

# Pediatric Physical Examination Core Curriculum Appendices

These appendices are to be used as a supplement to the Pediatric Physical Examination Core curriculum benchmarks of the 3<sup>rd</sup> year general pediatric clerkship.

As a 3<sup>rd</sup> year clerkship student you are not expected to MASTER this material. It is supplemental and provides additional detail about some of the maneuvers outlined in the Physical examination benchmarks.

As a 4<sup>th</sup> year student who will be caring for children in your rotations and future careers, your goal should be to master the material presented in the appendices. Continue to work on both the knowledge and skills presented here.

The specific techniques used to perform the maneuvers outlined in the core curriculum appear below with additional supplemental information. We hope that you will use this material as a guide to improving your physical diagnostic skills.

## Basic Approach

### **Do**

Assess the child's growth

- Complete a growth chart accurately plotting height, weight and head circumference on the CDC Growth charts of the United States.

Plotting growth measurements:

Assessing growth is a part of each pediatric encounter because this is a sensitive measure of overall health of the child. There are growth curves available for different age groups (0-36 months, 2-20 years).

Weight:

Infants should be weighed naked or in a diaper only. If the weight is too high/low recheck the weight and accuracy of the scale. Fluctuations in weight influence management of children, especially those who are hospitalized.

Height

Most children younger than 2 years cannot/ will not stand by themselves so their length is measured instead of their height. There are measuring devices to assist with accurate assessment. If there is any concern about growth, measure the length at least twice.

Head circumference:

The tape should encircle the most prominent portions of the head. For increased accuracy, measure three times. It is easy to make small changes in the measurements accidentally. Do not start your examination by obtaining this measurements b/c the infant may start crying!

BMI

BMI should be calculated in all children and followed in addition to height and weight. To calculate BMI:

Wt (kg) / stature (cm) / stature (cm) x 10,000

Or Wt (lb) / stature (in) / stature (in) x 703

Special situations:

Premature infants: the growth of premature infants is typically "corrected" for their premature birth. Although special growth charts are available, many pediatricians plot the current weight at the "chronological" age and then subtract the months/weeks of prematurity (e.g. if the child was born at 30 weeks they subtract 10 weeks) and plot the growth parameters at the "corrected" age. Plotting the corrected age usually continues until age 2 years.

Other populations: there are special growth charts available to plot the growth for children with Down syndrome, Turner syndrome and achondroplasia

Assess the child's development

Use a comment developmental screening instrument such as the Denver II or Ages and Stages questionnaire. You should practice doing this during your pediatrics/family medicine clerkships

•Tips for doing a developmental assessment:

- Ask open-ended questions about each area of development outlined on the Denver II
- Know 1-2 items in each category that you can ask initially, and then follow up any concerns (yours or the parents) by asking more specific questions from the Denver or other screening tool.
- You will get information about the child's development by history and your own personal observation

## **Know**

Be alert to the possibility of a problem when the head circumference is at one extreme or the other

Sequential measurements of growth are sensitive measures of overall health.

Alteration in the rate of growth "crossing percentiles" should alert you to possible underlying problems.

Typical weight gain: 20-30 grams/day in the newborn period

Typical height velocity:

In children 5years –puberty, normal growth velocity is  $\geq 5$  cm;  $< 5$  cm/year should be investigated;  $<4$  cm is pathologic

Patterns of growth:

- Growth hormone deficiency (high weight to height ratio)
- Chronic disease (e.g inflammatory bowel disease...low weight to height ratio)
- Constitutional growth delay (normal weight to height ratio)

Developmental delays identified on tools used in clinician's office are "red flags" and warrant further, more formal investigation.

## **The Newborn Examination**

**Fontanel assessment:**

### **Do**

- Palpate the anterior fontanel, assessing size and firmness
  - Place the infant in an upright position (and hopefully she/he will remain calm!)
  - Gently place your fingers over the anterior fontanel, located midline on the superior temporo-frontal portion of the skull.
  - Gently palpate for the edges of the fontanel.
- Palpate the posterior fontanel (may not be able to feel this)
  - Repeat the same procedure outlined above, feeling for the posterior fontanel, located in the midline occipital region.

### **Know**

- Craniosynostosis: premature closure of cranial sutures. This can be primary due to closure of one or more sutures due to abnormal skull development. This occurs in  $\sim 1/2000$  children and is most often present at birth. It can also be secondary due to abnormal brain development.
- Conditions associated with a large anterior fontanel (greater than 3 cm): hydrocephaly, achondroplasia, hypothyroidism, osteogenesis imperfecta, and Vitamin D deficiency rickets

**Eye Exam:**

### **Do**

Assess whether the red reflex is present

The newborn infant spontaneously opens his/her eyes if the head is gently tipped forward/backward. This is more effective than trying to force open tightly shut eyelids!

Test corneal light reflex

Shine your ophthalmoscope or penlight in the newborn's eyes; you are assessing whether the light is symmetrically placed on the cornea bilaterally. Many newborns appear to be "cross eyed" because of prominent epicanthal folds.

**Know**

- Presence of a red reflex bilaterally suggests absence of cataracts or intraocular pathology.
- Leukocoria (white papillary reflex) suggests cataracts, chorioretinitis, retinopathy of prematurity, persistent hyperplastic vitreous or retinoblastoma. Leukocoria mandates an immediate ophthalmologic evaluation.
- Asymmetric corneal light reflex is a sign of strabismus, an imbalance of ocular muscle tone. If this is not corrected early it can lead to blindness. Proper coordination of eye movements should be achieved by 3-6 months; persistent eye deviation requires evaluation.
- Visual acuity of a newborn is approximately 20/400; this rapidly normalizes and by 2-3 years of age is 20/30-20/20.

**Hip Exam:**

**Do**

- Assess the neonate for developmental dysplasia of the hip by performing:
  - Barlow Maneuver and Ortolani test
    - Place the baby on a firm surface in the supine position
    - Flex the thighs to a right angle to the abdomen and the knees at right angles to the thighs
    - Grasp each thigh with your forefinger along the outside shaft of the femur, with your middle finger on the greater trochanter and thumb medially
    - Adduct the femora fully and push down toward the bed. (**Barlow maneuver**)
    - Gently abduct each leg from the position of full adduction so that the knees come to lie laterally on the table
    - During adduction, push the greater trochanters medially and forward with your fingers (**Ortolani test**)

**Know**

The infant may have a congenitally dislocated or subluxable hip if:

- you feel or hear a click during either adduction or abduction
- there is spasm or discomfort of the adductor muscles of the femur

Developmental Dysplasia of the hip:

1/100 infants have clinically unstable hips; 1/800-1000 experience true dislocation. There is a positive family history in 20% of patients and associated generalized ligamentous laxity. 9:1 female to male ratio.

Developmental dysplasia typically presents after birth in most infants. If it is present at birth, you should look for an underlying neuromuscular disorder. This type of developmental dysplasia of the hip is called Teratologic DDH.

**Newborn reflexes:**

**Do**

As part of your newborn exam, elicit the following primitive reflexes.

Asymmetric Tonic Neck Reflex (Fencer's position)

- Place the infant on his/her back
- Turn the newborn's head to one side
- Observe the gradual extension of the arm on the side to which the head is turned
- Observe the flexion of the other arm

Moro Reflex (startle response)

- Hold the infant supine and support the infant's head with one hand
- Gently move the infant's head (while supporting it) below the level of the rest of the body
- Observe the infant extend both arms suddenly and rapidly with open hands
- Observe the infant bring both hands back to midline in an "embrace" movement

Palmar grasp

- Place your index fingers in each of the infant's open hands

- Observe the infant's fingers close around your fingers in a firm grasp
- Plantar grasp
- Place your thumb on the sole of the infant's foot under the toes
  - Observe the toes curl around your thumb

### **Know**

Reflexes should be symmetric. Asymmetry suggests weakness in a particular muscle group.

Primitive reflexes disappear as the infant matures; persistence of these reflexes is a signal of underlying neurological dysfunction.

Asymmetric Tonic Neck Reflex (Fencer's position)

Appears by 35 wks gestation, is fully developed at 1 month & lasts 6-7 months

Moro Reflex (startle response)

Appears by 28-30 wks gestation; if fully developed at term & lasts 5-6 months

Palmar grasp

Appears by 28 wks, is fully developed by 32 wks gestation & lasts 2-3 months

### **Skin exam**

#### **Do**

- Inspect all of the skin of the infant (including diaper area)
- Describe (size, shape, color, distribution) any rashes
- Note any areas lacking skin

#### **Know**

- Benign lesions that parents may have questions about include:
  - Small angiomas present on the eye lids, nape of the neck, forehead
  - Milia: small white spots on the skin, particularly on the nose and cheeks
  - Erythema toxicum: yellowish/white pustules on an erythematous base that occur singly or in groups.
- Concerning changes include large angiomas lesions, vesicles, pustules or areas lacking skin
- Midline abnormalities (dimple, hair tuft, moles) on the back may indicate an underlying abnormality in the bones/nervous system.

Examples of common neonatal skin lesions can be found at

## **Infant/Toddler Examination**

### **Ear examination**

#### **Do**

Ask about hearing concerns

- Inquire about infant's response to
- Observe an older infant's/toddlers speech pattern

Inspect the ears

- Assess the shape of the ears
  - Determine if both ears are well formed
- Assess the position
  - Examine the child from the front, with the child's head held erect and the eyes facing forward.
  - Draw an imaginary line between the inner canthi and extend it around the head.
  - This line should be at or above the top of the pinnae

Palpate the tragus and posterior auricular area

Otoscopic exam including insufflation

- Position the child for an ear examination

This part of the exam can be examined either on the examination table or in the caregiver's lap. The head should be stabilized to prevent movement during otoscopy. A parent or assistant can assist with the examination by folding the child's wrists and arms over the child's abdomen with one hand and then holding the child's head against the parent's/assistant's chest with the other.

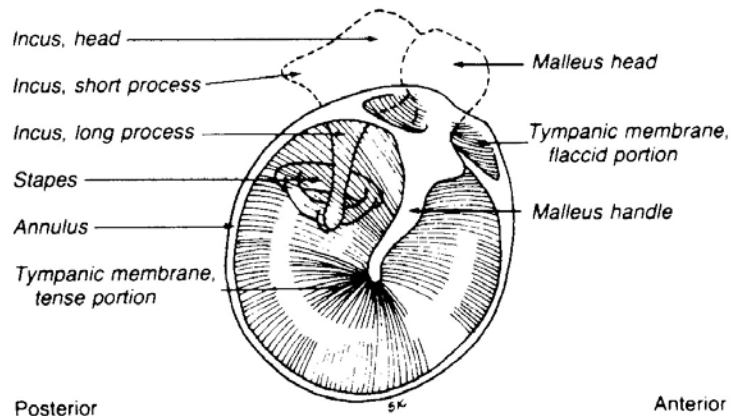
- Visualize the external canal

Gently hold the tragus and insert the otoscope while visualizing the canal. In contrast to adults, gentle posterior traction may help you visualize the canal and eventually the tympanic membrane.

- Visualize the tympanic membrane

Identify the landmarks starting with long handle of the malleus then moving to the "cone of light" in the pars tensa

Carefully visualize the pars flaccida



courtesy of M. Whipple, MD

- Perform pneumatic otoscopy

Hold the otoscope and bulb with one hand and retract the pinna with the other

Gently apply a small "puff" of air to the tympanic membrane

Normal movement: medially (away from you) with the application of air and laterally (toward you) when the bulb is released

## Know

### Hearing:

Any delay in language acquisition or loss of language milestones should prompt a referral for formal hearing testing

Hearing impairment is estimated to occur in 1-2/1000 live births

Some etiology of hearing loss in childhood

Sensory neural: cochlear malformation, damage to hair cells (due to noise, disease, ototoxic agents) or 8<sup>th</sup> nerve damage

Conductive: (most common)—ear canal atresia, cerumen impaction, otitis media with effusion

### Position/Shape of the ears

Malformed external and middle ears may be associated with serious renal or other craniofacial malformations

### Palpation:

Tenderness to palpation of the tragus is indicative of otitis externa.

You will also typically see white cheesy material in the external auditory canal.

Treatment is aural toilet and topical antibiotics

Tenderness to palpation and/or redness in the posterior auricular area may suggest mastoiditis.

### Otoscopy:

Areas of retraction in the pars flaccida may represent a cholesteatoma and should be further evaluated. A cholesteatoma acts as a benign tumor causing local bone destruction and is a nidus for bacteria to grow and cause chronic infections.

The most common reason for an immobile tympanic membrane (TM) with pneumatic otoscopy is a poor seal between the otoscope and ear canal

You must assess the movement of the TM to determine if a patient has otitis media. In addition to pneumatic otoscopy; acoustic tympanometry can be used.

Changes in the appearance of the TM that are highly suggestive of acute infection include: bulging or purulent material visualized behind the tympanic membrane.  
Guidelines for the diagnosis and treatment of otitis media: [www.aap.org](http://www.aap.org)

Removal of cerumen is difficult but sometimes necessary to adequately see the TMs. The external auditory canal bleeds easily with minor trauma so ask for help if you need to clear out cerumen. It can be done by gentle irrigation with warm water, H<sub>2</sub>O<sub>2</sub> or with direct visualization and use of a wire/plastic loop.

## Mouth examination

### Do

The approach

Save the mouth exam for the very last in young children

Ask child to open their mouth and show you their teeth (appropriate for an older toddler/child). If this doesn't work, be prepared to be fast with your tongue blade.

An alternative is to be flexible and look in the mouth when the child is crying for some other reason!!!

Inspect the teeth

Count the number of teeth and note position

Note any defects or discolorations

Inspect gums, mucosal surfaces and posterior pharynx

Inspect the buccal mucosal and gums looking for ulcers, candida or trauma

To see the posterior pharynx, you may have to use the tongue blade and gag the child.

Alternative tricks you can use include asking the child to "roar like a lion", "pant like a dog", have their parents model what you would like to child to do or have the child look in your mouth.

### Know

The numbering system for primary teeth is different than the system used in adults.

There are 20 primary teeth

Time for first tooth eruption is variable; delayed eruption maybe familial or associated with other syndromes/conditions (like hypothyroidism)

There may be developmental anomalies associated with tooth development

Dental caries is the most common chronic illness in the United States. More than 1/2 of children within the U.S. have dental caries. *Streptococcus mutans* is associated with the development of dental caries.

Early childhood caries may occur on the smooth surfaces of upper/lower incisors because of prolonged exposure to sugar containing substances.

Site for caries in children include pits/fissures of biting (occlusal) surfaces in older children (> 3 yo)

Using a tongue blade in this population is challenging. Inserting it along the side of the mouth and then gagging the child will allow for an unobstructed view of the posterior pharynx in most children.

The size of tonsils are described in the following way

Grade	Appearance
0	Absent
1	Visible between the tonsillar pillars
2	Easily visible outside of the tonsillar fossae
3	Enlarged and occupying >75% of posterior pharynx
4	Touching in the midline occupying all of the posterior pharynx

The diagnosis is streptococcal pharyngitis is a laboratory, not clinical diagnosis. Other infections that can cause tonsillar exudates include EBV infections, CMV infections, S. aureus infections, adenoviral infections.

## Heart Examination

The approach the pediatric heart examination is the same as in an adult. Included here is a brief discussion of MURMURS in children.

Newborn period

As the pulmonary vascular resistance decreases, flow through the Patent Ductus Ateriosus or Patent Foramen Ovale stops as these structures close. Some murmurs heard shortly after birth will disappear.

However, as the pulmonary vascular resistance decreases, this may allow left to right shunting and new murmurs may appear (such as seen with a VSD)

Presence of central cyanosis is an important clue for congenital heart disease. Those lesions associated with cyanotic heart disease are the "Ts": Tetralogy of Fallot, Tricuspid Atresia, Transposition of the Great Arteries, Total Anomalous venous return & Truncus arteriosus (there are others but these are easy to remember)

Beyond the newborn period

50% of children have innocent murmurs

Non-pathologic murmurs include:

Peripheral Pulmonary flow murmur:

Soft (1-2/6) systolic ejection murmur heard in L upper sternal border with radiation to the axilla and back

Venous hum

Soft (1-2/6) continuous murmur heard in 1<sup>st</sup> or 2<sup>nd</sup> ICS)

Innocent murmur

Soft (<3/6) early systolic murmur heard along the L sternal border between the 2<sup>nd</sup>/3<sup>rd</sup> or 4<sup>th</sup>/5<sup>th</sup>. Intensity varies with position & might be heard with the bell. "Vibratory/blowing/musical" in quality.

Hemic murmur (flow murmur)

Heard in states with increased physiologic need (fever, anemia). Heard at base of the heart, soft (<3/6) and often associated with tachycardia

## Musculoskeletal Examination

### Do

Observe the child closely; noting in particular range of motion and limb use

An excellent time to get this information is before the examination while the child is playing or interacting with their parents.

Inspect the joints for redness or swelling

Start with the hands or some non-threatening part of the examination; examine the affected joint last.

Palpate methodically and in a systematic manner the involved area and all other areas that influence the involved area.

Note muscles, bony prominences, other important landmarks, and joints of the involved body part.

Be observant for pain or warmth

Assess Active and Passive Range of motion for each major joint.

Young children may not cooperate with this part of the examination; you may have to range their joints and gauge how much they resist you to judge function.

## **Older child/Adolescent Examination**

You should be able to conduct a complete examination of all organ systems in all adolescents using an age appropriate approach. The physical examination in an older child/adolescent is very similar to that done in adults. Pay particular attention to patient modesty. Specific maneuvers that are a part of the older child/adolescent examination include:

### **Tanner staging**

#### ***Do***

Assess Tanner staging for both male and female patients. You should assess and report pubic hair development separately from breast or genitalia development.

<b>Girls</b>	<b>Hair (Pubic/Axillary)</b>	<b>Breasts</b>
Stage I	No coarse/pigmented hair	Papilla elevated only
Stage II	Scant course pigmented hair on labia	Breast buds palpable, areola enlarge
Stage III	Course, curly hair over mons pubis Axillary hair develops	Elevation on contour, areola enlarge
Stage IV	Hair of adult quality, not on lateral thigh	Areola forms a secondary mound on the breast
Stage V	Spread of hair to lateral thigh	Adult breast contour

See: Bickley, LS and PG Szylagyi. Bates' Guide to Physical Examination and History Taking, 8<sup>th</sup> edition. 2003. Lippincott Williams & Wilkins, Philadelphia pp: 700,714.

<b>Boys</b>	<b>Hair (Pubic/Axillary)</b>	<b>Testes length</b>	<b>Penis</b>
Stage I	No coarse/pigmented hair	<2.5 cm	No growth
Stage II	Scant course pigmented hair at base of penis	2.5-3.2 cm	Earliest increase length/width
Stage III	Course, curly hair over pubis	3.6cm	Increased growth
Stage IV	Hair of adult quality, not on lateral thigh Axillary hair develops	4.1-4.5	Continued growth
Stage V	Spread of hair to lateral thigh	>4.5 cm	Mature genital size

See: Bickley, LS and PG Szylagyi. Bates' Guide to Physical Examination and History Taking, 8<sup>th</sup> edition. 2003. Lippincott Williams & Wilkins, Philadelphia pp: 707

#### ***Know***

Pubertal changes typically occur between the ages of 8 and 14 in girls and 9 and 16 in boys. Occurrence of pubertal changes outside these ranges should be evaluated.

Precocious puberty:

Benign precocious adrenarche: may occur in boys before age 9 and girls before age 8; absence of penile enlargement in boys or of clitoral enlargement in girls distinguishes this from pathologic virilization.

Precocious thelarche: isolated premature breast development in girls

Other causes include: CNS tumors, Ovarian cysts, Gonadal tumors, Congenital adrenal hyperplasia, exogenous sources

Delayed puberty:

Constitutional (physiologic): most common, occurs in boys more often and is associated with delayed growth and bone age; ask about family history

Other causes: Malnutrition (including anorexia nervosa), chronic disease, Central causes (hypothalamic/pituitary abnormality, tumors, drugs, other endocrine problems like hypothyroidism), gonadal causes (chromosomal—XXY, XO, anatomic abnormalities, immunologic).

## Musculoskeletal exam

An excellent demonstration of the 2 minute orthopedic examination in an older child can be found: [www.clippcases.org](http://www.clippcases.org) case # 6 (Mike pre-sports physical); also Chapter 17 in Goldbloom's Pediatric Clinical Skills (p 311).

### **Do**

Be able to perform a basic musculoskeletal examination (see ICMII benchmarks)

Additional techniques:

Assess the strength major muscle groups of the upper and lower extremities

Be able to test pelvic girdle strength: Ask the patient to sit on the floor and then stand up.

Lower extremity strength/joint function: Ask the child to squat and walk like a duck across the room.

Back examination

Inspect the back for spinal dimples & midline abnormalities such as a tuft of hair, midline nevi or central dimple (this should be done beginning in infancy)

Assess whether the spinal dimples are level

Inspect the patient back from behind when they stand. If the spinal dimples are at the same level, there is not significant leg length discrepancy. (example page 273 Goldbloom)

Assess symmetry/ screening for scoliosis:

Shoulders should be at the same level, as should posterior superior iliac crest.

Inspect the patient's back when they are facing away from you.

Have the child bend forward at the waist keeping knees straight and allowing arms to hang freely; ribs/thorax should be symmetric

### **Know**

Gower's sign occurs when a child is unable to rise from a sitting to standing position without assistance. This sign indicates proximal muscle weakness

Midline abnormalities may indicate an underlying spinal cord or vertebral abnormality

Scoliosis occurs is common in children and screening is a part of the adolescent examination

Excessive thoracic kyphosis that persists when the child lies down is pathologic

## References:

Goldbloom, R B. Pediatric Clinical Skills, 3<sup>rd</sup> edition. 2003 Elsevier Science (USA) Philadelphia.  
*This is a gold mine of tips and techniques for the pediatric history and physical. Excellent pictures and explanations are included in each chapter.*

Bickley, LS and PG Szylagyi. Bates' Guide to Physical Examination and History Taking, 8<sup>th</sup> edition. 2003. Lippincott Williams & Wilkins, Philadelphia.  
*This textbook provides an excellent basic introduction to the pediatric history and physical.*

Zitelli, BJ and H. W. Davis. Atlas of Pediatric Physical Diagnosis, 4th Edition. 2002 Elsevier Science, Philadelphia.  
*This book is an outstanding reference for physical diagnosticians in pediatrics. It provides both normal and abnormal findings and is subdivided by subspecialty with an emphasis on diagnoses that have significant findings on physical exam.*

Other references:

1. Eye examination in infants, children and young adults by pediatricians. Pediatrics 2003 111:902-907. [AAP committee recommendations]
2. US Preventive Services Task Force. Screening for visual impairment in children younger than age 5 years: recommendation statement. Ann Fam Med May 1, 2004; 2(3):263-266.