral hygiene
  - antibiotic therapy ± root canal therapy or extraction
    - penicillin VK, erythromycin, or clindamycin
    - amoxicillin for bacterial endocarditis prophylaxis
  - surgical debridement if needed
- Complications:
  - infection can spread to sinus or brain if untreated

13.2.6 Oral Habits

- A normal part of early childhood development that is self-soothing
  - ex. pacifiers, sucking on fingers
- Frequency decreases as child ages
- When to stop?
  - 1-3 years for pacifiers, finger sucking by age 6

13.2.7 Dental Trauma

- Tooth luxations:
  - concussion: mild trauma with no tooth mobility
    - may result in color changes
  - subluxation: tooth loosening without displacement
  - intrusion: tooth driven into socket
    - most severe when primary maxillary front teeth are involved
  - extrusion: tooth dislocated from socket centrally
  - avulsion: complete tooth displacement
- Causes: falls, sports or playing, altercations, MVAs, child abuse
- Prevention:
  - mouthguards
- Treatment:
  - varies with primary vs permanent teeth
  - avulsed permanent teeth are medical emergency
13.2.8 Dental Needs in Selected Pediatric Patient Populations

- Immunosuppressed children:
  - increased risk of oral infections
  - need frequent monitoring for mucositis and ulcers and vigorous oral hygiene
- Bleeding disorders:
  - may need hospitalization for oral surgeries
  - may need antifibrinolytics after extractions

13.3 Pediatric Physical Exam & Health Maintenance Exams

13.3.1 Background

- Why examine a child when they appear healthy?
  - promote health, disease surveillance with age-appropriate screening, developmental surveillance, counseling, address any parental concerns
- Timing: 2-4 days, 1 mo, 2 mo, 4 mo, 6 mo, 9 mo, 12 mo, 15-18 mo, 2 year, then every year
  - Medicaid requires annual visits up to age 6

13.3.2 Pediatric History

- History:
  - 2-4 day visit: discuss birth history, review of newborn screens, hearing tests, flu of abnormal lab values
  - discuss acute and chronic problems
  - diet
  - meds
  - allergies
  - FH

13.3.3 Developmental Assessment

- Development is evaluated at each visit, but specific screens are only done at select visits
  - assess by observation, asking older children about school performance and future aspirations, and by parental report of milestones achieved
  - specific screens:
    - Denver II: classic but time consuming
    - PEDS:
    - Battelle Developmental Inventory Score Test
- Screen for autism between 16-30 months:
  - Modified Checklist for Autism in Toddlers (MCHAT): most commonly used screen, translations available

13.3.4 Vitals
- **Temperature:**
  - rectal is preferred as it is most accurate
    - mandatory up to age 10
  - normal in kids ranges from 97-100.3°
- **BP:** check at each visit starting at 3
  - normal values should be < 90th percentile for child’s age, sex, and weight
  - high normal if in 90-95th percentile
  - high if > 95th percentile
- **RR:** count full minute due to apneic breathing in infants
  - early childhood should be 20-40
  - late childhood should be 15-25
  - approaches adult levels by age 15
- **HR:**
  - age 1-2 should be 70-150 bpm
  - age 2-6 should be 68-138 bpm
  - age 6-10 should be 65-125 bpm
- **Growth:**
  - weight:
    - naked on a baby scale until age 1
  - height:
    - measure lying down up to age 2
  - BMI: used for 2-21 year olds with consideration of age and sex as an early indicator of childhood obesity
    - AAP recommends screening for pediatric obesity via BMI annually
    - underweight = BMI < 5th percentile
    - normal = BMI between 5th and 85th percentiles
    - overweight = BMI between 85th and 95th percentiles
    - obese = BMI ≥ 95th percentile
      - children should be referred to receive intensive counseling and behavioral therapy
  - head circumference: measure up to age 2 at each visit

### 13.3.5 Physical Exam Tips
- Be observant
- Exam techniques:
  - understand child’s developmental level
  - give child a choice in exam if possible
  - younger children should sit on parent’s lap
  - parents are an important part of the exam
  - limit exam to what is essential
  - vary sequence of exam relative to child’s age and comfort level
    - allow several minutes to pass before you touch the child
    - kids usually warm up later, so put off important examining areas of concern until last
  - reluctant children:
    - let them calm down
    - examine toy or stuffed animal first
    - give them something to hold in each hand
    - make toys out of simple supplies
    - make the exam a game

### 13.3.6 HEENT
- **Eyes:**
• AAP recommends routine vision testing at 5, 6, 8, 10, and 12 years, although Medicare requires screening starting at age 3
  o Snellen chart:
    ▪ age 1 should be ~20/200
    ▪ age < 4 should be 20/40
    ▪ age > 4 should be 20/30
  o refer for acuity poorer than 20/40
  o ask parents if they have noticed any abnormalities in vision
  o birth to 3 mo: evaluate for fixation, alignment, eye disease
• alignment:
  o if strabismus is present, follow up with cover test: affected eye will drift when covered and then will move quickly back when cover is removed
• Ears:
  • inspect ear alignment with relation to eyes
  • check auditory acuity
    o newborn screening is done before hospital discharge via auditory brainstem response & evoked otoacoustic emissions
    o pediatric hearing screen starting at age 3
      ▪ ask parents about hearing at visits
      ▪ whisper test for younger kids or audiometry for older kids
      ▪ pure tone audiometry at age 5, 6, 8, and 10 years of age
      ▪ Medicaid requires annual screens beginning at age 4
  • otoscopic exam
• Nose:
  • inspect for allergic salute
  • inspect turbinates for patency, polyps, foreign body, or signs of allergy (bogginess and edema)
• Mouth:
  • inspect gums, mucosal surfaces, posterior pharynx, teeth, gums
  • gag reflex
  • note quality of voice
• Neck: same exam as for an adult

13.3.7 Lungs & Thorax
• Inspect for abnormalities, retractions, use of accessory muscles
  • newborns may have breast buds
• Auscultate
  • make it a game by having child blow on Kleenex
  • auscultory fields are same as an adult

13.3.8 Heart
• Sinus arrhythmias and physiologic systolic murmurs are common
  • loudest at left sternal border
• Abnormal murmurs: loud, harsh, or diastolic murmurs
  • these are associated with malnourishment or heart failure

13.3.9 Abdomen
• Should auscultate mechanic tinkling every 10-30 sec
• Liver and spleen may be palpable

13.3.10 Musculoskeletal
• Observe standing and gait
• Check for leg length discrepancies
• Spine: routine screening no longer recommended
• Feet:
  • flat feet normal until age 3
  • true deformities don’t return to neutral position with manipulation

13.3.11 Genitalia & Breasts
• Female: document Tanner stage
• Male: inspect placement of urethra, palpate scrotum, transilluminate if mass is present

13.3.12 Rectal Exam
• Not routine

13.3.13 Further Screening
• Anemia: H/H once between 12-24 months, once for girls after onset of menses
• Lead levels: lab levels once between 12-24 as well as a questionnaire
  • medical emergency if > 70 µg/dL
  • if > 50 µg/dL: symptoms of colic, nausea, myalgia, seizures, headache, anemia
  • if > 10 µg/dL: decreased IQ and academic difficulties
  • acceptable levels are < 10, consider chelation if > 25
• Lipids: AAP recommends screening at 6, 8, 10, and every year after
  • children with h/o obesity, HTN, or diabetes should be screened as well
• Vitamin D levels?
• TB risk assessment:
  • screen if high risk (contact with TB, HIV+, birth in endemic area)
    • Mantoux can be done as early as 3 months
  • BGC vaccine is not a contraindication to TB skin testing
• HIV and other STDs
• Depression screening:
  • USPSTF: screen 12-18 year olds
  • AAP: annual psychosocial and behavioral assessment
  • tools: Children’s Depression Inventory, Reynolds Child Depression Scale
• Alcohol, drug, and tobacco use: screen annually starting at age 11
• No longer recommended: testicular exams, scoliosis screening, paps before age 21

13.3.14 Counseling
• Oral health: ask about water source and fluoride levels (should be > 0.6 ppm)
• Injury prevention: bicycle helmets, firearm safety, drowning, choking, poisoning, burns, car seat requirements and specifications
  • injuries are the #1 cause of death after age 1
• Newborns: feeding, voiding & stooling, care of umbilical stump, circumcision, sleep concerns
• Toddlers: picky eating, transitioning to cups and solid foods, temper tantrums, toilet training, speech
• Young children: separation anxiety, ADHD, bedwetting (normal until age 5-6), encopresis, eating issues and nutrition, routine dental care
• School-age children: safety precautions for firearms, sports, traffic, water, healthy lifestyles
• Adolescents: sexual maturity issues, emotional and behavioral issues, school performance, obesity, acne, substance abuse, violence, risk-taking
  • safe sex counseling for sexually active adolescents
13.4 Immunizations

13.4.1 Background

- US children are currently immunized against 15 diseases, which takes ~40 vaccinations total
  - federally-funded Vaccines for Children Program provides vaccines to healthcare professionals
    at no charge as long as they make them available to children up to age 19 who are un- or
    underinsured, or American Indian or Alaskan native
- Types of vaccines:
  - recombinant: genes that code for a specific viral protein are expressed in another microbe
  - conjugate: use LPS linked to a protein carrier
  - subunit: produced from specific purified antigens
- Live vaccines: measles, mumps, rubella, varicella, yellow fever, rotavirus, nasal influenza
- Vaccines generally recommended to be administered at the youngest age at which risk of disease
  is greatest and desired immunologic response can be obtained
- Routes:
  - most are IM
  - MMR, polio, and varicella are subq
  - rotavirus is oral
- Injections must be given at a different site with a different needle and syringe
  - exception is combination vaccines, which are recommended to decrease number of
    needlesticks

13.4.2 Hepatitis A Vaccine

- Transmission is fecal-oral
- Why vaccinate?
  - children don’t get very sick with hep A, but they are a reservoir for adults that do get very ill
    from hep A
- Implementation began in 1996
  - Recommended for all children at 12 months, with 2nd dose 6-12 months after 1st
- Forms:
  - Havrix and Vaqta for children under 18
  - Twinrix (hep A + B) for adults over 18

13.4.3 Hepatitis B Vaccine

- Transmission through infected body fluids
- Why vaccinate?
  - chronic infection is more likely if disease is acquired early in life
  - 1/4 of infected infants will die of related disease
- Recommended for all infants and unvaccinated kids by age 11-12
  - a 3 dose series: 1st dose before discharge at birth, 2nd at 1 mo, 3rd at 6-9 mo
- Available as a single vaccine or in combination with Hib or hep A
- Side effects: mild-mod fever, injection site reactions

13.4.4 Diphtheria, Tetanus, and Pertussis Vaccines

- Why vaccinate?
  - infections occur early in childhood, are highly contagious, and can have serious complications
  - booster needed for adults due to waning immunity
- Childhood vaccination in 5 doses: 2 mo, 4 mo, 6 mo, 12-18 mo, and 4-6 years
- Combination forms:
  - old vaccine is “DTP”
now “DTaP” for acellular pertussis, thought to reduce incidence of fever and adverse reactions in children receiving the vaccine
- vaccine for adults is TDaP, which has much lower doses of pertussis
  - childhood vaccine is too strong and would make adults extremely ill
  - brands: Adacel, Boostrix
- Alternative or single forms:
  - whole cell preparations are still available but are associated with higher incidence of adverse effects
  - DT is a pediatric vaccine used when pertussis is contraindicated in kids
  -Td is the adult vaccine routinely given for booster for tetanus and diphtheria
    - adolescents getting this should still get a single dose of TDaP
- DTaP/HIB combination
- diphtheria toxoid
- tetanus toxoid
- Side effects (mostly whole cell): high fever, unusual cry, seizures

13.4.5 HIB Vaccine
- Why vaccinate?
  - *Haemophilus* was a common cause of childhood invasive disease, including bacterial meningitis, pneumonia, cellulitis, epiglottitis, and septic arthritis
    - vaccination has decreased incidence by 99%
  - decrease nasal carriage
- Schedule: 4 doses given at 2 mo, 4 mo, 6 mo, and 12-15 mo
  - if unvaccinated and between 2-, kids only need a single dose
- Side effects: mild fever, injection site reactions

13.4.6 Polio Vaccine
- Why vaccinate?
  - polio is highly infectious and can cause viral meningitis and paralysis
- Forms:
  - OPV: oral vaccine that used to be standard but was associated with increased risk of viral shedding and giving polio to others
  - IPV: since 1999 all doses are now of the inactivated version
- Schedule: 4 doses, 2 mo, 4 mo, 6-18 mo, 4-6 years

13.4.7 MMR Vaccine
- Why vaccinate?
  - few practicing clinicians will recognize measles
  - measles causes death
  - mumps is very painful
  - prevention of congenital rubella syndrome
  - combination vaccine is more effective than giving each individually
- Schedule: 2 doses, 12 mo, 4-6 years
- Side effects: fever, rash, parotid swelling, arthralgias, limited study raising concern over IBD and autism correlations

13.4.8 Varicella Vaccine
- Why vaccinate?
  - highly infectious
  - complications necessitating hospital admission
  - severe neonatal infections
  - life-threatening infections in young adults
- Schedule: 2 doses
- Breakthrough disease occurs at a rate of 1% per year
- Side effects: injection site reactions, rash

13.4.9 MMRV

- New vaccine combining MMR and varicella
- Can be used for 1st dose and should always be used for 2nd dose unless there is a personal or FH of seizures

13.4.10 Pneumococcal Conjugate Vaccine

- Why vaccinate?
  - Strep pneumo is responsible for many cases of serious, invasive disease in kids under 5
- Schedule: 4 doses, 2 mo, 4 mo, 6 mo, 12 mo
  - brand: Prevnar
- Side effects: fever, injection site reaction
- Pneumococcal polysaccharide vaccine (PPSV) can be given to children ≥ 2 with underlying medical conditions

13.4.11 Rotavirus Vaccine

- Why vaccinate?
  - major cause of severe gastroenteritis, with large numbers of virus shed in stool
  - responsible for many hospitalizations
- Schedule: 3 doses, 2 mo, 4 mo, 6 mo
  - no doses should be given after 8 months of age
  - brand: RotaTeq

13.4.12 Meningococcal Vaccine

- Schedule: 2 doses, 11 years, booster at 16 years
  - no booster needed if first dose is at 16 years or older
  - brands: Menomune, Menactra (also against diphtheria toxoid, now the preferred vaccine)
- Side effects: injection site reactions

13.4.13 Influenza Vaccine

- Why vaccinate?
  - risk of hospitalization, neurologic and pulmonary complications
- Forms: TIV is inactivated, LAIV is live
  - choose with care, as not all formulations are approved for all ages and medical conditions
    - LAIV should not be given to kids under 5 with h/o recurrent wheezing in past 12 months
    - don’t give to children under 6 months
- Schedule:
  - kids under 9 being immunized for the first time need 2 doses separated by 1 month
- Side effects: mild systemic symptoms
- Egg allergies may be a contraindication
13.4.14  HPV Vaccine

- Why vaccinate?
  - HPV is the most common STD in the US
  - infections occur early after onset of sexual activity
- Controversy:
  - 34 deaths have occurred within a certain timeframe of being given the vaccine
    - due to blood clots
    - correlation, but not necessarily causation
- Recommended for all males and females ages 11-12
  - can be given as young as 9
  - catch-up for females 13-26
  - Medicaid won’t pay for after age 18
- Brands:
  - Gardasil protects against types 6, 11, 16, and 18
  - Cervarix protects against types 16 and 18
- Schedule:
  - 3 doses, recommended starting is at age 11-12 for both males and females
    - can be given as young as 9
    - catch-up recommended for all females age 13-26

13.4.15  Vaccine Caveats

- Some vaccines must be given at specified dates or they won’t “count”
  - there is a 4 day grace period for vaccines given earlier than minimum interval or prior to minimum age
- TB testing:
  - can’t do skin TB within 6 weeks of getting an MMR or there is potential of getting a false negative
  - can do both skin TB and MMR at the same time
- Precautions for all vaccines:
  - moderate or severe acute illness ± fever
  - severe symptoms ≤ 48 hours after a previous dose of any vaccine
  - pregnancy
  - receipt of antibody-containing blood product in last 11 months
  - thrombocytopenia
  - bad reaction to DTP or DTaP such as convulsions, hypotension, inconsolable crying > 3 hours, or unexplained neurologic disease
- Contraindications:
  - severe allergic reaction after previous vaccine dose
  - severe allergic reaction to a vaccine component
  - pregnancy
  - known severe immunodeficiency
  - encephalopathy or other serious neurologic sequelae after DTP or DTaP vaccination
  - influenza vaccination in patients with severe egg allergy

13.5  Child Development

13.5.1  Motor Milestones

- 2 months: able to lift head up on his own
- 3 months: can roll over
- 4 months: can sit propped up without falling over
- 6 months: is able to sit up without support
• 7 months: begins to stand while holding on to things for support
• 9 months: can begin to walk, still using support
• 10 months: is able to momentarily stand on her own without support
• 11 months: can stand alone with more confidence
• 12 months: begin walking alone without support
• 14 months: can walk backward without support
• 17 months: can walk up steps with little or no support
• 18 months: able to manipulate objects with feet while walking, such as kicking a ball

13.5.2 Language Milestones
• 3 months: markedly less crying than at 8 weeks, when talked to nodded at, smiles, followed by squealing or gurgling sounds, which is vowel-like in character and pitch modulated, sustains cooing for 15-20 seconds
• 4 months: responds to human sounds more definitely; turns head; eyes seem to search for speaker; occasionally some chuckling sounds
• 5 months: vowel-like cooing sounds begin to be interspersed with more consonantal sounds
• 6 months: cooing changes into babbling resembling one-syllable utterances but there is no repetition
• 8 months: continuous repetition, distinct intonation patterns, utterances can signal emphasis and emotions
• 10 months: vocalizations are mixed with sound-play such as gurgling or bubble-blowing; appears to wish to imitate sounds but is not successful; beginning to differentiate between words heard by making differential adjustments
• 12 months: identical sound sequences are replicated with higher relative frequency of occurrence; words are emerging; definite signs of understanding some words and simple commands
• 18 months: definite repertoire of words, 3-50, still babbling but now of several syllables with intricate intonation patterns; no attempt at communication information and no frustration for not being understood; understanding is progressing rapidly
• 24 months: vocabulary of > 50 items, begins spontaneously to join vocabulary items into two-word phrases, all phrases appear to be own creations, definite increase in communicative behavior and interest in language
• definitely want to have two word utterances by age 2
• 30 months: fastest increase in vocabulary with many new additions every day, no babbling at all, utterances have communicative intent, frustrated if not understood by adults, utterances cost of at least 2 words, many have 3-5 words, sentences and phrases have characteristic child grammar, that is, they are rarely verbatim repetitions of an adult utterance, intelligibility is not very good yet, seems to understand everything that is said to them - Very important, failure to reach these milestones is highly predictive of autism, learning disabilities, and mental retardation

13.5.3 Theories of Development: Freud, Erickson, and Piaget
• Stages all have similar ages because neural development follows an age relationship
• Piaget:
  • assimilation: making things fit our internal mentality
  • accommodatio: internal change as we are confronted with new information
  • stages of play:
    ○ solitary
    ○ onlooker play: watching other children
    ○ parallel play: alongside, but don’t interact with other children
    ○ associative play: interaction and sharing, but not playing the same game
    ○ cooperative play: playing together, learning to help and take turns, make games with rules
arguing is an important developmental phase during this period, and parents often intervene and end up interfering with this development.

13.5.4 Temperament

- **Characteristics:**
  - **activity:** the amount of physical activity present during the day
  - **rhythmicity:** the extent to which patterns of eating, sleeping, and elimination are consistent or inconsistent from day to day
  - **approach or withdrawal:** reaction to novel situations
  - **adaptability:** the ease of changing behavior in a socially desirable direction
  - **threshold of responsiveness:** the degree to which the person responds to light, sound, etc.
  - **intensity of reaction:** the amount of energy exhibited in emotional reactions. How big is your reaction.
  - **quality of mood:** the quality of emotional expression either positive or negative
  - **distractibility:** the ease of being interrupted by sounds, light, or unrelated behavior
  - **attention span and persistence:** the extent of continuation of behavior without interruption

- **Types:**
  - **easy temperament:** regular, positive approach to new things, adaptable, mild to moderate mood intensity, mainly positive mood, usually a joy; 40% of children
  - **difficult temperament:** irregular, negative withdrawal, non-adaptable, intense moods that are often negative; 10% of kids
  - **slow-to-warm-up temperament:** mildly intense negative responses, slow adaptability; 15% of kids
13.5.5 Attachment

- Definitions:
  - **proximity maintenance**: the desire to be near the people we are attached to
  - **safe haven**: returning to the attachment figure for comfort and safety in the face of a fear or threat
  - **secure base**: the attachment figure acts as a base of security from which the child can explore the surrounding environment
  - **separation distress**: the attachment figure acts as a base of security from which the child can explore the surrounding environment

- Attachment types:
  - **secure**: children are distressed when separated from caregiver (but know they will return) and happy when caregiver returns, seek comfort from caregivers when frightened
  - **ambivalent**: children are distressed when separated from caregiver and are uncertain if caregiver will return
    - a result of an inconsistent caregiver
  - **resistant (avoidant)**: children avoid caregivers, have no preference of complete stranger over caregiver
    - a result of an abusive or neglectful caregiver

- Moral Development
13.6 Common Behavior Problems

13.6.1 General Considerations

- Problem behaviors are "normal" although not appropriate or acceptable
  - need to socialize by setting limits and teaching appropriate choices
  - teach anger management skills
  - prevent it by childproofing, preparation, or avoidance
  - reassurance and support for fears and anxieties
  - ignore problem behaviors if you can
  - punish when necessary: time-outs, removal of privileges

13.6.2 Sleep Issues

- Brazelton’s states of consciousness in babies:
  - deep sleep
  - light or REM sleep
  - indeterminate state: rousing and returning to sleep
  - wide awake, alert
  - fussy but alert
  - crying

- Sleep becomes more predictable by 6 months of age
  - newborns sleep 16 hours per day, 2-4 hours at a time
  - 3-4 month olds sleep 4-8 hours at a time
  - 6-8 month olds sleep 8-12 hours a night with 2 hour naps
  - 12 month olds sleep about 14 hours total with some naps
  - 2 year olds: 11-12 hours per night and two 2-hour naps, transitioning to afternoon-only nap
  - 5-year olds: 11 hours at night
    - most kids stop napping by now
  - tweens: 10 hours a night
  - adolescents: 9 hours

- Sleeping through the night: 70% by 3 mo, 83% by 6 mo, 90% by one year

- Tips to help children sleep:
  - teach self-comforting
  - bedtime routines
  - prevent child from getting too tired
  - be firm
  - try not to be part of the child’s process of going to sleep

- Sleep problems in older children:
  - resistance to going to sleep
  - restlessness
  - nightmares
  - sleepwalking
  - sleep talking
  - night terrors: different form nightmares in that child is awake but not alert, terrified, does not know what is going on
  - insomnia
  - increased sleeping

13.6.3 Crying

- Normal crying
  - 6-8 week olds have a fussy period toward the end of the day that gradually disappears by 12 weeks
• Abnormal: crying after 1st year of age just for attention signals behavior problems in the future
• Babies need to develop self-comforting
• Parents should do what they can for the baby then soothe or leave them alone

13.6.4 Noncompliance

• Sometimes children are disobedient and this can be normal
  • passive: whining, putting, delaying
  • defiance: arguing, tantrums
  • spiteful: does the opposite
  • causes: inappropriate/harsh, lax, or inconsistent discipline, parental stress, negative parental attitude toward authority, child is tired, hungry, or upset

• Prevention of disobedience:
  • clear, fair expectations and swift consequences
  • give appropriate choices
  • use rewards for compliance
  • have a strong relationship with the child
  • know how to use time-out appropriately
  • ignore misbehavior when possible

• Extreme noncompliance needs referral to a behavioral health provider, as socialization requires children to learn to do things they are told to do whether they like it or not

13.6.5 Temper Tantrums

• Grumbling and grouching where slight provocation leads to outburst ❌ No no no!!! ❌ Leave me alone!! ❌ child eventually wears themselves out ❌ child becomes tired
• Most common in 2-4 year olds and most outgrow it

• Prevention:
  • parents set example of good anger management
  • warn child about looking angry
  • help child relax
  • attend to needs if tantrum is because child is hungry or tired
  • teach other ways to vent or express anger

• What to do during a tantrum:
  • ignore child
  • parent must separate from child
  • avoid rewarding the tantrum (if you stop, I’ll do ___), instead reward calm behavior

• Becomes a problem if it becomes the child’s preferred means of problem solving

13.6.6 Toilet Training and Issues

• Background
  • toilet training usually is successful between ages 2-3
  • tends to go more smoothly if parents wait until the child is ready
  • signs of readiness: discomfort with dirty diaper, staying dry for 2 hours straight, showing interest in the toilet, hiding when having a bowel movement

• Daytime enuresis: bedwetting during the day that is either physiological or psychological
  • physiological: UTI, bladder issue
  • if not physiological, wetting may be part of a larger behavioral problem

• Nocturnal enuresis: nighttime bedwetting
  • common until age 4-5, can persist into later childhood and adolescence, even adulthood
  • most bedwetting won’t stop no matter what is done
  • most are deep sleepers
  • can try meds and alarm training
• **Encopresis**: involuntary passage of stool in a child who has been toilet trained  
  • usually not psychiatric  
  • commonly begins with an episode of constipation  
  • treatment: colon cleanse, use of diet and laxatives to prevent further constipation, scheduled toilet time  
    o should improve slowly but steadily

13.7 **Pediatric Nutrition**

13.7.1 **Nutritional Assessment**

• Medical history: illnesses, pre-existing nutrient deficiencies, surgical history, meds  
  • children with special needs have more feeding difficulties  
• Anthropometric measures: linear growth, weight, head circumference, growth charts, BMI  
  • standing height for children older than 3, recumbent if younger  
  • arm-span measurement for children who can’t stand  
• compare to expected growth patterns and velocities:  
  o infants double birth weight by 4-6 weeks, triple weight by 1st year  
  o infant length increases by 50% in the first year  
  o infant head circumference increases by 40% the first year  
  o height increases 6-8 cm per year until puberty  
  o growth slows down during preschool years  
  o weight gain is slow and steady for elementary school aged children  
  o WHO growth standards are used to monitor growth for infants and children ages 0-2  
    • based on normal, healthy children  
    • not useful in teens  
  o BMI charts for children and teens

• Biochemical indicators: lab values that can provide information about a child’s macro and micronutrient stores  
  • ex. serum protein, iron status, vitamin and electrolyte levels  
• Clinical signs of nutritional status  
• Dietary: what are they usually eating, calories  
  • botanicals, vitamins, and minerals  
  • food allergies, aversions, or intolerances  
  • cultural or religious dietary concerns  
• Social: FH, number of caregivers, SES, family’s perception of child’s nutritional status, religious or cultural beliefs impacting food intake

13.7.2 **Infant Nutrition**

• Cow’s milk formula  
  • protein is casein and whey  
  • carbs from lactose  
  • fat source is a vegetable blend similar to breast milk  
• Soy formula  
  • protein is soy  
  • carbs are sucrose and corn syrup solids  
  • fat source is vegetable blend  
  • Ca and P added  
  • not recommended for babies born prematurely  
  • some thinks it helps with colicky babies  
• Protein hydrolysates  
  • protein is hydrolyzed casein or whey
source of carbs and fat varies with product
not recommended for colic, sleeplessness, or irritability
expensive = for infants not tolerating cow’s milk or with multiple food allergies

Amno acid-based formula
for infants with poor growth, not tolerating formula, blood in stool, atopic dermatitis
these are special order, not seen in grocery or drug store = very expensive
proteins are amino acids
carbs are corn syrup solids
fats are light chain FAs and medium chain TG

Volume and frequency of feeds:
from birth to 1 week, need 6-10 feeds per day @ 30-90 mL
1 week to 1 mo, need 7-8 feeds per day @ 60-120 mL
1-3 mo, need 5-7 feeds per day @ 120-180 mL
3-6 mo, 4-5 feeds per day @ 180-210 mL
6-9 mo, 3-4 feeds per day @ 210-240 mL
9-12 mo, 3 feeds per day @ 210-240 mL

When to introduce solids:
when infant sits with balance, is ready for a high chair, opens mouth when spoon comes towards them, transfers food from front of tongue to back, makes chewing motions
AAP recommends waiting until 4-6 months
babies are done when they turn head, close mouth, or force food back out of their mouth

13.7.3 Daily Caloric Needs
Age < 1 year need 98-108 kcal/kg
Ages 1-3 need 102
Ages 4-10: 70-90
Ages 10-teens: 40-55

13.8 Lactation Overview
13.8.1 Background
Physiology:
estrogen stimulates ductal system to grow, levels drop at delivery
progesterone increases during pregnancy and grows alveoli and lobes
  o drops at livery
human placental lactogen: grows breast, nipple, areola before birth
prolactin: contributes to growth of alveoli
oxytocin: simulates contraction of smooth muscle to squeeze out milk
amount of alveoli are what is responsible for volume of milk production, not the size of the breast
colostrum is milk precursor that is protein and antibody rich
transition to milk at 2-4 days postpartum
  o increased volume up to 1L
  o frequent feedings help transition to milk
Normal lactation process:
 baby to breast within 1-2 hours after birth
 latching is a normal reflex and lets you know baby is ready to nurse, they will also search for the breast
  o signs of a good latch: audible swallows
 following nursing, babies can go into a deep sleep that can last 24 hours
  o problem, as feeding should be 8-12 times per 24 hours in early postpartum period
  and baby may be hard to wake
• cluster feeding can occur
• average feeding is 20-40 minutes of active sucking and swallowing
  o foremilk is high in volume and low in fat
  o fat content increases as feeding progresses
  o hindmilk is low in volume but high in fat (may need to compress breast to express this)
  o don’t interrupt to switch breasts, let baby finish and then offer the other breast

Supporting breastfeeding families
• helping parents establish realistic expectations of breastfeeding in the early postpartum period has been associated with increased duration of breastfeeding
• need support from healthcare professional, family, and friends
  o family may not realize or understand needs
• different cultures have different expectations or rituals regarding birth and lactation
• teach feeding cues:
  o baby turns head when cheek is touched only when they are hungry
  o positioning and latch: let baby get into whatever position is comfortable
    ▪ football position: helpful for c-section moms
    ▪ choose a position that allows mom to secure infant with one hand and breast with the other
    ▪ moms may need to support large breasts so that infant can get a proper latch
    ▪ latch should be deep to avoid bloody/painful nipples
  o keep track of frequency and duration of feeds to establish a pattern
• Only 20% of breastfeeding is correlated to the breasts themselves, and 80% of it is in the woman’s head/history

13.8.2 Prenatal Lactation Counseling
• Encourage patient education prior to visit: books, websites, WIC resources
  • this way they can bring questions to the visit

13.8.3 Challenges Encountered Inpatient and Post-Discharge
• Engorgement:
  • physiological or pathological
  • onset may be gradual or immediately postpartum
  • bilateral, generalized heat and swelling, generalized pain
  • shouldn’t be associated with fever, maternal temp should be < 101
  • treatment: heat prior to feeding, ice post feeding
• Sore nipples:
  • tenderness is normal, pain is not
  • usually it is due to insufficient latch
  • treatment: begin feeding on least sore side, use correct latch and positioning, consider breast shells
• Mastitis:
  • usually unilateral, with fever, heat, erythema, florulike symptoms
  • treatment is to continue to breastfeed or pump and take antibiotics (dicloxacillin, oxacillin, 1st gen cephalosporin, erythromycin)
    o milk is not infected, safe for baby to drink
• Plugged ducts:
  • gradual onset
  • unilateral, little to no heat, shifting swelling, mild, localized pain, may have blebs on nipple
  • treatment: massage with warm washcloths or dunking breast in warm water
• Yeast infection:
  • presentation: nipples are persistently sore, unresponsive to position changes, sucking changes, or nipple creams, nipples are pink-red with shiny areola, white plaques on nipples
• treatment: treat mother and baby with azoles or nystatin

• Perceived insufficiency
• Breast surgery or augmentation:
  • can still breastfeed
  • breast reductions will typically produce less milk, may need supplementation, may have more issues with engorgement
• Late preterm infants (34-37 weeks):
  • have trouble breastfeeding as they are not fully developed
  • supplementation at the breast or with alternative feeding methods
    o ex. syringes, mammary gland device
  • feedings will improve as infant matures developmentally
• Premature infants:
  • preterm breast milk is uniquely suited for preterm baby = initiate pumping within 6-8 hours after delivery
  • pump every 3 hours around the clock while establishing supply (takes 2-4 weeks)
    o if you don’t establish supply then, it will be very hard to do it later
• Ineffective or non-nutritive breastfeeding
  • no strong tug on nipple, immature suck pattern, no audible swallows when feeding, baby falls asleep at breast after 5-10 minutes, etc.
  • pump to maintain supply while supplementing nutrition until infant learns how to feed
• Substance abuse: alcohol and cocaine are the worst offenders

13.9 Childhood Obesity

13.9.1 Background

• Helpful websites:
  • eatsmartmovemorenc.com
  • letsmove.gov
  • hbo.com, “Weight of the Nation” documentary
• Rate of pediatric obesity has tripled since 1970
• 1/3 of all children in the US are overweight or obese
  • greatest in black girls and Mexican-American boys, kids in poverty, kids with obese parents
• Obese children are almost 6x more likely than children with healthy weights to have an impaired quality of life equivalent to kids with cancer
  • increased risk of CAD, DM, stroke, several forms of cancer
• BMI and obesity in kids:
  • overweight = BMI 85<sup>th</sup>-94<sup>th</sup> percentile
  • obese = BMI ≥ 95<sup>th</sup> percentile
  • issue: BMI curves stop at 95<sup>th</sup> percentile, while many kids go up to 99<sup>th</sup> percentile

13.9.2 Causes of Childhood Obesity

• Endocrine disease
  • hypothyroidism
  • Cushing syndrome
  • GH deficiency
  • acquired hypothalamic lesions
• Genetic disease:
  • heritability of obesity
    o adoptee BMI correlates more to biologic parents than adoptive parents
    o but twin studies show it’s not all environment
  • single-gene defects
Prader-Willi syndrome: early onset obesity, hyperphagia, developmental delays and behavioral outbursts
Bardet-Biedl syndrome: obesity, retinal degeneration, extra digits, intellectual impairment
Cohen syndrome: small head, wave-shaped eyes, short upper lip, high and narrow palate, truncal obesity with slender limbs, low muscle tone, hyperextendable joints, poor eyesight, low WBCs

Environmental factors: huge!
- increased availability of cheap calories
- larger food portions
- fast food
- more screen time
- big food advertising
  - low profit margin of fresh foods
  - marketing directly to children
- low nutrition education
- school lunch
  - 94% exceed federal recommendations for fat and saturated fat
  - vending machines and commercial vendors
  - new standards have made a slight improvement
- less time for recess and PE classes
  - quality PE is shown to improve academic performance and decrease behavioral problems in schools

13.9.3 What to Do in Primary Care

Prevention:
- universal screening starting at birth
- show BMI charts to parents starting at age 2
  - use words “healthy weight for height and age”
- “5-3-2-1-almost none”
  - 5 fresh fruits and veggies a day
  - 3 meals a day: no skipping meals, fast food once a week at the most, families should eat together at the table, TV off
  - 2 hours or less of screen time
  - 1 hour of physical activity a day
  - almost none: sweet drinks, juice

Overweight patients:
- use motivational interviewing
- if parents are in denial of risks, ask them if anyone in their family has diabetes
- avoid lecturing if patient is not yet worried
  - “it worries me a bit, do you want me to tell you why?”

Obese patients
- refer to pediatric obesity specialist
  - monthly visits
  - counselor available
  - screen for comorbidities: HTN, lipids, DM, insulin resistance, PCOS, irregular menses, advanced puberty, obstructive sleep apnea, obesity hyperventilation syndrome, asthma, NAFLD, gallstones, GERD, constipation, pseudotumor cerebri, Blount disease, slipped capital femoral epiphysis, anxiety, depression
  - lifestyle changes
  - medications if needed: Meridia
  - last resort: childhood bariatric surgery
13.10 Adolescent Medicine

13.10.1 Background
- WHO considers this age group to be 10-19 year olds, variation of definitions from 11-21
- Different from other pediatrics in that there is completion of somatic growth, movement from concrete to abstract thinking, social, emotional, cognitive growth, establishment of identity, and preparation for career or growth
  - clinician needs to be able to relate to the patient in order to be effective

13.10.2 Early Adolescence: 10-14 Years
- Rapid growth and development of secondary sex characteristics
  - average weight at begin of menarche is ~100 lb
  - girls 1-2 years sooner, average of 12.9 for white females and 12.2 for black females
- Body image concerns, very privacy-conscious and easily embarrassed, uncertain if they are normal
- Need concrete answers to health questions
  - abstract reasoning is still developing
  - increasing ability to express themselves through speech
- Struggle over independence vs dependence
  - testing of authority
  - shift from parents to independent behavior
  - void filled by friends, fitting in is a critical concern
- Identity development
  - daydreaming
  - vocational goals that are vague or unrealistic
  - own value system
  - emergence of sexual feelings
  - lack of impulse control and seek immediate gratification

13.10.3 Middle Adolescence: 15-17 Years
- Decrease in pubertal growth rates
- Increased intensity of emotions
- Self-centered focus
- Body image: usually more comfortable, spend increased time on looks
- Boost in cognitive function
  - abstract thinking improves
- Independence vs dependence struggle intensifies
  - difficult parent-child relationship
- Peer group involvement becomes very important
  - increased dating activities
  - extra-curricular activities
- Identity development
  - increased creativity
  - more realistic vocational aspirations
  - feeling of omnipotence and immortality

13.10.4 Late Adolescence: 18-21 Years
- Less self-centered
- Improved self-identity
- Period of idealism and lofty goals
- Independence vs dependence struggle
• independent decisions but still rely on parents for assistance and advise
• Peer group involvement shifts from group to individual, one-on-one relationships
• Identity development:
  • practice of vocational goals
  • begin financial independence
  • further refinement of personal values
  • ability to delay or compromise, limit-setting
  • interests are more stable

13.10.5  Morbidity and Mortality in Teens

• Mortality:
  • mostly behavioral causes: accidents, injury, homicides, suicides
  • biggest cause is MVAs
    • alcohol frequently involved
  • speeding: need anticipatory guidance
  • more common in males
• Morbidity:
  • teen pregnancy: 78% are unintended, higher in black and Hispanic teens, US rate is twice as high as other developed countries
  • STIs: ethnic disparity in that black youth make up 55% of HIV cases diagnosed in adolescence
  • substance abuse: alcohol, marijuana, cigarettes
  • dropping out of school: rates declining, ethnic disparity
  • depression: most teens have at least a mild episode, 14% have major depressive disorder
    • associated with lower SES
  • running away from home
  • physical violence: ethnic disparity in homicide rate
  • rape

13.10.6  Legal Issues

• NC:
  • any minor can give effective consent for medical services for the prevention, diagnosis, and treatment of STIs, pregnancy, substance abuse, emotional disturbance
  • can't induce abortion, sterilize, or admit to a 24-hour facility without parental consent
  • caution minors about what might appear on the insurance bill that comes to their parents
  • Emancipated minors may consent to any medical treatment for themselves or child

13.10.7  Guidelines for Adolescent Preventive Services

• Developed by AMA to help providers care for adolescents with an emphasis on preventative services that are age and developmentally appropriate
• Goals: deter adolescents from participating in behaviors jeopardizing to health, detect problems early and intervene, reinforce and encourage behaviors that promote health, provide immunization against infectious diseases
• Recs:
  • annual visits between 11-21 years
  • developmentally appropriate and culturally sensitive care with confidentiality ensured
  • GAPS questionnaire: one for parent, one for adolescent
  • screens for many things
  • helps identify risk categories
    • low risk □ provide health guidance
    • moderate risk □ identify problem and negotiate solutions
    • high risk □ referral to appropriate resources
13.10.8 Adolescent Visit

- **Tips:** give clear evidence of your respect, make them aware of privacy privileges, don’t force conversation, begin by talking about their day to day experiences
- **History:**
  - home life
  - education and employment
  - activities
  - drugs (including herbals and vitamins), diet, depression
  - safety & sexuality
  - review of immunizations
  - adolescent ROS: eating, weight, family, friends, school, violence, safety, tobacco, alcohol, drugs, development, emotions
  - without parent present: tobacco, alcohol, drugs, sex, depression, suicide, abuse
- **PE:**
  - remember that adolescents may be shy and modest
  - useful to tell them if their exam is normal
  - essentials: height, weight, BMI percentile, BP, dentition and gums, skin, thyroid, spine, breasts, external genitalia
  - pelvic exam if h/o sex, abnormal vaginal discharge, menstrual irregularities, suspicion of anatomic abnormalities, pelvic pain, patient request
    - pap after 3 years of onset of sexual activity or age 21
  - Obesity counseling

13.10.9 Behavioral and Psych Issues in Adolescents

- **Conversion disorders**
  - underlying depression, guilt, or anxiety activates the autonomic nervous system
  - anxiety is then dissipated by the somatic symptom
    - ex. headaches, vomiting, tachycardia, hyperventilation, vasoconstriction
- **Depression**
  - need thorough medical exam with labs
  - counseling ± meds
- **Suicide:**
  - may represent an attempt to escape pain or to obtain relief
  - risk factors: prior suicide attempt, mental and substance abuse disorders, FH, stressful life event or loss, family discord, prior abuse, physical illness, gay or bisexuality, poor school performance, recent behavioral change, presence of firearms in the house
  - prodromal signs: sadness, hopelessness, emptiness, lack of energy, insomnia, eating problems, loss of interest in social life and school, boredom, loneliness, irritability, truancy, substance abuse, change in social behavior, accident proneness, giving away prized possessions, passive aggressive comments
  - most completions are by firearms
  - attempt rate is 3x higher in females, males are 5x more likely to complete a suicide
- **Substance abuse:**
  - risk factors: male, young age at first use, peer use
  - protective factors: supportive adults, strong commitment to school, cohesive family, good self-esteem
- **Eating disorders:**
  - anorexia nervosa: from generally white/middle or upper class family, excellent student, overachiever, withdrawal from peers, lack of concern over increasingly emaciated appearance, food as a battleground, weight loss, amenorrhea, hyperactivity, constipation, early satiety, easy bruising, postural dizziness or fainting, hair loss, yellow or dry skin, blue hands and feet, preoccupation with food, abdominal bloating or pain, cold intolerance, fatigue,
muscle weakness, cramps, frequent fractures, decreased temp, bradycardia, edema, dry skin with hyperkeratotic areas, carotenemia, nail changes, increased lanugo, scalp hair loss, systolic murmur, short stature
  - need early intervention, supportive family
- bulimia nervosa: normal weight, awareness that eating pattern is abnormal, feel out of control while eating, recurrent compensatory behavior to prevent weight loss, swelling of hands and feet, weakness, fatigue, headaches, abdominal pain or fullness, nausea, irregular menses, muscle cramps, chest pain and heartburn, easy bruising, bloody diarrhea, skin changes, enlargement of salivary glands, dental enamel erosion
- binge eating disorder: bingeing with no compensatory mechanism to lose weight, intense guilt, tendency towards obesity, depression, substance abuse
- Academic failure:
  - often brought on by fast change in complexity and amount of coursework from grade school to junior high
  - due to a deficit in cognitive capacity, study habits, motivation, concentration, interest, emotional focus, or support
    - learning disabilities
    - depression
    - vision/hearing problems
    - chronic disease
    - ADHD
    - drug or alcohol use

13.11 Sports Pre-Participation Physical

13.11.1 Background

- Goals of PPEs are to detect medical conditions that may limit participation or could be life-threatening or disabling, detect conditions predisposing to injury, to meet legal and insurance requirements, assess general health and maturity, assess fitness level, counsel on health-related issues, discuss preventative issues
- NOT meant to take the place of an annual exam, however for 75% of athletes this is their only health care contact for the year
- Who can do them?
  - most states specify a physician
  - 21 states allow PAs and NPs
  - 11 states allow chiropractors
  - 1 state allows naturopathic clinicians
- When are PPEs done?
  - at least 6 weeks prior to start of practice to allow time for further testing, referrals, and rehab
  - some states require annual testing
- Settings:
  - office-based with PCP
    - advantages: continuity of care, familiarity of patient, counseling opportunity, communication with parents, greater communication with parents
    - disadvantages: costs more, takes more time, provider may have less (or less up to date) sports med information, less communication with school athletic staff
  - station-based: multiple providers do different portions of exam
    - takes place at high schools, etc
    - advantages: sports specialized personnel, efficient, cost-effective, good communication with school athletic staff
    - disadvantages: limited privacy, noise, less communication with parents, no follow-up
  - group PPE: entire teams or groups are done at one time
13.11.2 PPE H&P

- **PMH:**
  - illnesses in the past year: any mono
  - chronic illnesses
  - hospitalizations
  - musculoskeletal problems
  - Past surgical history, any rehab
  - Immunizations
  - Meds: prescription, OTC, supplements
  - Allergies
  - Social:
  - **ROS:**
    - vision and hearing
    - heat intolerance or sickle cell trait
    - wheezing or SOB with exercise
    - weight loss or gain
    - injury to bone, muscle, ligament, or tendon that kept them out of practice
    - breaks or dislocations
    - stress fractures
    - any imaging, injections, or braces
    - any current injuries or musculoskeletal complaints
    - regular use of brace, orthotic, or other assistive device
    - h/o arthritis or connective tissue disease
    - cardiac: chest pain during or after exercise, passing out or feeling dizzy, getting tired faster than friends, racing heart or skipped beats, h/o HTN, high cholesterol, murmur, or heart problems, FH of sudden death or heart-related issues before age 50, FH of heart trouble or unexplained fainting
- **PE:**
  - height, weight, BMI
  - skin
  - eyes:
    - pupils: anisocoria
    - acuity: < 20/40 corrected or with legal blindness in one eye must wear protective eyewear
  - CV: BP, pulses, heart sounds
  - lungs: assess for asthma and other chronic lung disease
  - abdomen: masses, organomegaly
  - neuro:
  - msk: brief screen with focus on any past injured areas
    - symmetry, neck ROM, resisted shoulder shrug, resisted shoulder abduction, shoulder internal/external rotation, elbow maneuvers, finger clench, back extension/flexion, quad contraction, duck walk, heel-toe walk
  - males need a genitalia exam due to risk of injury or hernia:
    - if not done due to group exam, must document and refer patient to see their PCP for an annual exam
    - testes: single or undescended, masses
      - solitary testis needs a nut cup!
  - assess for Marfan’s: tall, thin, long extremities, hands and feet, kyphoscoliosis, high-arched palate, pectus excavatum, arachnodactyly, arm span > height, hyperlaxity (thumb sign or wrist sign)
    - 39% of cases are a result of a new mutation

13.11.3 Other Considerations for the PPE
• Labs: NCAA recommends screening for sickle cell trait
• Sudden cardiac death
  • most common causes:
    o hypertrophic cardiomyopathy: the #1 cause of sudden cardiac death in a young athlete
      ▪ an autosomal dominant mutation involving septal thickening, with absolute thickness of walls > 15 mm
      ▪ no murmurs, usually totally asymptomatic
      ▪ possible symptoms: dyspnea, chest pain, syncope, palpitations, fatigue, edema
      ▪ greatest risk in athletes performing moderate to severe exertion
        • highest in football, basketball, males in high school
  • other causes: commotio cordis, coronary artery anomalies, myocarditis, CAD if > 35
    o Cardiac screening:
      o screen athletes of average risk with focused H&P only
        ▪ HCM murmur due to hypertrophy and stiffness of left ventricle
        ▪ a systolic crescendo-decrescendo murmur heart best at left sternal border
        ▪ radiates to axilla but not neck
        ▪ increases with valsalva due to decreased venous return to heart
        ▪ decreases with squatting
        ▪ increases when the patient stands
  • screen with additional tests only for athletes at increased risk for HCM:
    o EKG and echo
      ▪ echo:
        ▪ physiologic hypertrophic heart is larger with larger chambers
          • vs. HCM heart, where chambers get smaller due to increased heart size
        ▪ expensive: $400-$2000
        ▪ not effective at identifying athletes of normal risk
        ▪ EKG: studies show it is not effective at identifying athletes of normal risk
          □ caveat: may be difficult to distinguish athlete’s heart from HCM
          • gray zone if septum is between 13 and 15 mm
          • EKG shows larger voltage throughout
          ▪ stress test
          ▪ genetic testing, may want to include family members
    • When to exclude from athletics:
      • Bethesda conference: puts together recommendations for athletes with CV disease
        o clinical diagnosis of HCM □ should exclude from most competitive sports unless low intensity
        o if genotype + but phenotype negative □ no evidence to DQ from sports
  • Murmurs:
    • when to refer on: any diastolic murmur, any murmur that gets louder with provocative testing, any murmur ≥ 3/6
• Hypertensive athletes:
  • can’t effectively dilate vessels
  • LVH associated with HTN is pathologic, not physiologic
    ▪ impairs athletic performance
  • increased risk of heat stroke due to impaired vasodilation response
  • recommendations:
    ▪ accurate screen
    ▪ thorough H&P, evaluate for secondary causes, ascertain end-organ damage
    ▪ pre-HTN □ lifestyle modifications, start a med and limit participation if LVH is present
    ▪ stage I HTN □ get a CBC, chem7, lipid profile, UA, EKG, no limitations as long as no LVH
    ▪ stage II HTN □ add echo and therapy, restricted participation until BP is controlled
Athletes should increase exercise gradually to avoid cardiac catastrophes

- Asthma:
  - Exercise-induced asthmatics have high prevalence in high school athletes
  - Take a good history, screening with PFTs is not practical

- Female athlete triad: disordered eating, amenorrhea, osteoporosis or osteopenia
  - Presentation: headache, dizziness, n/v, memory and attention deficits
  - Second impact syndrome: seen in players not fully recovered from initial concussion that sustain another, resulting in significant brain edema even if minor

- Multiple screening tools available

- Stingers:
  - Caused by stretch or compression of the brachial plexus
  - Recommendations:
    - Ok to play if 1st episode and there are no neurologic symptoms
    - Recurrent or persistent symptoms need and MRI to rule out spinal stenosis

13.11.4 Making the Decision to Clear

- Published guidelines are available for specific sports
- When to deny participation:
  - If the problem places the athlete at increased risk of injury
  - If another participant is at risk of injury because of the problem
  - If the athlete can’t safely participate in needed treatments (rehab, braces, etc)
- Limiting participation:
  - During initiation of treatment
  - Think about alternative activities that are safe

13.12 Pediatric Fever

13.12.1 Background

- Checking a temperature:
  - Rectal is gold standard, can be done starting after birth
  - Axillary temps should be done with old-school thermometer for at least 15 min
  - Tympanic temp is accurate for kids > 5 years old
- Treating a child’s fever:
  - Acetaminophen
  - Ibuprofen
  - Sponge baths, cooling blankets not recommended as they may cause shivering and other hypothalamic reflexes
  - Aspirin not recommended due to Rey syndrome correlation
- Working up a fever presentation:
  - Sick contacts: home, school
  - Lymphadenopathy
  - Look for DIFFERENCES
    - Change in appetite, behavior, urine output
    - Pulling on ears
      - May just be normal behavior of children exploring their bodies, not diagnostic in and of itself
    - ROS: cough, vomiting, headache, anorexia, nausea, earache
    - PE: HEENT, heart & lungs, abdomen if complaints
      - Crying, fever, trauma can make eardrums red, and it can be unilateral!
      - Limited labs needed with strong clinical presentation of earache, strep throat, etc.

13.12.2 Fever Without a Source
• Workup:
  • in this case, labs are needed:
    o CBC
    o UA & culture: biggest bang for your buck
    o blood culture
      ▪ pneumococcal bacteremia very common prior to vaccination and would typically self resolve in children (although deadly in adults)
      ▪ now, contamination rate is 10x higher than true pathogens = we are doing less blood cultures now due to low yield of useful information
    o BMP
    o LP:
      ▪ glucose/protein
      ▪ Gram stain and bacterial culture
      ▪ cell count and differential
        • beware! WBCs will vary depending on time from delivery
      ▪ don’t need to look for Cryptococcus
      ▪ PCR for HSV or enterovirus
      ▪ viral culture
    o CXR: yield low without chest symptoms
  • Treatment:
    • When to be admit:
      o under 6 weeks of age
    • antibiotics:
      o in neonatal period, need to cover *E. coli*, GBS, *Listeria*
        ▪ ampicillin + gentamycin
          • gentamycin ototoxicity is more correlated to lifetime dose exposure, but it is still a risk
        ▪ cefotaxime + ampicillin

13.13 Pediatric UTI

13.13.1 Background

• Higher rate in neonatal males, especially uncircumcised
• By 1-2 months, more higher in female infants and risk continues to increase as they grow
• Organisms:
  • mostly *E. coli*
  • also Klebsiella
  • less common: Proteus, enterococci, Pseudomonas, Staph aureus, GBS

13.13.2 Presentation

• Classic symptoms are the same
• Depending on age of child, you may not be able to tell if they have “classic symptoms”
  • what you can tell in a neonate:
    o fever
    o sepsis: hard to tell which came first, the sepsis or the UTI
    o jaundice: especially with *E. coli*
    o vomiting
    o failure to thrive with longstanding UTI
    o diarrhea
    o abdominal or flank pain…
  • school age:
  • Differentiating upper from lower UTI:
• toxic appearance: n/v, fever
• CVA tenderness: hard to elicit localized response in young child
• white cell casts indicate upper but are rarely seen
• CBC
• BUN/Cr are not very sensitive, need high renal impairment before this will happen
• blood culture: bacteremia more likely to be upper in an older child, less certain for neonate
• CRP or ESR only useful for determination in an adult

13.13.3 NEED CLINICAL JUDGMENT

• Investigation:
  • UA & culture:
    • sample:
      o clean catch: parents do better when you ask them to pre-clean with soap and water vs using a kit with wipe
      o catheterize
      o bag urine: not ideal, hard to tell if bacteriuria with it is significant
      o suprapubic tap: gives best sample in infants
      o leukocyte esterase: not a perfect test, moderate sensitivity & specificity
  • nitrite: high specificity, low sensitivity
    o and not all bacteria metabolize nitrate → nitrite (Pseudomonas and Enterococcus)
  • casts: WBC casts most diagnostic for upper UTI
  • don’t over-interpret bacteriuria
    o could be poor collection or storage
    o standard positive is ≥ 100,000 cfu/mL using a clean catch but there is plenty of fudge room either way as this is an artificial number
      ▪ drops to 10,000 for catheterized specimen and any growth for a suprapubic
  • blood culture

• Treatment:
  • 7 to 10 days of antibiotics (or 14 if pyelo), taking into account sensitivity patterns of your area
    o ciprofloxacin
      ▪ cautiously used due to black box warning, risk of causing cartilage defects
        • so far not seen
    o Septra
    o cephalosporins
    o amoxicillin:
      ▪ half of all E. coli are now resistant
      ▪ still desirable as it is excreted in the kidneys, can add clavulanate to make it more effective
  • admit if dehydrated, unable to keep orals down, need for IV antibiotics
    o will take 48-72 hours for child to feel better

• Follow-up:
  • who gets evaluated:
    o any child 2 months to 2 years
  • want to know why infection occurred
    o imaging:
      ▪ renal and bladder US: good to evaluate anatomy
        • should be done after 1st febrile UTI
      ▪ voiding cystourethrography: not a pleasant experience for a child
        • best way to visualize reflux
        • hold off on doing this unless US reveals abnormality indicating reflux or obstructive uropathy
  • if there is reflux:
- antibiotic prophylaxis
- surgical options: reimplantation, endoscopic placement of bulking agent
14 Pediatrics Exam II TRP

14.1 ADHD

14.1.1 Background

- Causes:
  - highly genetic: supported by twin and adoption studies
  - environmental causes: prenatal maternal substance use, maternal depression, negative parenting styles, lead and other environmental exposures
    - explain a small proportion of the variance in the disorder
  - structural: ADHD patients have significantly smaller overall brain size with cortical thinning
    - affected areas include cerebellum and subcortical areas, as well as specific regions thought to be associated with executive function
      - deficits in response inhibition and task-switching associated with fronto-striatal regions
      - deficits in divided attention tasks associated with basal ganglia inactivity
- More common in males
- Not an American phenomenon; occurs around the world
- Most common age of referral is 3rd-4th grade
- Only half of kids meeting criteria for disorder (and 10% of adults) have been treated for it in the last year
- 50-60% of school-age children with ADHD will continue to have problems into adulthood
- Frequently misdiagnosed

14.1.2 Presentation:

- Fetal: mother may have noticed pregnancy is different, with more activity, etc.
- Ages 3-5: motor restlessness, insatiable curiosity, vigorous and often destructive play, demanding or argumentative, excessive temper tantrums, low levels of compliance
  - hard to tease out from what is normal behavior for this age
  - not learning from consequences of mistakes
- School age: easily distracted, poorly organized homework containing careless errors, incomplete homework, blurts out answers before question is completed, disruptive in class, often interrupts or intrudes on others and displays aggression, difficulties in peer relationships, perception of immaturity = unwilling or unable to complete chores at home
  - acts sillier than expected for given age
- Adolescence: sense of inner restlessness, disorganized school work with poor follow-through, fails to work independently, engaging in risky behaviors, poor self-esteem, poor peer relationships, difficulty with authority figures
- Adulthood: disorganized, fails to plan ahead, forgetful, loses things, difficulty in initiating and finishing projects or tasks, misjudges available time, inattention/concentration problems, may have job instability and marital difficulties
- Adverse outcomes: lower academic achievement, higher divorce rate, lower occupational or vocational success, increased risk for wide range of other psychiatric problems, more likely to be arrested or incarcerated, increased risk of accidents and ER visits, increased risk of driving accidents and tickets

14.1.3 Investigation

- No objective tests available!
- Careful clinical interview with developmental history
- DSM-IV criteria:
  - significant and age-appropriate symptoms of inattention and/or hyperactivity/impulsivity
• onset prior to age 7
• cause some impairment in two or more settings
• cause significant impairment in social, academic, or occupational functioning
• are not better accounted for by another mental disorder

14.1.4 Treatment

• Interventions without conclusive evidence of efficacy:
  • cognitive therapy
  • individual psychotherapy
  • bio/neurofeedback
  • food allergy treatments
• Interventions with some evidence of efficacy:
  • computer-based working memory training
  • zinc, omega-3 supplementation
• Evidence-based treatments for ADHD:
  • stimulant medication:
    o proven short-term efficacy (1-3 months) but longest controlled trial was only 15 months
    o improvement in inattention, hyperactivity, impulsivity, noncompliance, aggression, social interactions, and academic productivity and accuracy
    o no improvement in intelligence, academic achievement, organizational skills, study skills, positive social skills, interpersonal skills, or athletic skills
    o effective for all age groups, response rate as high as 96% with careful titration and monitoring
    o side effects: sleep problems, decreased appetite, headaches, stomachaches, irritability, dysphoria, behavioral rebound
      ▪ long-term effects not well known
    o includes methylphenidate, dextroamphetamine, mixed amphetamine salts
      ▪ long-acting formulations available: Concerta, Adderall XR, Ritalin LA
      ▪ generally all are equally effective, but some individuals will have stimulant-specific responses
  • non-stimulant medication:
    o indications: unsatisfactory response to stimulants, inability to tolerate stimulants, comorbid conditions
    o side effects: GI upset, nausea, somnolence or sedation, fatigue, hypotension, bradycardia
    o includes atomoxetine, guanfacine, clonidine
• psychosocial & behavioral interventions
  o needed as many drugs fail to address other important problems associated with ADHD, and some patients will not respond to drug treatment
  o when combined with pharmacologic treatment, the gains many be superior to medication alone and can lower the dosages needed for medication
  o parent training is highly effective
  o classroom behavioral interventions are highly effective
  o summer treatment programs
  o interventions specific for adult patients
  o interventions specific to preschool age children

14.1.5 Counseling

• Education on symptoms, course, causes, and treatment of ADHD
• View ADHD as a disability
• Modify expectations of child
• Enlist as advocate for child and ally in treatment
• Talk about support and advocacy groups

14.2 Pediatric Imaging

14.2.1 Background

• How are kids different?
  • noncooperative patient
  • normal varies greatly by age
  • kids’ tissues are much more radiation sensitive than adults = greater effect of dose
    • deterministic effects: effects that increase with increasing dose
      ▪ threshold for effects
      ▪ severity depends on the dose
    • stochastic effects: severity is independent of absorbed dose
      ▪ no threshold for effects
      ▪ show up years after exposure
      ▪ risk of exposure is difficult to quantify
      ▪ includes cancer and genetic damage
  • longer lifetime to manifest radiation-induced injury
    • each imaging done has cumulative effects
      • ex. cancer, cataracts
  • Typical radiation doses:
    • CT: dose is extremely variable, from < 1 to 30 mSv, depending on site imaged
    • radiograph of extremities: tissue is highly radio-resistant, so doses are very low
      • about 1/14th the dose needed for CXR
    • PET involves lots of radiation, equal to 1165 CXRs
  • Responsibility of ordering clinician:
    • make sure test is necessary
    • understand general radiation doses of different modalities
    • prep the patient

14.2.2 Plain Films

• Used for screening
• Often only one imaging session needed
• Generally uses low-dose ionizing radiation
• Cheap and quick

14.2.3 Fluoroscopy

• Used frequently in the pediatric population for GI and urinary issues
• Gives functional information
• Continuous x-rays used to create a real-time video
• Uses ionizing radiation
• May be unpleasant for parents or patient

14.2.4 Ultrasound

• Usually good for peds as they are generally thin
• Doppler allows for detection of flow and determining direction of flow
• Can determine cystic vs solid
• Cheap and quick
• Quality depends on sonographer
14.2.5 CT
- Excellent spatial resolution with great anatomic detail
- Fast but expensive
- Uses ionizing radiation
- Motion sensitive

14.2.6 MRI
- Excellent tissue contrast with good spatial resolution
- No ionizing radiation
- Problem: kids move too much and these images take a long time to generate = kids may need general anesthesia or conscious sedation
- Expensive

14.2.7 Nuclear Medicine
- Radioisotope with a biological tracer is ingested or injected into the body → emission of gamma rays or positrons from the body that are detected to create an image
- Gives functional information
- Uses ionizing radiation
- Expensive
- May require sedation

14.2.8 Common Indications for Imaging

A.) Foreign body
- radiographs in right and left lateral decubitus positions
  - lung not being laid on should look very radiolucent
    - when laying on other side if lung still looks radiolucent there may be something blocking the exit of air (“air trapping”) → atelectasis
  - radiographs of diaphragm movement
    - nonmoving diaphragm indicates air trapping on that side
- may need bronchoscopy

B.) Epiglottitis
- “finger print sign”
- not seen much with use of vaccines
- an emergency if seen as any kind of manipulation could result in obstruction

C.) Vomiting: differential and imaging approach both vary by age
- reflux: usually requires only conservative management
  - upper GI rarely used
  - pH probe to monitor acidity
  - nuclear medicine study of ingested radioactive milk
- hypertrophic pyloric stenosis
  - most common in firstborn males
  - usually present within first month with projectile nonbilious vomiting but otherwise wellappearing, are hungry after vomiting
  - KUB may show “caterpillar sign” of huge stomach with strong peristaltic contractions
    - this is rarely seen, though
  - US preferred
    - muscle thickness of stomach > 3 mm with length > 15 mm
    - pylorus does not open
upper GI series rarely used
  ▪ would show delayed gastric opening, narrow pyloric channel, beak sign, mushroom sign, shoulder sign

obstructive causes:
  o usually see bilious emesis, which is a surgical emergency as it indicates obstruction
  o general imaging workup for bilious emesis: KUB, upper GI, possibly contrast enema if KUB suggests lower obstruction
  o could be malrotation and/or volvulus
    ▪ malrotation (anatomic problem) cause the volvulus (pinching off and symptoms of ischemia), which is a clinical diagnosis
      • can be intermittent
      • colon ends up on one side and small intestine on the other
      • risk of pinching off superior mesenteric artery ↔ small bowel ischemia
    ▪ 80% of cases will present within the first month
  o KUB not the best choice
  o fluoroscopy preferred
    ▪ NGT inserted to give contrast
      o watch movement of contrast from stomach to duodenum
      ▪ malrotation if contrast stays on one side

small bowel obstruction:
  o KUB is preferred: look for differences in air/fluid levels in same loop of at least 1 cm?, paucity of distal colonic gas, complications such as pneumoperitoneum, portal venous gas, dilated small bowel

appendicitis
  o US good for young, thin patients
    • helpful if positive, but can't rule it out if negative
    • look for blind-ending, noncompressible structure with no peristalsis, inflammation of periappendiceal fat, and possibly an appendicolith
    • pain when US probe presses on it (Murphy’s sign)
  o CT:
    • normal appendix looks like a small, gas-filled tubular structure with a blind end, < 6 mm in diameter
    • appendicitis looks like a dilated appendix with irregularly thickened and indistinct walls with stranding in the periappendiceal fat, may see appendicolith
    • high diagnostic accuracy
    • high radiation dose
    • oral contrast needed as well as IV contrast

intussusception
  o presentation: usually 6-36 months, with crampy, intermittent abdominal pain, vomiting, currant jelly stool
  o concern for malignancy if child is over 3
  o imaging:
    • KUB may show paucity of gas in the right abdomen
    • US is the test of choice
      ▪ “pseudokidney sign” or “lasagna sign”
  o treatment: reduction via surgery or enema
    ▪ enema:
      • multiple attempts can be performed, as kids can get it multiple times
      • requires pediatric surgical consult to rule ischemic bowel with risk of perforation
      • technique: immobilize patient, use rectal tube, insert probe, pump air into bowel to push structures out and reduce
14.2.9 Fractures

- Non-accidental injury:
  - metaphyseal corner fractures or posterior rib fractures are child abuse until proven otherwise
  - sternal or scapular fractures require high impact or trauma such as MVC or otherwise it could be child abuse
  - lower specificity for child abuse: clavicular fractures, long bone fx, linear skull fx, fx consistent with mechanism of injury
- Children’s bones are more pliable \( \square \) different kinds of fractures
  - all you may see with a torus fx is slight wrinkling of bony cortex
  - can also have bowing fx
- Toddler fractures are common in children beginning to walk
  - presentation: refusal to bear weight
  - imaging: radiograph may show very subtle fx only on one view (exception to the rule)
  - treatment depends on Salter-Harris classification:
    - types I & II only need conservative treatment unless there is displacement
    - type I includes slipped capital femoral epiphysis
    - types III-V have increased risk of growth disturbance \( \square \) need referral
- Supracondylar fracture:
  - anterior humeral line drawn will not bisect the capitate
  - displacement of fat pads \( \square \) posterior sail sign

14.2.10 UTI

- Female children are allowed one UTI before imaging is indicated while male children must always have imaging
- Investigation:
  - voiding cystourethrogram: fill up bladder with contrast using a catheter and observe voiding to look for reflux into the ureter or kidney
    - can also evaluate anatomy of urinary tract
      - ex. abnormal urethral valve
  - young children will need to be immobilized
  - renal US: assesses for hydronephrosis, anatomic variants, sequelae of infection such as scars or abscesses
  - Lasix renal scan:
    - assesses for obstruction and function
    - radioactive tracer given IV
    - imaging from behind patient of radioactivity in kidneys to look for obstruction
  - DMSA renal scan: assesses for size and cortical functioning of kidney, scarring
    - done in cases of multiple UTIs or prolonged obstruction
    - requires IV and possible sedation

14.2.11 Variants

- May see thymus in newborns before it involutes
  - “sail sign”
  - commonly mistaken for an anterior mediastinal mass
  - follow-up with US to make sure it’s not a mass
14.3 Pediatric Asthma

14.3.1 Background

- Asthma is a triad of airway inflammation, airway hyperreactivity, and reversible airway obstruction
- History:
  - asthma pyramid:
    - inquire about frequency and severity of symptoms
    - number of hospitalizations or ICU admissions
    - number of ER or urgent care visits
    - missed days of school or work
    - days per week with symptoms
  - ask about triggers: URIs, allergens, exercise, cold air, changes in weather, seasons, exposure to irritants, medications, emotional states, food additives
    - important because it will affect course of treatment
- Presentation: wheezing, coughing, chest tightness or pain, SOB
- less obvious: recurrent apparent bronchitis or pneumonia
- PE: pulm, HEENT, skin for eczema, extremities for clubbing (more likely CF vs asthma)
  - normal exam does not r/o asthma!
- Investigation:
  - differential: anatomic abnormality, infection, foreign body, CF, GERD, bronchopulmonary dysplasia, pulmonary edema, laryngeal dysfunction
    - remember, all asthma does not wheeze, and not all wheezing is due to asthma!
  - labs: CBC, antibody titers
    - not necessary for majority of kids
  - sweat test if thinking CF
  - skin tests: look for sensitivities, but don’t necessarily correlate to true allergies
    - can have very + skin test without any clinical manifestation of allergy
  - GERD eval
  - PFTs: most useful, including spirometry, methacholine challenge, exercise testing
    - may not be able to get good data until child is 7 or 8
    - PFTs commonly may look normal in kids
  - x-rays of chest and sinuses to look for congenital malformations or infections
    - indications: atypical presentation, asymmetric breath sounds, suspicion of foreign body, lack of clinical improvement, worsening of clinical course, persistent oxygen required
    - may be normal or show hyperinflation (retrosternal air, flattened diaphragm), atelectasis from mucus plug (may be mistaken for pneumonia infiltrates), pneumomediastinum
  - bronchoscopy
- Treatment:
  - patient education
    - use of spacer
    - always shake canister
o when canister is empty
  ▪ hard to tell as there is more propellant than drug in canisters
  ▪ medication counters are the only accurate way to tell
    • Ventolin brand always has a counter
  ▪ float test no longer accurate as formulations have changed

o home monitoring
  ▪ peak flows
    • problem: effort dependent
    • establishment of zones is best done using daily monitoring of personal bests
    • can be used to predict exacerbations
    • good candidates: patients with severe asthma, poorly controlled asthma, unaware of asthma triggers, those who underestimate degree of illness

o prevention or environmental control
  ▪ ex. vacuuming, washing linens, keeping house pet free

• pharmacotherapy
  o for most, daily anti-inflammatory plus PRN bronchodilator
    ▪ anti-inflammatories:
      • inhaled steroids: beclomethasone (required trial for Medicaid pts), fluticasone, budesonide, mometasone, ciclesonide, triamcinolone, flunisolide
        ▪ use minimal dose necessary to control symptoms
        ▪ always use a spacer! or else most will end up in the mouth
        ▪ remember that there must be a dose conversion when switching between formulations
        ▪ side effects: oral thrush, change in phonation, increased appetite, weight gain, fluid retention, irritability, growth suppression, adrenal suppression, immunosuppression, decreased bone density, HTN, diabetes, glaucoma, cataracts
      • mast cell stabilizers: cromolyn, nedocromil
        ▪ only good for mild to moderate asthmatics
      • leukotriene inhibitors: zileuton, zafirlukast, montelukast
      • anti-IgE antibodies
  ▪ bronchodilators:
    • theophylline
    • β-2 agonists: albuterol, levalbuterol, salmeterol, formoterol
      ▪ don’t use salmeterol as monotherapy
    • anticholinergics not as helpful in kids: atropine, ipratropium
  o combination inhalers: fluticasone/salmeterol, budesonide/formoterol, mometasone/formoterol
    ▪ should be tried 2nd line after failed monotherapy for mild asthma, part of first line therapy for moderate to severe persistent asthma
  o systemic steroids:
    ▪ useful in treatment acute attacks
    ▪ 3-5 days with no taper for mild-moderate flare
    ▪ 5 days with taper for moderate-severe flare

• when to refer: acute life threatening asthma attack, moderate to severe asthma, steroid-dependent asthma, atypical or complicated asthma, poor response to optimal therapy, confounding variables present, more complicated diagnostic studies needed

14.3.2 Rules for Good Asthma Control
• If child is on what appears to be a good asthma treatment plan but are doing poorly:
• not enough medication
• confounding feature being missed: allergies, GERD, CF
• wrong diagnosis
• suboptimal medication delivery: poor technique, poor adherence

14.4 Pediatric Snoring and Obstructive Sleep Apnea

14.4.1 Primary Snoring

• Background:
  • occurs in 7-10% of the pediatric population
  • after puberty is more common in males
  • associated with FH of snoring
• Presentation: no other complaints other than snoring, normal PE
• Investigation: normal labs
• Treatment:
  • waiting/no intervention
  • follow-up with specialist if needed

14.4.2 Sleep Apnea

• Background:
  • occurs in 1-3% of the pediatric population
  • peak ages in 2-7 years
  • causes: enlarged tonsils or adenoids, obesity, craniofacial abnormalities, nasal polyps, chronic allergic rhinitis, pharyngeal infections
• Screening: clinical screening tests available
• Presentation:
  • sleeping: snoring, observed apnea, resuscitative gasps, disturbed or restless sleep, paradoxical chest wall movements, observed difficulty breathing, enuresis
  • awake: mouth breathing, nasal obstruction, excessive daytime tiredness, behavioral problems, hyperactivity, trouble concentrating
  • PE: frequently normal, may have adenotonsillar hypertrophy, macroglossia, retrognathia (turtle chin), obesity or poor growth
  • site of obstruction can be anywhere from tip of nose to bottom of…
• Investigation:
  • CBC to look for polycythemia from nighttime hypoxia (rare, late finding), electrolytes
  • EKG
  • imaging: CXR, sinus films, lateral neck films
  • polysomnography is the most important study to do and will give you the most information
    • whether this must be done for confirmation before surgical intervention is evaluated case-by-case
  • can defer if patient is > 2 years old, has history classic for OSA, excellent underlying health, normal PE, no risk factors, and at low risk for postoperative complications
  • indications: snoring, witnessed apneas, excessive daytime tiredness, neuromuscular diseases with FEV1 < 50%, alveolar hypoventilation, poorly controlled sickle cell, unexplained pulmonary HTN, cor pulmonale, or polycythemia
  • traditional indications that may not be as important: sleep disturbances like nightmares, insomnia, poor sleep hygiene, seizures, known medical conditions that affect sleep
inpatient vs home (hard to do and troubleshoot)
- EEG
- can add in pH probe, video EEG, esophageal manometry
- variables measured: total time of study, total sleep time, sleep efficiency, sleep latency, REM latency, sleep staging, arousals, oxygenation, ventilation, apneas, hypopneas, periodic breathing, cardiac arrhythmias, seizure activity
  - determine obstructive vs central cause by looking at chest wall movements
    - obstructive = obstructive apnea for 2+ breaths
    - central = central apnea for > 20 seconds, or any central apnea associated with an O2 desat > 4% and/or bradycardia
  - other abnormal results:
    - hypopnia = ↓ in measured air flow of at least 50% interpreting all of this takes 30-40 min per study
- home videotaping of child sleeping
- wrist band actuator or bed monitoring for restless sleep
- overnight oximetry
- Treatment: observation, surgery, weight loss, CPAP, dental appliances, medication
  - indications for surgery:
    - must correctly identify area of obstruction for it to be successful
    - options: tonsillectomy, adenoidectomy, uvulopalatopharyngoplasty, laser-assisted uvulopalatoplasty, hyoid suspension and genioglossus advancement, mandibular or maxillary advancement, midline glossectomy, tracheostomy
    - adenotonsillectomy is the most common surgery for obstructive apnea
      - pros: safe, common, outpatient, frequently curative
      - cons: pain, dehydration, bleeding, post-op swelling temporarily worse obstruction, adenoids can grow back
  - treat the obesity:
    - meds for appetite suppressing
    - moderate weight loss
- CPAP:
  - applies positive pressure to keep collapsing airway open
  - decreases upper airway edema
  - complications: nasal or oral dryness, epistaxis, nasal congestion, sneezing, rhinorrhea, sinusitis, claustrophobia, mask irritation, nasal abrasions, aerophagy, facial deformities from pressure on growing bones, decreased cardiac output?
- medications if not surgical candidate or can’t tolerate CPAP:
  - oxygen, thyroxine, antidepressants
  - theophylline, acetazolamide, medroxyprogesterone for central sleep apnea
- Prognosis:
  - may need post-op or post-treatment f/u sleep study
  - adenoid tissue may regrow reappearance of symptoms
  - complications: pulmonary HTN, developmental delay, growth retardation, death, cor pulmonale, behavioral problems, failure to thrive

14.5 Pediatric GI Problems

14.5.1 Recurrent Abdominal Pain

- A common complaint in childhood
- About 10% of cases are functional in nature
  - pain will be poorly localized or periumbilical
  - may be modeled after a transient illness or family member’s symptoms
  - exacerbated by stress
  - may have symptoms for years but child will still have good growth and overall health
GI causes of abdominal pain: constipation, lactose intolerance, peptic disease, sorbitol, parasites, IBD, pancreatitis, cholelithiasis, postviral gastroparesis, congenital GI anomalies, GI polyps

Non-GI causes of abdominal pain: pyelonephritis, hydronephrosis, renal stones, meds, abdominal migraine, Celiac disease, sickle cell crisis, PID, Henoch-Schonlein purpura, familial Mediterranean fever, vertebral discitis or tumor, SLE, angioedema, porphyria, pneumonia

History:
- characterize pain:
  - location:
    - upper abdomen: peptic, non-ulcer functional dyspepsia, pancreatitis, gallbladder disease
    - mid abdomen: small bowel conditions, IBD, appendicitis, right colon lesions, functional pain
    - lower abdomen: constipation, IBS, IBD, renal issues, GU, appendicitis
  - quality: crampy, burning, bloating, stabbing (often functional), steady vs intermittent
  - timing and aggravating/alleviating factors: meals, bowel movements, response to prior treatments, sleep, stress, distraction

Investigation:
- evaluation is done according to character of pain as there is no one simple battery of tests

14.5.2 Constipation and Encopresis

Background:

Causes:
- functional: begins with an acute episode of constipation then is self-perpetuating
  - kids may hold stool to avoid painful BMs or going at school
  - results in chronic rectal distension \( \rightarrow \) decreased strength of rectosigmoid contraction, increased threshold for conscious need to defecate, promotion of relaxation of the internal anal sphincter and soiling = fecal soiling is almost always a result of constipation with overflow
  - less common causes: imperforate anus, Hirschsprung’s repair, Crohn’s perianal disease, psychogenic
  - symptoms: abdominal pain, decreased appetite, vomiting, irritability
- others: developmental, Hirschsprung’s, meds, hypothyroidism, spina bifida, tethered cord, anterior displacement of the anus, perianal disease, intestinal pseudo-obstruction, cystic fibrosis, Celiac disease, lead intoxication, botulism

History: stool pattern, age at onset, toilet training, meconium, stool holding, fecal soiling, perianal disease, previous treatment and response, symptoms of hypothyroidism, developmental and psychosocial history, UTIs

Presentation:
- infrequent, large stools, painful BMs ± blood, fecal soiling, abdominal pain, poor appetite, lethargy, chronic diarrhea
- PE: rectal (perianal soiling, skin tags, anal position, stool), skin (pilonidal sinus, spina bifida), neuro exam, signs of hypothyroidism

Investigation:
- developmental delay screen, autism screen
- imaging when indicated: KUB, barium enema, spinal MRI, upper GI series, bladder US
- rectal biopsy
- anorectal or colonic manometries
- GAS anal culture
- labs: thyroid panel, Ca, lead, Celiac

Treatment:
• disimpaction: enema, Golytely, etc.
• maintenance with stool softener
• diet modification

14.5.3 GERD in Infants and Children

• Background
  • regurgitation is developmentally normal in infants and should get better by 18 months of age
  • becomes pathologic when it is associated with feeding difficulty, pulmonary symptoms, esophagitis, esophageal strictures, Barrett esophagus, asthma, sinusitis, dental enamel erosion

• Treatment:
  • may not need treatment as long as it is not pathologic
  • elevate head of bed
  • thickening of liquids
  • acid blockers
  • prokinetic agents to keep material down have been problematic due to side effects and are frequently taken off the market
  • surgery reserved for children with significant problems

14.6 Pediatric Labs

14.6.1 Special Considerations

• Premature infants need more testing but have less blood so use microsamples from capillary puncture, or smaller Vacutainer tubes
• Removal of blood for testing is the most common reason for transfusion in the NICU

14.6.2 Neonates

1.) Newborn screen: screens for metabolic and genetic conditions that could be severe or lethal if not detected
  • these are conditions not detectable on routine neonatal PE
  • testing is population-wide, mandated by law, and paid for by the state
  • NC screen tests for 35 disorders
  • all states test for PKU and congenital hypothyroidism
  • technique:
    • ideal timing is 24-72 hours after birth
    • may need to be repeated in 7-14 days
    • blood from heel stick is allowed to dry on filter paper that is also the requisition form and is sent to the state lab for testing
  • limitations: false neg PKU if tested earlier than 24 hours, alcohol residue can dilute sample, blood supersaturation (prematurity, dialysis, etc), contamination of paper with water, lotions, formula, antiseptics
  • positive screens result in notification of health care provider, ordering confirmatory studies
  • negative screens in the presence of disease symptoms still need further workup

2.) Blood T&S and direct antiglobulin test
  • done at birth on all infants via cord blood
  • used to diagnose hemolytic disease of the newborn
  • infants < 4 months rarely make red cell alloantibodies, so any antibodies detected are passive maternal antibodies = a positive DAT is often consistent with maternal antibody attachment to infant's RBCs

3.) Bilirubin
• unconjugated and conjugated
• assesses risk for kernicterus (stratified based on age in hours, birth weight, and total bili concentration)
  • interpretation varies for preterm vs term infants
• limitations: light sensitivity, squeezing foot causes hemolysis, specimen must be centrifuged
4.) Glucose
• indicated for infants at risk for hypoglycemia: diabetic mother, preterm, small or large for gestational age, stressed
  • glucose < 45 needs to be treated
5.) TORCHES testing: group of perinatal congenital infections
• toxo, rubella, CMV, herpes simplex, syphilis
6.) Hb: screens neonates with risk or symptoms of anemia or polycythemia vera
• ideally done at 3-6 hours of age

14.6.3 Routine Screens in Children
1.) Hb:
• questionnaire screen with blood test f/u for at-risk children
  • 9-12 mo, 15-18 mo, annually through age 5
• risks: low birth weight, vegetarian diet, not breastfed
2.) Hb electrophoresis: indicated for high-risk children
• will detect HbC, HbE, sickle cell disease or trait
3.) Blood lead levels
• done for screening, confirmation, or f/u
  • screen @ 12-24 months (can use questionnaire), at a minimum once before 6 years, repeat in 12 months for high risk
    • if levels are 10-19, retest every 2-3 months until 3 consecutive levels are < 10
      • if high levels persist, refer for environmental investigation
    • confirmatory = venous specimen > 10 or two capillary or other specimens > 10 drawn within 12 weeks of each other
  • technique: fingertip capillary, wipe off first drop of blood, use pediatric EDTA tube treated to remove lead contamination, store refrigerated up to 2 weeks
4.) Tuberculosis skin testing
• assess risk at 1, 6, 12, 18, 24 mo, and then annually
• latent testing for high risk
• tuberculin skin test at age > 3 mo
5.) Cholesterol & lipids
• needed for brain development before age 2, so not tested before this
• screen kids > 2 if parents have total cholesterol > 240, FH of CV disease before 55
6.) UA only indicated for children with FH of hereditary kidney disease

14.6.4 Common Adolescent Tests
1.) Hb
• screening recs vary
  • those with risk factors: heavy menses, chronic weight loss, underweight or obesity, poor nutrition, vegetarian, athletes, chronic illness
2.) UA
• annual dipstick for leukocyte esterase in sexually active adolescents can detect WBCs and indicate GC/Chlamydia infection
• also consider if FH of hereditary kidney disease

3.) STIs: gonorrhea, Chlamydia, Trichomonas, syphilis, HIV
• consider especially with multiple partners, early onset of activity, symptomatic, h/o childhood sexual abuse
• parental consent not required

4.) Cervical cancer screen
• begin at age 21

14.7 Medical Evaluation for Child Abuse and Neglect

14.7.1 NC Laws
• Suspected child abuse or neglect is required to be reported to Child Protective Services
  • report made in good faith can’t be held legally liable
  • failure to report can result in provider being legally liable
  • caretakers and non-caretakers have different reporting laws
• Definitions:
  • caretaker: person other than the parent, guardian, or custodian who is responsible for the health and welfare of the juvenile in a residential setting
    • ex. step-parents, foster parents, entrusted adult relative, house parent in residential facility,
    • responsible adults in child daycare homes or centers, other persons approved by care provider to assume responsibility
  • abused juvenile: child less than 18 where parent, guardian, custodian, or caretaker inflicts or allows serious physical injury by nonaccidental means, or creates or allows substantial risk of serious physical nonaccidental injury, or uses or allows cruel or grossly inappropriate procedures or devices to modify behavior
  • sexual abuse: commission, allowance, or encouragement of sexual acts against a child including use of the child in pornography or displaying or disseminating pornography to a child
  • neglected juvenile: absence of proper care, supervision, or discipline in a child under 18
    • includes abandonment, lack of necessary medical care, living in an environment injurious to welfare, or placed for care or adoption that is in violation of the law
    • this can also be used to protect other children if another juvenile in the home has died or been abused by an adult in the home
  • emotional abuse: serious emotional damage created or allowed by caretaker
    • evidenced by severe anxiety, depression, withdrawal, or aggression towards himself or others
    • includes situations where caregiver encourages, directs, or approves delinquent acts
  • dependent juvenile: when caregiver is unable to provide for the juvenile’s care or supervision

14.7.2 Medical Providers and Child Abuse
• Yellow flags:
  • multiple ER or clinic visits for trivial complaints in an apparently well child
  • question of apnea
  • failure to thrive
• multiple injuries in the past
• doctor-shopping
• family in crisis: young or inexperienced parents, financial problems

• Red flags:
  • injuries where history does not fit
  • little knowledge of how an injury occurred
  • little desire to know how an injury occurred
  • blaming the child for being accident prone
  • unreasonable expectations for developmental age
  • delay in seeking care
  • dead on arrival

• Risk factors for physical abuse:
  • disabled child
  • domestic violence
  • substance abuse
  • prior abuse in the home
  • multiple caretakers
  • mental illness of caretaker
  • disability or prematurity of child
  • lack of family support or social isolation
  • inexperienced parent

• What to do when suspecting child abuse:
  • provide a complete medical evaluation
  • thorough documentation of information: reports, diagrams, photographs
  • evidence-based interpretation of medical, physical, and interview findings

14.7.3 Evaluation of Potential Abuse or Neglect

• Child abuse and neglect are valid medical diagnoses but they aren’t always the same as legal definitions of abuse and neglect
  • medical evaluation for abuse is not a legal investigation, but the information gathered by it can be used in legal proceedings

• Bruising
  • normal: bruises in healthy, active kids that are walking
    • usually over bony prominences
  • no way to accurately date bruises by appearance
  • abnormal: any bruising in neonates or young infants, extensive bruising
  • differential: temporary tattoo, Mongolian spot, impetigo, vasculitis, contact dermatitis, eczema, psoriasis, hemangioma, ITP, hemophilia, Ehlers-Danlos, photodermatosis, folk healing (coining, cupping)
  • investigation:
    • check for h/o prolonged cord bleeding as a neonate, prolonged bleeding after circumcision, FH of bleeding disorder
    • labs: CBC with platelets, PT/PTT, fibrinogen

• Switching: railroad-track signs

• Burn injuries:
  • 10-25% of all burns in children occur from abuse
  • most are in young children, ages 1-5
  • most common are scald burns
  • high mortality if inflicted

• Skeletal injury:
  • occurs in 10-50% of abused children
  • most specific for abuse in infants
usually diaphyseal fx in this population

- high specificity: metaphyseal fx, posterior rib fx, scapular fx, spinous process fx, sternal fx
- moderate specificity: multiple fx (especially if bilateral), fx of different ages, epiphyseal separations, vertebral body fx or subluxations, digital fx, complex skull fx
- low specificity: subperiosteal new bone, clavicular fx, long bone shaft fx, linear skull fx

### Investigation:
- differential: birth trauma, prematurity, rickets, scurvy, copper deficiency (Menke’s syndrome), congenital pain indifference, Caffey’s disease, osteogenesis imperfecta, osteomyelitis, congenital syphilis, TB, chemo, vitamin toxicity, anticonvulsants, diuretics, hyperalimentation
- skeletal survey: most include separate frontal views of the appendicular skeleton and frontal and lateral views of the axial skeleton
  - most sensitive in kids under 2, not as useful in kids over 5
  - don’t use “babygram” view where you get a x-ray of the whole infant laying down, it is of poor imaging quality, get individual views instead
  - bone scan may detect subtle fractures
  - may need to repeat in 2 weeks to be able to see callus formation

### Head injury:
- the leading cause of fatal child abuse
- non-specific symptoms of irritability, lethargy, vomiting, apnea, seizures, poor feeding, limpness, stiffness
- epidural hemorrhages are almost always accident
- subdural hemorrhages can be accidental or intentional
- retinal hemorrhages are more likely to be abuse
  - but can be normal in newborns less than 2-3 weeks, and also seen in coagulopathies, vasculitis, SBE, h/o ECMO, meningitis, severe HTN
  - seen in shaken baby syndrome
  - associated with subdural hemorrhage and brain injury, may have skeletal injuries
  - unilateral or bilateral and in multiple layers of the retina

### Investigation:
- differential: birth trauma, accidental trauma, metabolic disorder, meningitis, DIC, ITP, vitamin K deficiency, aneurysm, AVM, neoplasm
- head CT for acute assessment
- brain MRI for ongoing assessment
- skeletal survey and ophtho exam in kids under 2

### Sexual abuse:
- background:
  - risk factors: domestic violence, substance abuse, mental illness of caretaker, poor bonding or attachment disorder, multiple caretakers in different environments, prior abuse or neglect in the home, young age, developmental delay, chronic illness
  - perpetrator is usually a male who knows the child and has a caretaker role
  - abuse occurs gradually and progressively over time and is rarely an isolated event
  - it is unlikely that a child will disclose the abuse or their method of communicating may not be understood
    - any disclosure is usually delayed, conflicted, and unconvincing
    - if the child is not protected from the negative consequences of their disclosure, it is likely they will begin to retract
  - abuse is usually uncovered after disclosure to friend, teacher, or family member, accidental discovery, or during a custody dispute
- behavioral symptoms: sexual acting out, excessive masturbation, self-injurious behavior, eating or sleeping changes, promiscuity, substance abuse, fears, depression, aggression, anxiety, school issues, suicide
- physical symptoms: chronic medical complaints, stomachaches, anal pain, constipation, encopresis,
- bleeding, anal discharge, dysuria, hematuria, frequency, enuresis, discharge, bleeding, itching, rash, lesions, pain, amenorrhea, pregnancy, bruises, lesions, swelling
- performing the medical evaluation:
  - do a thorough medical exam, giving the child choices when possible
    - 85-90% of sexually abused children will have no specific or diagnostic physical findings
  - never forcibly restrain a child for the exam
  - help the child become comfortable with the room and equipment
    - typically takes hours
    - reassure child that the exam is being done to see if they are healthy
    - child friendly terms are used to describe exam positions and techniques
  - non-abusive pathology of the female genitalia: labial adhesions, urethral prolapse, paraurethral cyst, hemangioma of the hymen, imperforate hymen, failure of midline fusion, vaginal agenesis, lichen sclerosus, diaper dermatitis, GAS, hypopigmentation, Behcet's disease, eczema, psoriasis, tumors, tear from straddle injury, kick to genitalia, fall on object
  - signs of inflicted trauma to the female genitalia: petechiae, bruising, edema, hematomas,
  - attenuation tissue, vaginal foreign body, laceration, hymenal cleft or transection, avulsion of hymen, missing hymenal, hymenal scar
  - non-abusive trauma to the male genitalia: contact dermatitis, zipper injury, eczema, psoriasis, pearly pink penile papules, foreskin adhesions
  - normal findings of the anus: pectinate line, diastasis ani, failure of midline fusion, rectal prolapse, anal tag, anal fistula, ectopic anus
  - signs of inflicted trauma to the anus: abrasions, lacerations, fissures, tears, bruising, hemorrhage
    - dilation may or may not be abuse
  - signs of sexual abuse of the oral cavity: petechiae of the soft palate and uvula, bruising, lacerations, frenulum injury

14.8 Pediatric Infectious Disease

14.8.1 Background
- Many infections are accompanied by fever, rash, or lymphadenopathy
  - not all fever and not all rashes are infectious
- Most pediatric infections are viral
- Consider bacterial if ↑WBCs with left shift, ↑ESR or CRP
- Remember that any child under 3 mo with a fever > 101 has a potentially life-threatening illness and requires immediate and aggressive evaluation and treatment

14.8.2 Classic Childhood Exanthems
1.) Measles
   - aka rubeola or “first disease”
   - presentation: cough, coryza, conjunctivitis, Koplik’s spots, maculopapular rash starting at hairline and spreading down to confluence
   - treatment:
     - resolves on its own in 7-10 days
     - complications: subacute sclerosing panencephalitis, a rare fatal infection years after initial infection
2.) Scarlet fever
• “second disease"
  • presentation: pharyngitis, strawberry tongue, sandpaper rash that is worse in the groin and axilla, desquamation of palms and soles
  • investigation:
    • differential: hypersensitivity rash
  • treatment: penicillin VK or amoxicillin

3.) Rubella
  • aka German measles or 3-day measles, “third disease”
  • presentation: postauricular and occipital adenopathy, maculopapular rash on face that spreads
  • treatment:
    • resolves in 3 days
  • complications: arthralgias

4.) Erythema infectiosum
  • aka “fifth disease”
  • caused by human parvovirus B19
  • presentation:
    • mild flulike illness
    • rash @ days 10-17: initially appears like flushed cheeks, then encompasses whole body as a maculopapular rash, then becomes lacy in arms and legs
      • not contagious at this point
    • low grade fever
    • migratory arthritis in older patients that can last 6-8 weeks = mistaken for rheumatoid arthritis
    • older adolescents and young adults can have papular purpuric glove & sock
    • syndrome (more common in spring and summer, and occurs with lymphadenopathy, fever, and arthralgias in addition to rash)
      • lasts 1-2 weeks

5.) Roseola
  • aka exanthem subitum or “sixth disease”
  • caused by HHV-6 or HHV-7
  • affects young children, 6 mo to 3 years
  • presentation:
    • high fevers to 104 for 3-7 days with no rash
    • rash appears after fever goes away

14.8.3 Other Childhood Exanthems

1.) Varicella
  • caused by varicella zoster virus (HHV-3)
  • child will be contagious for 1 week
  • presentation:
    • intensely pruritic lesions appear on trunk, then face, head, and possibly extremities or mucous membranes
      • come in crops over 3-4 days
      • crust over in 3-5 days
      • see lesions in all different stages
  • treatment is symptomatic
    • no aspirin
    • consider acyclovir in teens
  • complications: herpes zoster (contagious varicella), pneumonia, encephalitis

2.) Hand-foot-mouth disease (herpangina)
  • caused by coxsackie A-16 virus
• highly contagious
• presentation:
  • vesicles on tongue, oral mucosa, hands, and/or feet
  • may have generalized scarlatiniform rash
  • children generally feel well
  • low-grade fever
  • anorexia due to mouth lesions
• treatment: symptomatic
• complications: myocarditis, substernal chest pain, dyspnea

3.) Gianotti-Crosti syndrome
• aka papular acrodermatitis of childhood
• usually caused by EBV (HHV-4) or other viruses like hep B
• often affects 6-14 month olds
• presentation: symmetric red-purple papules and papulovesicles on the face, buttocks, and extremities, lymphadenopathy, low-grade fever
• treatment: self-limiting in 3-4 weeks

4.) Entero-virus exanthems
• presentation:
  • varied rash, can be maculopapular, vesicular, petechial, or urticarial
  • may involve other organ systems

14.8.4 Mumps
• Caused by paramyxovirus
• 2-3 week incubation
• Presentation:
  • parotitis (usually bilateral) □ loss of mandibular angle
  • Stenson’s duct inflammation with yellow discharge
• Treatment is symptomatic
• Complications: orchitis, pancreatitis, oophoritis, aseptic meningitis

14.8.5 Gastroenteritis
• Causes: rotavirus, caliciviruses, astroviruses, adenoviruses, nontyphoidal *Salmonella, Shigella, Campylobacter, E. coli, Giardia*

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<th>Noroviruses</th>
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<th>Adenoviruses</th>
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<td>all ages</td>
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<td>&lt;50%, may be dominant feature</td>
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<tr>
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<td>clinical</td>
<td>stool EIA</td>
</tr>
</tbody>
</table>

• Presentation:
  • *Giardia* can cause vulvovaginitis in prepubescent girls
• Treatment:
  • most cases will be self-limiting
  • hydration
  • antibiotics for *Shigella*, EPEC, *Giardia lamblia* (metronidazole or can self-resolve), and *Campylobacter* (can self-resolve)
14.8.6 Cutaneous Infections

- NO antibiotics for *Salmonella* or EHEC

**Perianal dermatitis (perianal strep):**
- caused by GAS
- presentation: blood-streaked stools, painful defecation, pruritus
  - can be mistaken for *Candida*
- treatment: penicillin VK

**Tinea capitis:**
- presentation: black dot hair loss, scalp erythema and scaling

**Molluscum contagiosum:**
- caused by poxvirus
- presentation:
  - flesh-colored, dome-shaped lesions with umbilicated central core
  - lesions spread by autoinoculation
- treatment: self-limiting or cryotherapy

**Common warts:** treat with cryotherapy

**Candidiasis**
- presentation: rash is usually beefy red and painful with satellite lesions, diaper dermatitis in infants
- treatment: nystatin, airing area out

14.8.7 Meningitis

**Agents:**
- under 1 mo: GBS, E. coli, Listeria, Klebsiella, Enterobacter
  - less common: Staph aureus, Enterococcus, Pseudomonas, Salmonella, other Staph
- after 1 mo: Strep pneumo, Neisseria meningitidis
  - less common: GAS, gram negs, *Listeria*

**Investigation:**
- LP for CSF, blood cultures

**Treatment:**
- newborns: ampicillin + cefotaxime or gentamycin
- older than 1 mo: cefotaxime or ceftriaxone + vanco + dexamethasone

14.8.8 Infestations:

A.) Scabies
- presentation:
  - infants tend to get it from the neck up
  - everyone else gets it from the neck down (fingers, toes, wrists, axillae)
  - itching, scabs, and burrows
  - nodular scabies in immunocompromised or infants
- treatment:
  - permethrin or lindane cream (risk of neurotoxicity)
  - 1st gen antihistamines
  - prognosis: itch will persist for some time after treatment

B.) Pediculosis capitis (head lice)
- treatment:
  - lindane shampoo, with retreatment in 10 days
  - removal of nits not necessary
  - other option: Vaseline occlusion
C.) Enterobiasis (pinworms)
- presentation:
  - nighttime rectal itching
  - vaginitis or UTIs in prepubescent girls
- investigation: tape prep first thing in the morning
- treatment: mebendazole, with repetition in 2 weeks

14.8.9 Upper Respiratory Tract Infections

A.) Common cold
- background:
  - half of all URIs are viral: rhinoviruses, coronaviruses, parainfluenza viruses, RSV, adenoviruses, influenza, enteroviruses, human metapneumovirus
  - most children have 6-7 colds per year, some have more
  - risk factors: day care, school, parental smoking, low income, crowding
  - incubation of 2-8 days
- prevention: good handwashing, avoiding environment contaminated with nasal secretions, breastfeeding
  - no role for multivitamins or vitamin C
- presentation: nasal irritation, congestion, watery nasal discharge, sneezing, sore throat, fever, malaise, conjunctivitis, headache, myalgia
  - lasts 5-10 days
  - younger children may have high fevers with a cold even in the absence of a secondary infection
- investigation:
  - differential: pharyngitis, purulent rhinitis, sinusitis, allergic rhinitis
    - children < 6 months typically don’t have allergic rhinitis
- treatment:
  - no cough or cold meds for kids under 2!
  - nasal drops with frequent suctioning for infants
  - cool mist humidifier or vaporizer
  - maintain hydration
  - elevate HOB
  - saline gargles or lozenges for older kids
  - Vick’s vaporub
  - antipyretics for fever: acetaminophen or ibuprofen for children > 6 mo
  - decongestants:
    - oral: phenylephrine or pseudoephedrine
    - topical for kids over 2: phenylephrine or oxymetazoline
      - risk of rebound congestion if overused! 3 days on, 3 days off
    - cough suppressants: dextromethorphan, codeine, or hydrocodone
    - no role for antihistamines
- complications: bacterial secondary infections, most commonly otitis media, sinusitis, adenitis, pneumonia, bronchitis, asthma exacerbation
  - parents should be instructed to watch for any signs of difficult breathing or prolonged high fevers

B.) Purulent rhinitis
- agents: GAS, Strep pneumo
- usually kids in daycare
- presentation: intermittent fever for 2-3 weeks with thick, purulent nasal discharge
  - usually follows known mild URI but can be isolated

C.) Streptococcal pharyngitis:
• often seen in kids 5-10
• presentation:
  • sudden onset of sore throat, fever, headache, and abdominal pain
    o BUT can have atypical, nonpharyngeal presentation in younger kids
  • beefy red throat
  • usually a lack of respiratory symptoms
  • tender, enlarged anterior cervical nodes
  • exudate is nonspecific for strep!
  • may have scarlatiniform rash
• investigation:
  • throat culture and rapid Ag detection test
• treatment:
  • penicillin, amoxicillin, cephalaxin, or erythromycin
    o amoxicillin tastes better
  • clindamycin if failed initial treatment
  • treat for 24 hours before returning to school
• prognosis:
  • complications:
    o suppurative: peritonsillar cellulitis or abscess, otitis media, sinusitis, cervical lymphadenitis
    o non-suppurative: rheumatic fever, glomerulonephritis
D.) Other bacterial pharyngitis:
• Fusobacterium necrophorum
  • normal flora of the oropharynx, lives in tonsillar crypts
  • causes endemic pharyngitis in adolescents and young adults 15-30
    o dramatic increase in US in the past decade
  • presentation: severe pharyngitis, cervical adenopathy, headache, may have fever, unilateral neck pain or swollen neck
  • investigation: ↑WBCs with leukocytosis, extremely high CRP
  • treated due to risk of complications of Lemierre’s syndrome (septic thrombosis of the internal jugular vein from extension of infection: seeding of distant organisms, especially lungs) and death
    o use penicillin + clindamycin to cover anaerobes
• groups C and G strep
  • won’t be picked up on rapid strep test
• Corynebacterium diphtheriae
• Arcanobacterium haemolyticum
• Neisseria meningitidis
• Chlamyphila pneumoniae
• Mycoplasma pneumonia
E.) Viral pharyngitis:
• infectious mononucleosis:
  • presentation: exudative tonsillitis, cervical adenitis, fever, enlarged liver or spleen
  • investigation:
    o monospot frequently negative in kids under 9 or anyone infected < 2 weeks
      • takes 2 weeks to make IgM antibodies
    o atypical lymphocytosis
  • treatment:
    o steroids
    o splenic precautions: no lifting, straining, or contact sports
• herpetic gingivostomatitis
• aphthous stomatitis
• herpangina
• others: CMV, parainfluenza, RSV, influenza, rhinovirus

14.8.10 Rhinosinusitis

• Background:
  • uncommon in kids as their sinuses are not fully formed
  • risk factors for development: URI, dental infection, allergic rhinitis, vasomotor rhinitis, allergic fungal
  • sinusitis, GERD, nasal polyps, deviated septum, cleft palate, adenoidal hypertrophy, foreign body, immune deficiency, cystic fibrosis, immotile cilia syndrome
  • agents:
    o acute sinusitis: Strep pneumo, H. flu, M. cat
    o chronic: other strep, Staph aureus, anaerobes

• Presentation:
  • adults have headache, facial pain, fever
  • kids have two possible presentations:
    o subacute: 10 days of nasal congestion, purulent nasal drainage, or persistent cough
    o abrupt onset of fever > 101, facial pain, purulent nasal drainage

• Investigation:
  • usually clinical diagnosis
  • sinus films, especially if recurrent

• Treatment:
  • mild to moderate disease with no risk factors:
    o amoxicillin or 2nd or 3rd gen cephalosporin (remember ability to cover Strep pneumo varies greatly - use cefprozil, cefuroxime, cefdinir) or macrolide (risky)
    o 10-14+ days
  • severe disease or risk factors:
    o Augmentin or cephalosporins
  • for recurrent infections may need 28 day course of antibiotics with referral to ENT
  • adjuncts: topical or oral decongestant, saline irrigation, nasal or oral steroids, mucolytics
  • indications for referral: need for surgical drainage, need for polypectomy, recurrent sinusitis, isolation of are or resistant microbe, intracranial or orbital complications, suspected immunodeficiency

• Prognosis:
  • failure to improve after 72 hours suggests complication or resistance – consider imaging or IM or IV therapy
  • complications:
    o orbital cellulitis
    o epidural or subdural empyema
    o dural sinus thrombosis
    o brain abscess
    o asthma exacerbation
    o Pott’s puffy tumor: osteomyelitis of the frontal bone

14.8.11 Otitis Media

• Background:
  • due to eustachian tube dysfunction – creation of negative pressure in the middle ear – reflux of upper respiratory bacteria
  • peak incidence in 6 mo to 3 years, with a second peak at 5 years
  • risk factors: Alaskan native, native American, bottle-fed infant, daycare attendance, parental h/o ear
infections, parental smoking, siblings with recurrent AOM, maxillofacial abnormalities, HIV infection, Down’s
• agents: *H. flu, M.cat, S. pneumo* (down due to vaccination), rarely GAS, RSV, rhinoviruses, CMV, influenza
• Presentation: rapid onset, fever, irritability (especially when laying flat), pulling at ears, follows URI, bulging, erythematous, immobile TM
  • if there is also conjunctivitis think *H. flu*
• Treatment:
  • watchful waiting approach for afebrile kids ≥ 2 years
  • kids < 6 mo should be treated as well as any febrile children
  • antibiotics:
    o high dose amoxicillin (drug has difficulty reaching inner ear) or high dose Augmentin if no response within 72 hours
    o cefdinir, cefpodoxime, or cefuroxime for mild penicillin allergy
    o clarithromycin (tastes terrible) or azithromycin for severe penicillin allergy
      ▪ therapeutic limitations for macrolides in this situation
    o clindamycin + sulfisoxazole or Septra for moderate to severely ill children with penicillin allergy risk factors for resistance: day care, recurrent treatment with beta-lactams, recurrent OM, winter season, age < 2
  • surgical management indicated with bilateral effusion for a total of 3 mo and a bilateral hearing deficiency
    o tympanocentesis
    o myringotomy or tympanostomy tubes
• Complications: hearing loss, chronic effusion, cholesteatoma, mastoiditis

14.8.12 Influenza
• Background:
  • illness begins 1-4 days after exposure
• Prevention:
  • vaccination with appropriate vaccine for all kids 6 mo-18 years
    o need 2 shots the first time, separated by 4 weeks
    o especially for kids with asthma, as influenza can cause severe exacerbations
• Presentation:
  • sudden rise in temperature, rigors, myalgia, headache, lassitude, anorexia, acute bronchitis, croup, bronchiolitis, conjunctivitis, nonproductive cough
  • postviral asthenia
  • illness lasting several days
• Investigation:
  • clinical diagnosis
  • rapid nasal swab available, but hard to get this in kids
• Treatment:
  • antivirals available for influenza A
• Complications: pneumonia, myositis, myocarditis, pericarditis, aseptic meningitis, encephalitis, Reye’s syndrome, Guillain-Barre syndrome

14.8.13 Croup
• Background:
  • agent is usually parainfluenza virus, can also be influenza, RSV, human metapneumovirus
  • risk factors: male, FH, winter months
• Presentation:
  • typical affected child is 18 months old
• stridor, hoarseness, barking seal cough, low-grade fever
• rales, rhonchi, wheezing
• symptoms worse at night

Investigation:
• differential: epiglottitis, congenital anomaly, neoplasm, bacterial tracheitis, pharyngeal abscess, spasmodic croup, vocal cord paralysis, subglottic stenosis, foreign body
• usually clinical diagnosis
• CXR showing “steeple sign”

Treatment:
• supportive: cool mist humidifier, inhaled epinephrine for severe airway compromise (ED setting), IM or PO steroids, keeping child calm
• admission for children with stridor at rest

14.8.14 Bronchiolitis

Background:
• a nonspecific term for first time wheezing associated with a viral infection
• a result of airway obstruction
  o young infants at increased risk due to immature immune system and small airways
• agent is usually RSV, human metapneumovirus is emerging
  o other etiologies: parainfluenza, influenza, adenovirus
• usually in young infants < 2 years old, peak 2-6 months
• more common in the winter
• more common in males

Prevention:
• prophylaxis high risk infants with Synagis or RSV Ig during first RSV season
  o includes infants < 2 years with congenital lung disease, preterm during first RSV season, preterm with risk factors like daycare, school-aged siblings, abnormal airways, smoke exposure

Presentation:
• usually an accompanying URT infection, conjunctivitis, or OM
• wheezing, retractions, tachypnea, rales
• apneic spells in young infants

Investigation:
• differential: asthma, foreign body
• diagnosis is usually clinical
• antigen testing or culture of nasal secretions
• CXR may show hyperinflation, atelectasis, and infiltrates

Treatment:
• supportive: cool mist humidifier, oxygen
• ribavirin no longer used
• bronchodilators or corticosteroids for selected children with good initial response
• respiratory support if severe

14.8.15 Pneumonia

Background:
• infection of smaller airways and parenchyma with consolidation of alveolar spaces
• agents:
• most commonly viral: RSV, parainfluenza, adenovirus
• if < 1 month:
  o typically bacterial: GBS, Staph aureus, gram negs, Listeria, Treponema pallidum
    ▪ viral causes: CMV, HSV, rubella
• 1 mo-5 years: Strep pneumo is most common, H. flu, GAS, Staph aureus, Mycoplasma, Chlamydophila pneumoniae
• after 5 years: Mycoplasma pneumonia is most common, Strep pneumo, Chlamydophila
• less common causes:
  - *Chlamydia trachomatis*, *Mycoplasma hominis*, *Ureaplasma urealyticum*, CMV can cause afebrile pneumonia in children 2 weeks to 3 months
  - TB in all ages
  - pertussis in unimmunized or incompletely immunized children
  - consider fungal if immunocompromised
• Risk factors: congenital heart or lung disease, cystic fibrosis, asthma, sickle cell disease, immunodeficiency
• Presentation:
  - increased RR, ↓ breath sounds, dullness to percussion, rales or fine crackles, fever (high if bacterial)
  - older infants and children: rapid onset with cough, dyspnea, tachypnea, grunting, retractions, fever
  - neonates may have fever without any focal findings
• Investigation:
  - bacterial indicators:
    - CXR showing segmental infiltrates, atelectasis, may have pleural effusions
    - increased WBCs with neutrophilia
    - blood cultures positive in 10-30% of children with bacterial pneumonia
  - viral indicators:
    - CXR showing diffuse interstitial infiltrates, increased interstitial markings, hyperinflation
    - normal or slightly ↑ WBCs with lymphocytosis
    - rapid Ag detection tests
• Treatment:
  - if viral: supportive, nebulized albuterol, ipratropium, or epinephrine, consider steroids
  - amantadine or rimantadine for influenza A
  - bacterial: treat empirically, covering for atypicals and *Strep pneumo*
    - birth-1mo: inpatient ampicillin + gentamycin ± cefotaxime
    - 1 mo-3 years:
      - outpatient: erythromycin or azithromycin
      - inpatient: (erythromycin or azithromycin) + cefotaxime
    - 3 mo-5years:
      - outpatient: amoxicillin + (clarithromycin or azithromycin)
      - inpatient: cefotaxime or ampicillin
        - ceftriaxone if ICU
    - over 5:
      - inpatient: amoxicillin + (clarithromycin or azithromycin)
      - outpatient: amoxicillin + (doxycycline or erythromycin)

14.8.16 Pertussis
• Background:
  - incubation of 6 days
  - most common in infants under 4 months
• Presentation:
  - clinical disease has 3 stages that last ~8 weeks total
    - catarrhal stage: low grade fever with runny nose
    - paroxysmal stage: cough with inspirational whoop
    - convalescent stage: gradual symptom resolution
  - can be atypical in infants: apneic spells
• Investigation:
• culture
• PCR
• fluorescent antibody staining
• increased WBCs with lymphocytosis
• CXR showing segmental atelectasis and perihilar infiltrates
• Treatment: azithromycin

14.9 Autism

14.9.1 Background

• History:
  • first described by Leo Kanner in 1943
  • in 1950s was thought to be a result of a “refrigerator mother”
  • 1960s autism treatment was psychotherapy, screams, shocks
  • modern period began in 1970s □ autism now thought to be biologic rather than psychogenic
    □ considered to be related to mental retardation
    □ rediscovery of Asperger’s in 1979: spectrum of total aloofness to seeking engagement with peers, although inappropriately
      □ autism with normal IQ

• Possible causes:
  • highly genetic basis with possible environmental factors
  • mercury in vaccines?
    □ autism still rising despite removing thimerosal

• Current DSM-IV:
  • autism is included within the spectrum of pervasive developmental disorders
  • onset before age 3
  • impairments in three domains:
    1.) social interaction: at least 2/4
      ▪ markedly impaired eye contact, gestures, body communication to regulate social interaction
      ▪ failure to develop peer relations
      ▪ not seeking to share enjoyment or interests
      ▪ lack of social or emotional reciprocity
    2.) language: at least ¼
      ▪ delayed or absent spoken language without attempt to compensate with gestures or mime
      ▪ stereotypical and repetitive language
      ▪ inability to initiate and sustain conversation
      ▪ lack of spontaneous make-believe play appropriate for developmental level; literalness
    3.) interests and repetition: at least ¼
      ▪ stereotyped and repetitive motor mannerisms
      ▪ preoccupation with parts of object
      ▪ strong fixations to objects or restricted interests
      ▪ inflexible adherence to rigid routines
    □ may also exhibit sensory seeking or avoidant behaviors
14.9.2 Recognizing Autism

- It is important to recognize it early, as early intervention is believed to be critical to longer term outcome.
- Infancy: a search area, any clues will be very subtle and therefore it is rarely diagnosed in this period.
- Toddlers:
  - red flags:
    - no words by 18 months
    - no strings of words by 2 years
    - make requests by pulling parent’s hand, instead of pointing or using gestures
    - abnormalities of social interaction will be more prominent in this time period than repetitive behaviors
    - lack of joint attention may be the most important warning sign
      - ex. not following parent’s gaze when they move their eyes
  - milestones:
    - should be able to follow a point at 10-12 months
    - points to request an object at 12-14 months
    - points to share an object by 14-16 months
- 2 & 3 year olds:
  - red flags:
    - don’t look up for approval or share an activity
    - delayed echolalia
    - play characterized by lack of imagination, lining up or arranging toys, unusual attachment to objects
    - rocking and spinning
    - tantrums set off by sounds or changes in routine
- Preschoolers:
  - red flags:
    - inability to relate to peers
      - may want to relate, but don’t know how
    - can’t initiate conversation
    - one-sided conversation
    - difficulty with body space, gestures, or voice inflection
    - strong and obsessive interests
      - a “little professor”
      - preoccupation with routines or structure
  - Screening tools:
    - most popular is MCHAT
      - required by NC Medicaid at 18 and 24 month visits
      - applies to children up to age 4

14.9.3 Comprehensive Medical Evaluation

- Done after a positive screen.
- Referral to early intervention services for basic language and developmental testing.
- Typically involves a developmental pediatrician, psychologist, and speech therapist.
- Differential:
  - Rett syndrome: neurodegenerative condition that some argue should be not classified as a neurodevelopmental disorder (as autism is).
  - neurocutaneous disorders like tuberous sclerosis and NF-1
  - fragile X syndrome: the leading known genetic cause of autism, with 15-60% of children also having an autism spectrum disorder.
- **Angelman syndrome**: neurodevelopmental disorder that frequently coexists with autism
- **Down's syndrome**: can coexist with autism
- **Turner syndrome**: social deficits similar to autism
- **William syndrome**: many similarities to autism along with heart defects
- **metabolic disorders**

**Testing:**
- audiology of all patients
- investigating diagnoses suggested by history or PE
- microarray of genetic tests is recommended by ACMG
  - consider especially if there is concomitant mental retardation

### 14.9.4 Living With Autism After Diagnosis

- **Support groups**
- **Early intervention philosophies**:
  - **applied behavioral analysis**: use of positive reinforcement that varies in intensity
    - driven by child rather than therapist
    - best tested method of autism treatment
  - **TEACCH**: structured education with a modified environment designed to fit the child
    - visual aids
    - order and organization
    - floortime spent with child, following their lead to promote interaction
- **Language therapy**: different from speech therapy in that it focuses on pictures and visual communication
- **Social therapies**:
  - social skill groups where autistic children learn to talk to each other
- **Occupational therapy**:
  - goal is to develop fine motor skills as well as sensory integration
  - seeks to aid stimuli sensitivity
  - sensory “diet” of instructing parents to brush children, rub their arms, and put on special headphones with new age music
    - controversial
- **Dietary therapy**:
  - gluten- and casein-free diet
    - anecdotal evidence but not in randomized controlled trials
  - supplements such as omega-3 fatty acids
    - no consistent support from clinical trials
- **Unhelpful therapies**:
  - chelation therapy for mercury and heavy metals is dangerous
  - hyperbaric therapy does not work
  - facilitated communication (letter or picture board where child moves caregiver’s hand to words)
  - serotonin

### 14.9.5 Common Behavior Problems

- **Sleep disorders**
  - may reflect problems with transitions, sensory issues, or alterations in circadian rhythm
  - TV at bedtime or upon awakening can make problem worse
  - treatment:
    - rule out pain, constipation, reflux, or other potential cause
    - develop a consistent bedtime routine incorporating a picture schedule with several steps, comfortable dress, blankets, objects, consistent music or white noise
    - melatonin 30 min before bedtime is supported by controlled trials
- clonidine at bedtime for kids over 6

- Feeding disorders: children with autism often become extremely selective with their foods
  - like the same things over and over
    - ex. chicken nuggets, french fries, bananas
    - leads to constipation and GI pain
  - aversion to textures
  - treatment:
    - treat underlying conditions
    - keep a child on schedule, and don’t allow them to graze
    - encourage handling food in preparation and in eating
    - offer three items per meal
      - unpopular items may have to be seen or handled 20-30 times before acceptance
    - severe aversions: avoid gummy vitamins, nutrition consult, referral to OT or feeding program, GI referral if signs of reflux or GI pain

- Meltdowns
  - may be triggered by pain, frustration, sensory overload, unexpected changes in routine
  - caretakers often give in and worse behavior
  - management: figure out what causes the problem, if there are any warning signs, how others respond to/reward behavior
    - maintain structure and predictability
    - picture schedules for needed transitions
    - distraction if there is overstimulation

- Severe meltdowns or outbursts
  - consider referral to a developmental pediatrician or psychologist trained in autism
  - meds: consider guanfacine in kids over 6

- Aggression, self-injury, or refractory outbursts
  - behavioral approach to analyze
  - meds: neuroleptics like risperidone

### 14.10 The Allergic Child

#### 14.10.1 Atopy

- Describes children with hypersensitivity to environmental allergens
  - IgE mediated
  - genetic predisposition
  - modest eosinophilia

- Dramatic increase in cases in past few decades
  - overall incidence of 20% in infants and young children

- Possible causes:
  - hygiene hypothesis

- Risk factors: FH, infection, environmental exposure, dietary triggers

- Protective factors: breastfeeding

- Clinical manifestations: allergic rhinitis, atopic dermatitis, asthma, food allergies

- Treatment:
  - hydrolyzed milk protein formulas for infants with very strong h/o atopic disease that can’t be breastfed
  - use of soy formulas is not associated with decrease in allergic disease, but can help infants with gastrointestinal problems in response to milk proteins
14.10.2 Allergic Rhinitis

- Most common of the atopic disorders
- A result of allergen binding IgE on mast cells → release of chemical mediators
- Presentation:
  - seasonal allergic rhinitis caused by airborne pollen
    - unusual in children under 3
  - perennial allergic rhinitis due to indoor allergens
  - episodic allergies
  - repetitive sneezing
  - pruritus of nose, eyes, ears, and palate
  - clear rhinorrhea
  - stuffiness
  - postnasal drainage and epistaxis
  - irritability, sleep disturbances, impaired school performance
  - may have other atopic disease
- PE: inflamed conjunctivae and sclera, allergic shiners, Dennie’s lines, retracted TMs, serous effusions, swollen or boggy nasal turbinates, clear mucosal discharge, allergic salute, hyperplasia of palate or posterior pharynx
- Investigation:
  - differential: sinusitis, rhinitis medicamentosa, polyps, deviated septum, adenoid hypertrophy, FB, vasomotor rhinitis
  - diagnosis is usually clinical
  - allergy skin prick tests
  - serum RAST tests: much more expensive
  - nasal smear for eosinophilia
- Treatment:
  - allergen avoidance: windows closed, bed cases, washing linens weekly, removing stuffed animals, cockroach poison, mold precautions, HEPA filters
  - pharmacotherapy:
    - nasal saline
    - oral decongestants in older kids with nasal stuffiness
      - pseudoephedrine or phenylephrine
    - nasal steroids
    - 1st or 2nd gen antihistamines
    - antihistamines ± mast cell stabilizers for predominately eye symptoms
  - immunotherapy for children without significant improvement on pharmacotherapy and allergy control measures
    - consists of 3-5 years of allergy shots

14.10.3 Atopic Dermatitis

- Possible causes: genetics, environmental factors, cutaneous sensitivity, exaggerated immune response
- Triggers: mechanical trauma, bacterial antigens, allergen exposure, stress, anxiety, temperature extremes, irritants, allergens
  - strong association with food allergies such as eggs, milk, peanuts, soy, wheat, fish, shellfish, tree nuts
- Presentation:
  - usually the first atopic disease to present
  - “the itch that rashes”
  - acute and chronic phases
• onset before age 2
• personal h/o or FH of dry skin in past year, asthma, or allergic rhinitis
• common in skin creases such as popliteal and antecubital fossa
• common in children under 4 on the forehead, cheeks, and outer areas of limbs
• hyperpigmentation and lichenification with older lesions
• other clinical manifestations: xerosis, hyperlinear palms, infraorbital shiners, food intolerances, secondary cutaneous infections, intolerance to wool, increased itch with sweating

14.10.4 Food Sensitivities and Allergies

- Definition:
  - food intolerance (sensitivity): a result of pharmacologic properties of the food or host susceptibility
    - includes adverse reactions to caffeine or tyramine, lactose intolerance, non-IgE mediated pediatric GI syndromes
  - food allergy: refers to IgE mediated allergies rather than food sensitivities
    - more common in allergic children, especially with atopic dermatitis, and those with parental asthma
    - prevalence is 6-8% in children
  - oral allergy syndrome: IgE-mediated rapid onset oral pruritus after ingestion that is rarely progressive
    - usually occurs with fresh fruits and vegetables
    - cooked or heated foods are usually tolerated
    - a result of reaction to remnants of pollen remaining on produce
      - birch pollen rxn with apples, apricots, carrots, cherries, kiwi

- Investigation:
  - differential: seborrheic dermatitis, contact dermatitis, scabies
  - allergy skin tests
  - IgE level
  - skin culture if concern for secondary infection
  - double blind food challenge

- Treatment:
  - avoid environmental irritants
  - antihistamine for day and antihistamine for night
  - emollients: Cetaphil, Cerave, Eucerin, Aquaphor, Theraplex
  - not lotions!
  - topical steroids
  - non-steroidal creams: Elidel, Protopic
  - antibiotics for secondary infection: cephalexin
  - daily soaking baths
  - CAM: biofeedback, massage, behavior modification, counseling
• Foods accounting for 90% of all IgE mediated allergies:
  • milk: casein and whey proteins
  • albumin in eggs
  • peanut oil and other legumes
  • tree nuts: sensitivity will usually be lifetime
  • canned tuna and salmon is usually tolerated
  • wheat
  • soy
  • increasing incidence of sesame
  • rarely: chocolate, food additives or dyes, MSG
  • sulfites in asthmatics
• Presentation of food allergy:
  • pruritus, urticaria, angioedema, flushing, nasal congestion, cough, wheezing, vomiting, diarrhea, pruritus of lip or tongue, shock
  • symptoms generally occur within 1-2 hours after ingestion
• Investigation:
  • skin prick tests: positive predictive value of < 50% but negative predictive value of > 95%
  • specific IgE levels: especially useful in patients with severe atopic dermatitis or with h/o life threatening reaction or those who can’t stop antihistamines for the skin testing
    o decision points available to predict allergy for milk, egg, peanut, and fish
  • double-blind placebo-controlled food challenge is the gold standard
    o elimination of suspected food as well as antihistamines for 2 weeks
    o increased doses of food given every 10 minutes
    o observation for one hour after completion
• Treatment:
  • elimination of offending food
  • patient education: Food Allergy and Anaphylaxis Network, RD, medic alert bracelet, written emergency plan, EpiPen at home and school
  • current trials of supervised oral desensitization therapy
• Prognosis:
  • most milk, wheat, soy, and egg allergies resolve by 10-12 years of age while allergies to peanuts, tree nuts, and seafood persist
  • food sensitivities resolve in infants by ages 1-3, while toddler and adult forms are more persistent
  • follow-up needed for periodic reevaluation of tolerance

14.11 Dehydration

14.11.1 Background

• Definitions:
  • hypovolemia: a result of loss of both salt and water
  • dehydration: loss of water alone
• Causes:
  • usually a result of acute diarrhea
    o infectious causes: rotavirus, norovirus, enterovirus, Salmonella, Shigella, Campylobacter, Giardia, Cryptosporidium
    o antibiotics
    o food intoxication
    o systemic infection
    o toxic ingestion
    o hypothyroidism
• acute vomiting: infectious gastroenteritis, obstruction, reflux, toxic ingestion, systemic infection, migraine, meds, pregnancy in teens
• chronic dehydration in adolescents
• signs: worsening allergies, asthma, worsening acne, fatigue, headaches
• The leading cause of child morbidity and mortality
• average child will have 7-15 episodes in first 5 years of life
• Children at increased risk due to higher ratio of surface area to body weight, inability to communicate thirst, and higher metabolic rate
• Prevention: have oral rehydration solutions readily available at home, parental education

• Presentation:
  • mild dehydration: body weight loss of 3-5%, increased thirst, moist to slightly dry mucous membranes, normal production of tears and urine
  • moderate dehydration: body weight loss of 6-10%, irritability, lethargy, postural hypotension, sunken eyes and anterior fontanelle, decreased tear and urine production, decreased capillary refill
  • severe dehydration: body weight loss of 10% or more, lethargy, weak and rapid pulse, marked hypotension with poor peripheral perfusion, dry mucous membranes, anuria or severe oliguria, absent tear production
  • abdomen may have hyperactive bowel sounds in gastroenteritis
  • decreased turgor when pinching abdomen

• Investigation:
  • can evaluate severity using dehydration scales
  • urine dipstick for specific gravity and ketones
  • CBC and electrolytes if suspecting severe dehydration
  • serum bicarbonate most useful as it can distinguish mild dehydration from moderate to severe
  • determining type of dehydration may be important:
    • acute vomiting and diarrhea without replacement □ isotonic diarrhea
    • GI illness causing diarrhea with only plain water for rehydration □ hypotonic/hyponatremic
    • hypertonic/hypernatremic □ need to be careful when rehydrating to avoid cerebral edema

• Treatment:
  • mild or moderate dehydration □ oral rehydration therapy
    • contraindications: shock, intractable vomiting, high stool losses, severe gastric distension or abdominal ileus
    • cautions: abdominal pain, blood in stool, infant < 6 mo, AMS, other signs of progressing dehydration, suboptimal response to oral rehydration
    • WHO oral rehydration solution
      • contains Na, K, and glucose
      • manages cholera and non-cholera diarrheas, ETEC, and rotavirus
    • homemade sugar and salt solutions
      • 1 quart of water
      • 1/2 tsp baking soda
      • 1/2 tsp salt
      • 3 T sugar
      • 1/2 packet unsweetened Kool-Aid
    • homemade cereal-based oral rehydrating solutions
    • other solutions may not be optimal
      • apple juice and clear liquids may cause osmotic diarrhea
      • Gatorade does not have proper concentrations
    • two phases:
      1.) rehydration
      • done over 3-4 hours
give 50-100 mL of ORS/kg
- start with a teaspoon an hour
- increase in seizure as tolerated

2.) maintenance
- can start here for mild illness
- give 1 mL of fluid for every g of output
  - 10 mL of fluid for each loose stool
  - 2 mL for each episode of emesis
- avoid antidiarrheals, antiemetics, and antibiotics as they can cause serious side effects
  - exception: single dose ondansetron has been shown to be beneficial for emesis
- zinc supplementation may be helpful
- back to normal diet ASAP
  - BRAT diet no longer recommended
  - if formula-fed, give regular formulation, don’t dilute (risk of hyponatremia)
  - early refeeding decreases duration, severity, and nutritional consequences of diarrhea

- severe dehydration is a medical emergency!
  - IV fluid bolus
  - change to oral hydration when LOC has normalized

14.11.2 Hyperglycemic Hyperosmolar Syndrome
- A complication of undiagnosed DM2 that is often fatal
- At risk: obese black and Hispanic children
- Presentation:
  - several days of intractable nausea and vomiting, sometimes diarrhea, altered mental status, obesity
  - typical triad of hyperglycemia, hyperosmolality, and mild metabolic acidosis
    - BS usually > 600
- Treatment: graduate rehydration to avoid cerebral edema

14.12 Heart Disease in Childhood

14.12.1 Background
- Incidence of reported congenital heart disease is 8-10 per 1000 live births
- does not include bicuspid aortic valve as the problem does not surface until adulthood
- Adult cardiology rules don’t apply to children under age 3
  - ex. no Starling’s mechanism
- Most defects occur in otherwise healthy, well-developed term infants
- Half require treatment within first year of life, although many are asymptomatic
- Classification of defects:
  - by clinical presentation: acyanotic, cyanotic, or valvular/aortic
  - by physiology: L to R shunts, R to L shunts, other
    - L to R shunts are acyanotic because the oxygenated blood from the L side of the heart is just flowing back through the lungs again
    - R to L shunts are cyanotic because the deoxygenated R sided blood is skipping the pulmonary circulation and instead going directly into systemic circulation

14.12.2 Presentation of Congenital Heart Disease
- Majority of patients will present before age 2
  - serious defects will present within the first 3 months of life
o first day of life: AVMs, tricuspid regurgitation, sepsis, transposition of the great vessels
o first week of life: obstruction, ductal dependent lesion, transposition, tricuspid atresia, total anomalous pulmonary veinous return, tetralogy of Fallot
o weeks 2-4: ventricular septal defects
o weeks 4-8: ventricular septal defects, atrioventricular septal defects, truncus arteriosus
o weeks 8+: left-to-right shunts, myocarditis, anomalous left coronary artery

- Fetal & neonate presentations:
  - fetus in utero with heart defect may do very well and not exhibit symptoms until 24-48 hours after birth
    - due to conversion from fetal circulation to transitional physiology of childhood
  - fetus with lethal heart defects is usually aborted by end of 2nd month of pregnancy
    - this is the time when the heart is completed
  - general symptoms: angina pectoris, dyspnea or tachypnea, syncope, poor feeding, irritability, cyanosis, failure to thrive, edema, ascites, palpitations = when heart doesn’t act correctly, child does not act correctly
  - associated with childhood syndromes: Down’s, Turner’s, fetal DPH syndrome, trisomy 13 or 18, Marfan’s, VATER syndrome, Holt-Oram, Ellis Van Creveld, Edward’s, Noonan’s, Williams’, fetal alcohol syndrome, maternal DM or SLE
  - death in first week of life
    - due to hypoplastic left heart, coarctation of the aorta, congenital aortic stenosis, transposition of the great vessels
  - death after first week of life due to valvular defects
  - Childhood presentation of defects occurs in one of three ways:
    - cyanosis:
      - 95% will present before 3 mo
      - detectable on PE only after sats are < 85%
      - investigation:
        - differential: anemia, VQ mismatch, (GBS infection, RDS, meconium aspiration, airway obstruction, alveolar hyperventilation), R-to-L intracardiac or intrapulmonary shunt, abnormal Hb, shock, sepsis
        - hyperoxia test: a test that is performed to determine whether the patient’s cyanosis is due to lung disease or a problem with blood circulation
          - measure ABG on infant while breathing room air, then remeasure after infant has breathed 100% O2 for 10 min
          - if the cause of the cyanosis is due to poor oxygen saturation by the lungs, the 100% O2 will augment the lungs’ ability to saturate the blood with oxygen, and the partial pressure of oxygen in the arterial blood will rise
          - if the lungs are healthy and already fully saturating the blood that is delivered to them, then supplemental oxygen will have no effect, and the partial pressure of oxygen will usually remain below 100mmHg
            - in this case, the cyanosis is most likely due to blood that moves from the systemic veins to the systemic arteries via a right-to-left shunt without ever going through the lungs
      - treatment:
        - a medical emergency
    - CHF
      - a result of volume or pressure overload, change in inotropic state, or a chronotropic state as a result of the heart defect
      - usually present before 6 months
      - presentation is different from adults: tachypnea, loss of periodic breathing, sustained tachycardia, diaphoresis with feedings or increased feeding time, hepatomegaly, failure to thrive
• may have gallop rhythm or murmur
• may be precipitated by URI
• usually no rales or peripheral edema until end stage

• murmur or abnormal PE
  o the most common reason for cardiology referral
  o murmurs are hard to hear correctly before 6 months
  o functional murmurs are common in the first 12-18 months of life
  ▪ distinguish from pathological: no associated symptoms, normal CXR and EKGs, soft and change intensity with position, associated with signs of adequate cardiac output, associated with normal S1 and S2
  ▪ usually benign:
    • classic vibratory murmur: heard sometimes in infancy and in 3-6 year olds
    • b.) pulmonary ejection murmur: heard at 8-14 years of age
    • pulmonary flow murmur: heard in preemies and newborns, disappearing by 1st birthday
    • venous hum: heard in 3-6 year olds
    • carotid bruit: heart at any age

14.12.3 Investigation of Suspected Heart Defect

• Most cases are diagnosed prenatally by US screening @ 16-20 weeks
• In the neonate:
  • symptoms will likely appear within 24 hours
  • major culprits can be ruled out with O2 sats and BPs on all 4 extremities
    o O2 sats < 96% are always abnormal!
  • do a thorough PE including auscultation over the anterior fontanelle and liver
    o may not hear a murmur even if there is a defect
  • best initial screens are EKG and ABGs
• CXR
• Functional or anatomic studies:
  • echo: main diagnostic tool for congenital heart disease, identifies most defects
    o frequently overused and costs ~$3000
    o every child who has a heart murmur does not need a f/u echo:
  • MRI: similar utility to echo, better assessment of end-diastolic volumes
    o currently not very useful in kids
    o not the best for defining anatomy
  • cardiac cath: not routine, but commonly performed
14.12.4 Fetal Heart Circulation

1.) Blood carried in from placenta via umbilical vein □ liver □ bypass most of the liver via ductus venosus into the IVC □ right atrium
   - closes at birth with loss of placental circulation
2.) Blood in right atrium:
   - can bypass right ventricle and enter left atrium via foramen ovale shunt (the “dog door”)
     - foramen ovale kept open by increased right atrial pressures secondary to increased pressure in lungs from being fluid filled
       - at birth, ↑ pulmonary blood flow causes foramen ovale to close
   - or can enter right ventricle □ pulmonary artery
     - bypasses collapsed, fluid-filled lungs due to pressure resistance and instead travels via the ductus arteriosus to empty into aortic arch
       - problem if ductus arteriosus remains patent after birth!
         - normally closes due to ↑ oxygenation, ↓ prostaglandins, and ↓ pulmonary vascular resistance
3.) Blood travels from aorta □ abdominal aorta □ iliac artery □ back out to placenta via umbilical arteries = 2 right-to-left shunts: foramen ovale (RA to LA), ductus arteriosus (pulmonary artery to aorta)

14.12.5 Transition of Circulation

- Takes 4 months before pulmonary vascular resistance reaches adult levels
  - this is why some defects don’t emerge until several days or weeks after birth

14.12.6 Left to Right Shunts

I.) Atrial septal defects: can occur in the atrial septum, sinus venosus, ostium secundum, or ostium primum
  - more common in females
  - presentation: usually asymptomatic unless there are other defects
    - R heart failure, pulmonary edema, increased pulmonary vasculature
    - may also have mitral valve prolapse
    - wide S2 splitting, may have diastolic rumble
  - investigation:
    - EKG showing RVH
    - echo
  - treatment:
    - no endocarditis prophylaxis and no exercise restriction
    - surgical repair at age 2-3
      - small defects in boys don’t need closure if RV size is normal
II.) Ventricular septal defect: the most commonly diagnosed congenital cardiac defect
III.) Atrioventricular septal defect: entire septum between atria and ventricle is disrupted
- endocardial cushion defect
- associated with Down’s syndrome, asplenia, and polysplenia
- may also have tetralogy of Fallot or patent ductus arteriosus
- presentation: same as VSD
  - CHF by 2 months
  - R sided congestion ▯ hepatomegaly
- investigation: EKG, diagnostic echo
- treatment:
  - endocarditis prophylaxis
- surgical repair before 3 months

IV.) Patent ductus arteriosus: persistent shunt between aorta and pulmonary artery
- presentation: harsh continuous machine murmur
- treatment: meds to make ductal tissue regress, surgical repair

14.12.7 Presentation: pulmonary congestion
Eisenmenger’s syndrome (phenomenon occurring with longstanding L to R shunts where increasing peripheral vascular resistance from pulmonary congestion will result in shunt reversal to a R to L shunt)

14.12.8 Right to Left Shunts
- very unusual, as L sided pressures are usually much higher than the R side = most often occurs with transposition of the great arteries
I.) Transposition of the great vessels: aorta and pulmonary trunk switched so that deoxygenated blood gets pumped through the aorta to systemic circulation while the oxygenated blood gets pumped through the pulmonary artery back through the lungs
II.) **Truncus arteriosus**: when aorta and pulmonary trunk get merged into one single trunk to supply both systemic and pulmonary circulation with mixed blood
- presentation: cyanosis, systolic thrill, prominent apical pulse
- treatment: must be repaired before age 2, 10% operative mortality

III.) **Total anomalous pulmonary venous drainage**: all four pulmonary veins are malpositioned and drain into the RA, SVC, or IVC
- PFO or atrial septal defect must also be present for life to continue
- must be repaired before 1st birthday, or risk 80-90% mortality

IV.) **Tricuspid atresia**: absence of tricuspid valve → no connection of RA to RV
- ASD and VSD (or patent ductus arteriosus) must also be concomitantly
- keep infant alive after birth by injecting area with prostaglandin to keep ductus arteriosus open
V. **Tetralogy of Fallot**: pulmonary stenosis, overriding aorta, RV hypertrophy, and ventricular septal defect

- most common cyanotic heart defect
- results in decreased pulmonary blood flow

**Presentation:**
- progressive disease
- infant may look health and pink at birth
- cyanotic “tet spells” where child turns blue, squats to valsala and increase blood flow, harsh systolic precordial murmur
- may also have right aortic arch, Down’s, or DiGeorge syndrome
- systolic ejection murmur

**Treatment:** correction in early infancy

**Complications:** brain abscess, stroke, CNS injury, hypoxic spells

14.12.9 **Obstructing Lesions**

I. **Pulmonary stenosis**

- most common obstructive defect
- usually a valvular defect, but can be above or below

**Presentation:** usually asymptomatic
- exertional dyspnea if severe
- harsh systolic ejection murmur

**Investigation:** echo

**Treatment:**
- endocarditis prophylaxis
- cardiac cath with balloon valvuloplasty

II. **Aortic stenosis**

- valvular or above or below

**Presentation:**
- neonates with severe stenosis are critically ill
- children with mild stenosis may be asymptomatic
- systolic ejection murmur
- sudden death

**Investigation:**
- EKG may show LVH
- echo

**Treatment:**
- endocarditis prophylaxis
- cardiac cath with balloon valvuloplasty

III. **Aortic coarctation**: narrowing of aorta distal to L subclavian artery

- more common in males

**Presentation:**
- poor perfusion to LEs • diminished pulses, cyanosis, cardiogenic shock present for life to be sustained
  - associated with Turner’s syndrome, Shone’s syndrome, and bicuspid aortic valve

**Investigation:**
- measure BP on all 4 extremities
- echo

**Treatment:**
- reopen ductus arteriosus within 4 days of birth with prostaglandins
- surgical resection with aortic reconstruction

**Complications:** can recur
IV.) Vascular rings

V.) **Hypoplastic left heart syndrome**: results in severely underdeveloped left ventricle
- results in poor-performing ventricle
- treatment: surgical repair is done in 3 stages for a final result where the RV pumps to lungs and body all at once
- prognosis: high operative mortality, CHF by 30s, heart transplant needed soon after

14.12.10 **Chest Pain in Childhood**

- **Background**: a common childhood complaint
  - rarely comes from the heart
    - respiratory and musculoskeletal etiologies are most common
    - may be heart if associated with exercise, preceded by palpitations, or child has known heart disease
- **Causes**:
  - idiopathic: most common in adolescent girls
    - presentation: precordial catch, occurs at rest and exercise, sharp, stabbing pain of short duration, varies from sporadic to several times a day
    - investigation: normal EKG
    - treatment: gets better with sympathy, time, and reassurance
  - musculoskeletal:
    - presentation: sharp pain, related to trauma and movement, well localized, reproducible by placing pressure on affected area, usually acute, subsides over several days
  - cardiac: occurs with arrhythmia, rheumatic heart disease, congenital heart disease, Kawasaki disease, hypertrophic cardiomyopathy, aortic valve disease, pericarditis
  - respiratory: occurs with pleurisy, exercise-induced bronchospasm, reflux, ulcers

14.13 **Pediatric Pharmacology**

14.13.1 **Useful Resources**
- Lexi-Comp Pediatric Dosage Handbook
- Harriet Lane Handbook
- AAP Redbook for Pediatric Infectious Diseases
- Neofax for preterm neonatal dosing

14.13.2 **Pediatric Pharmacokinetics**

A.) Absorption
- oral absorption varies based on patient factors: surface area for absorption, gastric and duodenal pH, gastric emptying time, bacterial colonization of GI tract, underlying disease, drug interactions
- neonatal pH is very basic, especially if born before 32 weeks
  - ↓abs of acid-requiring meds, and ↑abs of base-requiring meds — why we don’t give a lot of oral meds in neonates
- prolonged neonatal gastric emptying time
  - delayed abs in intestine and increased abs in stomach
- diseases affecting oral absorption:
  - GERD delays gastric emptying time
  - congenital heart disease
  - short bowel syndrome
  - shock
  - hypo- or hyperthyroidism prolongs intestinal transit time
• Crohn’s disease: need to give meds IV during flares
• IM absorption varies based on blood flow to injection site and drug solubility at physiological pH
  • typically avoided in neonates due to lack of muscle mass unless it is a vaccination
• percutaneous absorption varies based on thickness of skin or extent of skin hydration
• rectal absorption

B.) Distribution
• differences in kids:
  • increased total body water volume
    o need to give higher doses of gentamycin, amikacin, tobramycin
  • reduced albumin □ greater free drug available □ need to give lower dose
    o need to check free levels of drugs like phenytoin vs total levels alone

C.) Metabolism
• hepatic metabolism
  • rate difficult to predict if premature or newborn □ need to monitor drug levels
  • some meds can cause hyperbilirubinemia due to their method of metabolism in the liver
    o ceftriaxone should not be given in infants < 30 d as they can displace bilirubin from binding sites and cause hyperbili
    o Bactrim is contraindicated in infants < 2 mo as it is metabolized in the same method as bilirubin and can lead to hyperbili

D.) Elimination
• glomerular filtration
  • affected by renal blood flow and area of glomerular membrane
    o decreased in preemies
    o does not reach adult levels until age 3, and is constantly changing up to this point - need to extend interval in which drugs are given
  • hard to assess creatinine clearance as there are not good formulas for peds and creatinine is a measure of muscle mass, which is decreased in all infants
    o instead, need to assess using 24 hour urine or measured urine output
      • especially with dosing certain meds like carboplatin and foscarnet
    o formulas estimating CrCl are especially not to be used in kids when:
      ▪ age is < 1 year
      ▪ severe muscle wasting
      ▪ severe starvation
      ▪ rapidly changing renal function
      ▪ receiving chemotherapy

14.13.3 Analgesic Dosing in Pediatrics
• Acetaminophen
  • the most widely used analgesic and antipyretic
  • oral, rectal, or IV
    o rectal dose is higher than oral

• NSAIDs
  • clearance and volume of distribution greater than adults
  • similar elimination half-life
  • Once a child reaches 3-40 kilos, the dosing tends to enter the adult category
    • so remember to never go above max adult dose
  • Alternating acetaminophen and ibuprofen?
    • not recommended outpatient in order to avoid confusion
    • occasionally done inpatient
14.13.4 Route of Administration
- Children can usually swallow whole tablets around 8 years
- Chewable tablets are a good option
- Liquids can be flavored at the pharmacy
- Write for liquid doses in mL, don’t convert to tsp to avoid errors in measurement
  - explain where to get calibrated syringes

14.13.5 OTC Cough and Cold Medications
- Not to be used in children under 2
- Use appropriate calibrated measuring devise
- Only treat symptoms

14.14 Pediatric Hematology
14.14.1 Background
- Abnormalities in a peripheral blood smear:
  - unusual size or variety of RBCs
  - unusual shapes or variety of RBCs
  - monotony in WBCs
  - cells that don’t belong in the peripheral blood: blasts, giant platelets, nucleated RBCs
- RBC lifespan is 120 days
  - released from bone marrow as a reticulocyte
- Each RBC contains hemoglobin to transport oxygen and CO2
  - hemoglobin types:
    - \( \text{HbA} \): normal majority adult; tetramer of \( \alpha_2\beta_2 \) chains
      - makes up 20% of Hb in a newborn
    - \( \text{HbA}_2 \): minority (1-2%) of adult Hb, tetramer of \( \alpha_2\delta_2 \) chains
    - \( \text{HbF} \): fetal Hb, majority of Hb until age 1, then HbA takes over
      - normally makes up 80% of newborn Hb
- Mean corpuscular volume is larger at birth and gradually increases during childhood
  - physiologic nadir at ~ 2 months is often mistaken for anemia
  - lower limit of normal = 70 + child’s age, up to 76

14.14.2 Anemia
- Caused by decreased RBC production or increased RBC destruction or loss
  - newborns: blood loss, hemolytic disease of the newborn
  - early infancy: pure red cell aplasia, physiologic anemia
  - 6 mo-12 years: nutritional anemias, acute inflammation, bone marrow infiltration
  - adolescent anemia: iron deficiency
- Presentation:
  - vary with how quickly Hb has dropped
  - physiologic disturbances once Hb is < 7-8
  - decreased oxygen transport □ fatigue, dyspnea, syncope □ decreased blood volume □ pallor, postural hypotension □ increased cardiac output □ CHF
- Ask about FH, diet, symptoms
- Investigation:
  - Hb & Hct, MCV, WBCs, platelets, reticulocyte count, peripheral smear
  - UA
  - direct Coomb’s test
  - stool guaiac
14.14.3 Microcytic, Hypochromic Anemias

- MCV < 80 with increased central pallor

A.) Thalassemias: inherited defective production of globin chains; can also be interpreted as an intrinsic hemolytic anemia (explains why retics are high when other microcytic anemias have low retics)

- **Alpha thalassemia:** gene deletion decrease or absence in α globins
  - mostly in southeast Asian, Mediterranean, or African descent
  - severity of disease depends on how many of the four α genes are deleted
    - Bart's thalassemia (hydrops fetalis): all 4 copies deleted, incompatible with life
    - **HBH disease:** most severe viable form with 3 copies deleted
      - unstable Hb and chronic microcytic hemolytic anemia pallor, splenomegaly
      - investigation: abnormal peripheral smear, elevated retic count due to chronic hemolysis?
      - treatments: splenectomy, folic acid, avoidance of Fe, oxidative drugs to avoid hemolysis
    - **A-thal trait:** mildest form with nearly normal erythropoiesis, some mild microcytic anemia normal life expectancy & normal clinical presentation under non-stressful conditions
      - investigation: a diagnosis of exclusion, Hb electrophoresis normal

- **Beta thalassemia:** gene mutation decrease (B⁺) or absence (B⁰) in β globins
  - mostly in Italians, Greeks, Asians, Africans
  - body can compensate by increasing % of HbA₂ and HbF
  - excess iron accumulates due to enhanced iron absorption produced by thalassemia, repeated blood transfusions or both
  - all forms have microcytosis with varying degrees of anemia
    - **thalassemia major (Cooley's anemia):** homozygous B⁰, severe chronic hemolysis jaundice, hepatosplenomegaly, anemia, transfusion dependent, Fe overload, bony abnormalities from hemolysis within BM, chipmunk face, growth retardation
      - investigation: Hb electrophoresis is predominant HbF
      - treatments:
        - blood transfusions every 2-4 weeks are mainstay of therapy
        - cure with allogeneic BMT
      - prognosis otherwise is life expectancy < 20 years
    - **thalassemia minor:** heterozygous, mild anemia, rare transfusions
      - investigation: Hb is mostly normal, with a bump in HbA₂ or HbF

B.) Iron deficiency anemia: not enough Fe to make Hb due to decreased intake (diet), decreased absorption (gastric, Celiac disease), increased loss (bleeds, HD, blood donation, malignancy, chronic aspirin use), or increased needs (growth spurts)

- the leading cause of anemia worldwide
- more common in toddlers and adolescents during periods of rapid growth
- normally iron is stored in WBCs, intracellular ferritin, and intracellular hemosiderin in macrophages
- clinical presentation: fatigue, DOE, tachycardia, cheilosis (cracked corners of lips), spoon-shaped nails, dysphagia d/t webbing of esophagus, pica, pallor, irritability
- investigation:
  - labs: ↓ Hb, MCV, and ferritin, ↑ TIBC (high when lacking iron)
  - staging based on length of deficiency:
    - **iron store depletion anemia:** low iron storage in ferritin but normal iron levels
    - **iron deficient erythropoiesis:** low ferritin, no marrow ferritin, body iron levels changed, mild normocytic anemia
    - **iron deficient anemia:** low ferritin, abnormal iron indices, microcytic anemia, abnormal peripheral smear with anisocytosis, maybe increased platelets
• treatment:
  • therapeutic trial of oral iron supplements
  • consider parenteral iron by hematologist if oral therapy is not tolerated or rapid enough
  • limit milk: has a direct toxic effect on intestinal mucosa of infants and can cause microscopic blood loss, has low iron bioavailability
  • RBC transfusion for severe anemia with cardiac decompensation
  • follow-up: check CBC in 3-4 weeks, check ferritin in 8 weeks, continue PO supplement 3-6 months post hemoglobin recovery
  • failure to recover after supplementation is often due to poor compliance

C.) Lead poisoning anemia: enzyme disorder in which the body has enough Fe but can’t make it into Hb because lead inhibits enzymes necessary for production
• clinical presentation: only anemia symptoms (fatigue, pallor)
• investigation:
  • mild-moderate anemia, low MCV, high serum Fe
  • peripheral smear shows basophilic stippling of RBCs
• treatment: chelation using Succimer

14.14.4 Macrocytic Anemias
• MCV >100
• Causes: Down’s syndrome, folic acid deficiency, vitamin B12 deficiency
  • can also occur in a normal newborn
• Investigation:
  • peripheral blood smear
  • B12 and folate levels
  • Schilling test for B12 deficiency
  • bone marrow biopsy to rule out myelodysplastic syndrome

14.14.5 Normocytic Anemias
• Causes: chronic inflammatory disease, congenital pure red cell aplasia, transient erythroblastopenia of childhood (acquired after 6 mo of age)
  • aplastic anemia: from bone marrow failure due to injury or suppression of HSC
    • causes: idiopathic, phenytoin, sulfas, chemo, radiation, chemicals (benzene, solvents, insecticides), viruses, pregnancy
    • can be hereditary as Fanconi’s anemia (diagnosed in childhood)
    • presentation: abrupt onset, fatigue, weakness, dyspnea, excess bleeding & bruising, petechiae, purpura, pallor, infections
  • investigation: pancytopenia, severe anemia, decreased retics, normal morphology, reduced cells in BM with replacement with fat
  • treatment based on severity of disease
    • no treatment if mild
    • if severe, BMT or immunosuppression
  • prognosis: untreated is rapidly fatal
  • Low reticulocyte response

14.14.6 Hemolytic Anemias
• RBCs destroyed sporadically or continually
• Classified based on whether RBC destruction is a result of intrinsic abnormalities of the RBC or extrinsic factors
• intrinsic causes:
• **hereditary spherocytosis**: intrinsic inherited defective spectrins in red cell membrane □ weak, deformed, spherical RBCs (spherocytes) prone to rupture in blood vessels or spleen

• **hereditary elliptocytosis**:

• **glucose-6-phosphate dehydrogenase deficiency**: results in oxidation-prone RBCs □

• intracellular precipitation of oxidized Hb into **Heinz bodies** □ spleen removal of Heinz bodies □ bite cells & intrinsic hemolysis
  - definitive test is G6PD assay

• **sickle cell disorders**: inherited mutation in Hb □ HbS □ chronic intrinsic hemolysis
  - genotypes SS, SC, SB, SA (trait)
    - SC □ smear will show microcytosis, hyperchromia, and target cells
    - SF □ smear will show sickled cells and polychromasia
  - presentation: lifelong anemia with acute and chronic tissue damage
    - acute pain crises, stroke, chest syndrome, anemic episodes due to splenic sequestration, aplastic crises
    - chronic manifestations in the CNS, CV, respiratory, hepatobiliary, ocular, skeletal, and genitourinary systems, problems with nutrition, growth, and development
  - treatment:
    - increased susceptibility to encapsulated organisms due to functional asplenia
    - penicillin prophylaxis until age 5, Pneumovax needs to be given
    - indications for transfusions: pre-anesthesia prep, stroke, severe acute chest syndrome, aplastic crisis with severe anemia, splenic sequestration crisis, elevated transcranial Doppler velocity
    - hydroxyurea to increase fetal Hb and decrease sickle cell events

• extrinsic/acquired causes: TTP, HUS, giant hemangioma, artificial heart valves, sepsis, DIC, autoimmune hemolytic anemia, hemolytic disease of the newborn

• results in a high reticulocyte response!

### 14.14.7 Platelet Disorders

• Background:
  - thrombocytes are cellular fragments from megakaryocytes
    - appear as the largest cell in the bone marrow when viewed in low power
    - no nucleus
    - essential for clotting
    - lifespan of 5-9 days before removal by the spleen and liver

• Disorders:
  - thrombocytopenia
  - **immune thrombocytopenic purpura (ITP)**: caused by antibody binding platelet membrane
    - common in children 1-4 weeks following a viral infection
    - presentation: abrupt onset of petechiae, epistaxis
    - investigation: labs show severe thrombocytopenia
    - treatment: most self-resolve within 6 months
  - **neonatal alloimmune thrombocytopenic purpura (NATP)**: occurs as a result of sensitization of mother to antigens present in fetal platelets □ attack of fetal platelets
    - fetus at risk for ICH in utero
    - investigation: percutaneous umbilical blood sampling to measure fetal platelet count
    - treatment: c-section with possible steroids after birth for infant
  - **thrombotic thrombocytopenic purpura (TTP)**: a congenital or acquired deficiency of the enzyme needed to cleave vWF
    - presentation: jaundice or pallor, CNS symptoms, renal disease
    - investigation: labs showing severe thrombocytopenia, schistocytes in circulation
  - treatment: plasma exchange to remove antibody causing problems and replace missing enzyme e.) **thrombocytopenia with absent radii syndrome (TAR)**: congenital thrombocytopenia associated with orthopedic abnormalities
14.14.8 Clotting Factor Disorders

A.) Von Willebrand disease: inherited deficiency, dysfunction, or complete absence of vWF
- presentation: epistaxis, menorrhagia, bleeding after tooth extraction or shedding, ecchymoses, petechiae, gingival bleeding, postop bleeding, GIB, hematuria, joint bleeding, intramuscular or submucous bleeding
- investigation: vWF antigen, vWF activity/ristocetin cofactor, PTT
- treatment: desmopressin, aminocaproic acid
- vWF concentrate in severe episodes

B.) Hemophilia A: factor 8 deficiency
- presentation: varies with degree of deficiency
  - mild may go unnoticed until severe trauma
  - may have target joints that frequently bleed
- investigation: prolonged aPTT should correct to normal when mixed with normal plasma, specific factor assays
- treatment: early and appropriate replacement therapy with factor 8, home managed bleeding episodes

C.) Hemophilia B (Christmas disease): factor 9 deficiency
- presentation: clinical findings indistinguishable from hemophilia B
- investigation: prolonged aPTT, need specific factor assays
- treatment: replacement therapy, manage bleeding episodes at home

D.) Disseminated intravascular coagulation (DIC): usually occurs when shock causes widespread activation of the coagulation cascade
- investigation: ↓ platelets and fibrinogen, ↑ PT and aPTT, ↑ d-dimer
- treatment: treat underlying disorder
  - supportive: correct hypoxia, correct acidosis, correct poor perfusion, replace depleted blood products, maybe heparin

E.) Pediatric thrombosis:
- causes:
  - hereditary predisposition to clotting: deficiency of anticoagulant protein, abnormality of procoagulant protein, or damage to endothelial cells
  - indwelling catheters, trauma, surgery, infection
- investigation: venous Doppler US or venogram (gold standard)
- treatment: heparin

14.15 Pediatric Oncology

14.15.1 Background
- Causes are largely unknown
- Most common cancers involve WBCs, brain, bone, lymphatics, muscles, kidneys, and nervous system
  - most commonly leukemia, lymphoma, brain and CNS tumors, and sarcomas
- Average age of child diagnosed with cancer is under 6
- Overall survival rate for pediatric cancers is 80%
- Prevention:
  - generally unknown, as these cancers are usually not secondary to modifiable risk factors
• exceptions: screening children known to genetically be at risk, hep B vaccination to lower rates of HCC, HPV vaccination

• Presentation:
  • children often present at a more advanced stage at time of diagnosis than adults do
  • nonspecific manifestations: fever, fatigue, weight loss, night sweats, anorexia, malaise, limp, lymphadenopathy, mass or swelling, pain, bruising, petechiae, bleeding, headache, vomiting, cough, dyspnea, papilledema
  • warning signs: unexplained weight loss, headaches with vomiting in the morning, increased swelling or persistent pain in bones or joints, lump or mass in abdomen or elsewhere, whitening of pupil or sudden vision change, recurrent fever not caused by infection, excessive bruising or bleeding, noticeable pallor, prolonged fatigue

• PE should include review of growth, vitals, general appearance, skin, lymph nodes, abdomen, neuro eval, funduscopic exam, any areas of masses

• Investigation:
  • differential: infection
  • CBC with differential and smear is the best screening test for most pediatric malignancies
  • LDH and uric acid are elevated in fast-growing tumors
  • electrolytes
  • renal and hepatic panels
  • CXR to evaluate cervical adenopathy or mediastinal masses
  • abdominal US or CT to evaluate masses
  • head CT or MRI to evaluate headache, vomiting, neurologic symptoms
  • plain films of bone for suspicious mass or limping
  • need a tissue diagnosis from biopsy or aspirate
  • PET scan may help stage a cancer once already diagnosed

• Treatment:
  • goal is to cure all patients with minimal toxicity
  • localized or systemic
  • surgical resection indicated for solid tumors
  • radiation
    • not all tumors are radiosensitive
  • chemo is used in almost all pediatric cancers
    • many pediatric tumors have a high risk for micromets
    • exceptions: low-grade neuroblastoma or other low-grade CNS tumors
  • supportive: PCP prophylaxis, blood products, nutritional support, intensive care, psychosocial support

• Prognosis:
  • many children who survive experience infertility, heart failure, or secondary cancers

14.15.2 Acute Leukemia

• accounts for 30-40% of childhood cancers

A.) Acute lymphoblastic leukemia (ALL): 80% of leukemia cases
  • arises from B or T cell lineage
  • incidence peaks @ 2-5 years and drops @ 8-10 years
  • more common in white children and boys
  • presentation: fever, pallor, petechiae, ecchymoses, lethargy, malaise, anorexia, bone or joint pain
  • investigation:
    • differential: infection, aplastic anemia, juvenile RA, other malignancy
    • CBC with differential showing 1-2 cytopenias
    • confirmatory: smear or bone marrow aspirate showing blasts
    • need urgent bone marrow biopsy
    • LP to eval for CNS involvement
• treatment:
  • 3-4 agent induction therapy
  • radiation if CNS disease is present
  • continuous therapy for 2-3 years
    o longer for boys as leukemia cells can hide in the testicles
  • prognosis: overall cure rate 80%
B.) Acute myeloid leukemia (AML): 15-19% of leukemia cases
• most common in first 2 years of life, nadirs at 9 years, increases again in adolescence
• more common in Hispanic and black children
• presentation is similar to ALL
• investigation is similar to ALL
• treatment:
  • myelosuppressive chemotherapy
  • matched stem cell transplant after first remission
• prognosis: cure rate approaches 50%
C.) Chronic myeloid leukemia (CML): 1% of leukemia cases

14.15.3 Lymphoma
• 3rd most common malignancy in childhood
• unknown cause: EBV may play a role
A.) Hodgkin lymphoma: a group of cancers characterized by the orderly spread of disease from one lymph node group to another and by the development of systemic symptoms with advanced disease
• peaks in adolescence and young adulthood, and in ages 50+
• presentation: painless, firm lymphadenopathy (often supraclavicular and cervical areas), mediastinal mass causing cough or SOB, fever, weight loss
• investigation:
  • differential: leukemia, rhabdomyosarcoma, nasal pharyngeal cancers, germ cell tumors, thymomas, infection like cat scratch fever
  • tissue biopsy or pleural or peritoneal fluid eval showing Reed-Sternberg cells
• treatment:
  • chemo
  • low-dose radiation
• prognosis: overall survival 90% but there are 3 separate risk groups
B.) Non-Hodgkin lymphoma: a diverse group of blood cancers that include any kind of lymphoma except Hodgkin lymphomas
• associated with congenital or acquired immunodeficiency
• incidence increases with age
• more common in white and male patients
• presentation: lymphadenopathy, may have abdominal pain
• investigation: tissue biopsy
• treatment: systemic chemo
• prognosis: 70-90% survival rate

14.15.4 Neuroblastoma
• Background:
  • derived from cells forming the adrenal medulla and sympathetic nervous system
  • most common extracranial solid tumor of childhood and most common malignancy in infancy
  • average age at diagnosis is 20 months
• Presentation: abdominal pain or mass, periorbital bruising from mets
14.15.5 Wilms Tumor

- **Background:**
  - Arises from precursor cells of normal kidney
  - Cause unknown
- **Presentation:** Abdominal mass, abdominal pain, fever, hypertension, hematuria
- **Investigation:**
  - Differential: Hydronephrosis, polycystic kidney disease, benign renal tumor, lymphoma
  - Abdominal US or CT, CBC, liver and kidney panels, tissue analysis
- **Treatment:**
  - Nephrectomy
  - Chemo
- **Prognosis:** 85% cure rate if localized

14.15.6 Bone Tumors

A.) **Osteosarcoma:** Arises from primitive bone-forming mesenchymal stem cells

- Most common malignant bone tumor
- Peak incidence in 12-25 year olds
- Most in the metaphyses
- Presentation: Pain, palpable mass or swelling
- Investigation:
  - Differential: Trauma, infection
  - Radiographs showing lytic lesions with calcification
  - Needle biopsy showing “osteoid substance”
- Treatment:
  - Pre and postop chemo
  - Limb salvage or amputation
- Prognosis similar to Ewing’s

B.) **Ewing’s sarcoma:** May arise from soft tissue or any bone

- Peaks @ 10-20 years
- Presentation: Local pain and swelling, fever, weight loss
- Investigation:
  - Differential: Benign lesion, infection, orthopedic problem
  - MRI of primary lesion
  - Tissue biopsy
  - Eval for mets
- Treatment:
  - Preop chemo
  - Limb salvage or amputation
  - More chemo
- radiation
- prognosis: cure rate for local disease is 60-70%, 30-35% if lung mets

14.15.7 **Rhabdomyosarcoma**

- Background:
  - derived from mesenchymal cells following skeletal muscle lineage
  - most common soft tissue sarcoma in kids
  - peak incidence in ages 2-6
  - presentation: head and neck symptoms, urethral or vaginal mass, trunk or extremity mass, pain from mass effect
- investigation:
  - differential: neuroblastoma, Wilms, infection, benign tumor
  - tissue diagnosis
  - check for mets
- treatment: chemo, surgery, maybe radiation
- good prognosis for localized disease

14.15.8 **Retinoblastoma**

- Background:
  - tumor of embryonic neural retina
  - most cases before age 4
- Presentation: depends on size and position of tumor
  - leukocoria is most common
    - clinically indistinct from other causes of leukocoria
  - strabismus
  - proptosis
- Investigation:
  - dilated eye exam under anesthesia to look for chalky white-gray retinal mass with a soft, friable consistency
  - head MRI
- Treatment: enucleation, radiation, cryotherapy, laser ablation, chemo
- Prognosis: survival rate of 93%, cured if in remission for 5 years

14.16 **Common Pediatric Musculoskeletal Disorders**

14.16.1 **Background**

- Mechanisms of pediatric orthopedic problems
  - congenital: malformation, disruption, deformation, dysplasia
  - acquired: infection, inflammation, trauma, tumor
    - ends of long bones much more prone to trauma and infection

14.16.2 **Pediatric Fractures**

- Fracture not seen in adults:
  - bowing fractures aren’t seen in skeletally mature patients = primarily pediatric fracture
    - will be healed by periosteum, doesn’t need surgical intervention
  - buckle (greenstick) fractures
- Growth plate fractures
  - peak incidence in 11-12 year old females and 13-14 year old males
  - Salter-Harris classification system
- Treatment:
  - most commonly closed reduction
  - kids heal faster than adults due to more active periosteum and higher percent cartilage
  - a small minority will need internal fixation or ORIF

14.16.3 Upper Extremities

A.) Brachial plexus injury
- investigation:
  - if unilateral complaint that resolves < 15 min, not huge concern for injury
  - if bilateral and persisting > 15, concern is for fx or other injury

B.) Supracondylar fracture
- FOOSH
- classification: Gartland system
- investigation:
  - concern for median or ulnar nerve injury
  - x-ray showing fat pad sign or sail sign

C.) Radial head subluxation (nursemaid’s elbow)
- presentation: crying, screaming, elbow pain, holding arm flexed against belly, refusal to use arm
- treatment: reduce with supination and flexion of the arm
- prognosis: high rate of recurrence, especially if under 2
  - rarely needs surgery to tighten annular ligament

D.) Medial epicondylitis (Little Leaguer’s elbow)
- a result of repetitive tension force at the radial aspect of the elbow and compression force at the lateral aspect
- investigation:
  - x-ray findings vary from normal, to apophyseal avulsion, osteochondritis dessicans at the capitellum or radial head

E.) Scaphoid fracture
- FOOSH
- treatment: immobilize in a thumb spica

F.) Distal radial fracture
- Colles and Smith

G.) Ganglion cysts

H.) Trigger thumb

I.) Trigger finger
- from thickening of flexor tendon catches in bent position under pulley
- may need surgical intervention

14.16.4 Spine

A.) Kyphosis
- causes:
  - congenital: result of intrauterine growth restriction
    - requires early surgical intervention
  - postural

B.) Scheuermann’s
Pediatric Quick Notes

- usually occurs in teens
- most common thoracic kyphosis
- can only differentiate from postural by x-ray
- look for irregular, wedge-shaped discs

C.) Spondylolysis and spondylolisthesis
- **spondylolysis**: stress fracture of the pars interarticularis
  - most commonly in L5
  - seen in gymnasts, football, weight lifting
  - presentation: pain is adjacent to midline and is aggravated with extension and rotation, or may be asymptomatic
  - investigation: x-ray showing "scotty dog with collar"
  - treatment: modification of activities, core strength
- **spondylolisthesis**: displacement of a vertebra anteriorly or posteriorly
  - presentation: usually worse with standing or extension, may feel step-offs
  - investigation: x-ray showing slip
    - grade I-V depending on degree of displacement
  - treatment:
    - if asymptomatic ⏯ no restrictions, core exercises
    - if symptomatic ⏯ same but with brace
    - progressive with deficits ⏯ surgery

D.) Scoliosis
- females more likely to progress
- causes:
  - idiopathic: includes juvenile, adolescent, and infantile scoliosis
  - congenital
- presentation:
  - right is most common
  - left is less common and needs further workup
- treatment:
  - monitor if < 20 degrees
  - bracing for 25-45 degrees
  - surgery for > 45 degrees

14.16.5 Lower Extremities

A.) Toddler’s fracture
- oblique fx of distal tibia
- typically in 1-3 year olds
- presentation: may or may not be painful, limp
- investigation:
  - unusual in that there is no concurrent fibular fx
- treatment: immobilization

B.) Limping
- always needs a workup!
- investigation:
  - differential: antalgic gait, Trendelenberg gait, waddling gait, toe walking
  - toe walking after age 3 needs further neuro workup

C.) Transient monoarticular synovitis
- could be viral or hypersensitivity
- presentation:
  - acute onset of pain at the anterior thigh, knee, or groin/hip
• afebrile
• limp
• investigation:
  • differential: septic arthritis, osteomyelitis must be excluded
  • normal WBCs and ESR
  • normal hip films
  • may see small joint effusion on US
  • bone scan

D.) Legg-Calve-Perthes disease
• avascular necrosis of the femoral head
• presentation: loss of internal and external rotation, gradual pain in groin & anterior thigh that is worse with movement
• investigation:
  • x-ray showing mottled head of femur
• treatment:
  • PT
  • cast in internal rotation and abduction to promote reossification
  • may need surgical repair

E.) Slipped capital femoral epiphysis
• femoral head displaced from neck through the physis
• cause is usually idiopathic
• at risk: obese, hypogonadic adolescent boys
• presentation:
  • 20% of cases presenting will be bilateral, and 40% of unilateral cases will progress to bilateral
  • limp, affected leg turns out and appears shorter, loss of flexion, internal rotation, and abduction
• treatment:
  • an orthopedic emergency
  • requires surgical repair

F.) In-toeing
• causes:
  • metatarsus adductus
  • tibial torsion: internal twisting of the tibia
    • prevent by avoiding belly sleeping and internal rotation position
    • treatment: should self-correct by 2-4 years, otherwise can do splints or orthotics and encourage sitting in lotus position
  • increased femoral anteversion: when femur turns inward
    • most obvious in 5-6 years old
    • presentation: clumsy gait, patellae and feet point inward, frequent tripping, sitting in “W” position
    • treatment: usually resolves by late childhood, consider surgery for severe deformity
  • genu varum: bow legs
    • may be normal or abnormal
    • abnormal: vit D deficiency rickets, Blount’s disease
    • treatment: should spontaneously correct within 2-3 years if physiologic, otherwise may need brace or surgery

G.) Other deformities
• genu valgum: knock knees
• investigation: imaging if valgus is > 15-20 degrees
• treatment: should have normal alignment by early adolescence

H.) Patellofemoral disorders
• idiopathic anterior knee pain that worsens with activity, going up and down stairs, or after prolonged sitting
• investigation:
  • r/o patellar subluxation or dislocation

I.) Osgood-Schlatter
• tibial tubercle apophysitis as a result of overuse
• most common in males age 10-14
• presentation: worse with growth spurt or increased activity, localized pain, swelling, step-offs
• investigation: x-ray to rule out avulsion
• treatment:
  • activity as tolerated
  • stretching, strengthening, icing
  • patellar brace

J.) Sever’s
• a result of Achilles tendon pulling at the calcaneal apophysitis
• most common in 7-15 years
• presentation: well localized posterior calcaneal pain along Achilles insertion
• investigation: no x-ray indicated
• treatment: activity as tolerated, stretching, strengthening, icing, NSAIDs after activity
  • should be self-limiting
  • heel cups?