



# **PEDIATRIC INFECTIOUS DISEASE**

**Lauren Paluch, DMSc, MPA, PA-C**

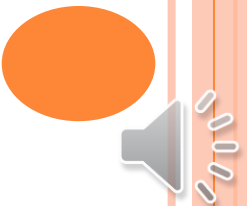
**Children's Hospital of the King's Daughters**

**Assistant Professor, Eastern Virginia Medical School**



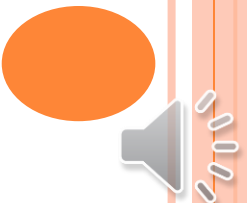
# DISCLOSURES

- No relevant commercial relationships to disclose



# LEARNING OBJECTIVES

- At the conclusion of this talk, the learner will be able to:
  - Identify illnesses that predominate with rash and fever
  - Distinguish bullous from non-bullous impetigo and how their treatments differ
  - Differentiate causes, treatment modalities and prognosis for meningitis and encephalitis
  - Manage wheezing in the context of bronchiolitis
  - List the common etiologies of osteomyelitis and infectious arthritis in children



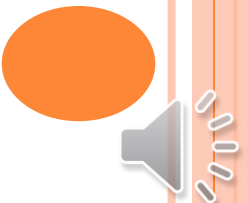


# FEVER AND RASH



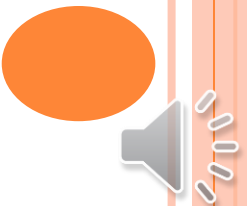
# MEASLES (RUBEOLA)

- Single-stranded RNA paramyxovirus
- Infects the upper respiratory tract and regional lymph nodes
- Virus is passed through respiratory secretions, blood and urine



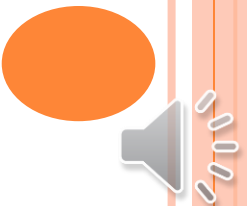
# MEASLES

- Four phases
  - Incubation
  - Prodromal (catarrhal)
  - Exanthemous (rash)
  - Recovery



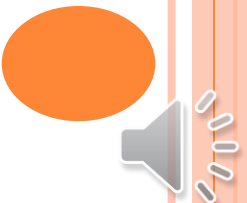
# MEASLES

- Incubation Phase
  - 8 to 12 days from exposure to onset of symptoms



# MEASLES

- Prodromal Phase
  - Cough
  - Coryza
  - Conjunctivitis
  
  - Koplik spots

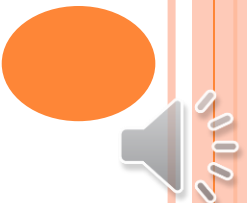




# MEASLES

## ○ Exanthemous Phase

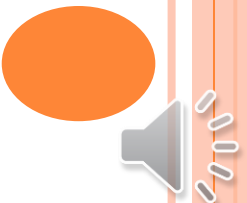
- High fever
- Rash spreads in a cephalad to caudal manner
- Patients may develop cervical lymphadenopathy, splenomegaly and mesenteric lymphadenopathy with abdominal pain



# MEASLES

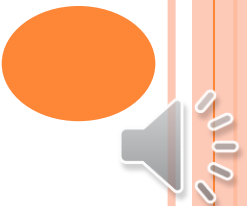
## ○ Work Up

- Leukopenia
- Thrombocytopenia
- Serologic testing for IgM antibodies confirms clinical diagnosis



# MEASLES

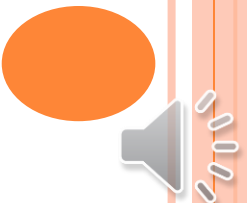
- Treatment
  - Maintain hydration
  - Antipyretics
  - Supplemental Vitamin A



# MEASLES

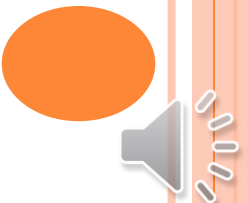
## ○ Complications

- Otitis Media
- Pneumonia
- Encephalomyelitis
- Activation of latent TB
- Myocarditis (rare)
- Mesenteric Lymphadenitis (rare)
- Subacute Sclerosing Panencephalitis



# RUBELLA

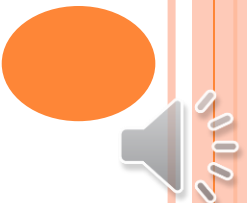
- Also known as the German measles/3-day measles
- Single-stranded RNA virus with a glycolipid envelope
- Invades the respiratory epithelium and disseminates via primary viremia



# RUBELLA

## ○ Presentation

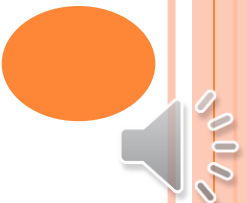
- Incubation period is typically 16-18 days
- Mild prodromal symptoms may go unnoticed
- Retroauricular, posterior cervical and posterior occipital lymphadenopathy with rash are characteristic
- Forchheimer spots
- Rash



# RUBELLA

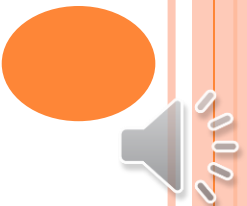
## ○ Work Up

- Routine labs are non-specific and generally not helpful
- Diagnosis is confirmed by serology testing for IgM antibodies or by a fourfold or greater increase in specific IgG antibodies
- Cases should be reported to the health department immediately



# RUBELLA

- Treatment
  - Supportive care
  - Maintain hydration
  - Antipyretics

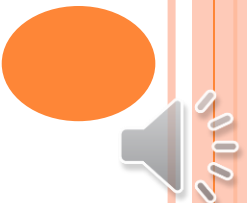




# RUBELLA

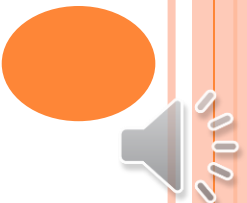
## ○ Complications

- Rare postnatally
- Congenital Rubella Syndrome
  - Intrauterine growth retardation
  - Cataracts
  - Deafness
  - Neurologic deficits
  - PDA



# ROSEOLA INFANTUM

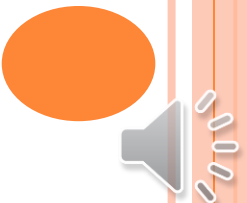
- Caused by HHV-6 and HHV-7
- Enveloped double stranded DNA viruses
- Infect mature mononuclear cells
- Transplacental protection until about 6 months of age
- Essentially all children are seropositive by 2-3 years old



# ROSEOLA INFANTUM

## ○ Presentation

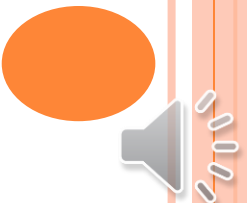
- High fever starts abruptly and lasts 3-5 days
- Fever ceases then rash appears
- Rash lasts 1-3 days but is not present in all infants with HHV-6 infection
- URI and GI symptoms can occur



# ROSEOLA INFANTUM

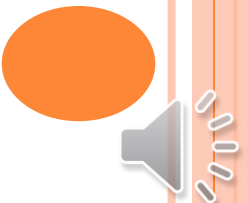
## ○ Work Up

- Routine labs are non-specific and generally not helpful
- HHV DNA detection via PCR



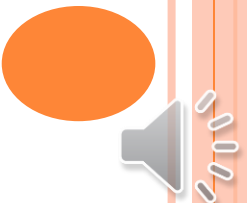
# ROSEOLA INFANTUM

- Treatment
  - Supportive Care
  - Maintain Hydration
  - Antipyretics



# ERYTHEMA INFECTIONOSUM

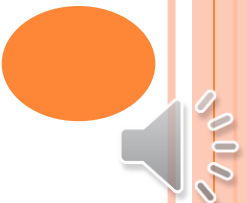
- Caused by human parvovirus B19, a single stranded DNA virus
- Produces a benign exanthem in healthy children
- Causes aplastic crises in patients with hemolytic anemias
- Causes fetal anemia and hydrops fetalis if acquired during pregnancy



# ERYTHEMA INFECTIONOSUM

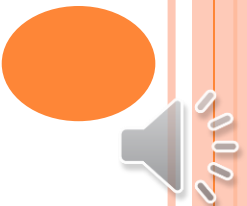
## ○ Presentation

- Incubation period is usually 4-14 days
- Initially patients will have non-specific symptoms such as fever, headache, malaise and myalgias
- Rash generally appears 7-10 days later
- Transient aplastic crisis



# ERYTHEMA INFECTIONOSUM

- Work Up
  - Mild leukopenia early
  - Parvovirus B19 can be identified by PCR

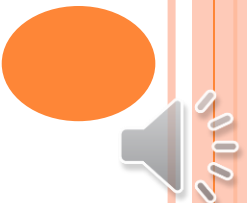




# ERYTHEMA INFECTIONOSUM

## ○ Treatment

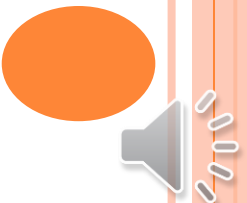
- Supportive care
- Transfuse transient aplastic crises
- IV immunoglobulin for immunocompromised patients with severe anemia
- Intrauterine transfusion for hydrops fetalis

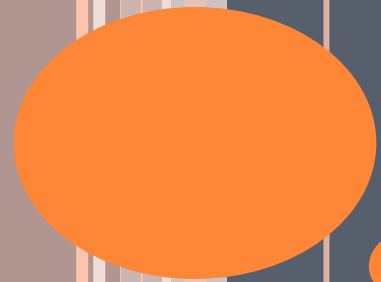


# ERYTHEMA INFECTIONOSUM

## ○ Complications

- Prognosis is generally excellent
- Fatalities associated with aplastic crises are rare
- Greatest risk is to pregnant women





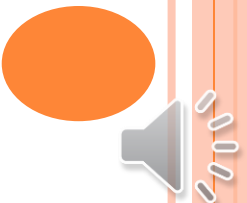
# IMPETIGO

Bullous vs Non-bullous



# IMPETIGO

- *Staphylococcus aureus* or group A *Streptococcus*
- Non-bullous versus Bullous
- Fever is uncommon
- Most commonly on face and extremities



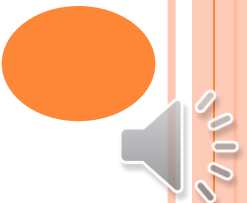
# DIFFERENTIAL DIAGNOSIS

## ○ Non-Bullous Impetigo:

- Contact dermatitis
- Tinea
- Eczema
- Herpetic infection

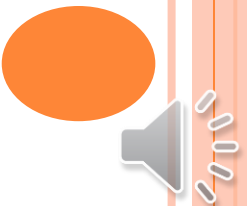
## ○ Bullous Impetigo:

- Bullous pemphigoid
- Drug eruption
- Varicella
- Burns



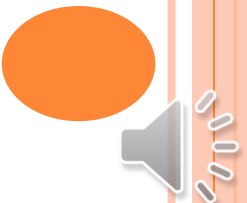
# IMPETIGO

- Ecthyma
- Cellulitis



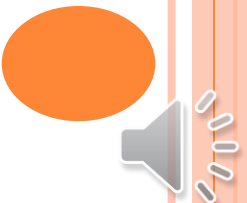
# IMPETIGO

- Treatment
  - Cephalexin
  - Clindamycin if MRSA suspected
  - Outbreaks
  - Coinfection with scabies



# IMPETIGO

- Outbreaks
- Co-infection with scabies
- Follow up
- Return to school





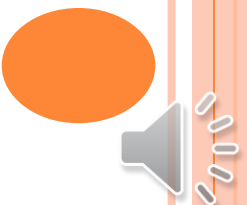


# MENINGITIS ENCEPHALITIS



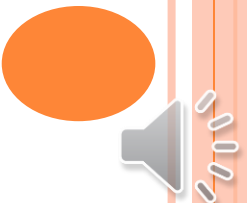
# MENINGITIS

- Inflammation of the leptomeninges
- Bacterial, viral and fungal (rare) etiologies
- Historic bacterial etiologies were *Haemophilus influenzae*, *Streptococcus pneumoniae* and *Neisseria meningitides*
- *Staphylococcus aureus* meningitis occurs mainly in those who have undergone neurosurgery or suffered penetrating head trauma



# MENINGITIS

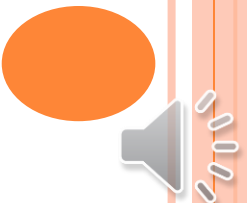
- Viral meningitis is primarily caused by enteroviruses and parechoviruses



# MENINGITIS

## ○ Epidemiology

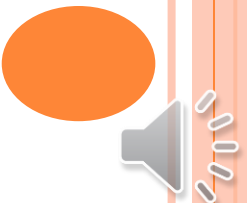
- Incidence of bacterial meningitis is highest among children less than one year of age
- Native Americans, Alaskan Natives and Australian Aboriginals are disproportionately affected



# MENINGITIS

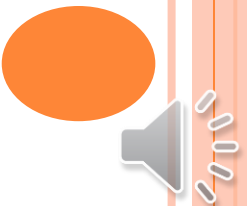
## ○ Presentation

- Preceding URI type symptoms are common
- Symptoms
  - HA, nausea, stiff neck, lethargy, photophobia, vomiting, fever
- Kernig's/Brudzinski's signs in children older than 12 months
- Infant presentation



# MENINGITIS

- Presentation
  - Illness progression
  - Papilledema uncommon

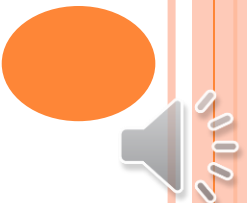


# MENINGITIS

## ○ Work Up

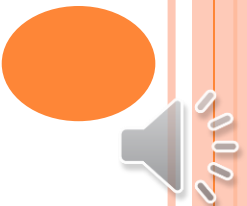
### • Lumbar Puncture

- CSF analysis includes WBC count, differential, protein and glucose levels and a Gram stain
- CSF culture can determine specifics
- CBC
- Leukocytosis



# MENINGITIS

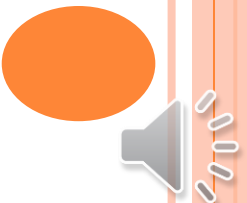
- Differential Diagnosis
  - Encephalitis
  - Hemorrhage
  - Rheumatic diseases
  - Malignancies
  - Intracranial Brain Abscess





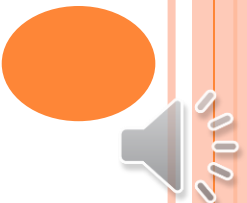
# MENINGITIS

- Treatment
  - IV Antibiotics
    - Empiric treatment until susceptibilities obtained
    - Duration of treatment
      - *N. meningitidis*: 5-7 days
      - *H. influenzae*: 7-10 days
      - *S. pneumoniae*: 10-14 days
  - Dexamethasone
  - Supportive therapy



# MENINGITIS

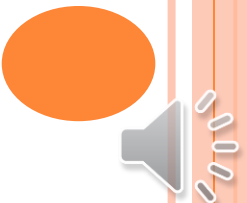
- Complications and Prognosis
  - Subdural effusions
  - Persistent fever
  - Mortality rate (even with proper antibiotics)
    - *S. pneumoniae* : 25%
    - *N. meningitidis* : 15%
    - *H. influenzae*: 8%
  - 35% of survivors encounter some sequelae



# MENINGITIS

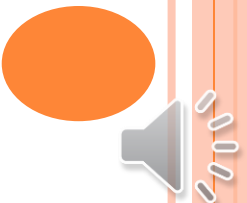
## ○ Prevention

- Vaccination
  - *H. influenzae* and *S. pneumoniae* beginning at 2 months of age
  - Quadrivalent vaccine against *N. meningitidis* for adolescents, college freshman, military personnel and for people who travel to endemic areas
- Chemoprophylaxis for close contacts of the index case



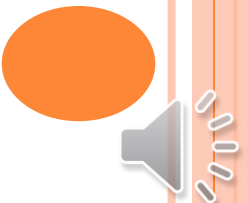
# ENCEPHALITIS

- Inflammatory process of the brain parenchyma leading to cerebral dysfunction
- May be diffuse or localized
- Two mechanisms
- Viruses are the primary cause
- Subacute encephalitis may result from HIV, measles, Creutzfeldt-Jakob disease



# ENCEPHALITIS

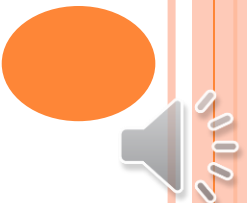
- Epidemiology
  - Arboviral and enteroviral etiologies
  - Arbovirus is limited to certain geographic areas
    - California encephalitis
    - Eastern equine encephalitis virus
    - Western equine encephalitis virus
    - West Nile Virus



# ENCEPHALITIS

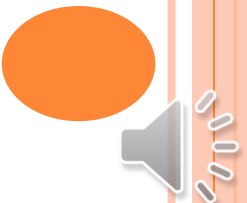
## ○ Presentation

- Prodromal, non-specific symptoms
- Progresses to lethargy, behavioral changes and neuro deficits
- Seizures are common



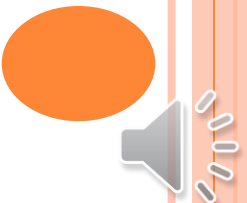
# ENCEPHALITIS

- Work Up
  - CSF
  - EEG is definitive
  - Neuroimaging
  - Serologic testing
  - Viral cultures
  - PCR
  - Brain biopsy



# ENCEPHALITIS

- Differential Diagnosis
  - Reye's Syndrome
  - Hypoglycemia
  - Collagen vascular disorders
  - Drugs
  - Hypertension
  - Malignancies

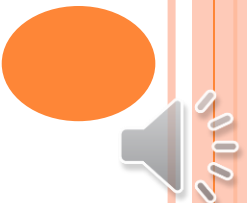




# ENCEPHALITIS

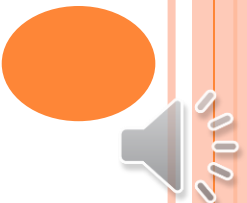
## ○ Treatment

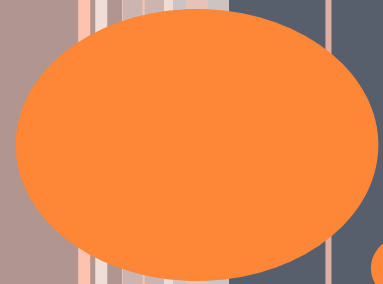
- Specific treatment for HSV, varicella-zoster, cytomegalovirus and HIV
  - Otherwise, no particular therapy for viral encephalitis
- Reduce ICP and maintain adequate cerebral perfusion pressure



# ENCEPHALITIS

- Complications and Prognosis
  - Overall mortality is 5%
  - Symptoms usually resolve after 2-3 weeks
  - HSV and Eastern equine encephalitis etiologies have a worse prognosis



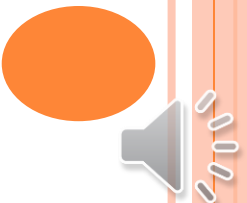


# BRONCHIOLITIS



# BRONCHIOLITIS

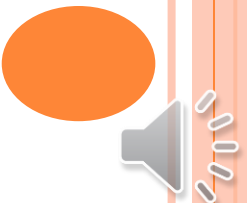
- Respiratory tract inflammation with airway obstruction resulting from swelling of the bronchioles
  - Leads to inadequate expiratory flow
- RSV is the primary cause



# BRONCHIOLITIS

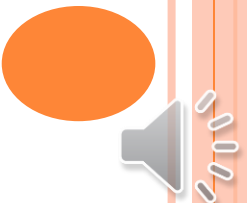
## ○ Epidemiology

- Leading cause of hospitalization in infants
- Approximately 50% of children will have bronchiolitis by age 2
- Peak presentation of 2-6 months old
- Males are affected 1.5:1 to females



# BRONCHIOLITIS

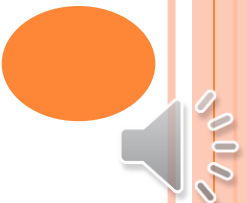
- Presentation
  - Cough
  - Coryza
  - Rhinorrhea
  - Audible wheezing
  - Low grade fever



# BRONCHIOLITIS

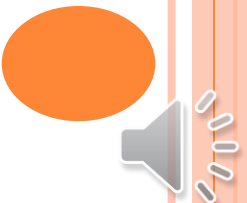
## ○ Work Up

- Monitor pulse ox
- Cardiorespiratory monitoring
- Routine lab tests are not helpful
- Antigen or PCR tests for etiology
- CXR often shows hyperinflation from air trapping
- Lung ultrasound



# BRONCHIOLITIS

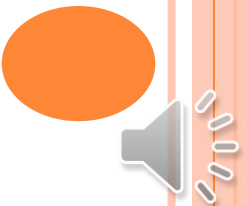
- Differential Diagnosis
  - Reactive airway disease
  - Foreign body aspiration
  - Congenital airway obstructive lesion
  - Cystic fibrosis
  - Bronchopulmonary dysplasia
  - PNA
  - GERD





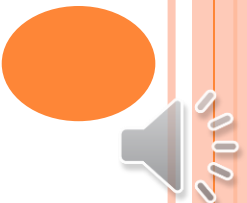
# BRONCHIOLITIS

- Treatment
  - Control fever
  - Maintain hydration
  - Upper airway suctioning
  - Oxygen if needed



# BRONCHIOLITIS

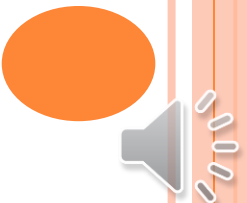
- Complications/Prognosis
  - Most hospitalized children improve within 2-5 days
  - Apnea is a major concern for young infants
  - 1-2% mortality rate



# BRONCHIOLITIS

## ○ Prevention

- Monthly injections of Palivizumab for children with chronic lung disease, very low birth weight or hemodynamically significant chronic heart disease
- Influenza vaccine
- Maternal vaccine



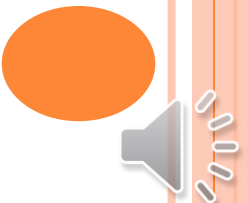


# OSTEOMYELITIS INFECTIOUS ARTHRITIS



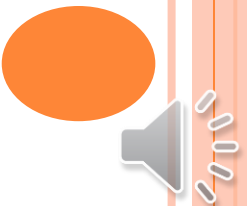
# OSTEOMYELITIS

- Infection of the bone
- Hematogenous osteomyelitis
- Subacute osteomyelitis
- Chronic osteomyelitis



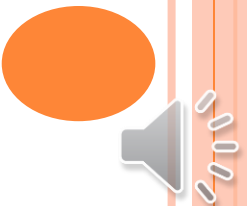
# OSTEOMYELITIS

- Subacute focal bone infections
- Pseudomonas chondritis
- Sickle cell disease



# OSTEOMYELITIS

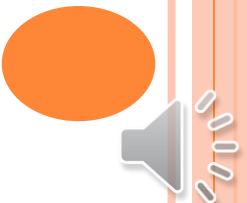
- Epidemiology
  - Most common in children 3-12 years old
  - Affects males 2:1



# OSTEOMYELITIS

## ○ Presentation

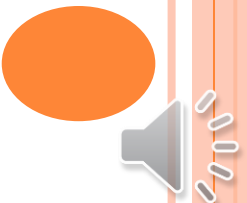
- Focal pain
- Point tenderness to the bone
- Warmth
- Erythema
- Swelling





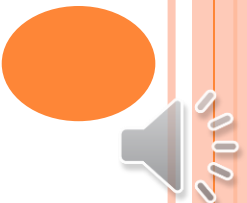
# OSTEOMYELITIS

- Work Up
  - Blood cultures
  - Needle aspiration
  - ESR/CRP
  - Plain films
  - MRI



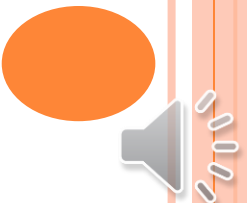
# OSTEOMYELITIS

- Treatment
  - IV antibiotics
    - Tailored to the culprit
    - Surgical debridement in severe cases
    - Antibiotics for a minimum of 4-6 weeks



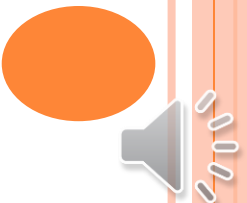
# OSTEOMYELITIS

- Complications/Prognosis
  - Complications are uncommon
  - Young children more likely to experience septic arthritis
  - Approx. 4% of infections recur



# INFECTIOUS ARTHRITIS

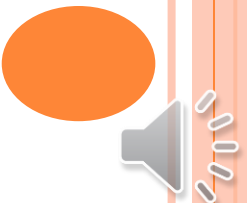
- AKA septic arthritis
- Source and offending organism vary with age
- Epidemiology
  - Occurs most commonly in children under 5 and adolescents



# INFECTIOUS ARTHRITIS

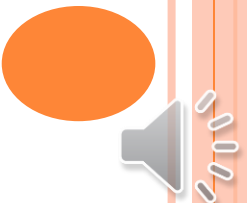
## ○ Presentation

- Erythema, warmth, swelling and tenderness over the affected joint
- Palpable effusion
- Decreased ROM
- Lower extremity joints are most common



# INFECTIOUS ARTHRITIS

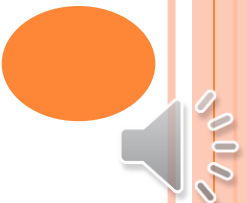
- Work Up
  - Arthrocentesis
  - Leukocytosis as well as elevated ESR and CRP
  - Ultrasound
  - MRI



# INFECTIOUS ARTHRITIS

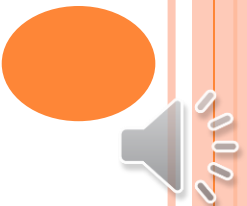
## ○ Treatment

- Surgical drainage + antibiotics
- Neonates: nafcillin and cefotaxime
- Children 3 mo to 5 yrs: staph aureus coverage
- Consider immunization status when selecting antibiotics
- Duration of therapy depends on the severity of the infection



# INFECTIOUS ARTHRITIS

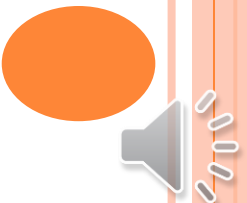
- Complications/Prognosis
  - Generally good if joint is aspirated before the articular cartilage is affected





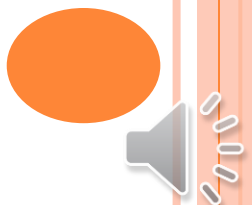
## TAKE HOME POINTS

- Febrile illness with rash is common in children, and often treated symptomatically
- Steroids and bronchodilators are not indicated in the treatment of bronchiolitis as they have not been shown to impact on bronchiolitic wheezing
- Causes of osteomyelitis and infectious arthritis are similar, based upon the child's age
- Routine childhood immunizations are important and can prevent deadly disease processes



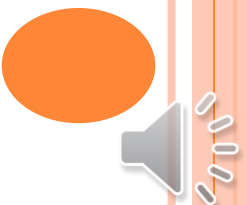
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