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The New and Nuanced Ways to Evaluate Fever in Infants Aged less than 60 days

- Beech Burns, MD, MCR
- Associate Professor of Pediatrics and Emergency Medicine
- Medical Director, Pediatric Emergency Department
- Oregon Health and Science University

Objectives

At the conclusion of this educational session, learners will be able to:

- 1. Review the historical approach to the evaluation of young children with fever
- 2. Examine new evidence undergirding the American Academy of Pediatrics guideline for evaluating patients under 60 days with fever
- 3. Describe the practice implications of adopting these new guidelines.

Disclosures

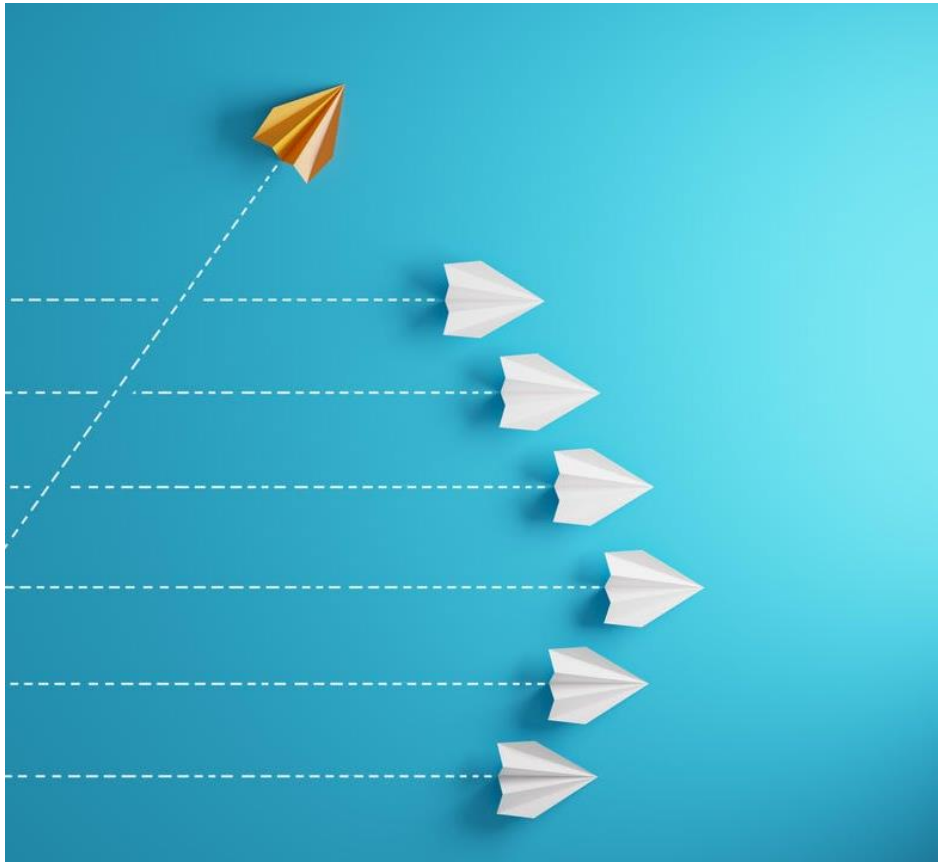
No financial or otherwise

Where we started

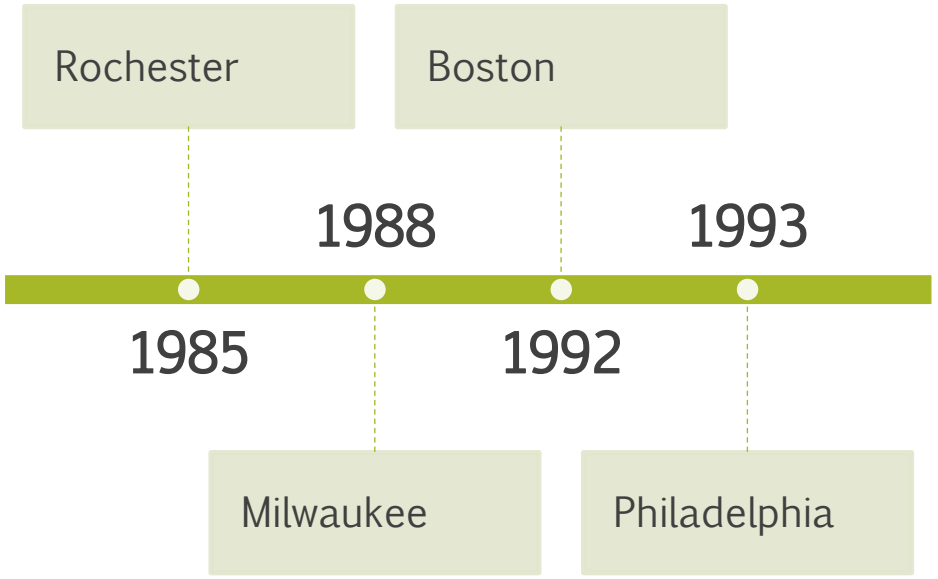
- Example of the primary evidence:
  - "…305 infants less than 60 days of age with temperatures > 38.0 were evaluated…Of these 20.6%...had significant diseases…3.6% had bacteremia. Neither the age of the child (above or below 30 days of age) nor the height of the fever helped to identify infants with bacteremia. WBC count > 15,000/mm3 was useful in identifying bacteremic infants over 30 days of age only. The differential white blood cell count was not helpful…"
- Conventional wisdom, circa 1984:
  - "Rules for the care of the infant aged 1 to 8 weeks: 1. The patient should be admitted to the hospital for evaluation, observation, and therapy. Having made an exception to this rule, both doctor and parent should have disruption of REM (rapid eye movement) sleep…"
- Antibiose, admit them all!

A Change in Paradigm

- "Then Keith Powell and his colleagues at Rochester proposed an alternative strategy: instead of focusing on who had bacteremia, focus on those who did not and create criteria for a ***low-risk category*** that could permit infants to avoid unnecessary (over) treatment."
  - Roberts KB, Pantell RH. "Development of the New AAP Febrile Infant Clinical Practice Guideline" Hospital Pediatrics, Sept 2021



A Better Way?



	Boston criteria	Milwaukee criteria	Philadelphia criteria	Rochester criteria
Age range	▪ 28 to 89 days	▪ 28 to 56 days	▪ 29 to 60 days	▪ ≤60 days
Temperature	▪ ≥38.0°C	▪ ≥38.0°C	▪ ≥38.2°C	▪ ≥38.0°C
History*	▪ No immunizations within last 48 hours ▪ No antimicrobial within 48 hours ▪ Not dehydrated	▪ Not defined	▪ Not defined	▪ Term infant ▪ No perinatal antibiotics ▪ No underlying disease ▪ Not hospitalized longer than the mother
Physical examination*	▪ Well appearing ▪ No sign of focal infection (middle ear, soft tissue, bone/joint)	▪ Well appearing (normal breathing, alert, active, normal muscle tone) ▪ Not dehydrated ▪ No sign of focal infection (middle ear, soft tissue, bone/joint)	▪ Well appearing ▪ Unremarkable examination	▪ Well appearing ▪ No sign of focal infection (middle ear, soft tissue, bone/joint)
Laboratory parameters*	▪ CSF <10/mm^3 ▪ WBC <20,000/mm^3 ▪ UA <10 WBCs/hpf ▪ Chest radiograph: no infiltrate (if obtained)	▪ CSF <10/mm^3 ▪ WBC <15,000/mm^3 ▪ UA <5 to 10 WBCs/hpf (no bacteria, negative LE/nitrite) ▪ Chest radiograph: no infiltrate (if obtained)	▪ CSF <8/mm^3 ▪ WBC <15,000/mm^3 ▪ UA <10 WBCs/hpf ▪ Urine Gram stain negative ▪ CSF Gram stain negative ▪ Chest radiograph: no infiltrate ▪ Stool: no blood, few or no WBCs on smear (if indicated) ▪ Band-neutrophil ratio <0.2	▪ CSF: NA (no lumbar puncture is indicated) ▪ WBC >5000 and <15,000/mm^3 ▪ ABC <1500 ▪ UA ≤10 WBCs/hpf ▪ Stool: ≤5 WBCs/hpf smear (if indicated)
Management strategy for low risk	▪ Home/outpatient ▪ Empiric antibiotics ▪ Follow-up required	▪ Reliable caretaker followup required ▪ IM ceftriaxone 50 mg/kg followed by re-evaluation within 24 hours	▪ Home/outpatient ▪ No antibiotics ▪ Followup required	▪ Home/outpatient ▪ No antibiotics ▪ Follow-up required
Management strategy for high risk	▪ Hospitalize ▪ Empiric antibiotics	▪ Not defined	▪ Hospitalize ▪ Empiric antibiotics	▪ Hospitalize ▪ Empiric antibiotics

What labs did they use and what was recommended management?

	Boston criteria	Milwaukee criteria	Philadelphia criteria	Rochester criteria
Age range	▪ 28 to 89 days	▪ 28 to 56 days	▪ 29 to 60 days	▪ ≤60 days
Physical examination*	▪ Well appearing ▪ No sign of focal infection (middle ear, soft tissue, bone/joint)	▪ Well appearing (normal breathing, alert, active, normal muscle tone) ▪ Not dehydrated ▪ No sign of focal infection (middle ear, soft tissue, bone/joint)	▪ Well appearing ▪ Unremarkable examination	▪ Well appearing ▪ No sign of focal infection (middle ear, soft tissue, bone/joint)
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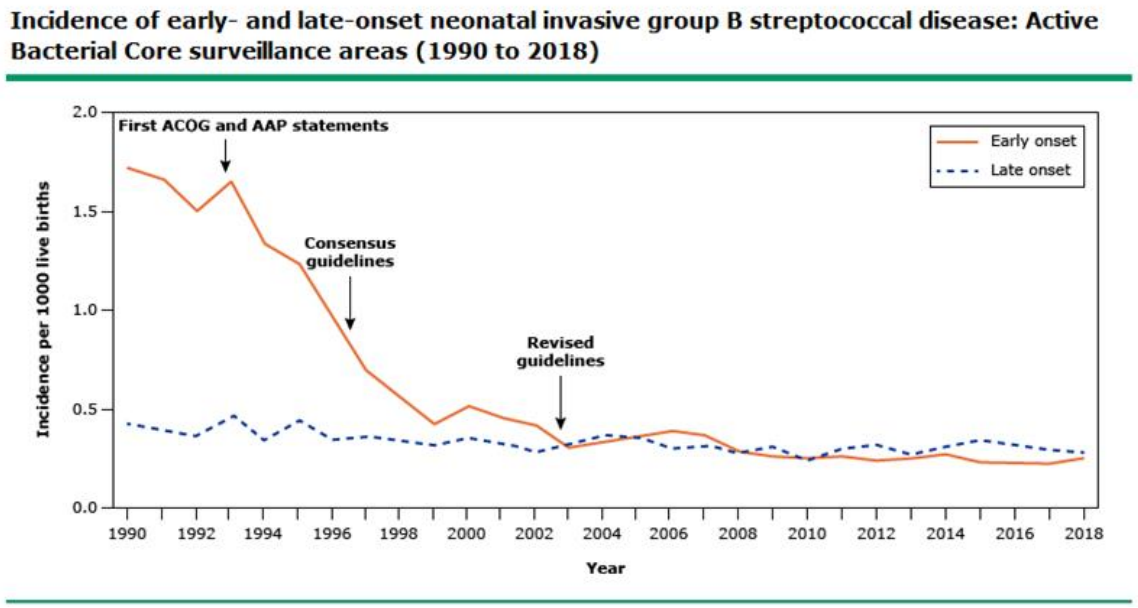
Management strategy for high risk	▪ Hospitalize ▪ Empiric antibiotics	▪ Not defined	▪ Hospitalize ▪ Empiric antibiotics	▪ Hospitalize ▪ Empiric antibiotics

The steady erosion of traditional risk stratification systems (Part 1)

- Changing Bacterial Epidemiology
- Derived from large, single center studies



How do these criteria hold up?

	IBI		SBI	
	Boston Criteria	Philadelphia Criteria	Boston Criteria	Philadelphia Criteria
Sensitivity, % (95% CI)	62.7 (55.9 to 69.3)	71.7 (65.2 to 77.6)	79.4 (76.7 to 81.9)	86.2 (83.9 to 88.3)
Specificity, % (95% CI)	59.2 (58.1 to 60.2)	46.1 (45.0 to 47.2)	64.6 (63.5 to 65.7)	51.3 (50.1 to 52.5)
Negative predictive value, % (95% CI)	98.4 (98.0 to 98.8)	98.3 (97.9 to 98.7)	95.8 (95.2 to 96.4)	96.3 (95.6 to 96.9)
Positive predictive value, % (95% CI)	3.9 (3.2 to 4.6)	3.5 (3.0 to 4.1)	23.5 (22.0 to 25.0)	20.1 (18.9 to 21.4)
Negative likelihood ratio (95% CI)	0.6 (0.5–0.8)	0.6 (0.5–0.8)	0.3 (0.3–0.4)	0.3 (0.2–0.3)
Positive likelihood ratio (95% CI)	1.5 (1.4–1.7)	1.3 (1.2–1.4)	2.2 (2.1–2.4)	1.8 (1.7–1.8)

"Using the decision models of the 1980s today can lead to misclassification of bacterial meningitis in 23.3% to 32.1% of cases"

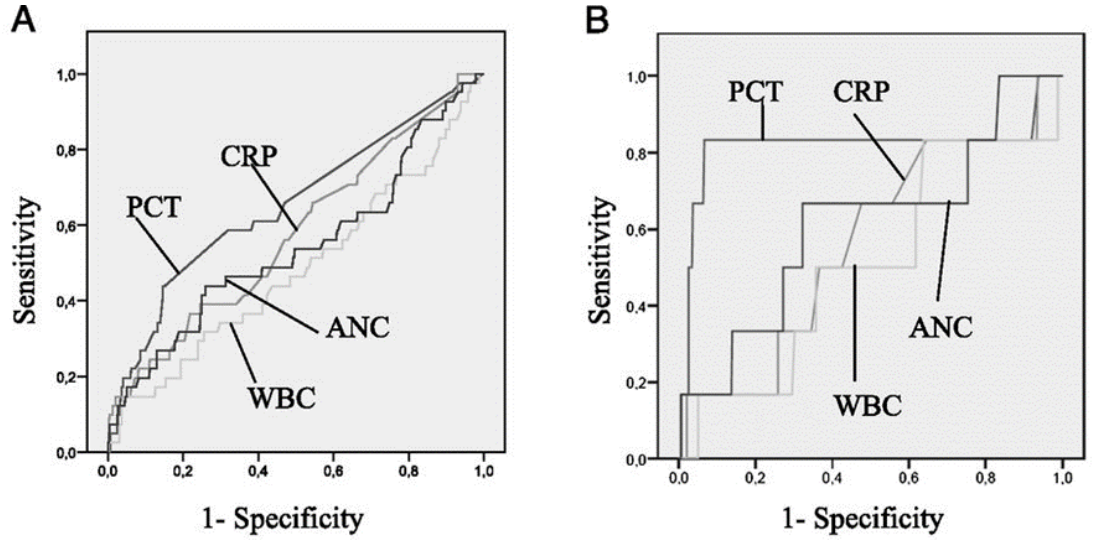
Lyons TW, Garro AC, Cruz AT et al; Herpes Simplex Virus Study Group of the Pediatric Emergency Medicine Collaborative Research Committee (PEM CRC). Performance of the modified Boston and Philadelphia criteria for invasive bacterial infections. Pediatrics. 2020;145(4):e20193538

The steady erosion of traditional risk stratification systems (Part 2)

- BETTER TESTS
  - Quicker pathogen identification – blood cultures, ME panels
  - Viral testing
  - Newer and better tests—C-reactive protein, Procalcitonin

Procalcitonin for SBI *and* IBI

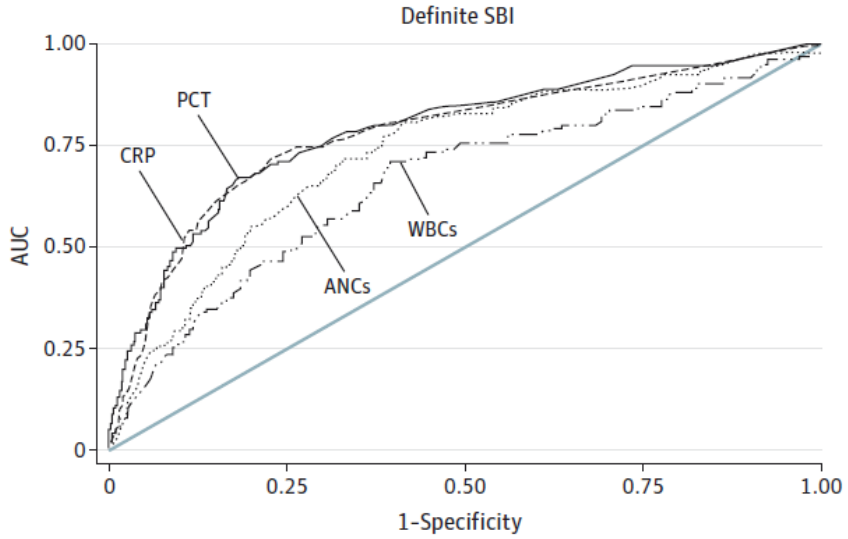
ROC curves to detect definite (A) SBIs and (B) IBIs among infants with normal UD and fever of recent onset.

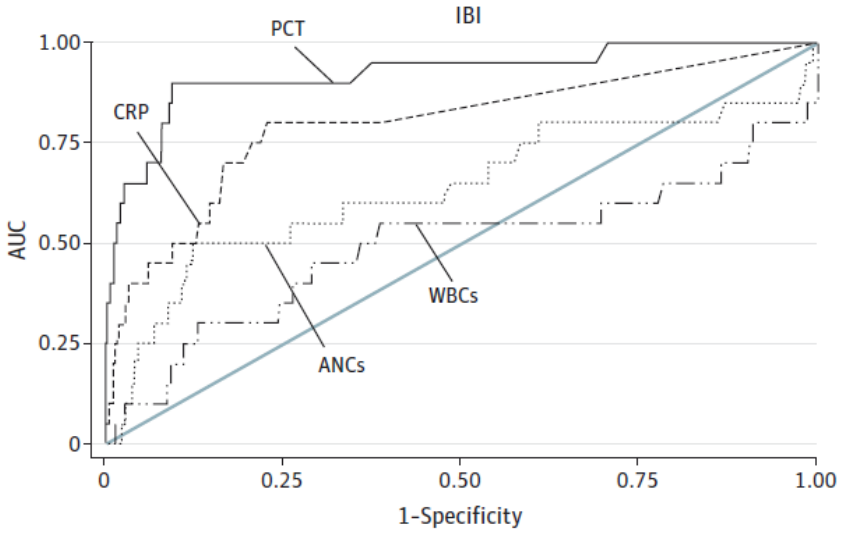


Infection biomarkers	Area Under the ROC Curve (95% CI)	
	SBI	IBI
PCT	0.652 (0.555–0.748)	0.819 (0.551–1.087)
CRP	0.577 (0.481–0.673)	0.563 (0.333–0.793)
ANC	0.541 (0.437–0.645)	0.613 (0.368–0.858)
WBC	0.483 (0.381–0.585)	0.509 (0.269–0.749)

Procalcitonin for SBI and IBI

Area Under the Curve (AUC) for the ROC Curves for Biomarkers to Detect Definite SBIs and IBIs

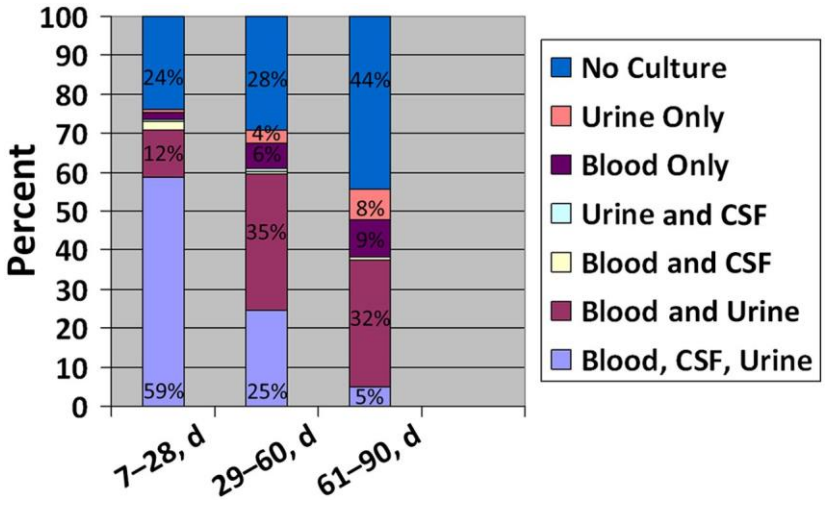




	Definite SBI (n = 139)		IBI (n = 21)	
Biomarker	AUC (95% CI)	*P* Value*	AUC (95% CI)	*P* Value*
PCT, ng/mL	0.81 (0.75-0.86)		0.91 (0.83-0.99)	
CRP, mg/L	0.80 (0.75-0.85)	.70	0.77 (0.65-0.89)	.002
ANCs, /µL	0.73 (0.66-0.79)	.08	0.61 (0.45-0.77)	.004
WBCs, /µL	0.66 (0.58-0.73)	<.001	0.48 (0.31-0.66)	<.001

*Compared with PCT.

The steady erosion of traditional risk stratification systems (Part 3): Cost of Unnecessary Care



- N = 1,380 children
- 195 with SBI
  - 13.2% UTI
  - 2.6% bacteremia
  - 0.3% meningitis
- 68% had at least one culture obtained
  - 59% aged 7 to 28 days had full evaluation
  - 25% 29 to 60 days
  - 5% 61 to 90 days

Reasons Cited for Cultures not Obtained in Febrile Infants

Days Old, *N* (%)			
	7–28	29–60	61–90
Reason cultures not obtained			
Other diagnosis (ie, otitis media, pneumonia, etc)	8 (14)	12 (7)	10 (5)
Immunization	0	41 (22)	45 (24)
Upper respiratory symptoms/bronchiolitis	10 (18)	62 (34)	83 (43.5)
Sick contacts appeared well	3 (5)	25 (14)	31 (16)
Did not believe thermometer environmental conditions	35 (63)	35 (19)	15 (8)
Parents decline	0	5 (3)	6 (3)
Laboratory error/unknown	0	2 (1)	1 (0.5)
Total	56	182	191

"A disconcerting reality of common practice of medicine is what seems to be a dismissal by many practitioners of established scientific evidence…Numerous publications of prospectively collected data have repeatedly found a 6% to 7% concurrence of bacterial infection in febrile infants with demonstrated viral infection…the very low incidence of bacteremia and bacterial meningitis can skew that perception of risk…Often, our management practices are affected by commonalities of practice, which might be influenced by patient conveniences, personal habits, or other experiential biases."

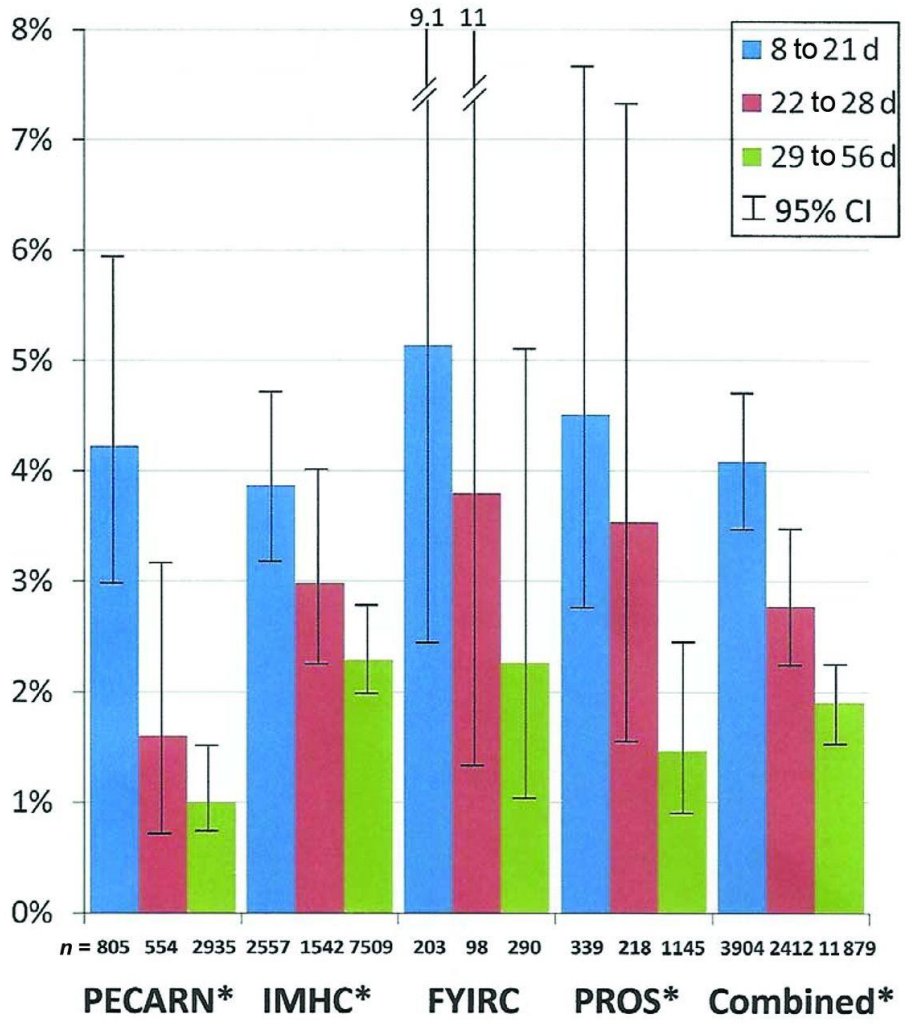
- Management of Fever in Young Infants: Evidence Versus Common Practice, Pediatrics (2016) 138 (6): e20162085

What should a new stratification system look like?

- Uses newer and better laboratory tests
- Laboratory values should emerge from primary data, rather than set a priori
- Age stratifications more closely align with risk of infection

What age categories align most closely with risk?

Rate of bacteremia by age groupings. * χ2 for trend: P < .001.



Robert H. Pantell et al. Pediatrics 2021;148:e2021052228

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Alright, somebody just throw together an AAP Guideline, would ya?

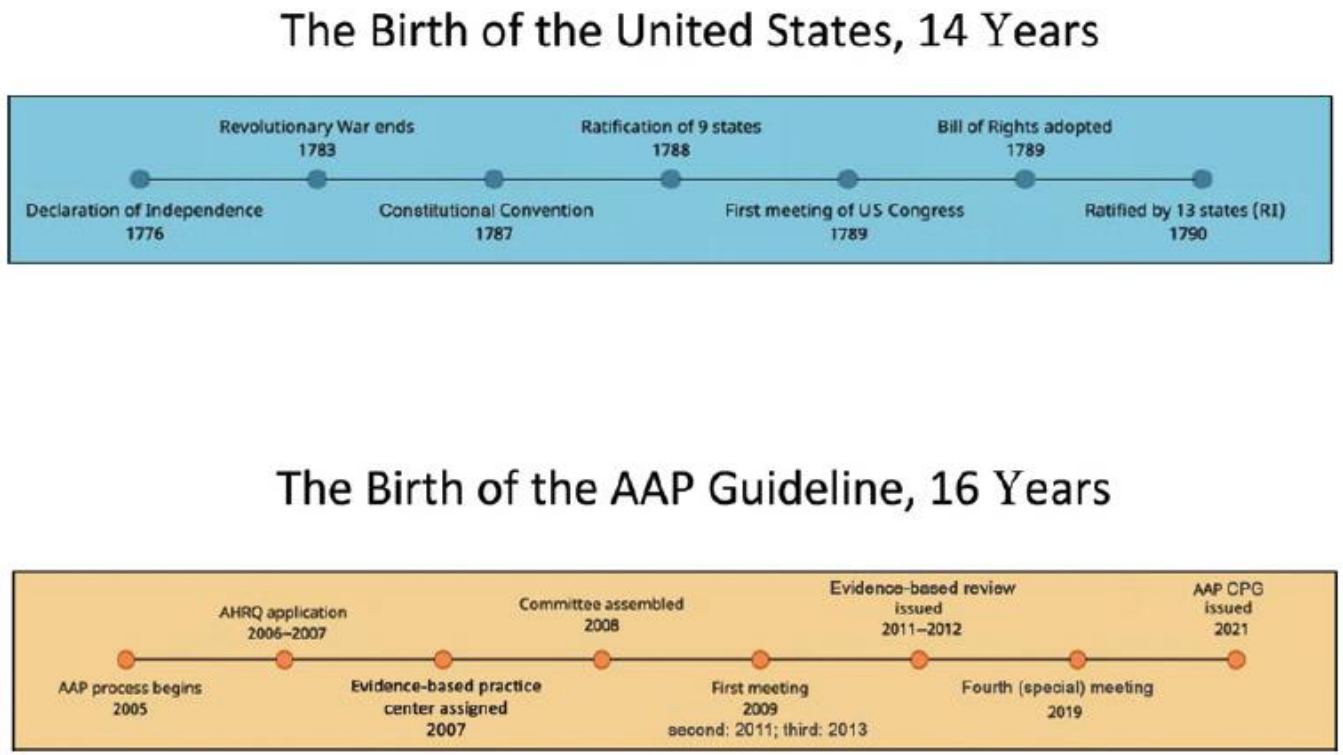
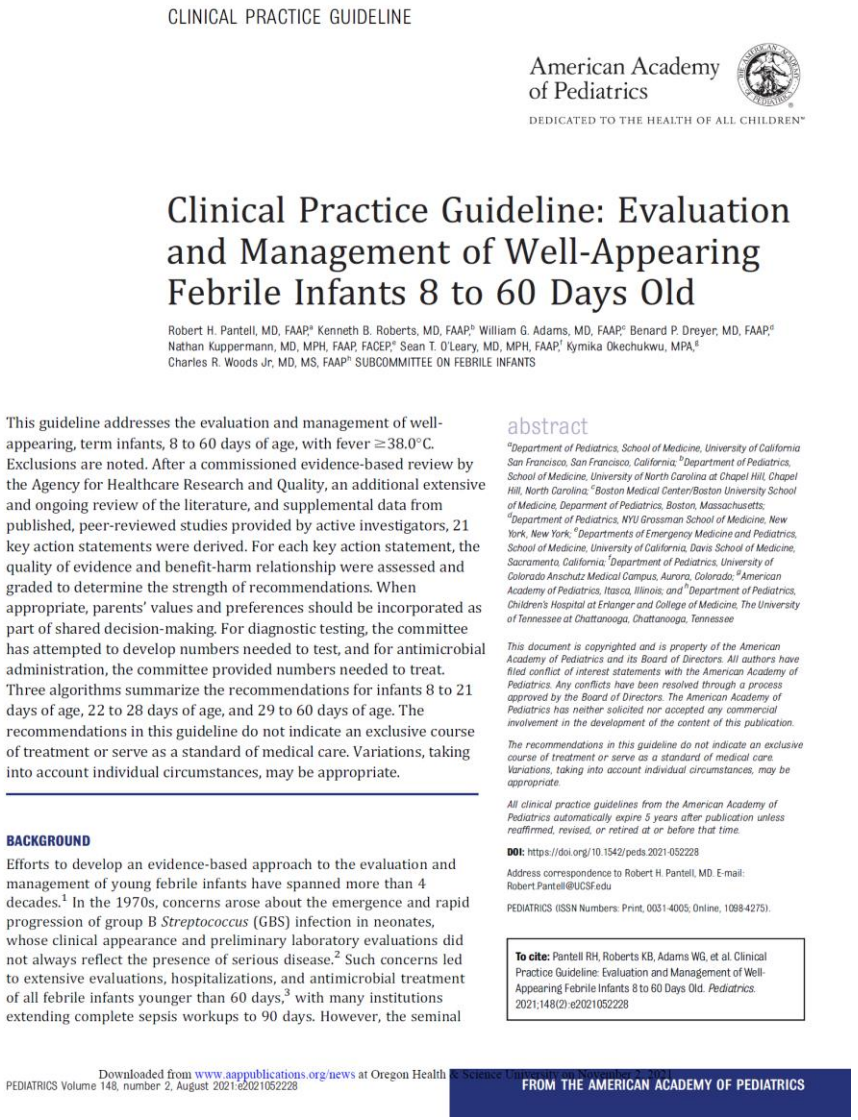


FIGURE 3 Two time lines. AHRQ, Agency for Health Research and Quality.

Then, at long last…



CLINICAL PRACTICE GUIDELINE

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Clinical Practice Guideline: Evaluation and Management of Well-Appearing Febrile Infants 8 to 60 Days Old

Robert H. Pantell, MD, FAAP,[a] Kenneth B. Roberts, MD, FAAP,[b] William G. Adams, MD, FAAP,[c] Benard P. Dreyer, MD, FAAP,[d] Nathan Kuppermann, MD, MPH, FAAP, FACEP,[e] Sean T. O'Leary, MD, MPH, FAAP,[f] Kymika Okechukwu, MPA,[g] Charles R. Woods Jr, MD, MS, FAAP[h] SUBCOMMITTEE ON FEBRILE INFANTS

This guideline addresses the evaluation and management of well-appearing, term infants, 8 to 60 days of age, with fever ≥38.0°C. Exclusions are noted. After a commissioned evidence-based review by the Agency for Healthcare Research and Quality, an additional extensive and ongoing review of the literature, and supplemental data from published, peer-reviewed studies provided by active investigators, 21 key action statements were derived. For each key action statement, the quality of evidence and benefit-harm relationship were assessed and graded to determine the strength of recommendations. When appropriate, parents' values and preferences should be incorporated as part of shared decision-making. For diagnostic testing, the committee has attempted to develop numbers needed to test, and for antimicrobial administration, the committee provided numbers needed to treat. Three algorithms summarize the recommendations for infants 8 to 21 days of age, 22 to 28 days of age, and 29 to 60 days of age. The recommendations in this guideline do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

BACKGROUND

Efforts to develop an evidence-based approach to the evaluation and management of young febrile infants have spanned more than 4 decades.[1] In the 1970s, concerns arose about the emergence and rapid progression of group B *Streptococcus* (GBS) infection in neonates, whose clinical appearance and preliminary laboratory evaluations did not always reflect the presence of serious disease.[2] Such concerns led to extensive evaluations, hospitalizations, and antimicrobial treatment of all febrile infants younger than 60 days,[3] with many institutions extending complete sepsis workups to 90 days. However, the seminal

abstract

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The recommendations in this guideline do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

All clinical practice guidelines from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

DOI: https://doi.org/10.1542/peds.2021-052228

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

To cite: Pantell RH, Roberts KB, Adams WG, et al. Clinical Practice Guideline: Evaluation and Management of Well-Appearing Febrile Infants 8 to 60 Days Old. *Pediatrics.* 2021;148(2):e2021052228

Who's In?

- Well appearing infants aged 8 to 60 days who have a documented *rectal* temperature of ≥38.0°C at home or in a clinical setting in the past 24 hours and had a gestation between ≥37 and <42 weeks

- Even if they have…
  - Respiratory symptoms
  - Diarrhea
  - Otitis media

  OR
  - Positive viral test results

Who's Out?

- Ill appearing or not sure
- Preterm
- Infants < 2 weeks whose perinatal course complicated by maternal fever, infection, antimicrobial use
- High suspicion of HSV (e.g. vesicles)
- Focal bacterial infection (e.g. cellulitis, omphalitis)
- Clinical Bronchiolitis*
- Suspected or known immune compromise
- Previous surgery or infection
- Congenital or chromosomal abnormalities or medically fragile infants
- Infants immunized in the last 48 hours (***fever > 40%*** within first 48 hours)

Table III. Rate of SBI among febrile infants with and without documented viral infections

	Virus positive		Virus negative, n (%) (95% CI)		Risk Ratio (95% CI)
	n (%)	95% CI	n (%)	95% CI	
Any SBI	44/1200 (3.7%)	2.7%-4.9%	222/1745 (12.7%)	11.2%-14.4%	3.5 (2.5-4.8)
UTIs	33/1200 (2.8%)	1.9%-3.8%	186/1745 (10.7%)	9.2%-12.2%	3.9 (2.7-5.6)
Bacteremia	9/1199 (0.8%)	0.3%-1.4%	50/1743 (2.9%)	2.1%-3.8%	3.8 (1.9-7.7)
Meningitis	5/1200 (0.4%)	0.1%-1.0%	14/1745 (0.8%)	0.4%-1.3%	1.9 (0.7-5.3)

Table IV. Rate of SBI stratified by age among febrile infants with and without documented viral infections

Variables	Virus positive	Virus negative	Age-specific RR
SBI			
≤28 d	4.2% (2.4%-6.7%)	16.9% (14.2%-19.8%)	4.0 (2.4-6.6)
>28 d	3.4% (2.3%-4.9%)	9.9% (8.1%-11.9%)	2.9 (1.9-4.3)
UTI			
≤28 d	2.6% (1.3%-4.8%)	13.3% (10.9%-16.1%)	5.1 (2.7-9.6)
>28 d	2.8% (1.8%-4.2%)	8.8% (7.2%-10.7%)	3.1 (2.0-4.9)
Bacteremia			
≤28 d	1.1% (0.3%-2.7%)	4.4% (3.0%-6.1%)	4.1 (1.5-11.6)
>28 d	0.6% (0.2%-1.4%)	1.8% (1.1%-2.9%)	3.0 (1.1-8.1)
Meningitis			
≤28 d	0.8% (0.2%-2.3%)	1.7% (0.9%-2.9%)	2.1 (0.6-7.5)
>28 d	0.2% (0.0%-0.9%)	0.2% (0.0%-0.7%)	0.8 (0.1-5.6)

The percentages in the columns represent the proportion of infants with the type of SBIs stratified by age category and by individual type of SBI.

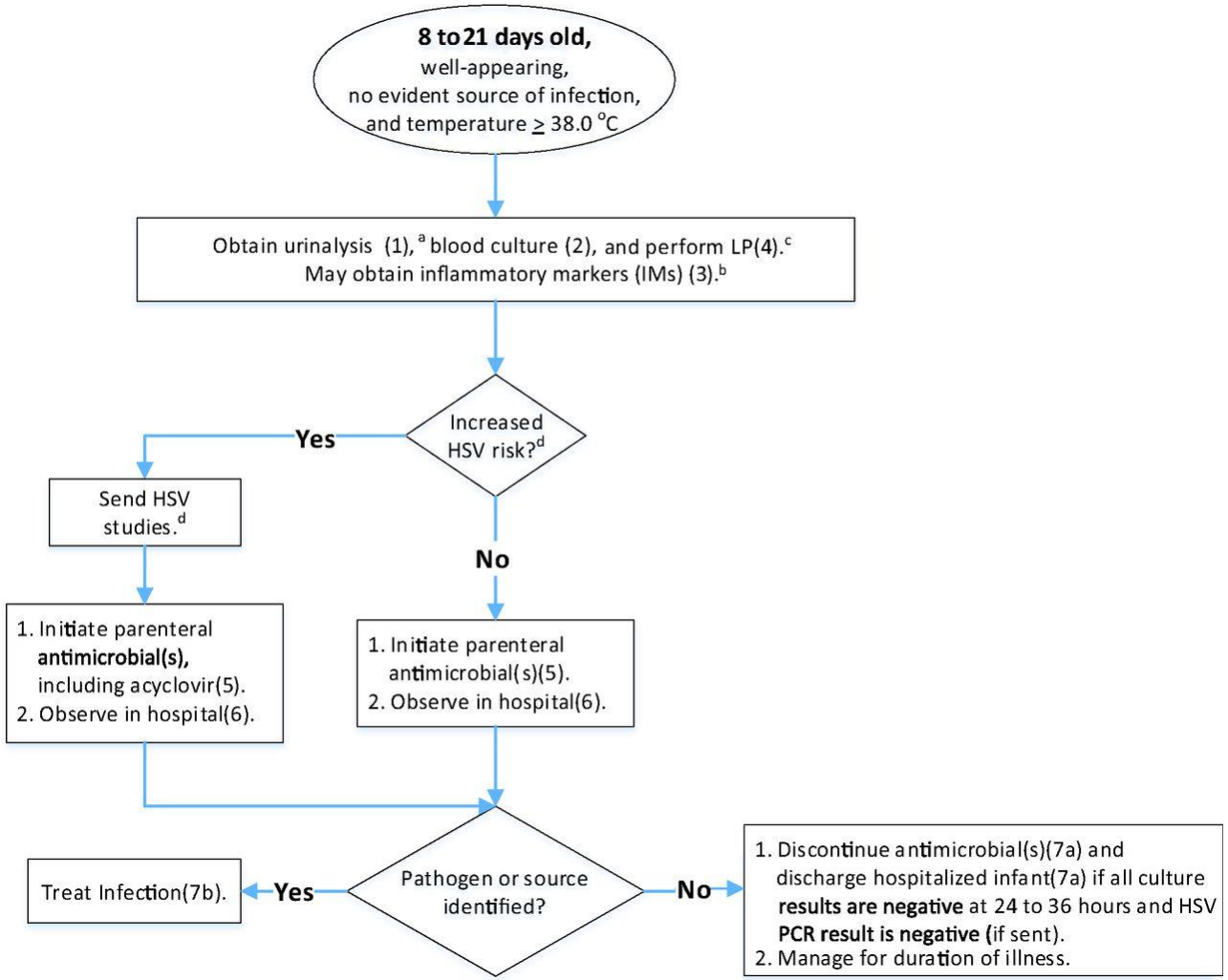
Really? Positive viral testing doesn't matter?

For that family that doesn’t want their infant catheterized, let alone lumbar punctured…

- Risk Tolerance: A Number is Not a Decision
- “Even with the availability of valid and reliable data, thoughtful investigators and clinicians will have different thresholds for recommending diagnostic tests and therapeutic interventions…Differences in risk tolerance also exist between parents and physicians and may exist among family members. A clinician may estimate that an infant’s risk of meningitis is 1% and an LP is indicated, whereas a parent may have a higher threshold for consenting to the procedure.”

To the Algorithms!

Algorithm for 8- to 21-day-old infants. a KAS references are shown in parentheses. b Laboratory values of inflammation are considered elevated at the following levels



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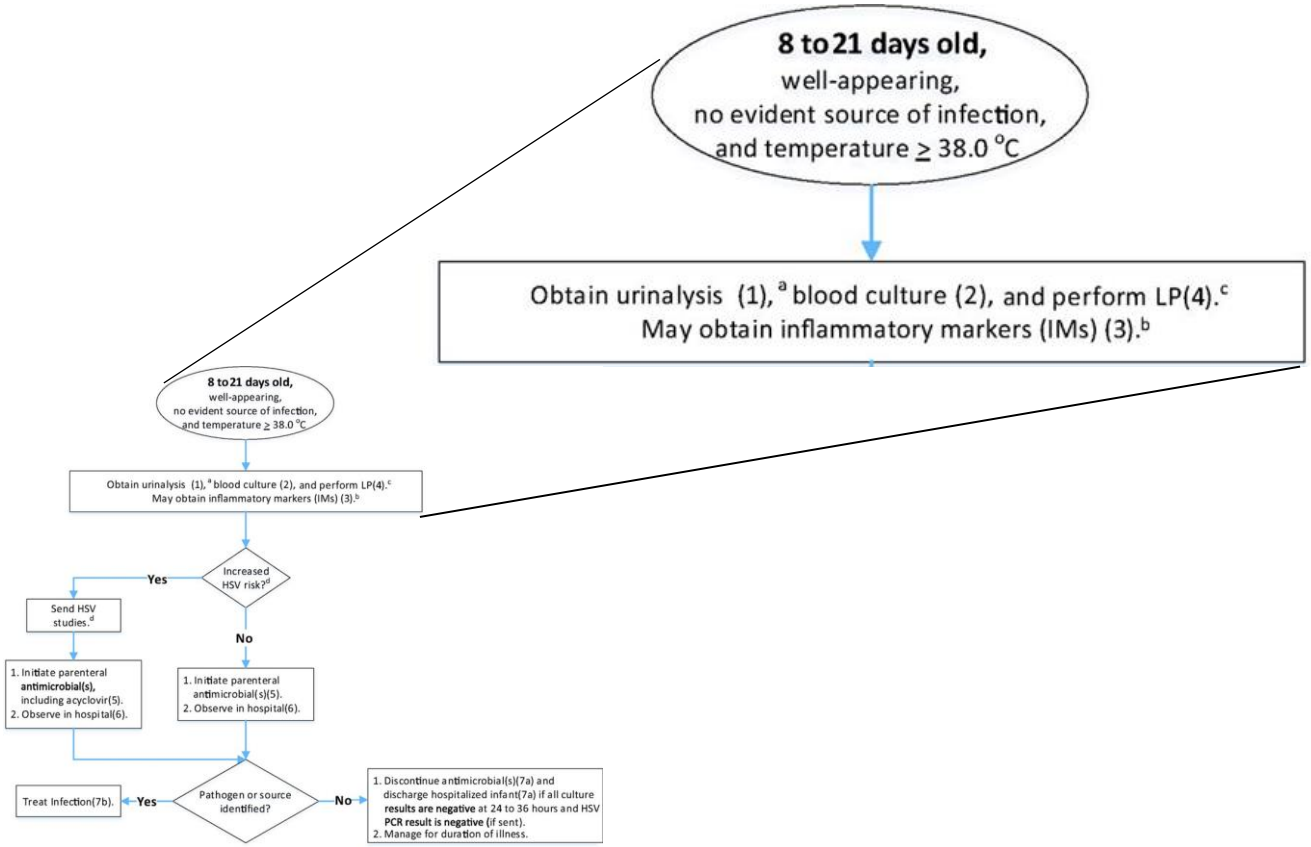
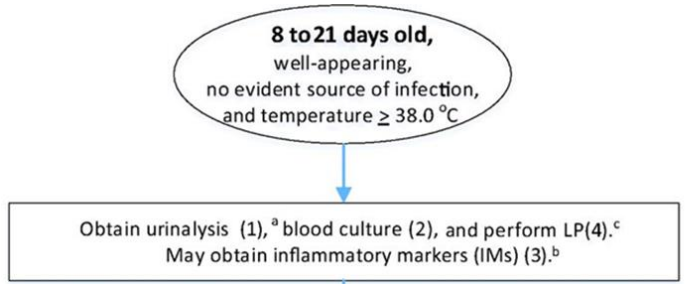
What's the Same?

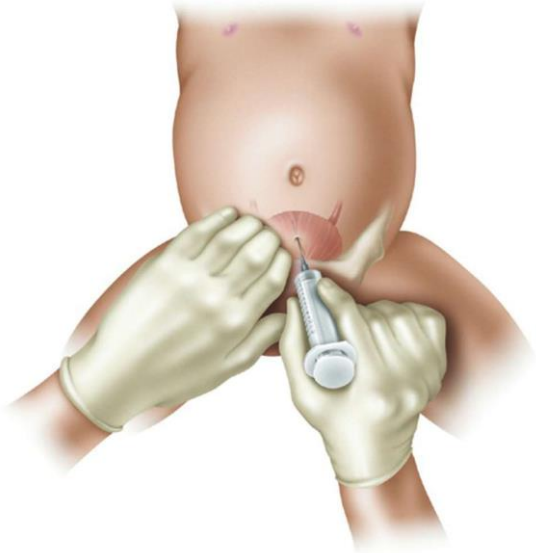
- Get all the fluid (blood, urine, CSF)



What's the Same?

- **Get catheterized or SPA urine, not wee bag or bladder stimulation technique**



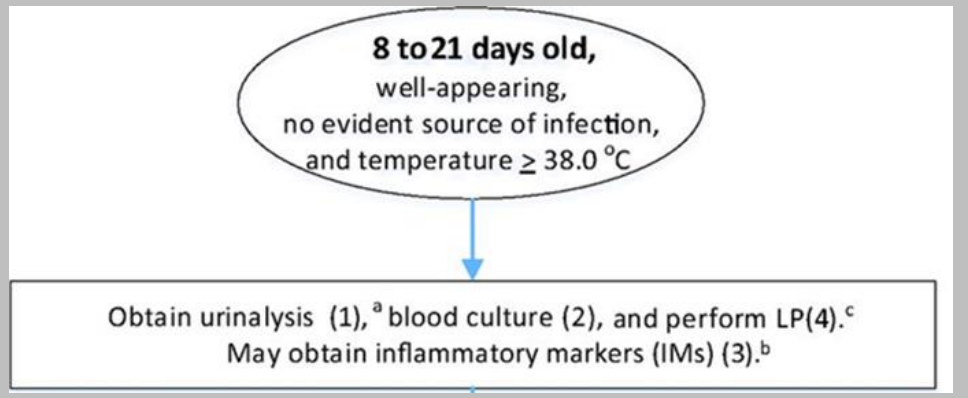


A Word on Urine

- Get catheterized or SPA urine, not wee bag or bladder stimulation technique
  - Cultures of urine specimens collected in a bag…have an unacceptably high false-positive rate
    - With a prevalence of UTI of 5% and a high rate of false-positive results (specificity: ~63%), a "positive" culture result for urine collected in a bag would be a false-positive result 88% of the time.
    - For febrile boys, with a prevalence of UTI of 2%, the rate of false-positive results is 95%; for circumcised boys, with a prevalence of UTI of 0.2%, the rate of false-positive results is 99% *(!!!!!!!)*.

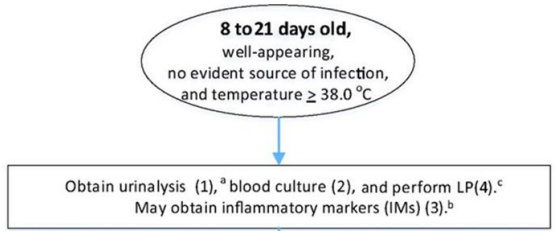
What's the Same?

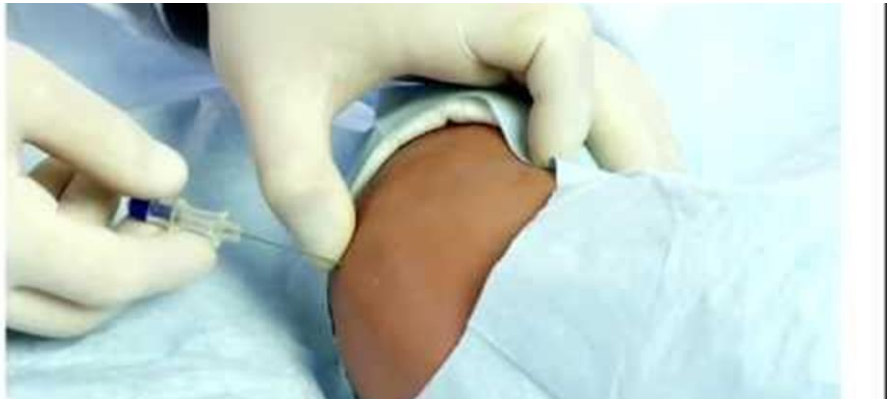
- Get catheterized or SPA urine, not wee bag or bladder stimulation technique
- **Get blood culture**
  - **3.9 to 5.1% in this age group, 15-20% with UTI**



What's the Same?

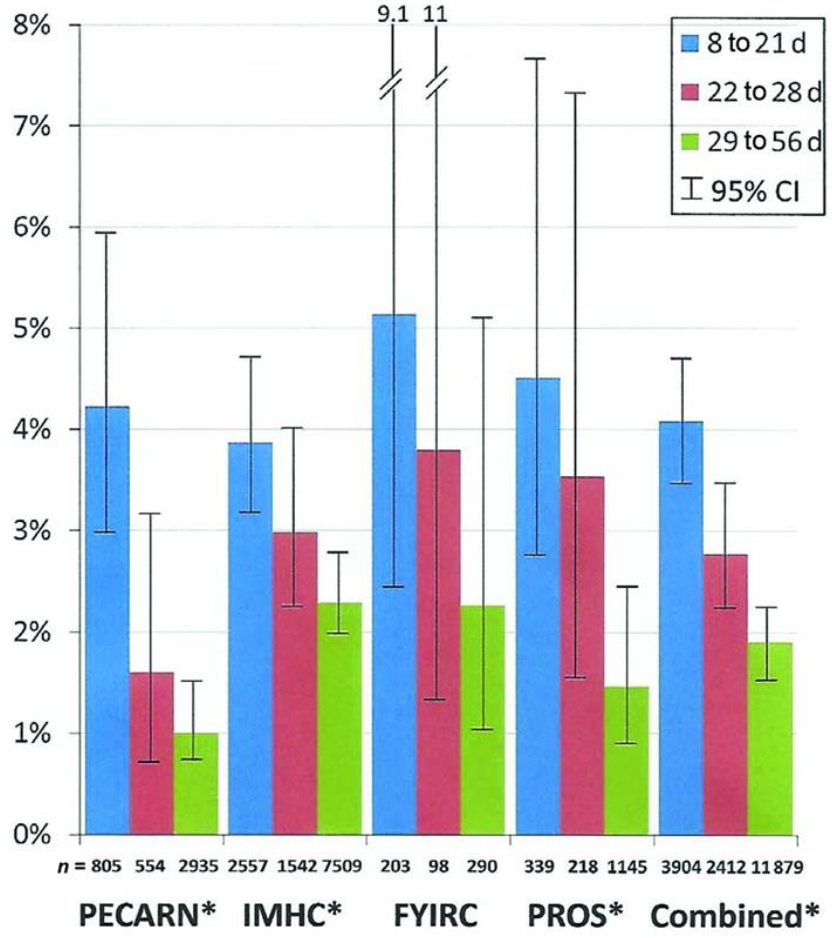
- Get catheterized or SPA urine, not wee bag or bladder stimulation technique
- Get blood culture
- **Perform LP**
  - **Meningitis 0.5-1.3%**





What's the Same?

- Get catheterized or SPA urine, not wee bag or bladder stimulation technique
- Get blood culture
- Perform LP
- **Treat them all with antibiotics and admit them all**
  - **IBIs highest in this age category and ~2% (number needed to treat 50) even in infants with negative urinalysis and/or IMs.**
  - **Infants with viral infections have a risk of IBI of ~1% or a number needed to treat of 100.**



What's Different?

- UA and culture should be interpreted differently

More words on urine: culture and urinalysis in young infants

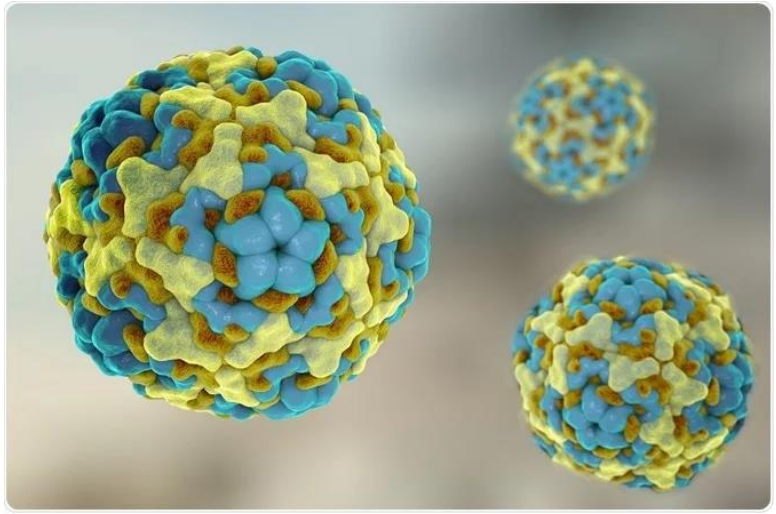
- Since 2014, multiple high-quality studies have been published evaluating the definition of UTI in kids < 60 days, looking at sensitivity of UA and the minimum CFU requirement for UTI.
  - **Implications:**
    - **UA is a sensitive indicator of UTI (94%, higher in those with concurrent bacteremia)**
    - **1000 febrile infants, 94-98 with UTIs detected by UA, 2-6 'missed'. Missed may mean UTI, asymptomatic bacteruria, or contaminant.**
    - Recent literature indicates culture should be considered positive if 10,000 CFUs if pyuria present (rather than 50,000 CFU in AAP UTI guideline)

What's Different?

- UA and culture should be interpreted differently
- **MAY obtain inflammatory markers**
  - **Could affect duration of therapy**

What's Different?

- UA and culture should be interpreted differently
- May obtain inflammatory markers
- **Test CSF for enterovirus in the summer months**
    - **Test if pleocytosis and during months where there is a seasonal increase.**



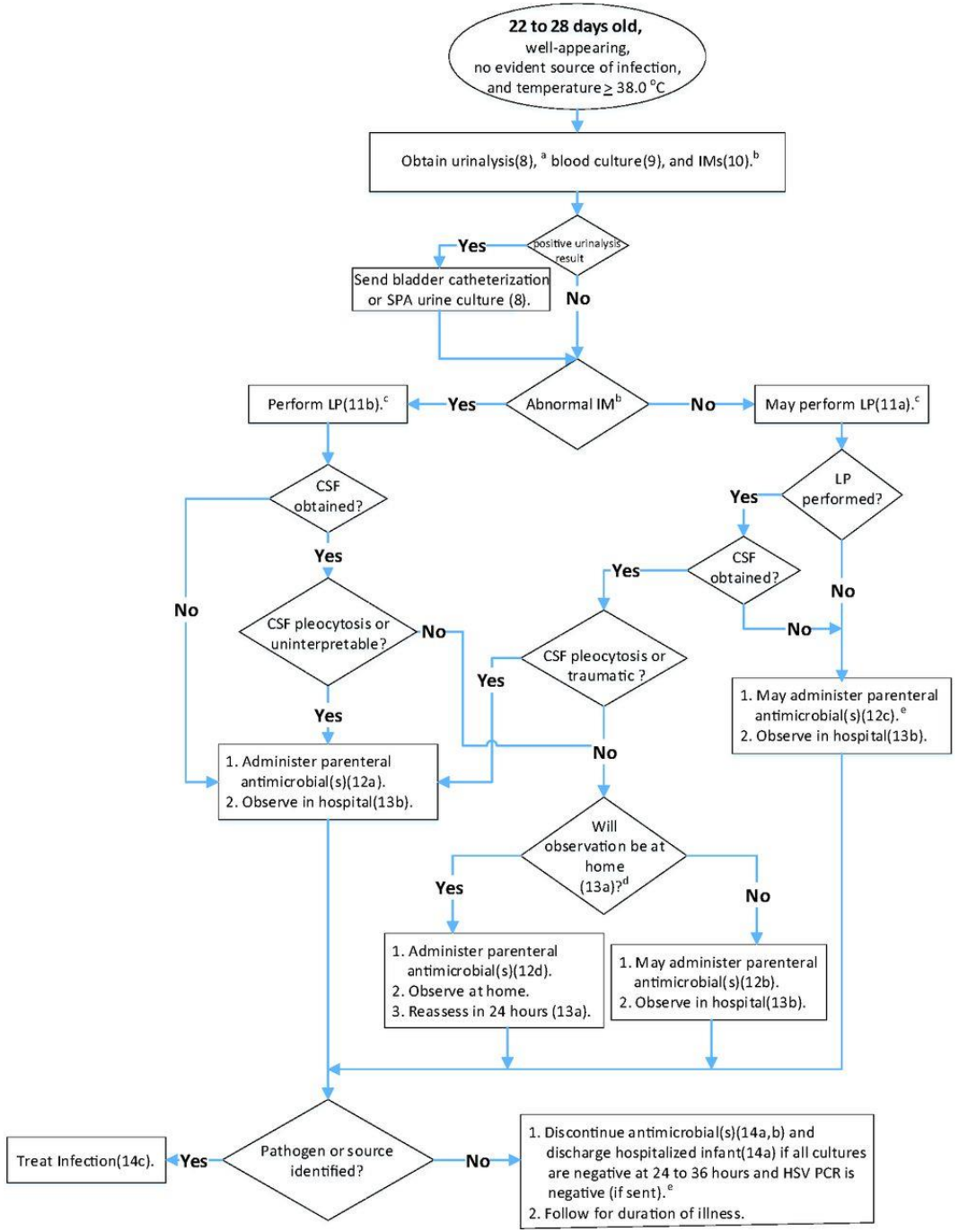
What's Different?

- UA and culture should be interpreted differently
- May obtain inflammatory markers
- Test CSF for enterovirus in the summer months
- **Test and treat for HSV if risk factors are present**
  - Seizures
  - CSF pleocytosis with a negative Gram stain
  - Leukopenia
  - Thrombocytopenia
  - Hypothermia
  - Mucous membrane ulcers
  - Elevated ALT
  - Maternal history of genital HSV lesions or fever from 48 hours before to 48 hours after delivery

What's Different?

- UA and culture should be interpreted differently
- May obtain inflammatory markers
- Test CSF for enterovirus in the summer months
- Test and treat for HSV if risk factors are present
- **Discharge at 24-36 hours if looking better, cultures negative or positive for contaminant, and no other reason to keep them**

Algorithm for 22- to 28-day-old infants.

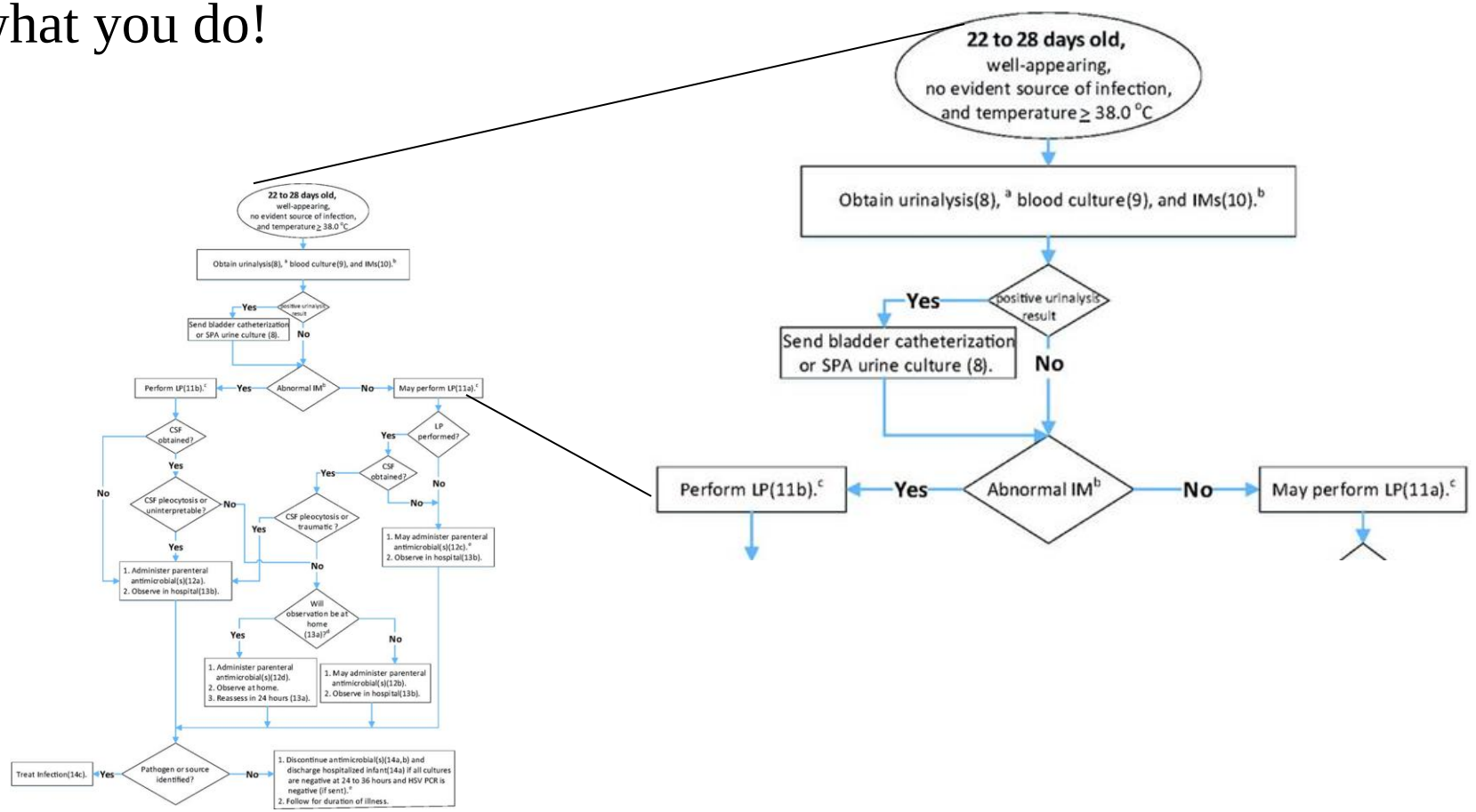


Robert H. Pantell et al. Pediatrics 2021;148:e2021052228

PEDIATRICS®

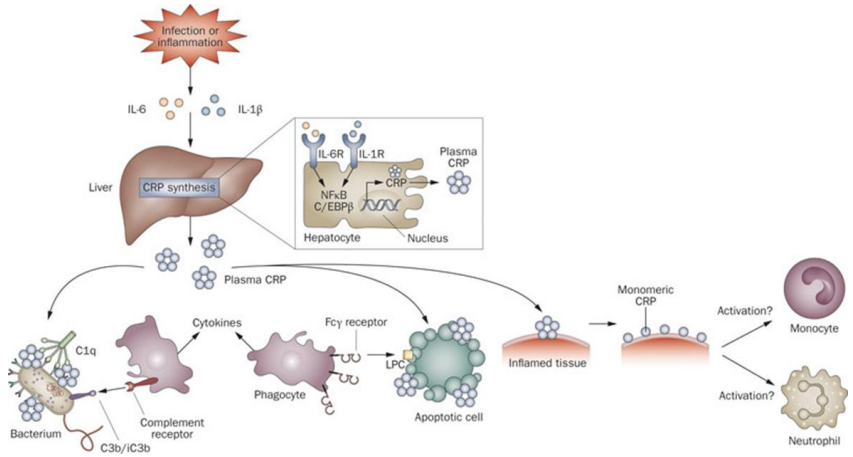
What's Different?

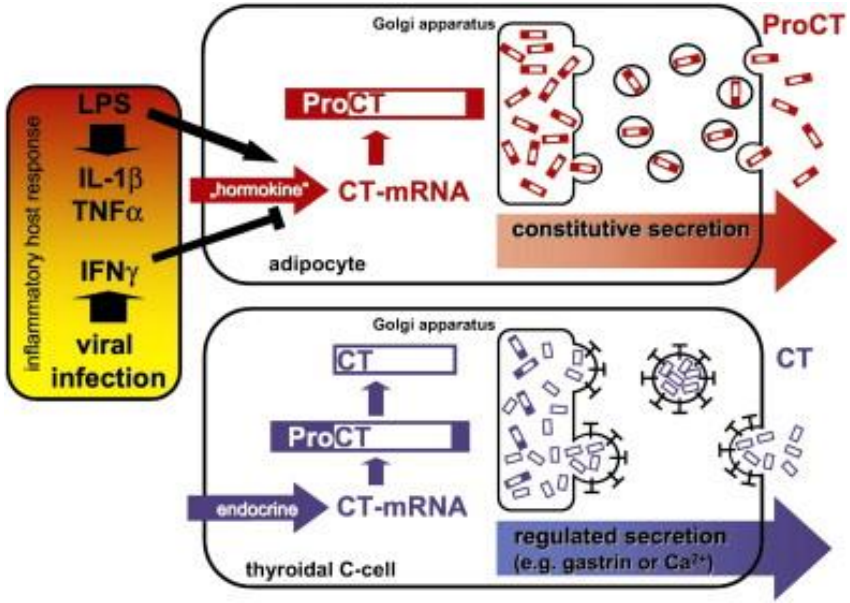
- Should obtain inflammatory markers
  - ***Will*** affect what you do!



What counts as an inflammatory marker?

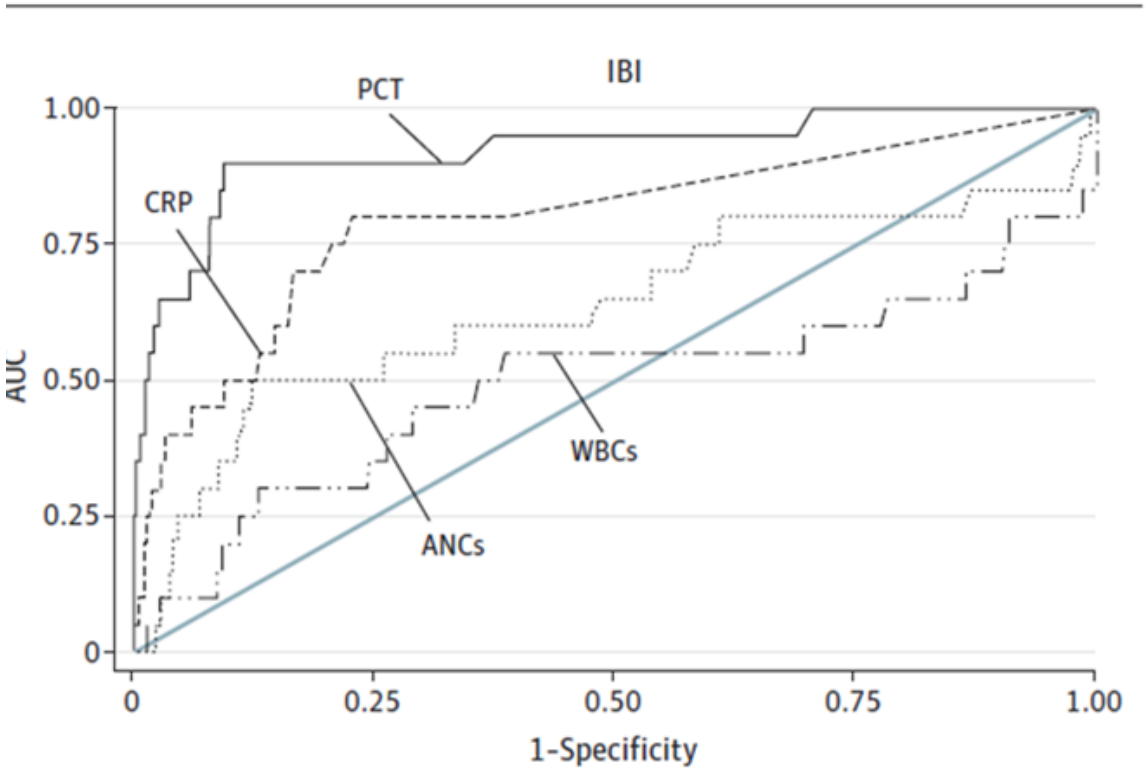
- Not just ‘newer tests’
  - CRP > 20mg/L
  - PCT > 0.5ng/ml
  - ANC (> 4000 or >5200- PECARN or FYIRC)
  - Temperature > 38.5





Which IMs should we use?

- None in isolation. However…
  - "Serum procalcitonin, as an independent predictor of bacterial infections, has better test characteristics than other laboratory markers of inflammation."
  - "The committee recommends procalcitonin in all age groups. If procalcitonin is unavailable or results are not reported in a timely fashion, the committee recommends using a fever of >38.5°C in combination with other IMs for purposes of risk stratification."



What's Different?

- Should obtain inflammatory markers
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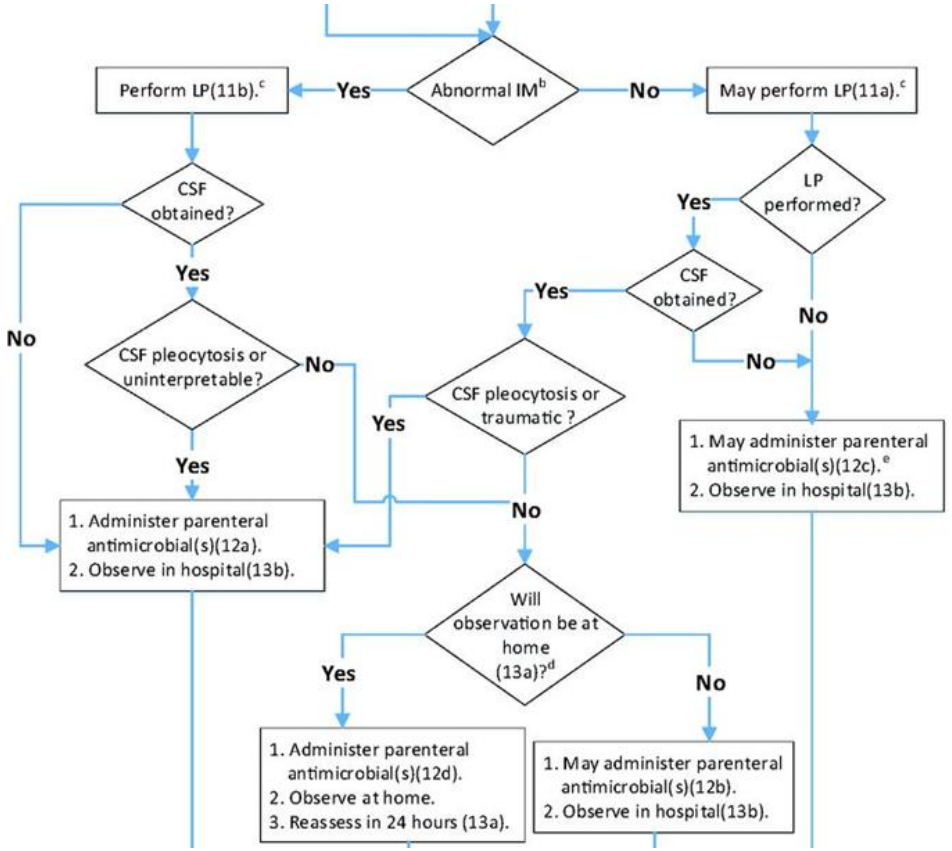
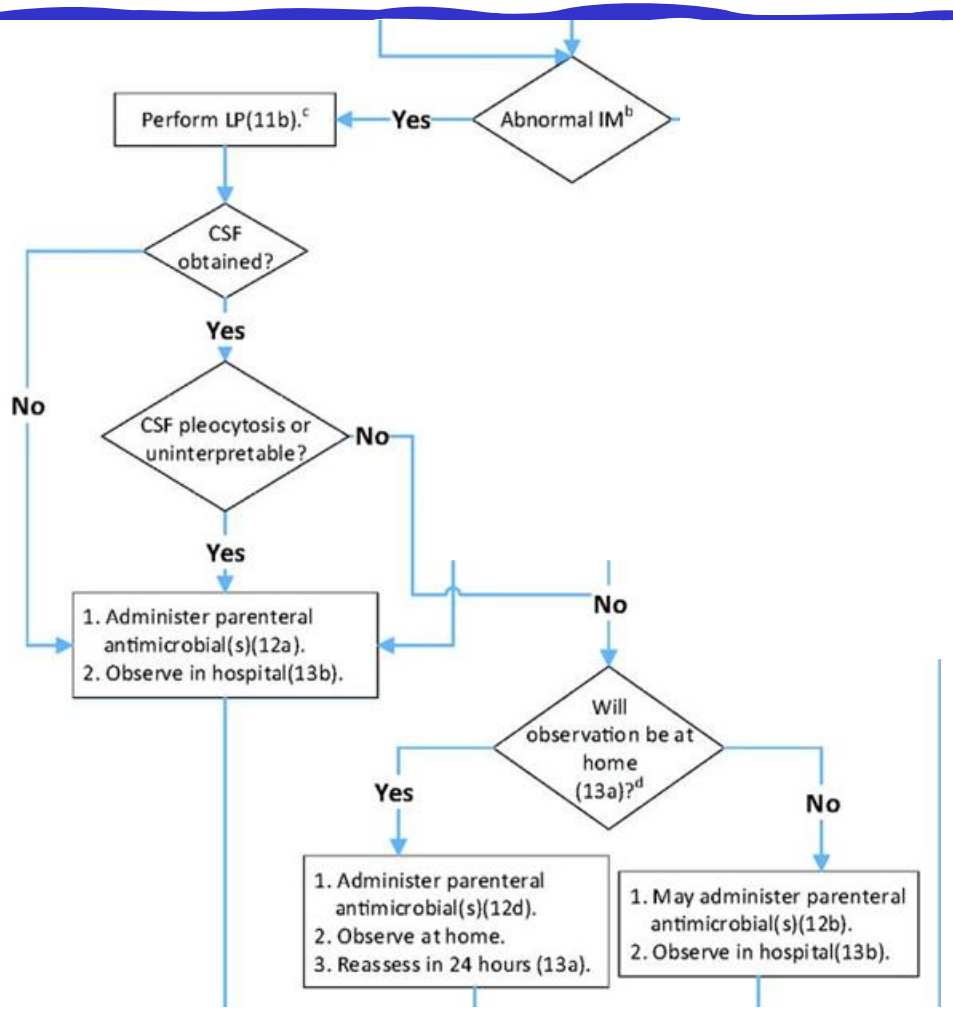


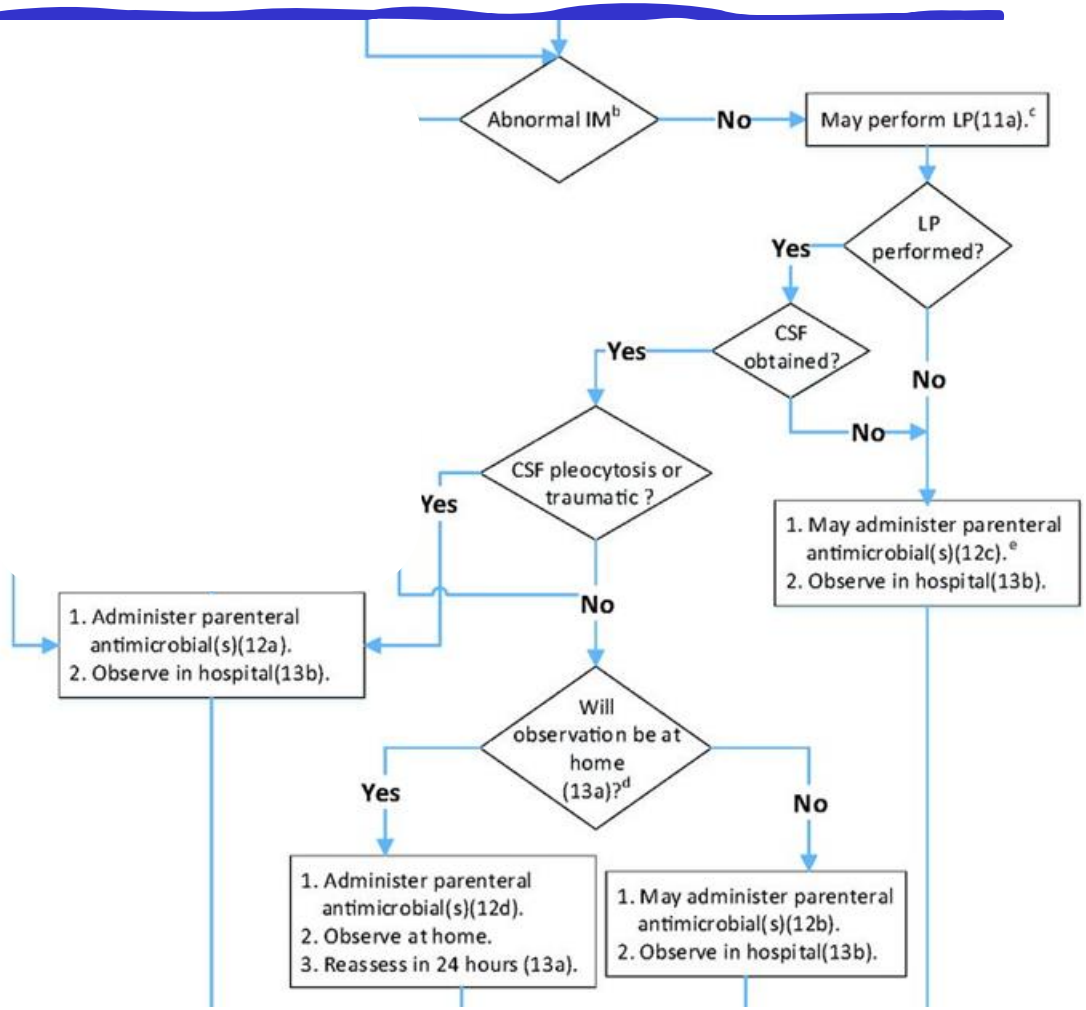
What's Different?

- Should obtain inflammatory markers
  - ***Will*** affect what you do…
- **If IM's positive, you should perform an LP**
  - **If there is pleocytosis or its traumatic, or you cannot obtain CSF, you should start abx and admit**
  - **If CSF is normal, you should still start abx and admit**



What's Different?

- Should obtain inflammatory markers
  - ***Will*** affect what you do…
- **If IMs negative, you MAY perform LP…**

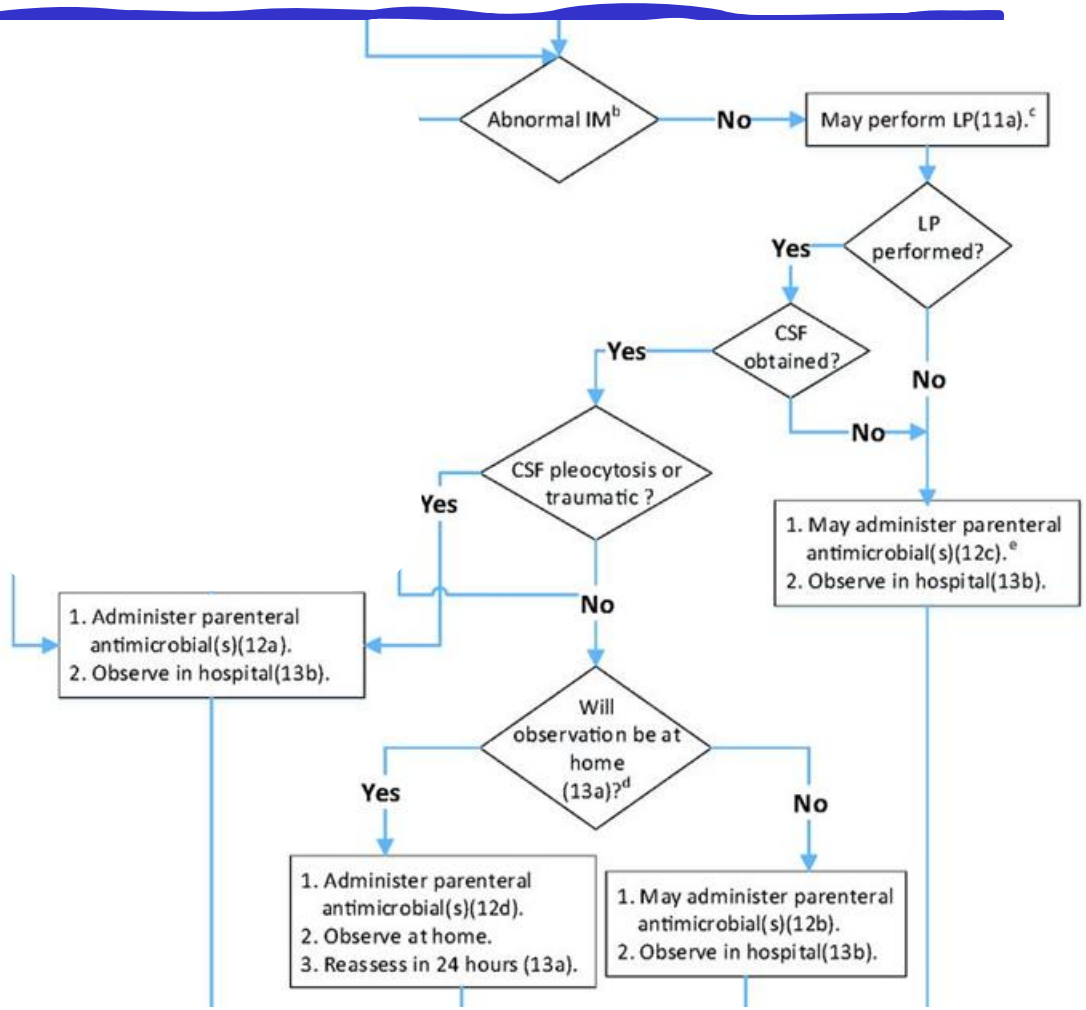


Really? LP may not be necessary?

- Meningitis rates 0.39 to 0.46 = 1 in 200 to 250
- No case of bacterial meningitis missed by PROS, Step-by-Step, or PECARN (Sensitivity 100%; CI 84-100%)
- If lower end of sensitivity = 84%, would require **1250-1560 LPs** to detect each case of missed bacterial meningitis

What's Different?

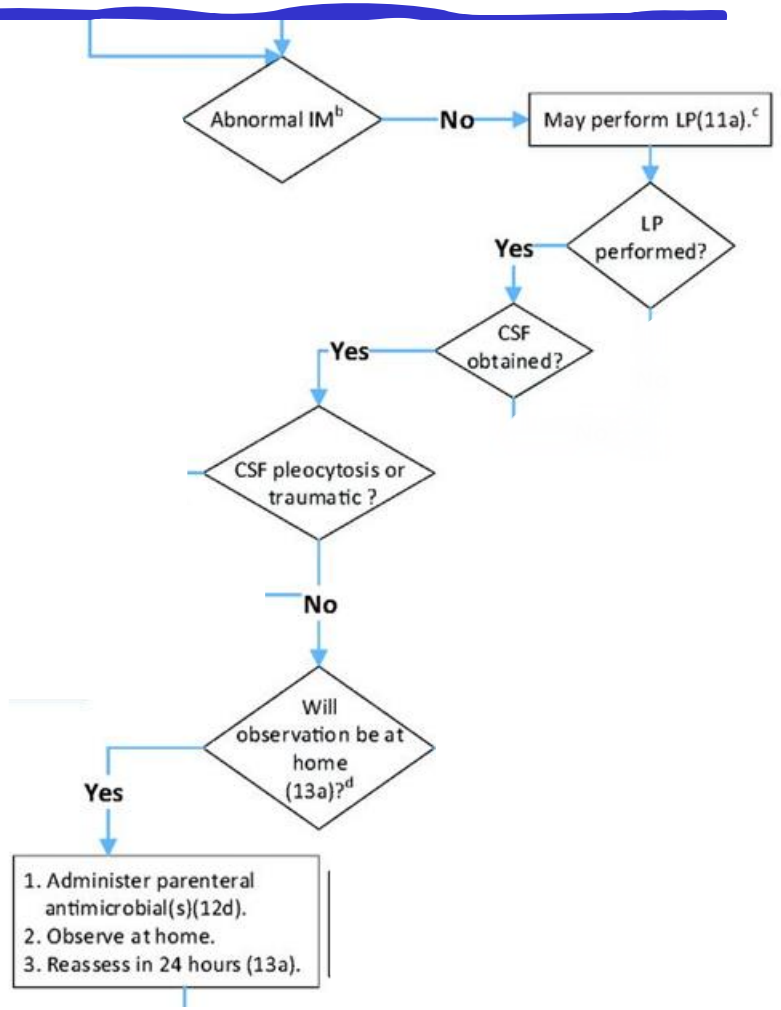
- Should obtain inflammatory markers
  - ***Will*** affect what you do…
- **If IMs negative, you MAY perform LP…**
  - If you do perform LP and there is pleocytosis or its traumatic, or you cannot obtain CSF, or you choose not to perform LP, you should start abx and admit



What's Different?

- Should obtain inflammatory markers
  - ***Will*** affect what you do…
- **If IMs negative, you MAY perform LP…**
  - If patient has normal IMs AND negative UA AND CSF is obtained, interpretable, and normal, patient may be discharged after IV or IM antibiotics*

**bacteremia 1-2%, NNT 50 to 100*



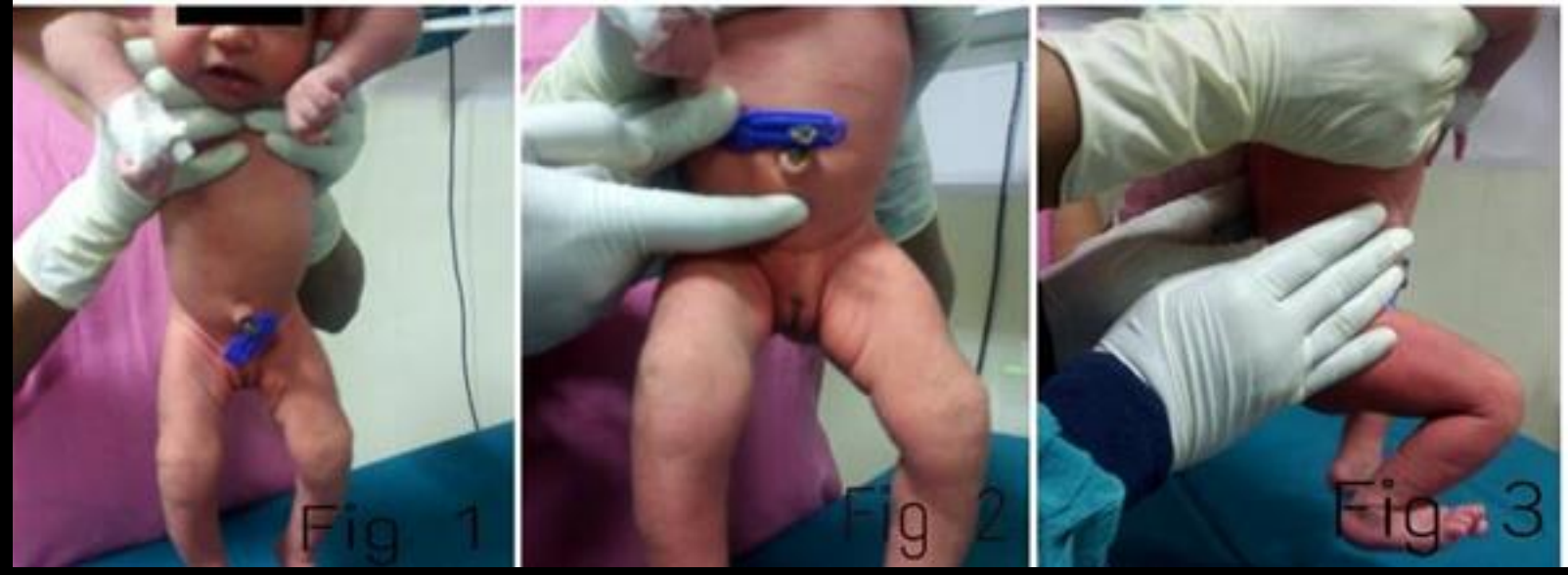
What's the Same?

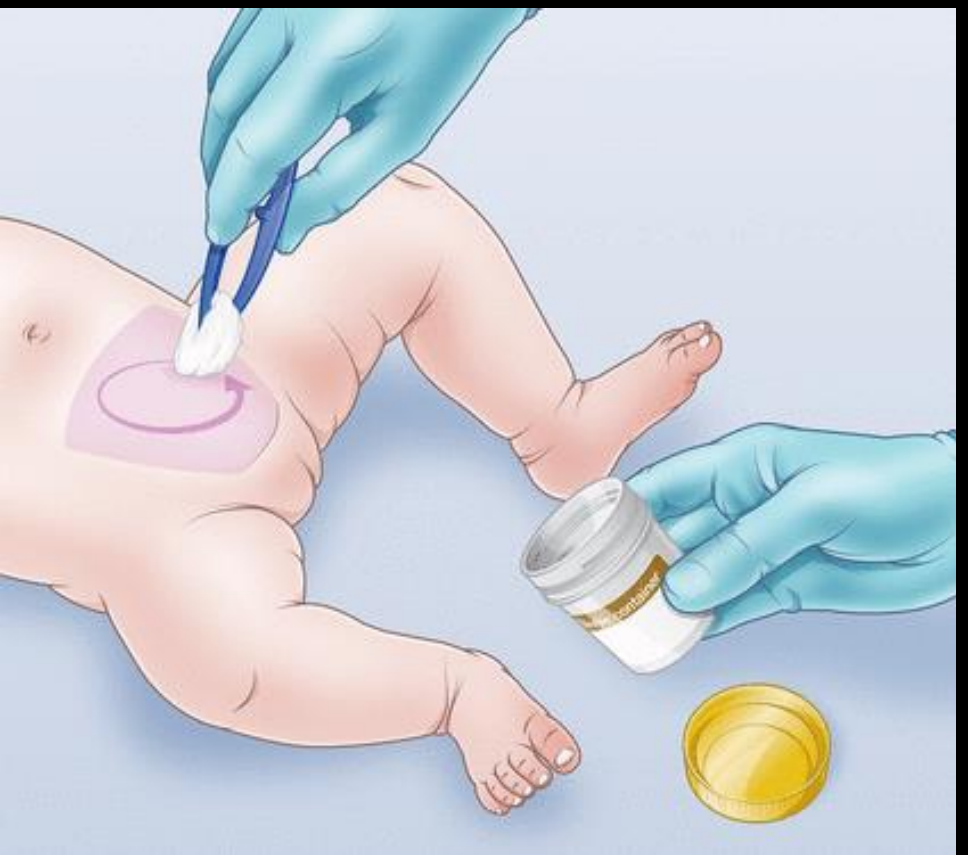
- Catheterized or SPA urine is still the best, but…
  - Get catheterized or SPA urine for tests and culture

  OR

  - Get for UA via wee bag or bladder stimulation, and, if positive, perform cath or SPA for culture

Get urine HOW?





- Specimens obtained by methods other than catheterization or SPA are **not suitable for culture because of a high contamination rate (6.8% in a 2020 study – OR 5.61 in multi-variate analysis)**

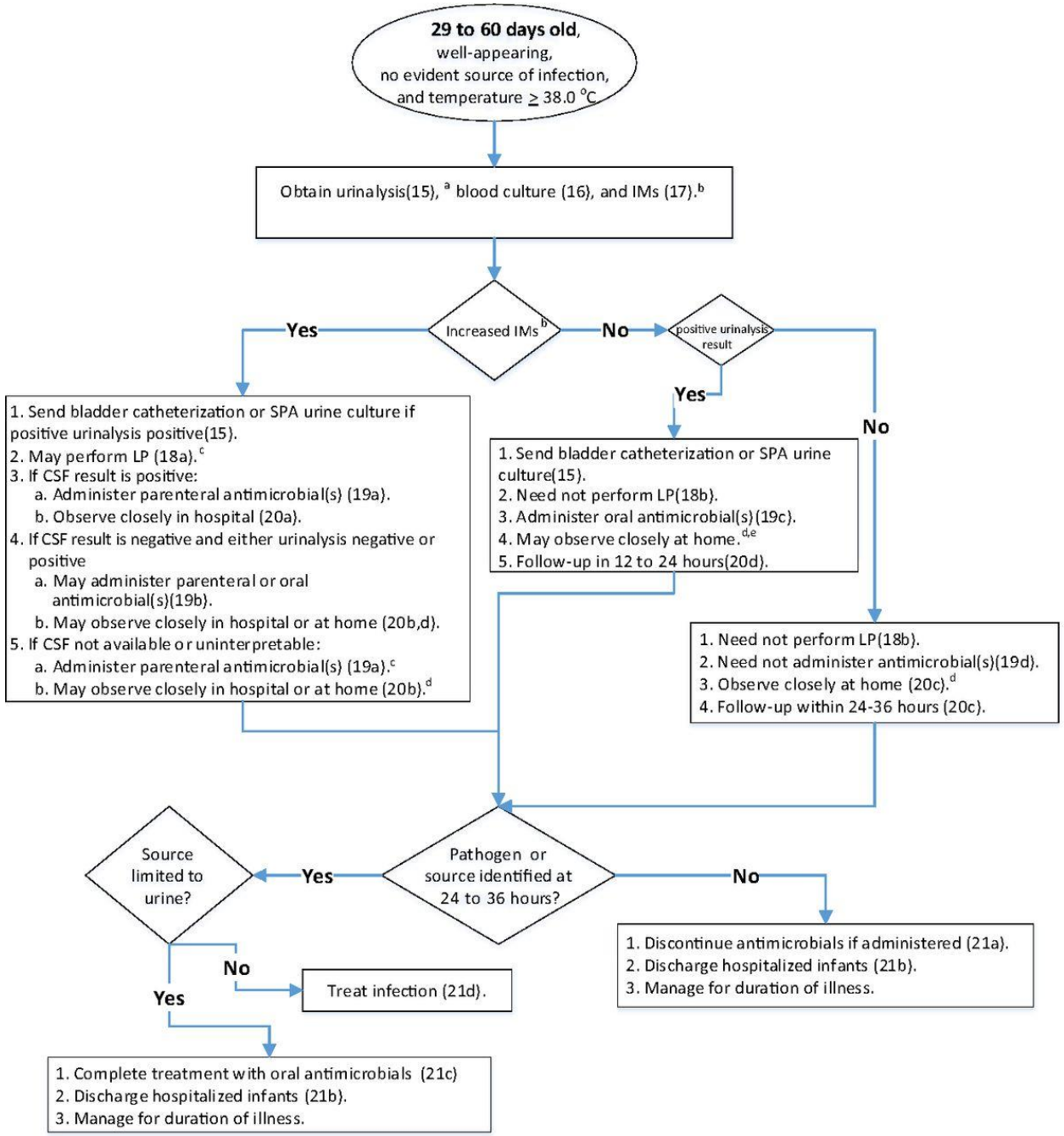
What's the Same?

- Get catheterized or SPA urine for tests and culture, OR get for UA via wee bag or bladder stimulation, and, if positive, perform cath or SPA for culture
- **Obtain blood culture**
  - **1.6 to 5% in this age group all comers, 7.5-10% with UTI**

What's the Same?

- Get catheterized or SPA urine for tests and culture, OR get for UA via wee bag or bladder stimulation, and, if positive, perform cath or SPA for culture
- Obtain blood culture
- **If UA *or* LP positive, admit and start antibiotics**
  - remember, 7.5 to 10% bacteremia for those with UTI

Algorithm for 29- to 60-day-old infants



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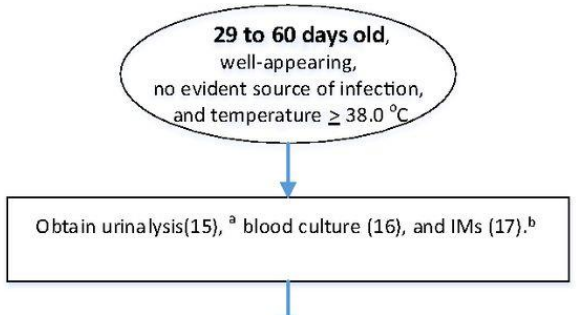
PEDIATRICS®

What's the Same?

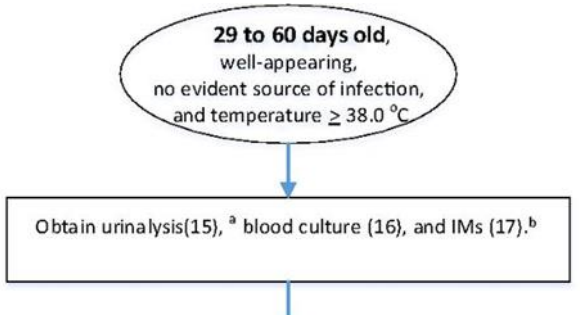
- **Get urine**
  - Still most common occult bacterial infection (~10%)
  - As with ages 22-29d, one step vs two step method okay



What's the Same?

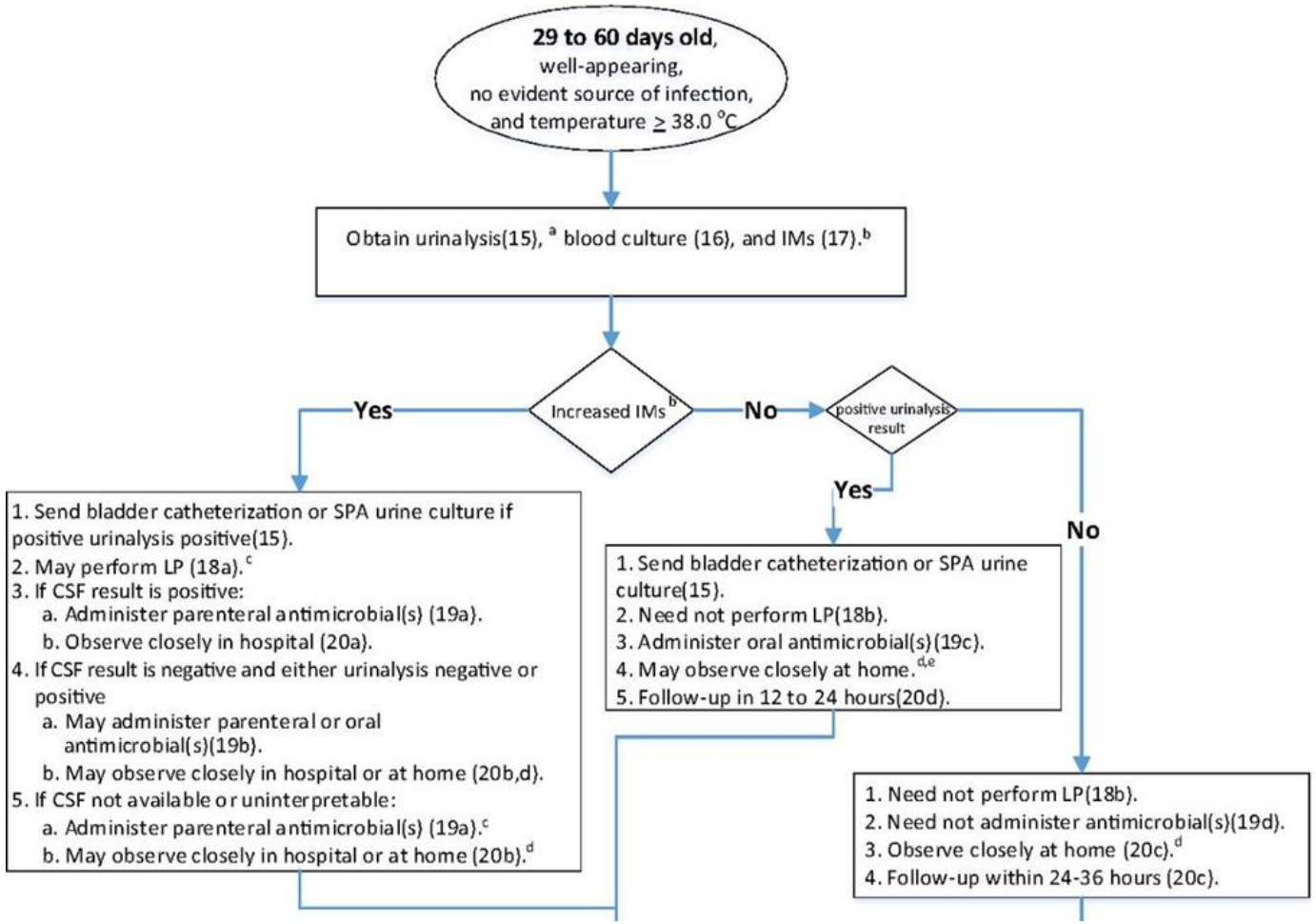
- Get urine
  - Still most common occult bacterial infection (~10%)
  - As with 22-29, one step vs two step method okay
- **Get blood culture**
  - 1.1-2.2% in this age group

  and 5-10% of infants with UTI



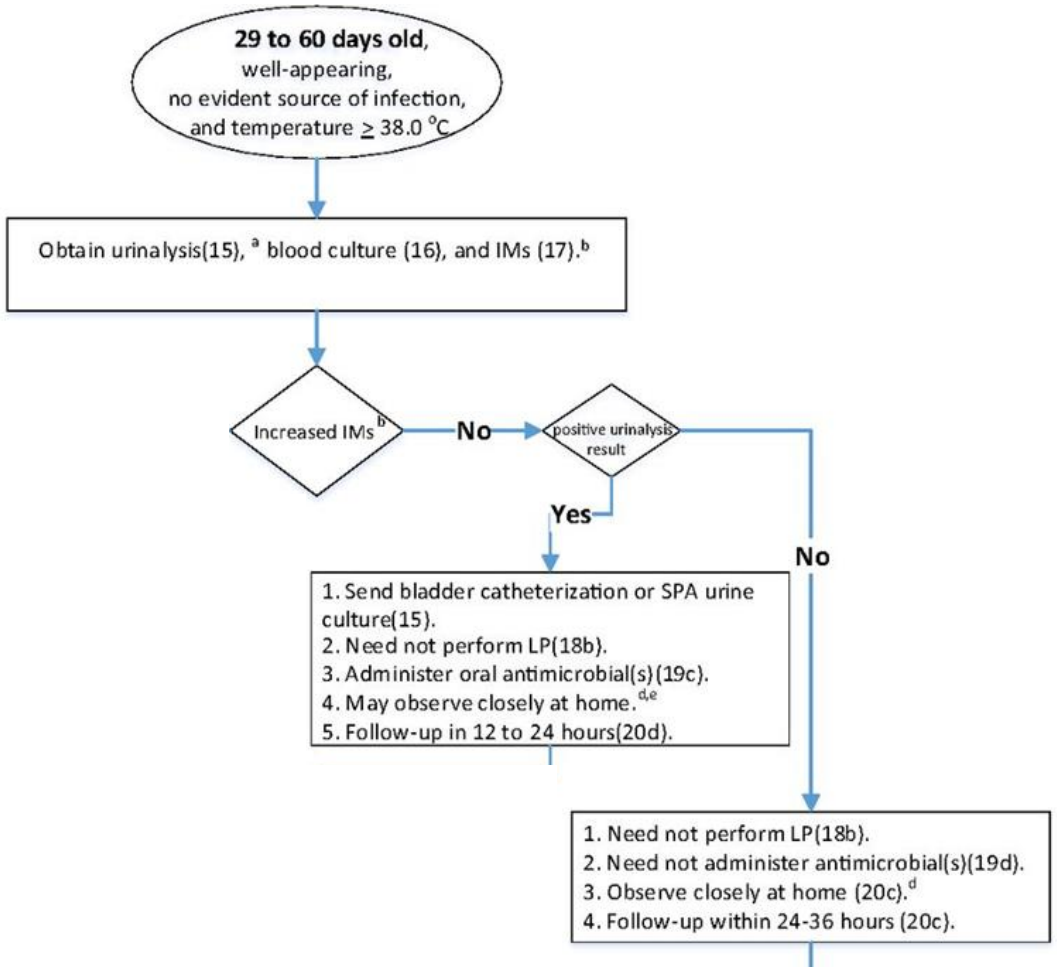
What's Different?

- Should obtain inflammatory markers
  - ***Will* REALLY** affect what you do!



What's Different?

- Should obtain inflammatory markers
  - ***Will* REALLY** affect what you do!
- If IM's negative, ***NEED NOT PERFORM LP and NEED NOT GIVE ABX***



Safely Doing Less

MENINGITIS: For all 29-60 day old infants:

- Prevalence of meningitis = 0.25%
- Sensitivity of clinical prediction rules using IMs is greater than 90%.
- Chance of missing meningitis with negative IMs is 0.025%

4000 successful LPs to avoid delay of detection of 1 case of bacterial meningitis

BACTEREMIA: For 29-60 day old infants with negative IMs:

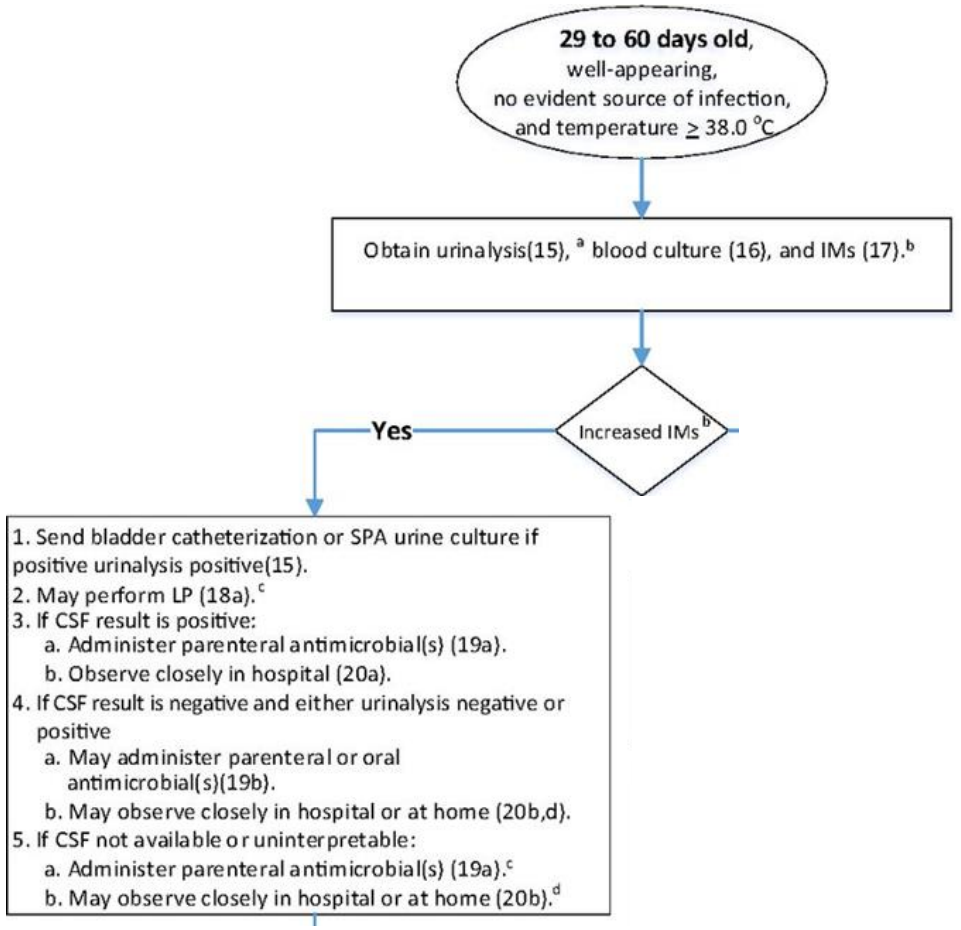
- Prevalence of bacteremia is about 0.1%

300-1,000 doses of antibiotics to avoid delay in treatment of 1 case of bacteremia

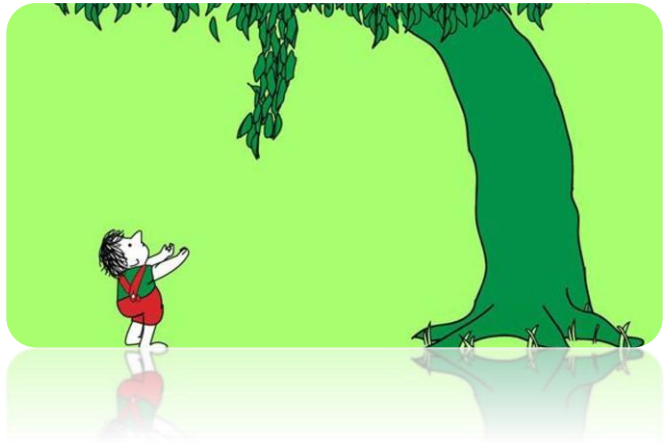
PECARN 2019: 1266 infants x 61% LR = 776 who don't need LP, abx, admission

What's Different?

- Should obtain inflammatory markers
  - ***Will* REALLY** affect what you do!
- If IM's positive, **consider** LP



The LP Decision Tree



- If CSF positive:
  - Give Abx, admit
- If CSF negative with +/-UA:
  - IV or PO* antibiotics
  - Admit or discharge with f/u
- If CSF not available or uninterpretable:
  - IV antibiotics
  - Admit or discharge with f/u.

1. Send bladder catheterization or SPA urine culture if positive urinalysis positive(15).
2. May perform LP (18a).[c]
3. If CSF result is positive:
   a. Administer parenteral antimicrobial(s) (19a).
   b. Observe closely in hospital (20a).
4. If CSF result is negative and either urinalysis negative or positive
   a. May administer parenteral or oral antimicrobial(s)(19b).
   b. May observe closely in hospital or at home (20b,d).
5. If CSF not available or uninterpretable:
   a. Administer parenteral antimicrobial(s) (19a).[c]
   b. May observe closely in hospital or at home (20b).[d]

Initial Empiric Therapy

Suspected Source of Infection	8–21 d Old	22–28 d Old	29–60 d Old
UTI[a]	Ampicillin IV or IM (150 mg/kg per d divided every 8 h) and either ceftazidime IV or IM (150 mg/kg per d divided every 8 h) or gentamicin IV or IM (4 mg/kg per dose every 24 h)	Ceftriaxone IV or IM (50 mg/kg per dose every 24 h)	Ceftriaxone IV or IM (50 mg/kg/dose every 24 h). Oral medications for infants older than 28 d.[b] Cephalexin 50–100 mg/kg per d in 4 doses or cefixime 8 mg/kg per d in 1 dose
No focus identified[c]	Ampicillin IV or IM (150 mg/kg per d divided every 8 h) and either ceftazidime IV or IM (150 mg/kg per d divided every 8 h) or gentamicin IV or IM (4 mg/kg per dose every 24 h)[d]	Ceftriaxone IV or IM (50 mg/kg per dose every 24 h)	Ceftriaxone IV or IM (50 mg/kg/dose every 24 h)
Bacterial meningitis[e]	Ampicillin IV or IM (300 mg/kg per d divided every 6 h) and ceftazidime IV or IM (150 mg/kg per d divided every 8 h)	Ampicillin IV or IM (300 mg/kg per d divided every 6 h) and ceftazidime IV or IM (150 mg/kg per d divided every 8 h)	Ceftriaxone IV (100 mg/kg or d once daily or divided every 12 h) or Ceftazidime IV (150 mg/kg or d divided every 8 h) and vancomycin[f] IV (60 mg/kg or d divided every 8 h)

Summary

- 7-21 days
  - Full-work up every time
  - Evaluate for and treat HSV based on risk factors
- 22-28 days
  - Inflammatory markers help determine who must get an LP, but most kids will still get IV abx and most will be admitted
- 29-60 days
  - Inflammatory markers determine whether you need an LP and parenteral antibiotics
  - We can expect to do far fewer LPs and admit far fewer kids

THANKS FOR YOUR ATTENTION!

DOERNBECHER CHILDREN'S HOSPITAL
Oregon Health & Science University

Questions?

burnsb@ohsu.edu

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