Use + Share + Adapt

{ Content the copyright holder, author, or law permits you to use, share and adapt. }

- **Public Domain – Government**: Works that are produced by the U.S. Government. (17 USC § 105)
- **Public Domain – Expired**: Works that are no longer protected due to an expired copyright term.
- **Public Domain – Self Dedicated**: Works that a copyright holder has dedicated to the public domain.

**Creative Commons – Zero Waiver**

**Creative Commons – Attribution License**

**Creative Commons – Attribution Share Alike License**

**Creative Commons – Attribution Noncommercial License**

**Creative Commons – Attribution Noncommercial Share Alike License**

**GNU – Free Documentation License**

Make Your Own Assessment

{ Content Open.Michigan believes can be used, shared, and adapted because it is ineligible for copyright. }

- **Public Domain – Ineligible**: Works that are ineligible for copyright protection in the U.S. (17 USC § 102(b)) *laws in your jurisdiction may differ*

{ Content Open.Michigan has used under a Fair Use determination. }

- **Fair Use**: Use of works that is determined to be Fair consistent with the U.S. Copyright Act. (17 USC § 107) *laws in your jurisdiction may differ*

Our determination **DOES NOT** mean that all uses of this 3rd-party content are Fair Uses and we **DO NOT** guarantee that your use of the content is Fair.

To use this content you should **do your own independent analysis** to determine whether or not your use will be Fair.
Fever in the Emergency Department
Special Considerations in Pediatrics

Hannah Smith, MD
Washington University in St. Louis School of Medicine
Objectives

• Background
• Pathophysiology
• Definition
• Approach
  – General
  – 0 to 3 months
  – 3 to 36 months
  – Other
Background

• Most frequent chief complaint in children < 3 years
• 10-20% of pediatric visits to emergency department in US
• 20% of these will have no localizing source
• Infants < 3 months of age highest rates of serious bacterial infection (SBI)
Background

- Abnormal elevation of body temperature
- Recognized for centuries as a “sign of disease”
- Problem commonly encountered in pediatrics
Objectives

• Background

• **Pathophysiology**

• Definition

• Approach
  – General
  – 0 to 3 months
  – Greater than 3 months
  – Other
Pathophysiology

• **Complex process**
  – Autonomic
  – Neuroendocrine
  – Behavioral responses

• **Caused by a production of signaling proteins**
  – Or endogenous pyrogens which enter circulation and interact with specialized receptor neurons

• **Results in physiologic changes**
  – Peripheral vasoconstriction minimizing skin heat loss
  – Decreased sweating as vasopressin secretion falls
  – Lowered extracellular fluid volume
  – Shivering, seeking warmer environment
Pathophysicsology

• Benefits of fever:
  – Impaired replication of microbes, enhanced phagocytic bactericidal activity
  – Glucose metabolism decreases in favor of that based on lipolysis and proteolysis (depriving bacteria of favorite food)
  – Hepatic production of acute-phase reactant proteins bind divalent cations which are growth factors for microorganisms
Objectives

• Background
• Pathophysiology
• **Definition**
• Approach
  – General
  – 0 to 3 months
  – 3 to 36 months
  – Other
Definition

• Difficult to pinpoint lowest temperature elevation considered to be definitely abnormal for all children in all circumstances

• Natural diurnal variations in temperature, peak between 17:00 and 19:00
  – Variation less pronounced in infants
Definition

• **Rectal temperature of 38°C (or 100.4°F)**
  – Appropriately dressed child
  – Child at rest for 30 minutes
  – Optimal technique includes appropriate positioning, 2 to 3cm depth, not in fecal mass
    • Glass probes take 2 to 3 min to equilibrate
• **Oral temperatures are usually about 0.6°C (1°F) lower than rectal temperature**
• **Axillary temperatures are usually about 1.1°C (2°F) lower than rectal temperature**
• **Tympanic membrane are accurate**
• **Pacifiers and forehead strips are not reliable**
Objectives

- Background
- Pathophysiology
- Definition
- **Approach**
  - General
  - 0 to 3 months
  - 3 to 36 months
  - Common things being common
  - Other
Approach

• Major challenge
• Many principal causes of fever
• Systematic approach
Approach

• Magnitude of fever reduction in response to antipyretics does not distinguish children with serious bacterial infection (SBI) from those with viral diseases
  – SBI includes:
    • Meningitis
    • Sepsis
    • Bone and joint infections
    • UTI
    • Pneumonia
    • Enteritis
Approach

• Age-based
• Duration-based
• Accounts for underlying illness
• Varies with vaccine status
• Differs with endemic diseases or travel history
Approach

• All febrile children who are toxic-appearing should be hospitalized for evaluation and treatment of possible sepsis or meningitis

• Toxic-appearing:
  – Lethargy
    • (Level of consciousness characterized by poor or absent eye contact or as the failure of a child to recognize parents or interact with persons or objects in the environment)
  – Signs of poor perfusion or marked hypoventilation
  – Hyperventilation
  – Cyanosis
Evaluation

• 0-3 months
  – Risk of SBI is higher
  – Higher suspicion for possible bacterial etiology
  – Strong consideration of empiric antibiotics is indicated

• Goal:
  – Strategically separate patients into high and low risk groups for SBI based on readily obtained clinical and laboratory data
Why Are Infants at Risk?

• Immature immune system
  – Deficiencies in specific antibody, complement, opsonins, phagocyte number and function \( \{GBS\} \)
  – Reduced attraction of macrophages to site of infection \( \{intracellular\ organ\} \)
  – Lack of passively acquired antibodies and decreased activity of nonimmune and immune cellular cytotoxic mechanisms \( \{HSV\} \)

• Neurologic and behavioral immaturity

• Variable presentation

*Slide courtesy of and adapted from David Jaffe*
Sepsis Presentation

• Varies from toxic-appearing to well-appearing
• Neurologic and behavioral immaturity may confound
• History should focus on changes in infant’s behavior
  – Increased or decreased sleeping
  – Decreased feeding
  – Irritability
  – Respiratory distress
  – Agitation
  – Lethargy
Non-Toxic Appearing Febrile Infants (0-3 Months)

- Incidence of SBI: 8 – 10%
- Bacteremia < 3%
- Meningitis ≤ 1%
- UTI ≈ 7%
- Some multiple site infections
- Large majority presumed or confirmed viral
- Risk stratification important

Serious Bacterial Infection (0-3 Months)

• Growth of bacterial pathogen from body fluid:
  – Blood
  – Urine
  – CSF
  – (Joint fluid)
  – (Bone)

• 0 to 3 months:
  – E. coli
  – GBS
  – L. monocytogenes
  – S. pneumoniae
  – Salmonella
  – N. meningitidis
  – H. influenzae
  – S. aureus
  – Klebsiella
Rates of Bacteremia and Bacterial Meningitis (0-3 Months)


Slide courtesy of and adapted from David Jaffe
The Need for Risk Stratification

• Variation in evaluation and management
• Many infants have self-limited viral infections
• Problems with routine hospitalization:
  – Costly
  – Increasing antibiotic resistance
  – Iatrogenic complications
    • IV infiltrates
    • Fluid or drug overload
    • Fever due to isolette temperature
    • Distraught mother
    • Thrush/candidiasis
    • Diarrhea
    • Stolen infant

# Classic Studies 0-3 months from US

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-3 months</td>
<td>1-2 months</td>
<td>0-2 months</td>
</tr>
</tbody>
</table>

**Key Idea**
- All get ceftriaxone; more difficult to be high risk
- Low risk go home, no antibiotics; more difficult to be low risk
- To identify criteria

**Physical Exam**
- Nontoxic, no focal infection
- Infant observation score <10, no focal infection
- Appears well, no focal infection

**Labs**
- WBC <20,000
- UA <10 WBC/hpf or negative LE
- CSF <10 WBC/mm³
- CXR (if obtained) - no focal infiltrate
- WBC <15,000
- BNR <0.2
- Spun UA <10 WBC/hpf, no bacteria
- Spun urine <10 WBC/hpf
- CSF <8 WBC/mm³, negative gram stain
- CXR – no focal infiltrate
- Stool (diarrhea) <5 WBC/hpf

---

*Slide courtesy of and adapted from David Jaffe*
Prevalence of UTI in Childhood: A Meta-Analysis

<table>
<thead>
<tr>
<th></th>
<th>Prevalence</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>7.0%</td>
<td>5.5-8.4</td>
</tr>
<tr>
<td>Females (0-3 months)</td>
<td>7.5%</td>
<td>5.1-10.0</td>
</tr>
<tr>
<td>Circumcised Males</td>
<td>2.4%</td>
<td>1.4-3.5</td>
</tr>
<tr>
<td>Uncircumcised Males</td>
<td>20.1%</td>
<td>16.8-23.4</td>
</tr>
<tr>
<td>White Infants* (0-3 months)</td>
<td>8.0%</td>
<td>5.1-11.0</td>
</tr>
<tr>
<td>Black Infants* (0-3 months)</td>
<td>4.7%</td>
<td>2.1-7.3</td>
</tr>
</tbody>
</table>

*only 4 studies contributed to ethnicity data

Shaik N et al, PIDJ 2008;27:302-308

Slide courtesy of and adapted from David Jaffe
Current Approach: Infant < 28 Days

• Full septic evaluation for all:
  – Culture blood, urine, CSF
  – CBC, urinalysis, CSF studies (gram stain and differential, glucose/protein)
  – Viral testing per season: Enterovirus, Influenza, RSV, HSV
  – CXR, stool studies as clinically indicated

• Hospitalization

• Parenteral antibiotics
  – Ampicillin
  – Gentamicin or Cefotaxime
  – Acyclovir, if signs of HSV, elevated transaminases, (expectant use for < 21 days sometimes recommended, but controversial)
Current Approach Infant 1 to 2 Months

Screen for risk:
- CBC, blood culture, UA and urine culture
- Viral testing per season

If **LOW RISK***, especially if virus positive
- No antibiotics
- Re-evaluate at 24 hours

If **HIGH RISK**
- Admit
- Complete sepsis work-up, including LP
- Parenteral antibiotics

*LOW RISK MEETS ALL CRITERIA:
- Non-toxic appearance
- No focus of infection on exam (except otitis media)
- No known immunodeficiency
- WBC <15,000/mm³
- Band to neutrophil ratio (BNR) < 0.2
- Normal UA
- CSF < 8 WBC/, negative gram stain, normal glucose/protein (LP may be deferred based on physician experience)
- Normal chest radiograph (if performed)
- Born at EGA >37 weeks
Infants 2 to 3 months

- Some treat the same as > 3 months
- Not a well-studied subgroup
- UA, urine culture
- Viral testing per season
- Further work-up depends on quality of follow-up
- If follow-up not assured, screen as in younger age
  - High risk: complete sepsis work-up, admit
    - Other options: IV antibiotic or observe
  - Low risk: home, no antibiotics
- Follow-up important
# Approach to Febrile Infant 0-3 Months in St. Louis, Missouri

## Evaluation and Management of Infants 0 to 3 months with T >38°C

<table>
<thead>
<tr>
<th>AGE</th>
<th>EVALUATION</th>
<th>MANAGEMENT</th>
</tr>
</thead>
</table>
| 0-28 d | 1. Detailed history and complete physical exam  
2. Laboratory evaluation for sepsis:  
   - Blood: CBC w/diff and culture  
   - Urine: cath urinalysis and culture  
   - CSF: cell ct, protein, glucose, g stain, culture  
   - Chest radiograph (if indicated)  
   - Stool for heme test and culture (if indicated)  
   - Consider HSV and enteroviral PCR for CSF | 1. Admit for IV/IM abx until culture results available:  
   - Ampicillin:  
     - <1 wk, 100 mg/kg/dose, Q 12 h  
     - >1 wk, 50 mg/kg/dose, Q 6 h  
   - Plus cefotaxime:  
     - <1 wk, 50 mg/kg/dose, Q 8 h  
     - 1-4 wk, 50 mg/kg/dose, Q 6 h  
   - Or plus gentamicin: 5 mg/kg/day, Q 24 h  
   - If herpes suspected, acyclovir: 20 mg/kg/dose, Q 8 h |
| 29-60 d | 1. Detailed history and complete physical exam  
2. Laboratory eval for sepsis: as for 0-28 d  
3. Determine if patient is low-risk for SBI by meeting ALL criteria listed here:  
   - Non-toxic appearance  
   - No focus of infection on exam (except OM)  
   - No known immunodeficiency  
   - WBC <15,000/mm³  
   - Band to neutrophil ratio (BNR) <0.2  
   - Normal urinalysis  
   - CSF: <8 WBC/mm³, - gram stain, nl gluc/prot (Consult with attending if plan to defer LP)  
   - Normal chest radiograph (if done) | 1. If toxic-appearing, hosp. for IV/IM abx until ex results available:  
   - Ampicillin: 50 mg/kg/dose, Q 6 h  
   - Plus cefotaxime: 50 mg/kg/dose, Q 6 h (meningitic dose)  
   (Or plus gentamicin 2.5 mg/kg/dose, Q 8 h if meningitis not suspected)  
   - If herpes suspected, acyclovir: 20 mg/kg/dose, Q 8 h  
2. If high-risk, hospitalize for IV/IM abx until ex results available:  
   - Ampicillin: 50 mg/kg/dose, Q 6 h  
   - Plus cefotaxime: 50 mg/kg/dose, Q 6 h (meningitic dose)  
   (Or plus gentamicin 2.5 mg/kg/dose, Q 8 h if meningitis not suspected)  
3. If low-risk, choose option after discussion w/attending and PMD:  
   - A. 50 mg/kg ceftriaxone IM and reexam at 24 & 48 h (Must have LP)  
   - B. No abx and reexam at 24 & 48 h |
| 61-90 d | 1. Detailed history and complete physical exam  
2. Limited laboratory evaluation for sepsis:  
   - Blood: CBC w/diff and culture  
   - Urine: cath urinalysis and culture  
   - LP if clinical concern for meningitis  
   - Chest radiograph (if indicated)  
   - Stool for heme test and culture (if indicated) | 1. If toxic-appearing, perform LP and hospitalize for IV/IM abx until culture results available:  
   - Ceftriaxone: 50 mg/kg/dose, Q 12 h  
2. If non-toxic appearing:  
   - No antibiotics and reexamination at 24 and 48 h |

**Note:** The evaluation and management of febrile infants 29-60 days of age is particularly challenging due to behavioral immaturity and lack of clear and convincing medical literature.
Approach to Febrile Infant 0-3 Months in St. Louis, Missouri

Summary: Evaluation and Management of Well-appearing Febrile Infant

<table>
<thead>
<tr>
<th>AGE</th>
<th>INFECTION FOCUS</th>
<th>EVALUATION</th>
<th>ABX</th>
<th>*ADMIT?</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;28 d</td>
<td>None</td>
<td>**B, U, C</td>
<td>IV/IM</td>
<td>Yes</td>
</tr>
<tr>
<td>&lt;28 d</td>
<td>OM</td>
<td>B, U, C</td>
<td>IV/IM</td>
<td>Yes</td>
</tr>
<tr>
<td>&lt;28 d</td>
<td>Bronchiolitis, Influenza</td>
<td>B, U, C</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td>1-2 m</td>
<td>None</td>
<td>(a) B, U, C</td>
<td>IV/IM</td>
<td>+/-</td>
</tr>
<tr>
<td>1-2 m</td>
<td>(b) B, U, ± C</td>
<td>No</td>
<td>+/-</td>
<td>+/-</td>
</tr>
<tr>
<td>1-2 m</td>
<td>OM (unequivocal)</td>
<td>B, U</td>
<td>Oral</td>
<td>No</td>
</tr>
<tr>
<td>1-2 m</td>
<td>Bronchiolitis, Influenza</td>
<td>U</td>
<td>If UTI</td>
<td>No</td>
</tr>
<tr>
<td>2-3 m</td>
<td>None</td>
<td>B, U, ± C</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>2-3 m</td>
<td>OM (unequivocal)</td>
<td>Not necessary</td>
<td>Oral</td>
<td>No</td>
</tr>
<tr>
<td>2-3 m</td>
<td>Bronchiolitis, Influenza</td>
<td>U</td>
<td>If UTI</td>
<td>No</td>
</tr>
</tbody>
</table>

*Discuss disposition/treatment plans with EU attending and available PMDs

**B=cbc and blood culture U=cath UA and culture C=CSF

NOTE: LP indicated for all toxic-appearing pts or those in whom meningitis is suspected
Utah Algorithm (0-2 months)

- History, PE, FBC, UA, blood and urine culture for all
- Use modified Rochester criteria to classify low vs. high risk
  - Age < 28 days or preterm (< 37 weeks)
  - Chronic medical conditions
  - Abnormal CBC (WBC < 5,000 or > 15,000)
  - Abnormal UA (> 10 WBC /HPF)
- **If low risk**, no antibiotics, no admission to hospital

Slide courtesy of and adapted from David Jaffe*
Utah Algorithm (0-2 months)

If high risk:

• Admit and begin antibiotics
• Viral diagnostic testing
  – Respiratory viruses by NP (DFA or PCR)
  – Enterovirus by PCR, June-November or if CSF pleocytosis
• Duration of antibiotics and length of stay (LOS) based on results of testing at 24 hours
• If culture negative and viral positive, discharge at 24 hours and stop antibiotics
• If culture negative and viral negative, discharge at 36 hours **(as long as patient is well appearing, able to eat and follow-up arranged)**
• If culture positive, treat for appropriate infection


Slide courtesy of and adapted from David Jaffe
Utah Algorithm (0-2 months)

• Outcomes
  – More infants had definitive diagnosis of UTI or viral infection
  – More admitted infants positive for SBI
  – No missed SBI
  – Low risk infants more often managed without antibiotics
  – Hospital admissions shortened by 27%
  – Mean cost per admitted infant decreased from $7,178 to $5,979 (-17%)

Slide courtesy of and adapted from David Jaffe
Approach to 3 to 36 months

• History and physical give important clues
  – Learn length of febrile illness, pattern of fever
• General impression obtained in a few moments key
  – Decide if child toxic or nontoxic in appearance as you observe them
• Immunizations make a difference!
Approach to 3 to 36 months

• Concentration on:
  – Discovering cause of fever
  – Treat underlying illness

• Any fever may signify serious infection, but hyperpyrexia (temperature of 41.1°C (106°F) or higher) is more often associated with diagnoses of pneumonia, bacteremia or meningitis
Approach to 3 to 36 months

• Risk of occult bacteremia with fever without a source 3-11% with mean probability 4.3% in children 3 to 36 months with temp >39ºC

Evaluation

• Blood film for malaria parasites
• FBC – examine a thin film for morphology
• HIV test
• UA including micro
• Mantoux
• Chest radiograph
• Blood culture
• Lumbar Puncture
Evaluation

• CBC
  – White blood count (WBC) has been recommended as a screening tool since 1970s
  – WBC remains a useful screening tool
    • Rapid to perform
    • Widely available
  – Total WBC count, absolute neutrophil count and absolute band counts have all been shown to be associated with SBI
Values for WBC

- **WBC counts > 15,000 are associated with SBI**
  - Sensitivity 40 - 52%, Specificity 76 - 84%
  - Likelihood ratio 2.11 - 2.5 in infants < 2 months
  - Area under ROC 0.70 in infants < 2 months
- **Elevated absolute band counts and absolute neutrophils counts are also associated with SBI, in infants < 12 months**
- **Elevated ANC slightly better than WBC**


*Slide courtesy of and adapted from David Jaffe*
Evaluation and Treatment Strategy
3 - 36 months

• Routine testing (FBC and blood culture) not indicated for well-appearing children age 3 - 36 months with fever without focal source

• Universal antibiotic administration for possible occult bacteremia not indicated

• Pneumococcus pneumonae and Haemophilis influenzae vaccines reduce risk

Evaluation and Treatment Strategy
3 - 36 months

• Empiric IV antibiotics (ceftriaxone) may be given when patient has close follow up, BUT blood cultures must be obtained pre-treatment
  – Blood cultures means of differentiating between viral from bacterial meningitis and partial treatment from occult bacteremia from viral syndrome in event child deteriorates

• Empiric IV antibiotics without LP
  – Must consider consequences of partially treated meningitis and delayed diagnosis
  – May be used in non-toxic appearing children with fever without a source, particularly in those with *H. influenzae* type B vaccine

Evaluation and Treatment Strategy
3 - 36 months

• In the event of a positive blood culture result, child should be recalled for re-evaluation

• Repeat blood culture and LP, admit and continue IV antibiotics for:
  – Children who are still febrile
  – Children who appear ill
  – Children with blood cultures positive for Neisseria meningitidis or H. influenzae

• May consider repeat IV/IM Ceftriaxone and PO course penicillin for pneumococcus positive blood cultures

• Patients with positive urine cultures who are afebrile and tolerating PO may do course of oral antibiotics

Common Things Being Common
UTI

• Consider UA and culture for boys < 6 months and girls < 2 years, risk stratify per AAP guidelines
  – Common in boys during young infancy due to posterior urethral valves

AAP = American Academy of Pediatrics
AAP UTI Guidelines

• In febrile infant, obtain UA and culture if antimicrobial therapy being given for pressing reason

• Assess likelihood of UTI
  – If low, follow-up without testing
  – If not low, obtain UA and culture
    • Catheter or suprapubic aspirate (SPA)
    • Bag for UA and obtain catheterized specimen or SPA if UA suggests UTI

• Diagnosis based on pyuria and at least 50,000 CFU per mL of a single uropathogen

AAP Subcommittee on Urinary Tract Infection, Pediatrics 2011;128:595

Slide courtesy of and adapted from David Jaffe
AAP UTI Guidelines

### Individual Risk Factors: Girls
- White race
- Age < 12 mo
- Temperature $\geq 39^\circ\text{C}$
- Fever $\geq 2$ d
- Absence of another source of infection

<table>
<thead>
<tr>
<th>Probability of UTI</th>
<th>No. of Factors Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\leq 1%$</td>
<td>No more than 1</td>
</tr>
<tr>
<td>$\leq 2%$</td>
<td>No more than 2</td>
</tr>
</tbody>
</table>

### Individual Risk Factors: Boys
- Nonblack race
- Temperature $\geq 39^\circ\text{C}$
- Fever $> 24$ h
- Absence of another source of infection

<table>
<thead>
<tr>
<th>Probability of UTI</th>
<th>Uncircumcised</th>
<th>Circumcised</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\leq 1%$</td>
<td>a</td>
<td>No more than 2</td>
</tr>
<tr>
<td>$\leq 2%$</td>
<td>None</td>
<td>No more than 3</td>
</tr>
</tbody>
</table>

**FIGURE 2**
Probability of UTI Among Febrile Infant Girls and Infant Boys According to Number of Findings Present. aProbability of UTI exceeds 1% even with no risk factors other than being uncircumcised.
Child with Fever and Rash

• Febrile, toxic-looking child with poor perfusion and hemorrhagic or petechial rash
  – Concern for SBI
    • Rickettsial
    • Spirochetal disease

• Carefully obtain blood culture, WBC and start antibiotics – do not delay!

• Gram stain exam ofuffy coat and fluid from pustular or petechial skin lesions
Meningitis

Early diagnosis and treatment is essential!

<table>
<thead>
<tr>
<th>In the history</th>
<th>In the exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>Stiff neck</td>
</tr>
<tr>
<td>Vomiting</td>
<td>Irritability</td>
</tr>
<tr>
<td>Irritability</td>
<td>Convulsions</td>
</tr>
<tr>
<td>Headache</td>
<td>Lethargy</td>
</tr>
<tr>
<td>Neck ache or back pain</td>
<td>Bulging fontanelle</td>
</tr>
<tr>
<td>Convulsions</td>
<td>Skin rash - petechiae</td>
</tr>
<tr>
<td>Recent head injury</td>
<td>Ear discharge</td>
</tr>
<tr>
<td>Recent infection</td>
<td>Kernig's &amp; Brudzinski signs</td>
</tr>
<tr>
<td></td>
<td>Signs of raised ICP</td>
</tr>
<tr>
<td></td>
<td>Irregular breathing</td>
</tr>
<tr>
<td></td>
<td>Posturing</td>
</tr>
<tr>
<td></td>
<td>Unequal pupils</td>
</tr>
<tr>
<td></td>
<td>Focal neuro signs</td>
</tr>
</tbody>
</table>

Slide courtesy of and adapted from Malawi College of Medicine
Bacterial Meningitis in Africa in Children > 2 months

• Most prevalent to least:
  – *Streptococcus pneumoniae*
  – *Haemophilus influenzae*
  – *Salmonella typhi and enteritidis*

• Less common:
  – *Staph aureus, Neisseria meningitidis, E. coli*

• Consider also:
  – TB meningitis (prolonged fever)
  – Cryptococcal meningitis (headache without neck stiffness, HIV positive, Dx: India ink stain)
Septic Arthritis or Osteomyelitis

- Child refusing to bear weight or move affected extremity
  - Children <3 years
    - *Haemophilus influenzae* type B
    - *Strep pneumoniae*
    - *S. pyogenes* group A
    - *Salmonella*
    - *Klebsiella kingae*
  - Children >3 years
    - Staph aureus
- If suspected, use sterile needle to obtain culture
- Treat with appropriate antibiotics until extremity regains mobility, patient can bear weight and fever resolved
  - {Clinical pearl: Do not discharge someone who cannot walk}
Other

{Clinical Pearls}
Child With Fever

• Is the child seriously ill?
• If yes, is there an obvious source of infection?

• Past History: HIV (pneumocystis, TB), sickle cell (pneumococcus), nephrotic syndrome (pneumococcus), rheumatic fever (SBE)

• Current Illness: Duration and type of fever, recent tick or louse bites (relapsing fever, rickettsia), water source (typhoid), living conditions – rats, fleas (plague, leptospirosis), infectious contacts (TB, influenza)
Diagnostic Clues

• Fever pattern
  – Relapsing fever
  – Remittent fever
• Fever with anemia
• Fever with jaundice
• Fever with an obvious rash
• Fever with lymphadenopathy
• Fever with white blood cell abnormalities
  – Eosinophilia
  – Neutrophilia
  – Neutropenia
Fever Pattern

- Relapsing Fever
  - Malaria
  - Visceral leishmaniasis (protozoan parasite)
  - African trypanosomiasis (parasitic protozoan trypanosomes)
  - Brucellosis
  - Filariasis (roundworm)
  - Lyme disease

- Remitting Fever
  - Tuberculosis
  - Infectious mononucleosis
  - Typhoid
  - Visceral larva migrans (roundworm)
  - HIV infection
  - Bacterial endocarditis
  - Amebiasis
  - Trichinosis (roundworm)
Malaria

• Uncomplicated vs Complicated
• You know more about this than I do!

{Clinical pearl: Always check blood sugar in someone that is obtunded}
Fever with Anemia

• Malaria
• Incidental pre-existing anemia
• Bartonellosis
• Babesiosis
Fever with Jaundice

- Viral hepatitis
- Epstein-Barr virus (infectious mononucleosis)
- Malaria
- Typhoid
- Leptospirosis
- Cytomegalovirus
Fever with an Obvious Rash

- Meningococcemia
- Rickettsial spotted fevers
- Viral hemorrhagic fevers
- Dengue and similar arboviruses
- Leptospirosis
- Secondary syphilis
- Collagen-vascular disease and drug reactions
Fever with Lymphadenopathy

• Fever and Cervical Lymphadenopathy
  – Primary toxoplasmosis
  – Bartonella (cat scratch disease)
  – Atypical TB

• Fever and Generalized Lymphadenopathy
  – Epstein-Barr virus (infectious mononucleosis)
  – Trypanosomiasis (parasitic protozoan trypanosomes)
  – Toxoplasmosis
  – HIV infection
  – Filariasis
  – Leptospirosis
  – Leukemia/lymphoma
  – Juvenile rheumatoid arthritis
  – Drug reactions
  – Secondary syphilis
Fever with White Blood Cell Abnormalities

- **Eosinophilia**
  - Fasciola hepatica (liver fluke)
  - Filariasis (roundworm)
  - Visceral larva migrans (roundworm)
  - Trichinosis (roundworm)
  - Severe strongyloidiasis (roundworm)
  - Drug reactions

- **Neutrophilia**
  - Pyogenic abscess
  - Leptospirosis (a spirochaete bacterium)
  - Relapsing fever (louse-born bacteria *Rickettsia* and *Borrelia*)
  - Amebic liver abscess
  - Collagen-vascular disease

- **Neutropenia**
  - Viral infections
  - Rickettsial infections
  - Typhoid
Collagen-vascular diseases

- Rheumatic Fever
- Juvenile Rheumatoid Arthritis (JRA)
- Kawasaki’s disease
Other Fevers

• Drug reactions
• Tumors
• Familial fevers
Child With Fever

- Fever With Localizing Signs
  - Meningitis – bulging fontanel, stiff neck, irritable
  - Otitis Media – ear pain or discharge
  - Mastoiditis – tender swelling behind the ear
  - Osteomyelitis – refusal to bear weight, tender area over bone
  - Septic Arthritis - hot swollen, tender joint
  - Infectious Endocarditis - heart murmur, enlarged spleen, petechiae, anemia, weight loss, splinter hemorrhages (under nail), microscopic hematuria
  - Miliary TB – enlarged spleen ± liver, anorexia, night sweats, weight loss, family history of TB, fine infiltrates on chest radiograph {Note: Mantoux test often negative with Miliary TB, severe malnutrition or HIV}
  - Acute Rheumatic Fever – heart murmur, heart failure, arthritis/arthralgia, tachycardia, pericardial friction rub, migrating rash, chorea, history of sore throat
  - Skin and Soft Tissue Infection - erythema, tenderness, warmth, swelling, pus drainage
  - Pneumonia – fast breathing, grunting, crackles, retractions, nasal flaring
  - Viral URI – cough and rhinorrhea, no systemic symptoms
  - Retropharyngeal Abscess – refusal to move neck, pharyngitis, refusal to drink
  - Sinusitis – tenderness and pain over affected sinus
  - Hepatitis – jaundice
  - Rash - petechiae, purpura, maculopapular; cellulitis, pustules
Child With Fever

- **Fever Without Localizing Signs**
  - Malaria
  - Septicemia
    - Primary bacteremia, plague
  - Malignancy
  - Typhoid
    - Particularly consider if fever persists >7 days and malaria has been excluded
    - Complications: acute abdomen, coma, convulsions, cardiac failure, shock
  - Urinary Tract Infection
  - Infection Associated with HIV
  - Other protozoa
    - Babesiosis (parasitic disease via ticks)
    - Toxoplasmosis (parasitic disease from protozoan)
  - **Bartonella species**
    - Carrion’s disease (Peruvian warts via sandflies); Cat scratch disease
  - Arboviral fevers
    - Dengue fever
  - Hemorrhagic fevers
    - Lassa fever, Marburg virus disease, Ebola virus disease, Dengue hemorrhagic fever group, Congo-Crimean fever
Fever Follow Up

• Advise patient to come back if fever persists, overall worsening, unable to drink or to take medications due to persistent vomiting
Sources

• Hospital Care for Children. 2nd Ed. World Health Organization. 2013.