Febrile Infants
&
Neonatal Hyperbilirubinemia

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APP Virtual Conference

Learning Objectives

By the end of this presentation, learners will be able to

1. Contrast the differing management strategies for neonatal fever based on patient age

2. Identify which infants are at risk of hyperbilirubinemia and bilirubin-induced neurotoxicity

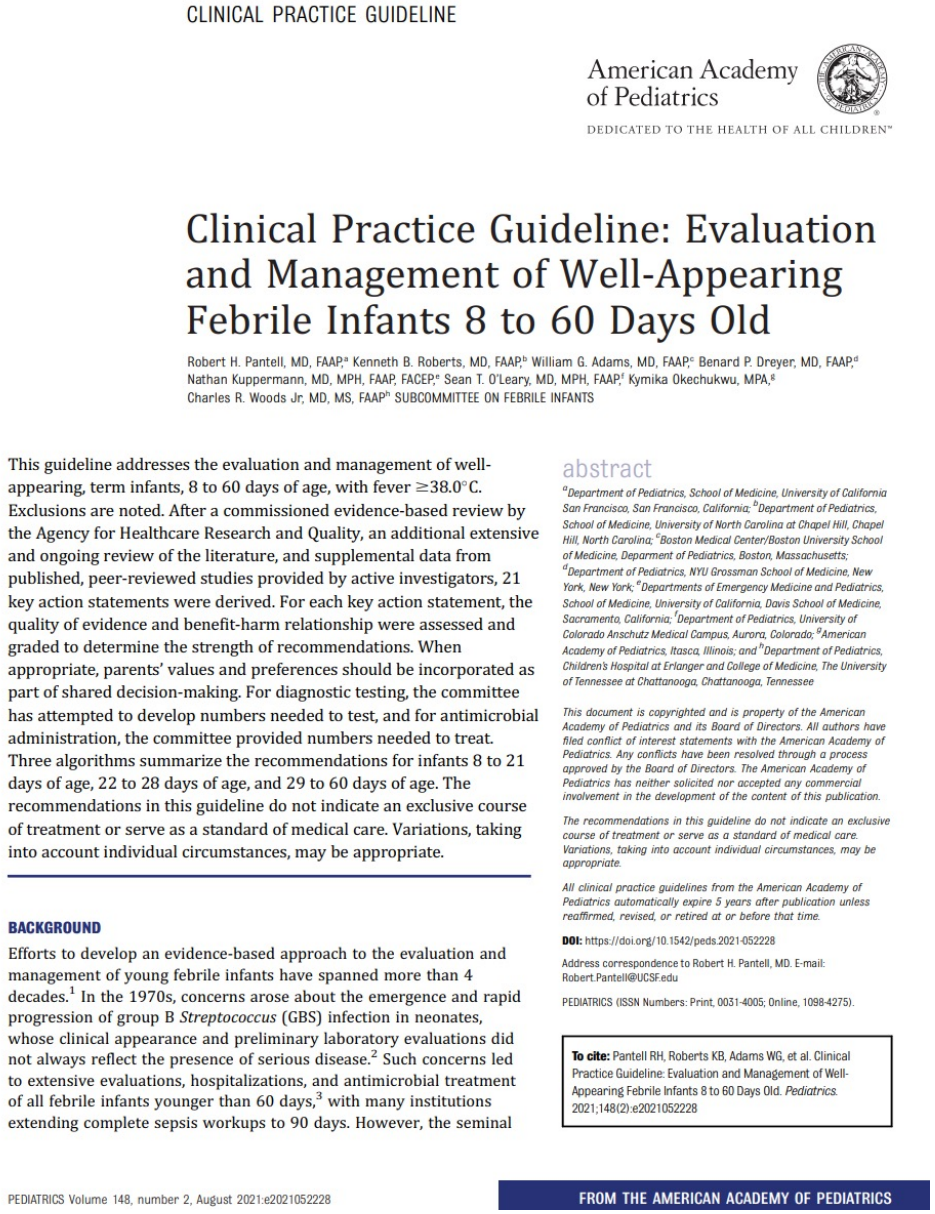
3. Formulate a management strategy for an infant with hyperbilirubinemia

Febrile Infants

Why do we care?

- Fever as a sign of infection
- Risk of Invasive Bacterial Infection (IBI)
  - Clinical diagnosis challenging
  - Risk Stratification

August 2021 – new AAP guidelines



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

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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.

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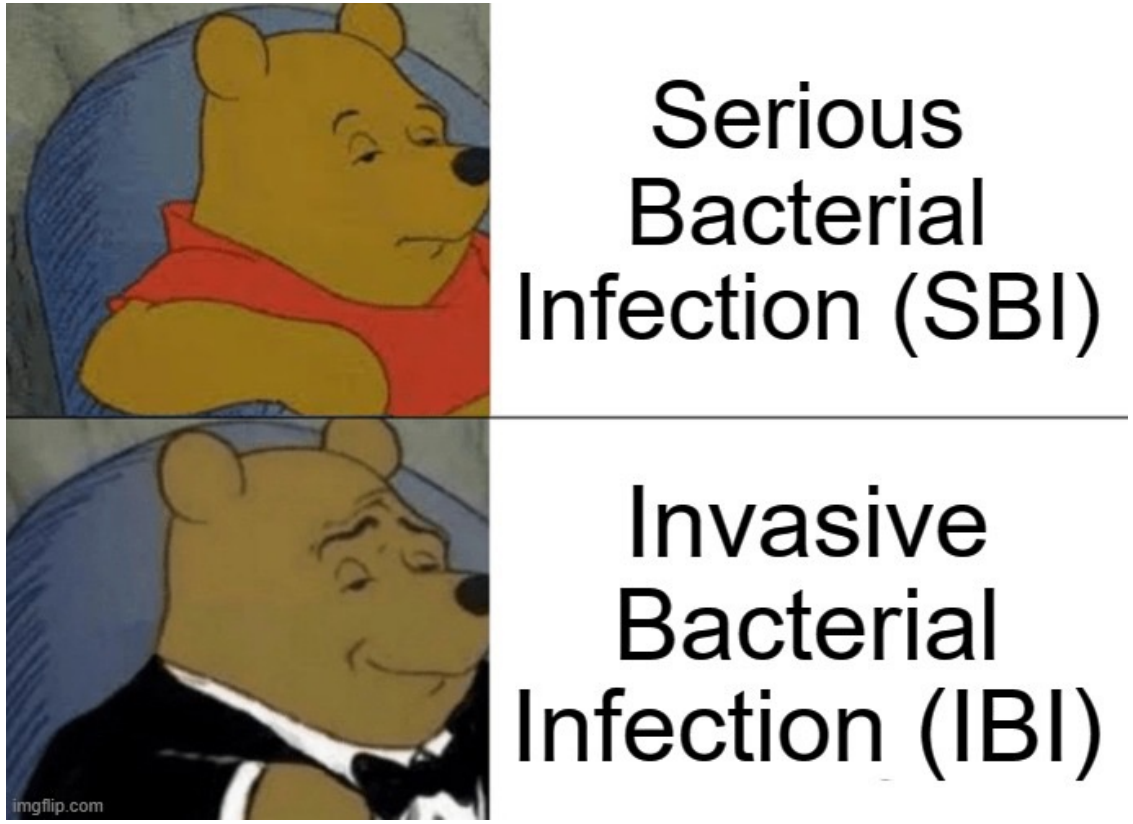
Microbiology Review

- Invasive Bacterial Infections (IBI)
  - Replaces the old term SBI
  - Bacteremia (E. coli most common)
  - Meningitis (S. agalactiae, aka GBS, most common)
- Other bugs
  - L. monocytogenes (think processed lunch meats) – less common
  - Herpes Simplex 1 and 2
    - Vaginal herpes AND cold sores



What about HSV?

- HSV is *scary* in neonates
- <20 days usually more worrisome

Herpes Simplex Virus (HSV) Checklist

	YES	NO	
1.	O	O	Patient is hypothermic?
2.	O	O	Maternal history of HSV (prior disease or active lesions)?
3.	O	O	History of seizures or seizures during the evaluation?
4.	O	O	Vesicles on skin exam (including scalp), mucus membrane ulcers?
5.	O	O	Thrombocytopenia?
6.	O	O	Elevated ALT?
7.	O	O	CSF with pleocytosis for age? (if LP performed)

If any "Yes" proceed to HSV High Risk recommendation

- HSV workup
  - *HSV blood PCR*
  - *HSV swabs*
    - *Conjunctiva*
    - *Nares*
    - *Throat*
    - *Rectum*
  - *Meningitis encephalitis film array does have HSV on it*
  - *HSV skin/wound swab (if a vesicle is present)*
- Acyclovir for treatment

Inclusion Criteria

1) Well-appearing
2) Gestational age between 37 and 42 weeks
3) 8-60 days old
4) Fever ≥100.4°F or 38.0°C
   - Guidelines recommend rectal at home or in clinical setting in last 24h
   - Do NOT add 1° to axillary temp
   - Still consider fever by history

Eligibility Criteria

- Well appearing infant
- Documented rectal temperature of ≥ 38.0°C or 100.4°F at home in the past 24 hours OR determined in a clinical setting.
- Gestational age between ≥37 and <42 weeks
- Infant is 8 to 21 days of age and at home after discharge from a newborn nursery or born at home.

Exclusion Criteria (there are a lot of them)

- There are a lot of them --->

Exclusion Criteria

- Not well-appearing infants.
- Pretem infants <37 weeks' gestation
- Infants < 2 weeks of age whose perinatal courses were complicated by maternal fever, infection, and/or antimicrobial use.
- Focal bacterial infection (eg, cellulitis, omphalitis, septic arthritis, osteomyelitis).
- Clinical bronchiolitis, with or without positive test results for respiratory syncytial virus (RSV).
- Documented or suspected immune compromise.
- Neonatal course was complicated by surgery or infection.
- Congenital or chromosomal abnormalities.
- Medically fragile infants (technologically dependant)
- Infants who have received immunizations within the last 48 hours.

**(Patients meeting exclusion criteria should receive individualized care)

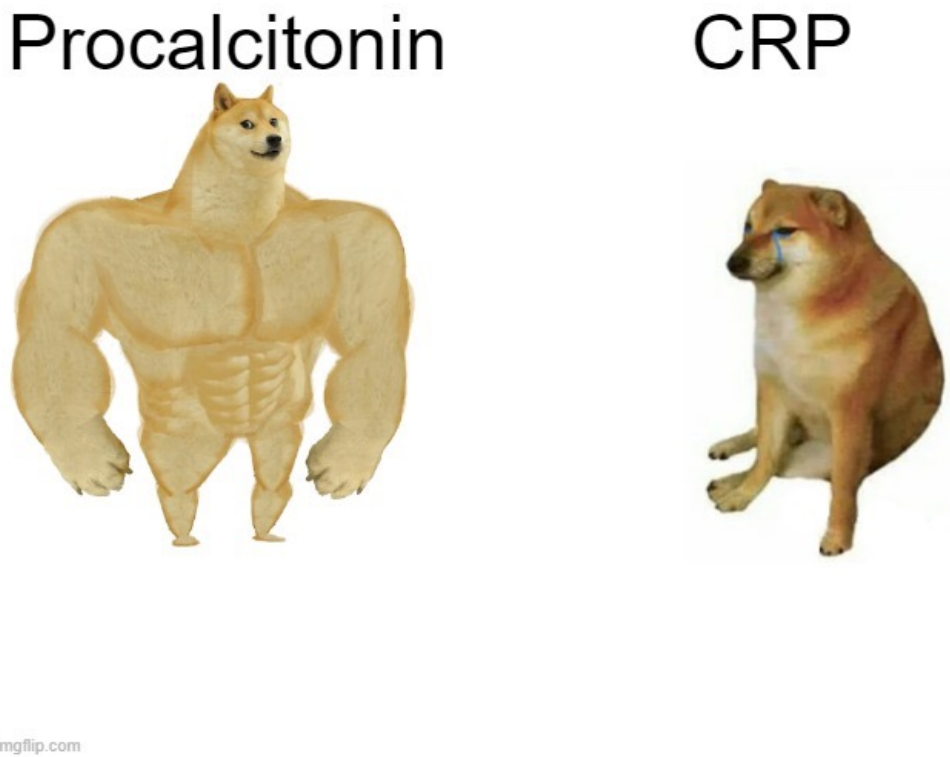
The following infants should still be included

1) Upper respiratory infection
2) Diarrhea
3) Acute Otitis media
4) Recent antibiotic use if >2 weeks of age (individualized decision)
5) Positive viral testing

Example: infant with URI and fever with RFA positive for rhino/entero should still be evaluated per guidelines

Inflammatory Markers

1) Fever >38.5°C
2) Procalcitonin (abnormal >0.5ng/mL)
3) ANC (abnormal >4000 if also using procal, >5200 if not using procal)
4) C-reactive protein (>2.0 mg/dL)
    - Check your units!



Applies to neonatal fever only

Big Picture

IBI risk decreases with chronologic age

3 risk stratifications

- 8-21 days old
- 22-28 days old
- 29-60 days old

Fever Without a Source Well Appearing Infant 8 to 21 days of age

Akron Children's Hospital

Yes

Does patient have any exclusion criteria? — Yes → Exclude from Algorithm

No

High Risk HSV? (Complete questions 1-3 on HSV Checklist) — Yes → High Risk HSV

High Risk HSV → Full Sepsis and Full HSV Risk Assessment/Evaluation* Initiate antimicrobials including acyclovir

No

Obtain

- UA and urine culture via catherization
- CBC with diff -consider abnormal if ANC >4000 per mmx3
- Blood Culture
- Lumbar puncture
- Procal (preferred), CRP (better option at MV given turn around time.) Consider elevated if PCT >0.5ng/mL or CRP >2mg/dL
- Resp viral testing (optional)

Full Sepsis and Full HSV Risk Assessment/Evaluation* Initiate antimicrobials including acyclovir → Initiate Antibiotics and admit to the hospital

Obtain → Initiate Antibiotics and admit to the hospital

Initiate Antibiotics and admit to the hospital → Source Identified?

Source Identified? — Yes → Treat the Source

Source Identified? — No →

- Discontinue antimicrobials at 24-36 hrs
- Consider discharge if all test negative and infant improving and there is no other reason for hospitalization
- Manage for duration of illness (eg. fever, poor feeding)

Eligibility Criteria

- Well appearing infant
- Documented rectal temperature of ≥ 38.0°C or 100.4°F at home in the past 24 hours OR determined in a clinical setting.
- Gestational age between ≥37 and <42 weeks
- Infant is 8 to 21 days of age and at home after discharge from a newborn nursery or born at home.

Exclusion Criteria

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- Preterm infants <37 weeks' gestation
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- Focal bacterial infection (eg, cellulitis, omphalitis, septic arthritis, osteomyelitis).
- Clinical bronchiolitis, with or without positive test results for respiratory syncytial virus (RSV).
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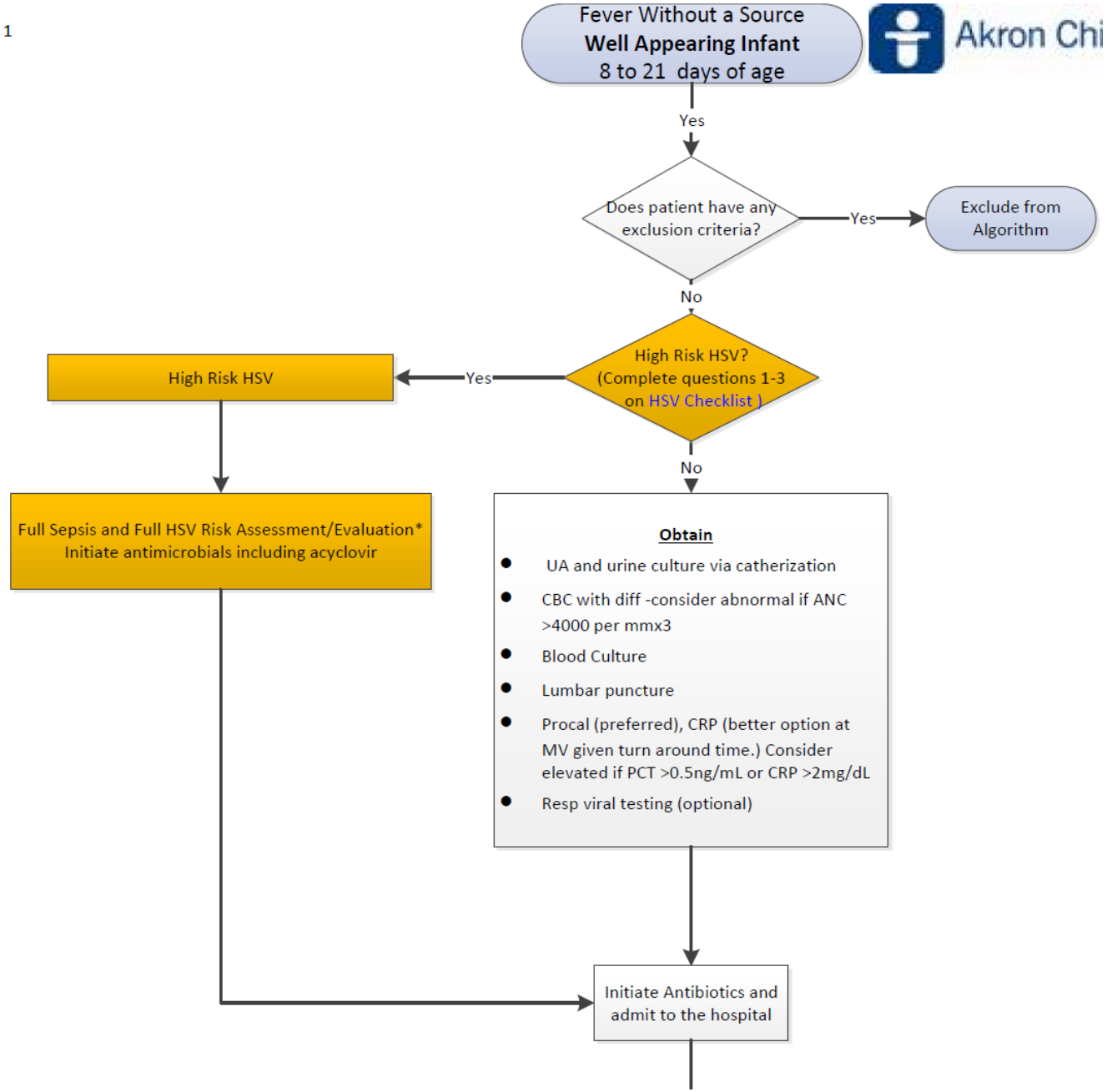
5.	O	O	Thrombocytopenia?
6.	O	O	Elevated ALT?
7.	O	O	CSF with pleocytosis for age? (if LP performed)

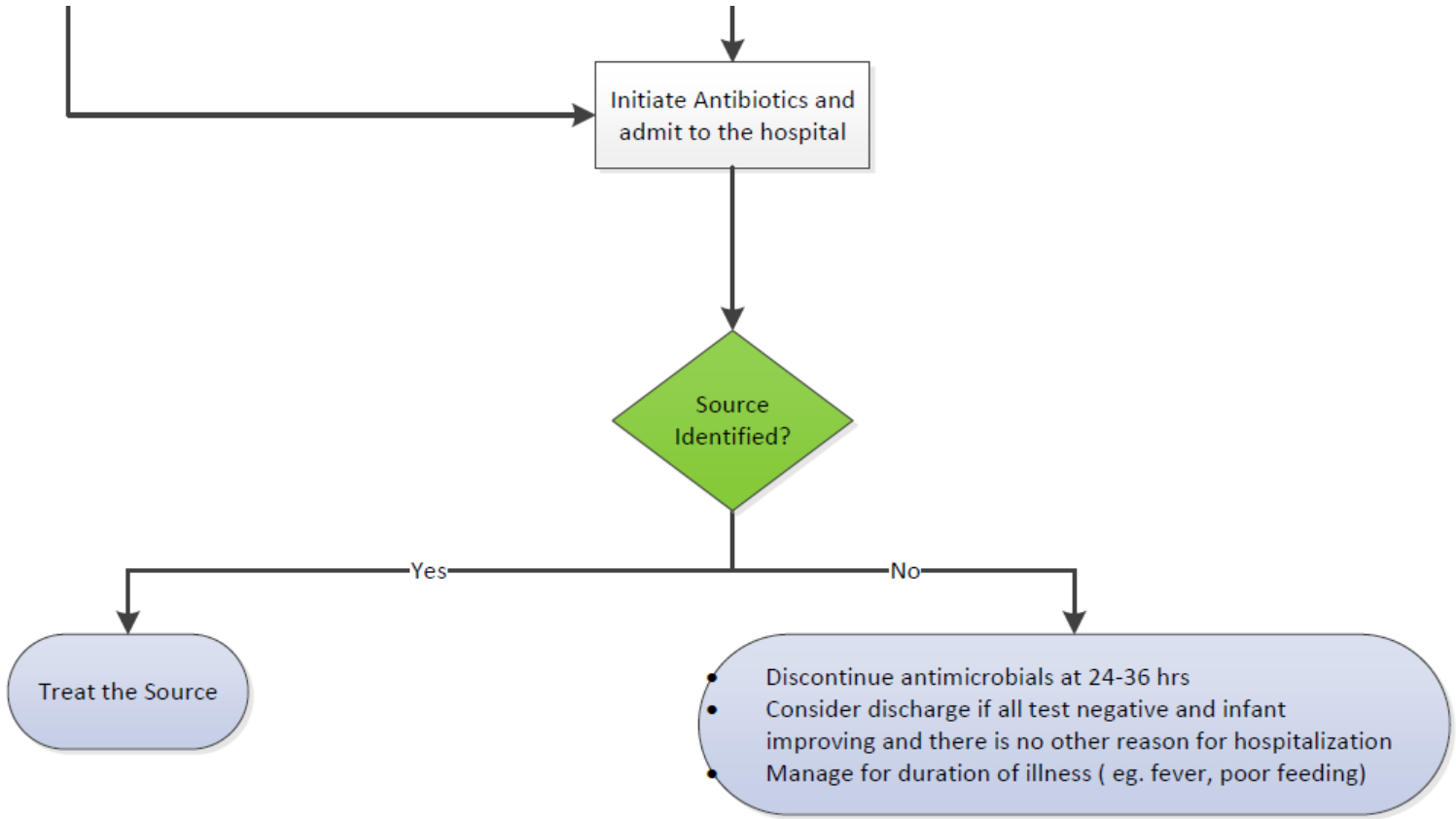
If any "Yes" proceed to HSV High Risk recommendation

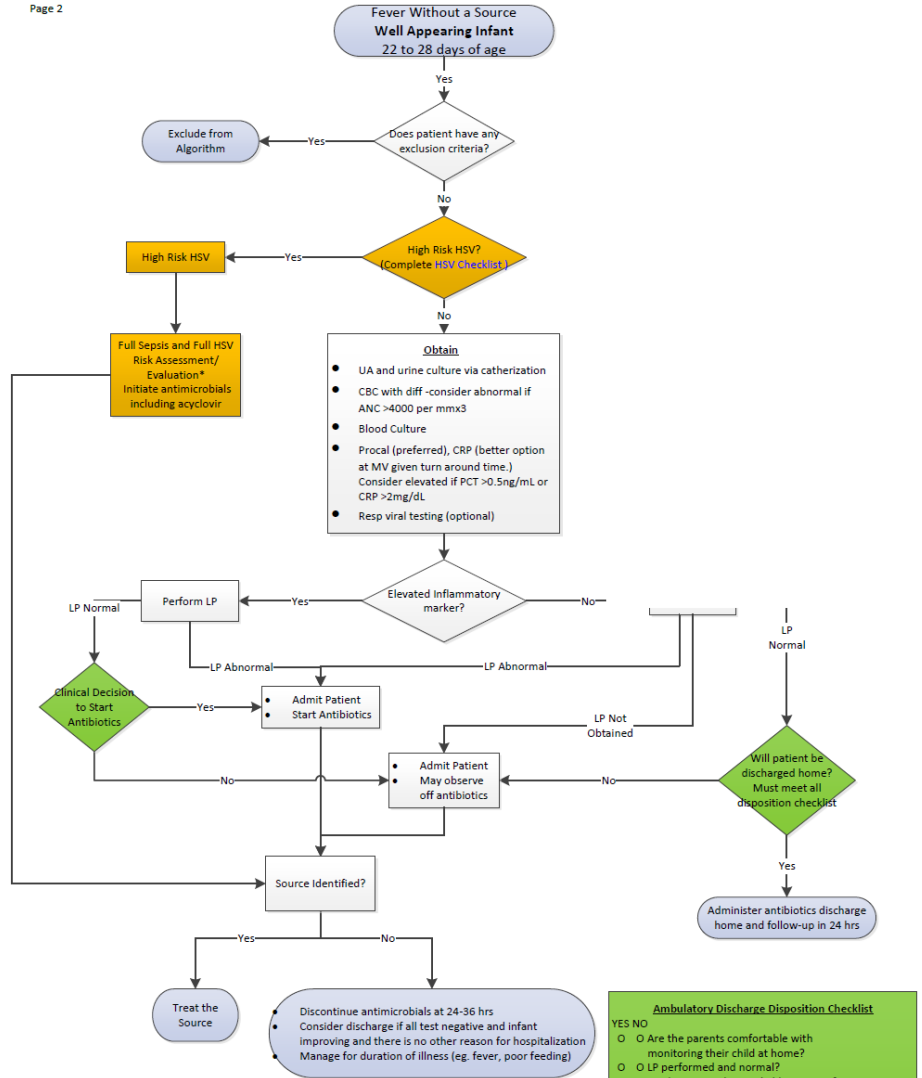
Epic Dot Phrase:
.HSVchecklisted

Use "ED Fever Under 60 days" Order Set for ED orders
Use "Hosp IP Fever Under 60 days" Order Set for Inpatient Orders

Team Leads: Prabi Rajbhandari, MD; Crista Cerrone, MD & Scott Pangonis, MD
Revised: Feb. 2022


Fever Without a Source
Well Appearing Infant
8 to 21 days of age
Akron Chi
Yes
Does patient have any exclusion criteria?
Yes
Exclude from Algorithm
No
High Risk HSV?
(Complete questions 1-3 on HSV Checklist)
Yes
High Risk HSV
No
Full Sepsis and Full HSV Risk Assessment/Evaluation*
Initiate antimicrobials including acyclovir
Obtain
UA and urine culture via catherization
CBC with diff -consider abnormal if ANC >4000 per mmx3
Blood Culture
Lumbar puncture
Procal (preferred), CRP (better option at MV given turn around time.) Consider elevated if PCT >0.5ng/mL or CRP >2mg/dL
Resp viral testing (optional)
Initiate Antibiotics and admit to the hospital


Initiate Antibiotics and admit to the hospital
Source Identified?
Yes
No
Treat the Source
Discontinue antimicrobials at 24-36 hrs
Consider discharge if all test negative and infant improving and there is no other reason for hospitalization
Manage for duration of illness (eg. fever, poor feeding)



Ambulatory Discharge Disposition Checklist

YES NO

- O O Are the parents comfortable with monitoring their child at home?
- O O LP performed and normal?
- O O Do the parents have reliable means of receiving communication daily?
- O O Can bacterial culture results be followed daily?
- O O Can the patient follow-up with their PCP in 24 hours?

If any "No" admit the patient.

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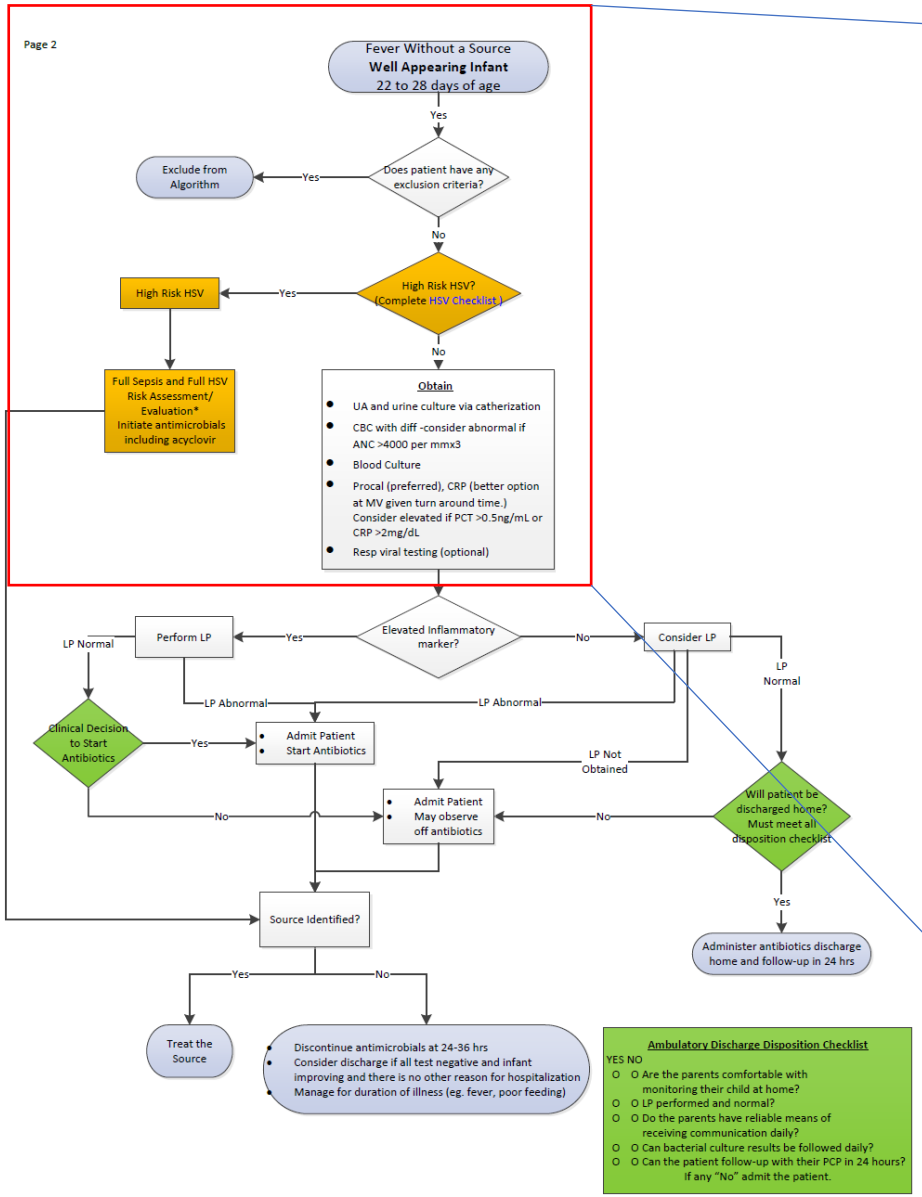
Page 2
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Well Appearing Infant
22 to 28 days of age
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Resp viral testing (optional)
Elevated Inflammatory marker?
Yes
No
Perform LP
LP Normal
LP Abnormal
Consider LP
LP Normal
LP Abnormal
LP Not Obtained
Clinical Decision to Start Antibiotics
Yes
No
Admit Patient
Start Antibiotics
Admit Patient
May observe off antibiotics
Will patient be discharged home? Must meet all disposition checklist
No
Yes
Administer antibiotics discharge home and follow-up in 24 hrs
Source Identified?
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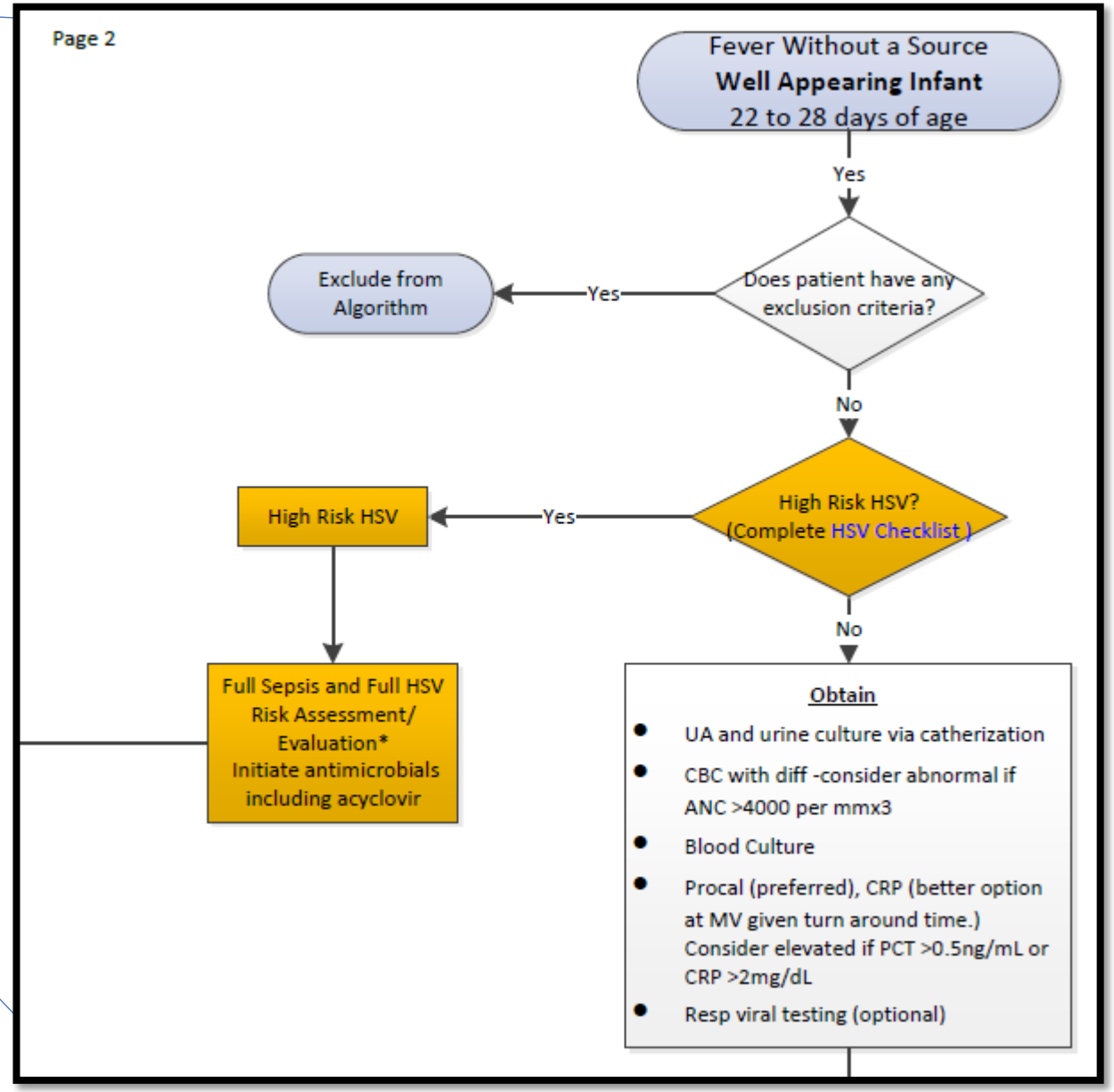
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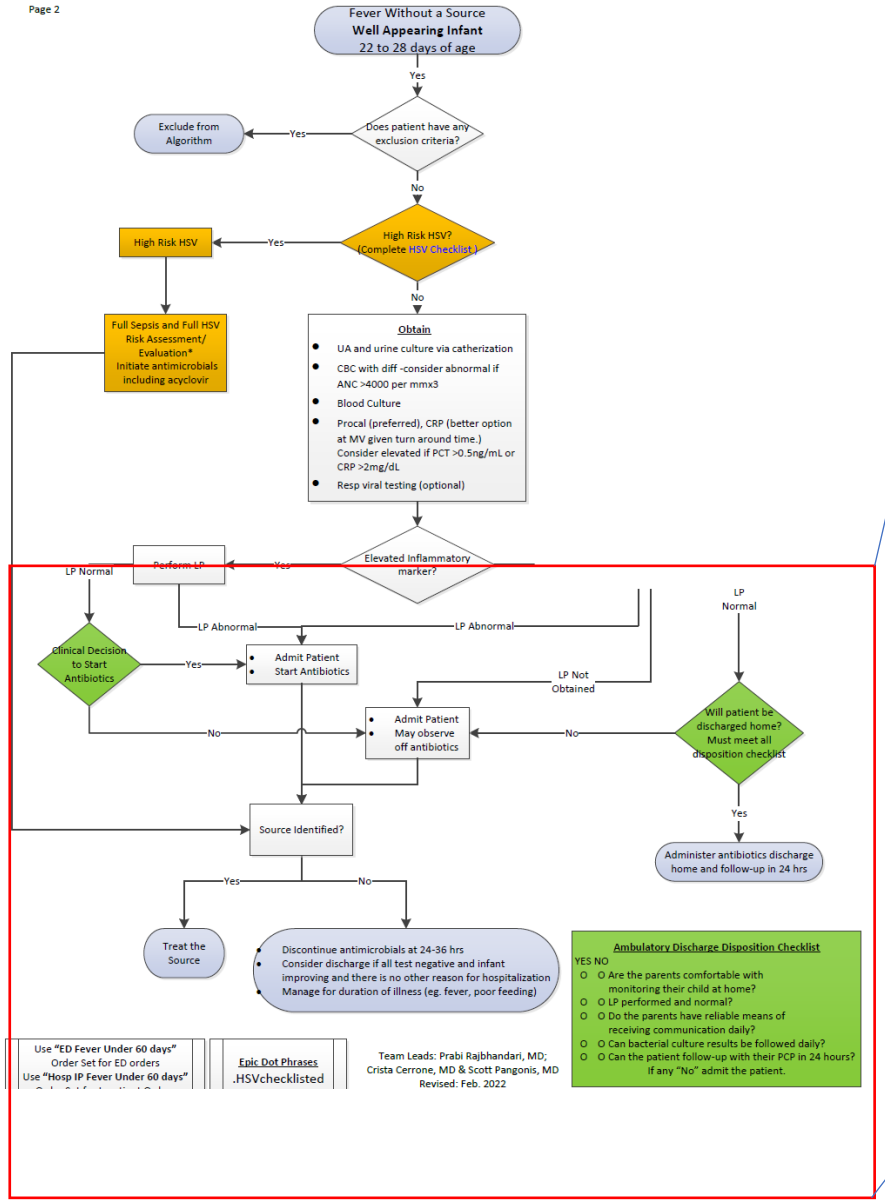
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Elevated Inflammatory marker?
Yes
Perform LP
LP Normal
LP Abnormal
LP Abnormal
Clinical Decision to Start Antibiotics
Yes
Admit Patient
Start Antibiotics
LP Not Obtained
No
Admit Patient
May observe off antibiotics
No
LP Normal
Will patient be discharged home? Must meet all disposition checklist
Yes
Administer antibiotics discharge home and follow-up in 24 hrs
Source Identified?
Yes
No
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Use "ED Fever Under 60 days"
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Use "Hosp IP Fever Under 60 days"
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.HSVchecklisted
Team Leads: Prabi Rajbhandari, MD;
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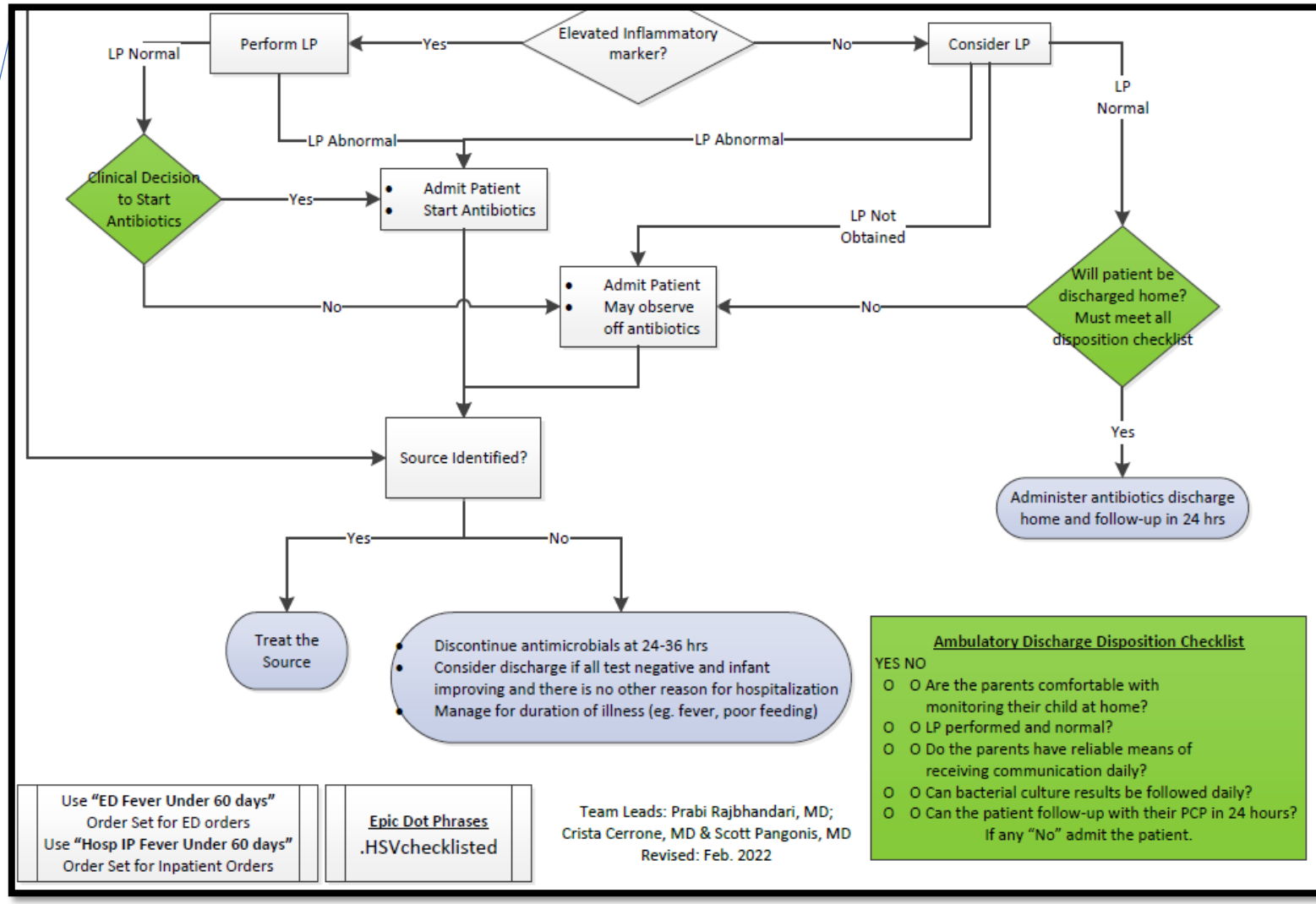
Revised: Feb. 2022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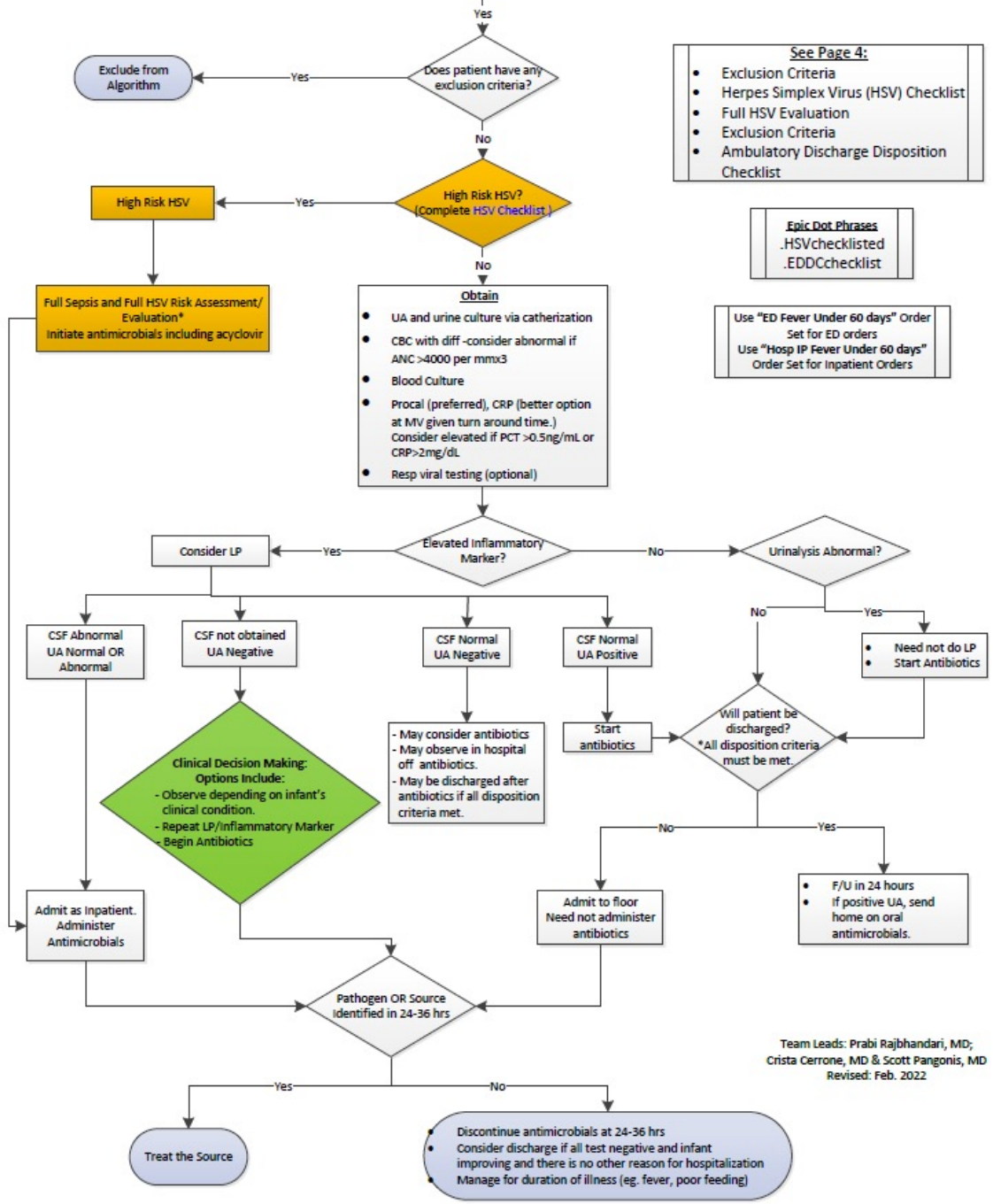
Fever Without a Source Well Appearing Infant 29 to 60 days of age

Akron Children's Hospital



See Page 4:
- Exclusion Criteria
- Herpes Simplex Virus (HSV) Checklist
- Full HSV Evaluation
- Exclusion Criteria
- Ambulatory Discharge Disposition Checklist

Epic Dot Phrases
.HSVchecklisted
.EDDCchecklist

Use **"ED Fever Under 60 days"** Order Set for ED orders
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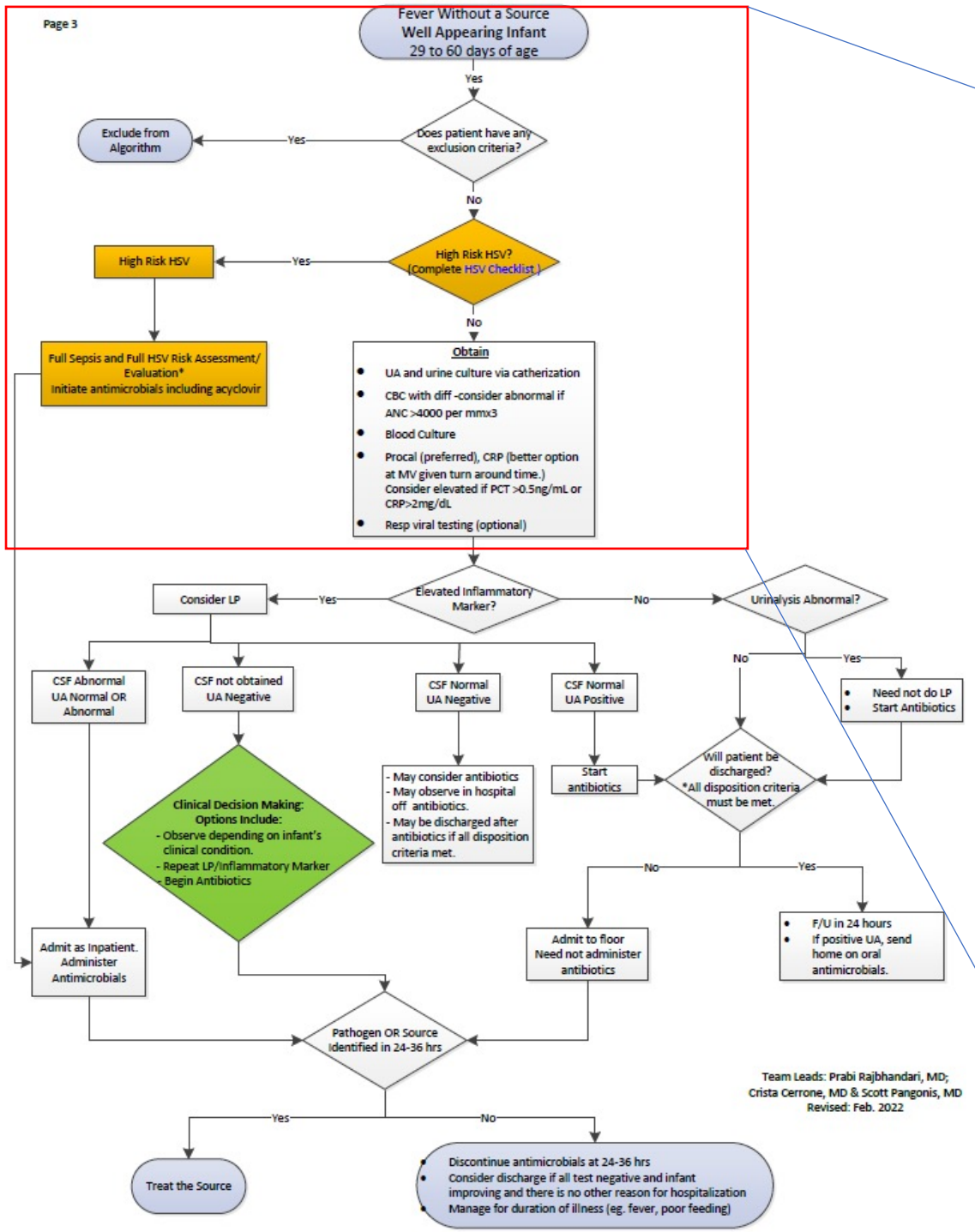
Team Leads: Prabi Rajbhandari, MD; Crista Cerrone, MD & Scott Pangonis, MD
Revised: Feb. 2022



Team Leads: Prabi Rajbhandari, MD;
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Revised: Feb. 2022

Page 3

Fever Without a Source
Well Appearing Infant
29 to 60 days of age

Yes

Does patient have any exclusion criteria?

Yes

Exclude from Algorithm

No

High Risk HSV? (Complete HSV Checklist.)

Yes

High Risk HSV

No

Full Sepsis and Full HSV Risk Assessment/ Evaluation*
Initiate antimicrobials including acyclovir

Obtain

- UA and urine culture via catherization
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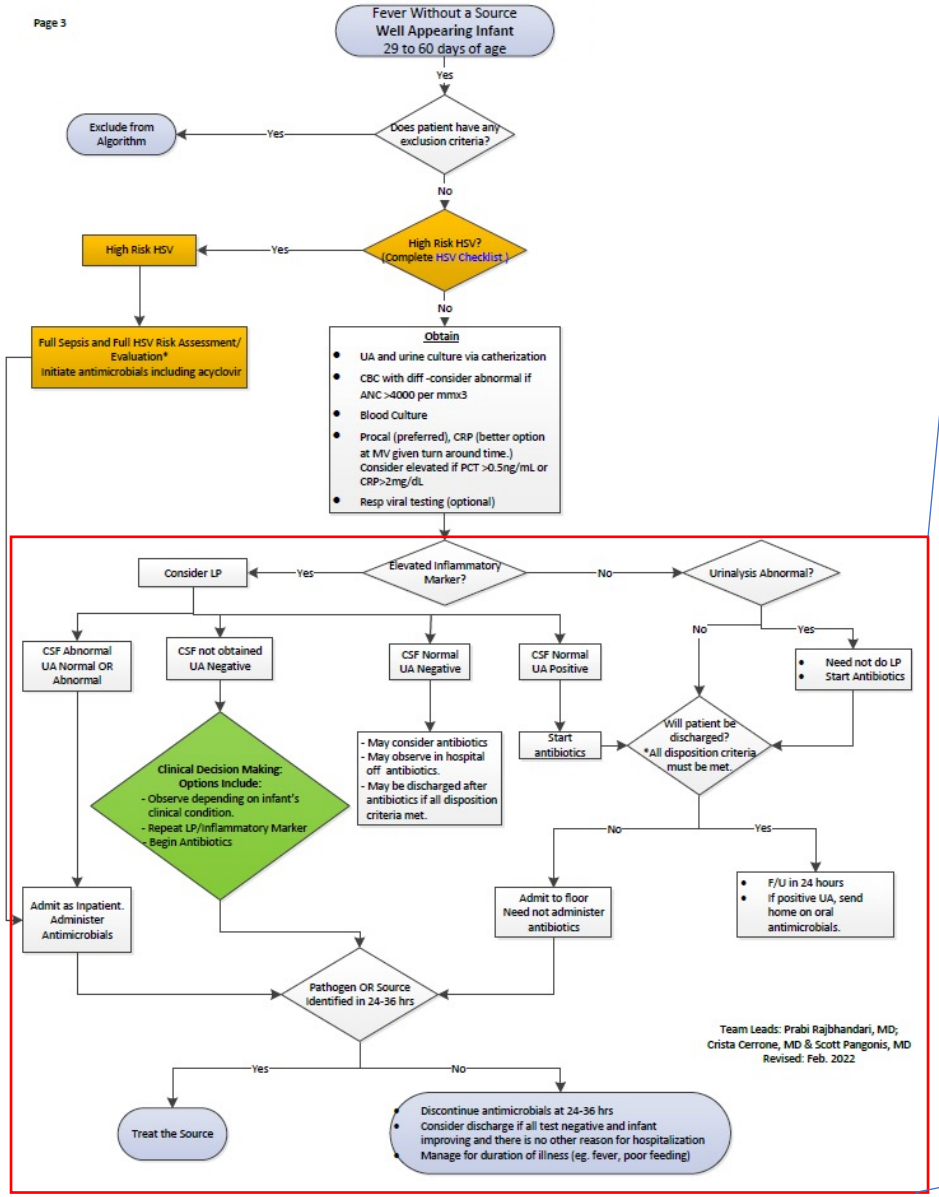

Consider LP
Yes
Elevated Inflammatory Marker?
No
Urinalysis Abnormal?
CSF Abnormal UA Normal OR Abnormal
CSF not obtained UA Negative
CSF Normal UA Negative
CSF Normal UA Positive
No
Yes
Need not do LP
Start Antibiotics
Clinical Decision Making:
Options Include:
- Observe depending on infant's clinical condition.
- Repeat LP/Inflammatory Marker
- Begin Antibiotics
- May consider antibiotics
- May observe in hospital off antibiotics.
- May be discharged after antibiotics if all disposition criteria met.
Start antibiotics
Will patient be discharged?
*All disposition criteria must be met.
No
Yes
Admit as Inpatient. Administer Antimicrobials
Admit to floor
Need not administer antibiotics
F/U in 24 hours
If positive UA, send home on oral antimicrobials.
Pathogen OR Source Identified in 24-36 hrs
Yes
No
Treat the Source
Discontinue antimicrobials at 24-36 hrs
Consider discharge if all test negative and infant improving and there is no other reason for hospitalization
Manage for duration of illness (eg. fever, poor feeding)
Team Leads: Prabi Rajbhandari, MD;
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Antimicrobials (hint: look at order sets)

Antimicrobial Recommendations by Age

Age	Well-appearing and no CSF pleocytosis	Ill-appearing and/or CSF pleocytosis
0-21 Days	Ampicillin Ceftazidime Acyclovir	Vancomycin Cefepime Acyclovir
22-28 Days	**Abnormal UA or IM** Ampicillin Ceftazidime Consider acyclovir – see HSV Testing Indications	Vancomycin Cefepime Consider acyclovir – see HSV Testing Indications
29-56 Days	**Abnormal IM, Normal UA** Ceftriaxone **Abnormal UA** Ceftriaxone Ampicillin Consider acyclovir – see HSV Testing Indications	Vancomycin Ceftriaxone Consider acyclovir – see HSV Testing Indications

Credit: Children's Hospital Of Philadelphia

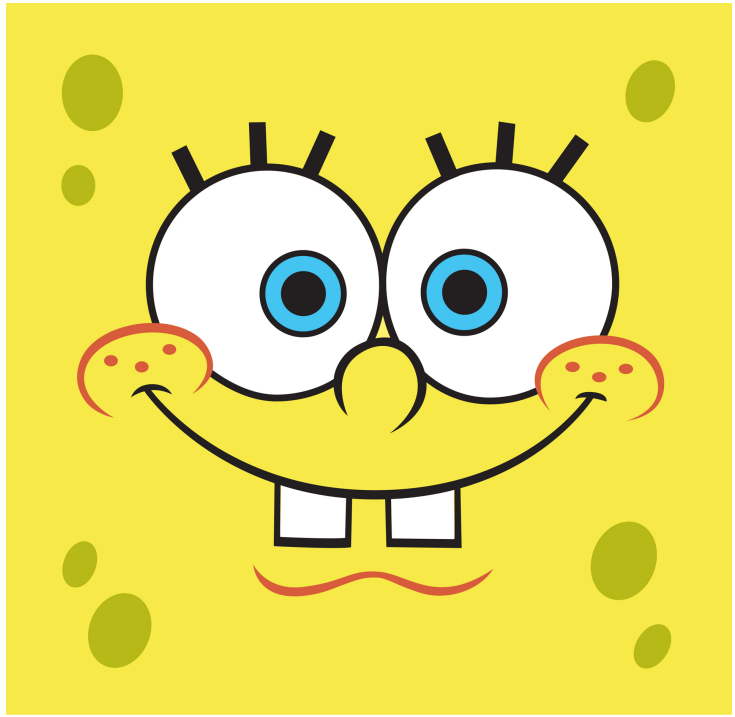
Challenges and Pitfalls

- "Oh but they look so good"
- "RFA is positive for parainfluenza"
  - Guidelines mention *clinical* bronchiolitis only
- What about antibiotics before the LP?

Neonatal Hyperbilirubinemia

Background

- Bilirubin
  - Breakdown product of RBCs
  - All babies have increased indirect bili to some degree
  - If it gets too high, unbound bilirubin can affect the baby
    - Jaundice, scleral icterus
    - Bilirubin-induced neurologic dysfunction
    - Bilirubin encephalopathy (acute and chronic)
  - Bilirubin typically peaks around day 3-4



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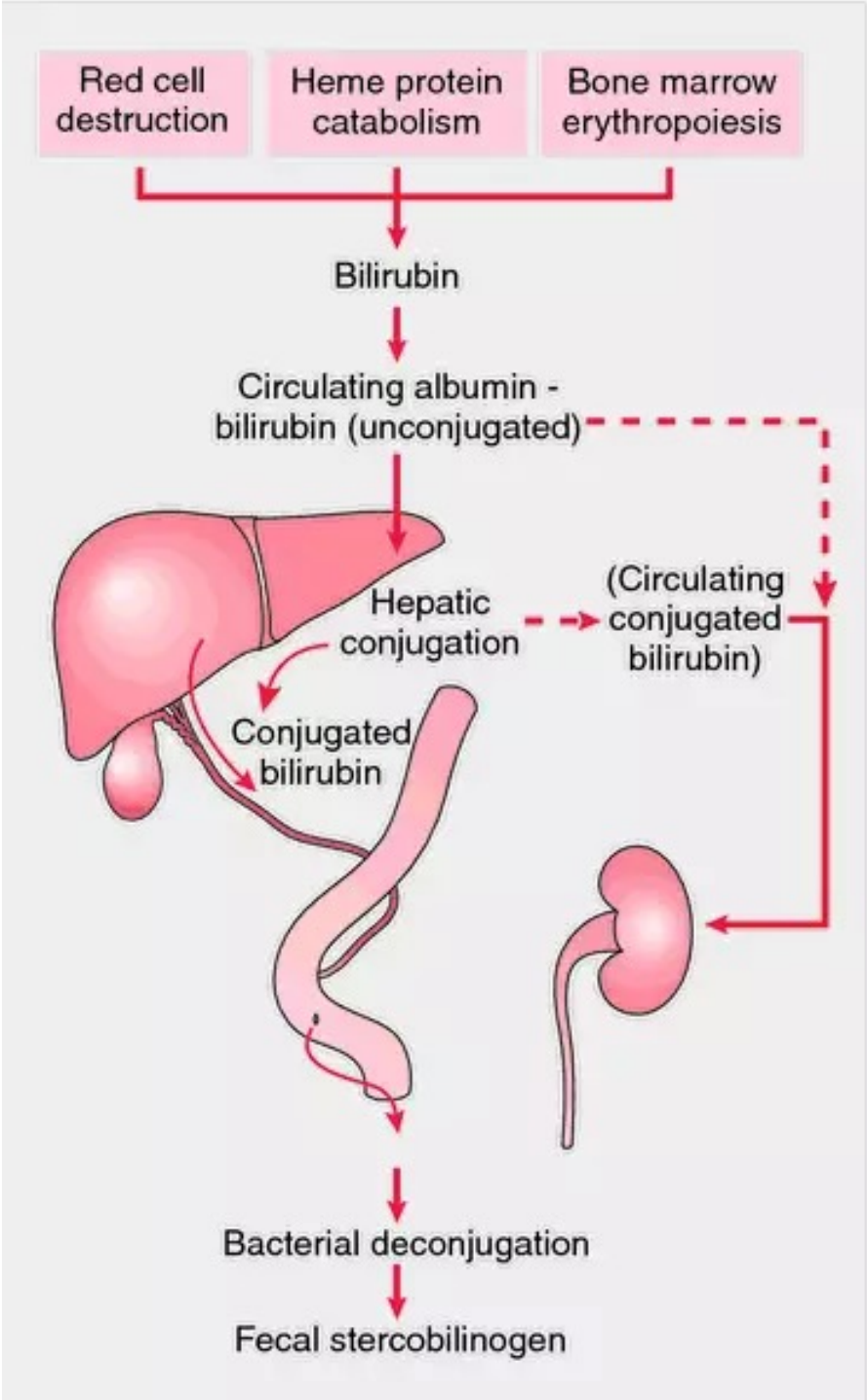
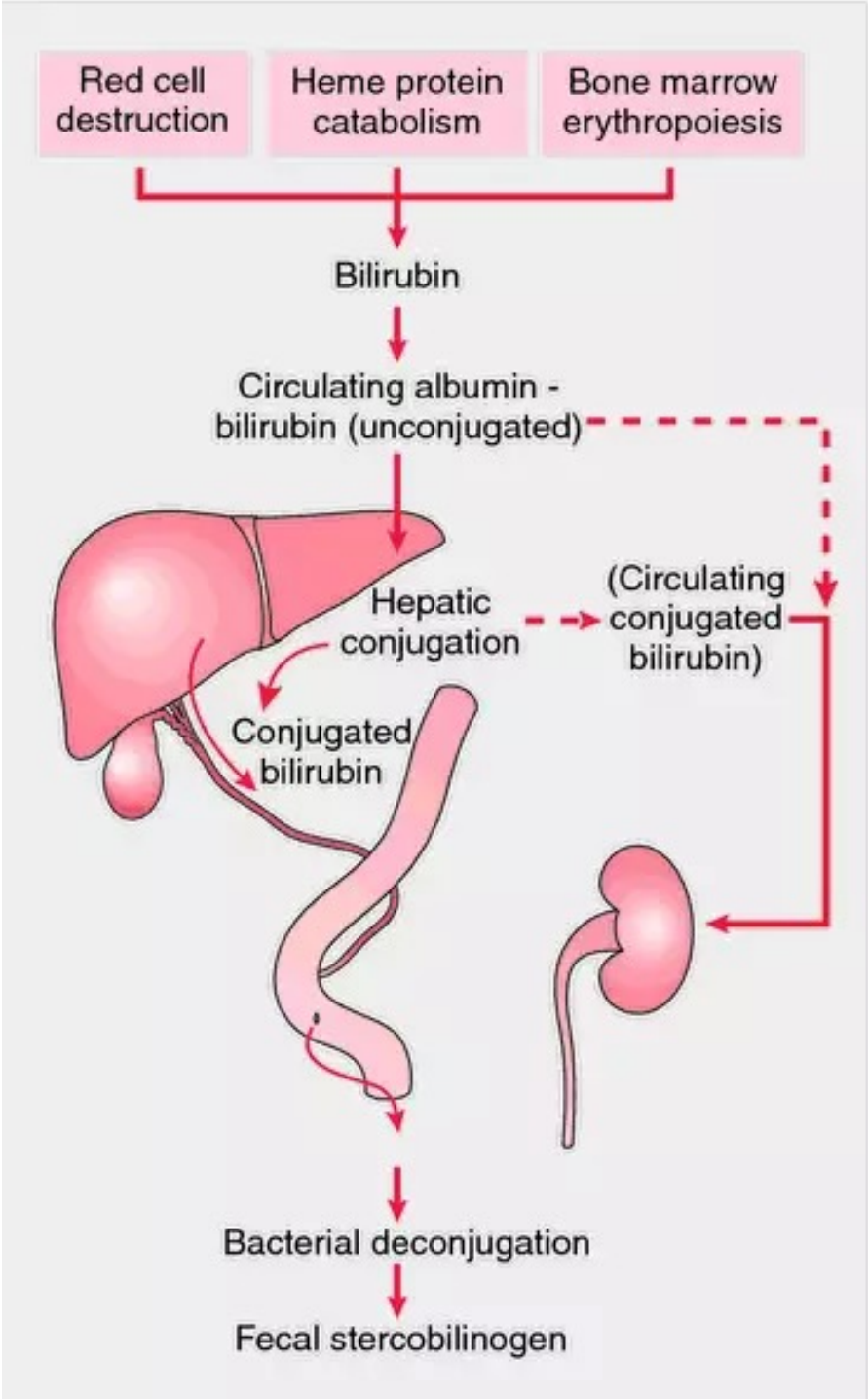
Normal Metabolism

- Binds to albumin and goes to liver
- In liver, becomes conjugated into direct bili
- Direct bili gets excreted into intestines via bile
- Bile gets excreted via stool OR reabsorbed



What goes wrong

- Too much hemolysis
  - ABO and/or Rh incompatibility
- Not enough albumin
- Problems with conjugation
- Can’t excrete conjugated bilirubin
- Can’t stool enough
- Too much reabsorption



What about non-newborns?

- Scleral icterus and jaundice can happen outside of infancy too
  - Usually pathologic
  - Consider excess hemolysis, liver dysfunction (crigler-Najjaar, Gilbert's, hepatitis),biliary obstruction, etc

Treatments

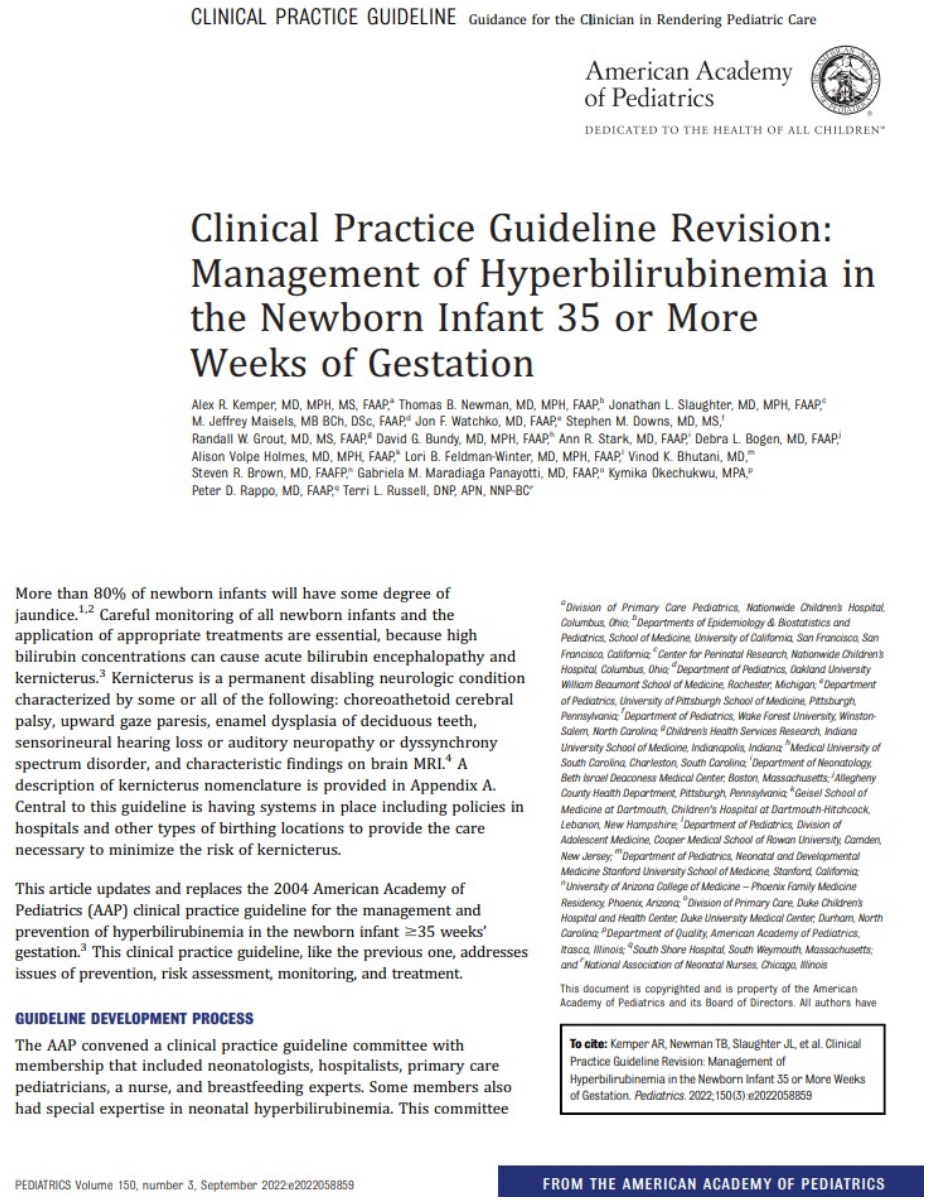
- Supportive Care (home)
  - Feed the baby
- Phototherapy (hospital, sometimes home)
  - Intensive phototherapy: 475nm wavelength
  - Not entirely without risks
    - Cost, possible increased risk of epilepsy
- Exchange Transfusion (NICU)
- IVIG (NICU)

https://www.sciencerepository.org/phototherapy-and-its-applications

https://motifmedical.com/bilitouch-phototherapy-blanket

The New Guidelines

- Released 8/2/2022
- Biggest changes from 2004 guidelines
  - Higher phototherapy levels!
  - Clear guidelines on recommended follow-up!
  - No more "low-intermediate risk, high-intermediate risk, etc" nonsense!
  - Clear guidelines on escalation of care!



CLINICAL PRACTICE GUIDELINE Guidance for the Clinician in Rendering Pediatric Care

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

Clinical Practice Guideline Revision: Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation

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More than 80% of newborn infants will have some degree of jaundice.[1,2] Careful monitoring of all newborn infants and the application of appropriate treatments are essential, because high bilirubin concentrations can cause acute bilirubin encephalopathy and kernicterus.[3] Kernicterus is a permanent disabling neurologic condition characterized by some or all of the following: choreoathetoid cerebral palsy, upward gaze paresis, enamel dysplasia of deciduous teeth, sensorineural hearing loss or auditory neuropathy or dyssynchrony spectrum disorder, and characteristic findings on brain MRI.[4] A description of kernicterus nomenclature is provided in Appendix A. Central to this guideline is having systems in place including policies in hospitals and other types of birthing locations to provide the care necessary to minimize the risk of kernicterus.

This article updates and replaces the 2004 American Academy of Pediatrics (AAP) clinical practice guideline for the management and prevention of hyperbilirubinemia in the newborn infant ≥35 weeks' gestation.[3] This clinical practice guideline, like the previous one, addresses issues of prevention, risk assessment, monitoring, and treatment.

GUIDELINE DEVELOPMENT PROCESS

The AAP convened a clinical practice guideline committee with membership that included neonatologists, hospitalists, primary care pediatricians, a nurse, and breastfeeding experts. Some members also had special expertise in neonatal hyperbilirubinemia. This committee

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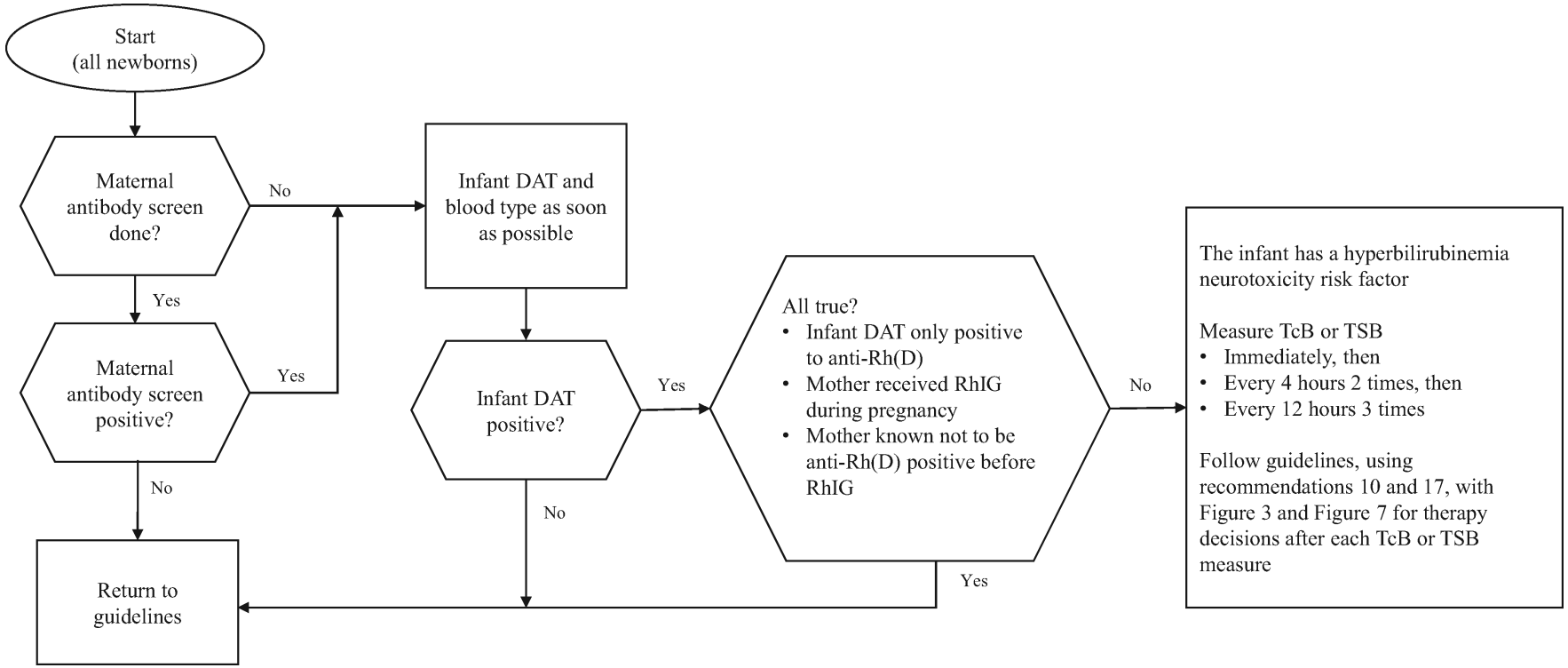
FROM THE AMERICAN ACADEMY OF PEDIATRICS

Prevention

Prevention of Isoimmune disease

- All expectant mothers should have prenatal antibody screening done. If not done, check blood type and direct antiglobulin test (DAT) in baby ASAP



Prevention

- Feed the baby to prevent dehydration and promote bowel function

- Breastfeeding jaundice vs breast milk jaundice

Assessment and Monitoring

Risk Factors
• Lower gestational age (ie, risk increases with each additional week less than 40 wk)
• Jaundice in the first 24 h after birth
• Predischarge transcutaneous bilirubin (TcB) or total serum bilirubin (TSB) concentration close to the phototherapy threshold
• Hemolysis from any cause, if known or suspected based on a rapid rate of increase in the TSB or TcB of >0.3 mg/dL per hour in the first 24 h or >0.2 mg/dL per hour thereafter.
• Phototherapy before discharge
• Parent or sibling requiring phototherapy or exchange transfusion
• Family history or genetic ancestry suggestive of inherited red blood cell disorders, including glucose-6-phosphate dehydrogenase (G6PD) deficiency
• Exclusive breastfeeding with suboptimal intake
• Scalp hematoma or significant bruising
• Down syndrome
• Macrosomic infant of a diabetic mother

Neurotoxicity risk factors

Risk Factors
• Gestational age <38 wk and this risk increases with the degree of prematurity[a]
• Albumin <3.0 g/dL
• Isoimmune hemolytic disease (ie, positive direct antiglobulin test), G6PD deficiency, or other hemolytic conditions
• Sepsis
• Significant clinical instability in the previous 24 h

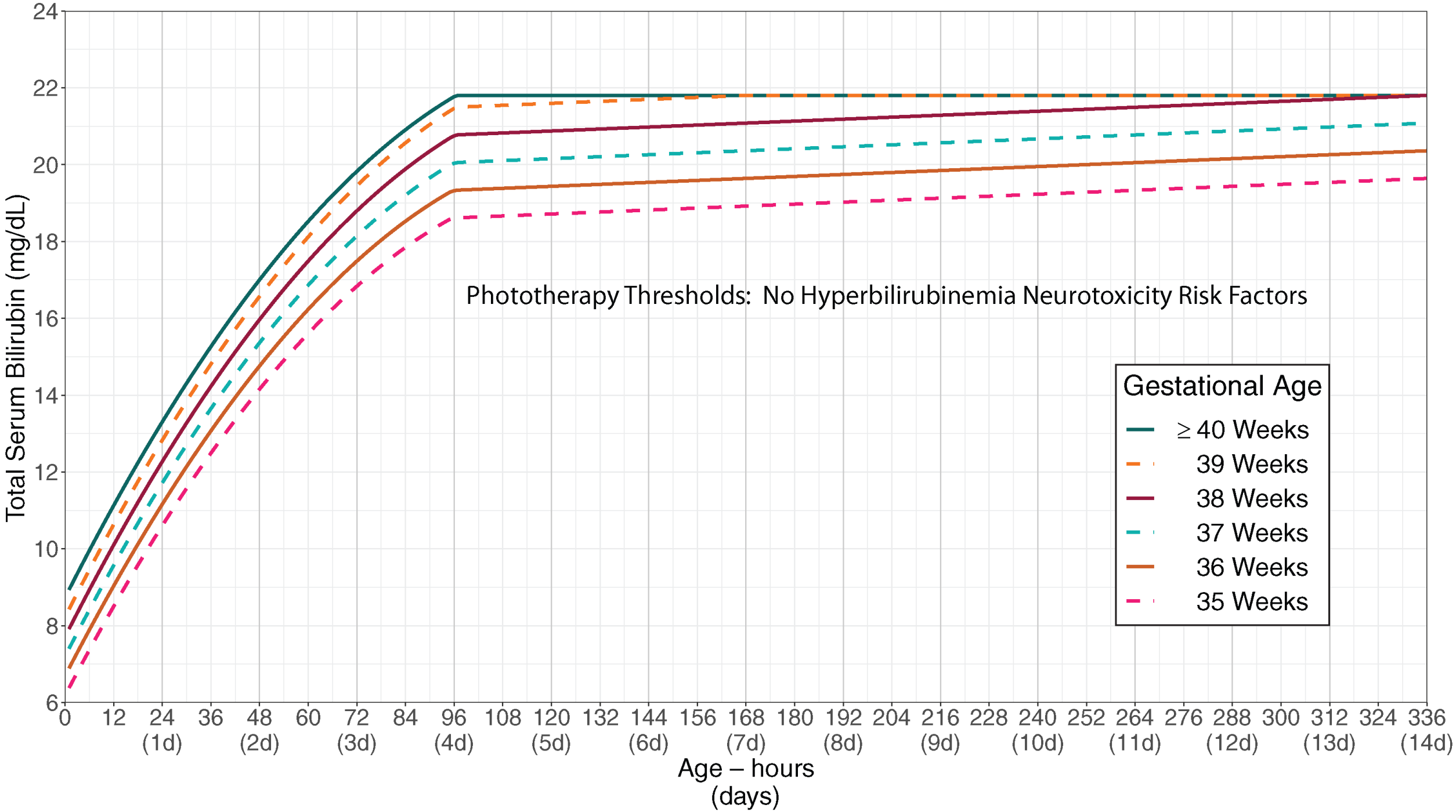
Assessment and Monitoring

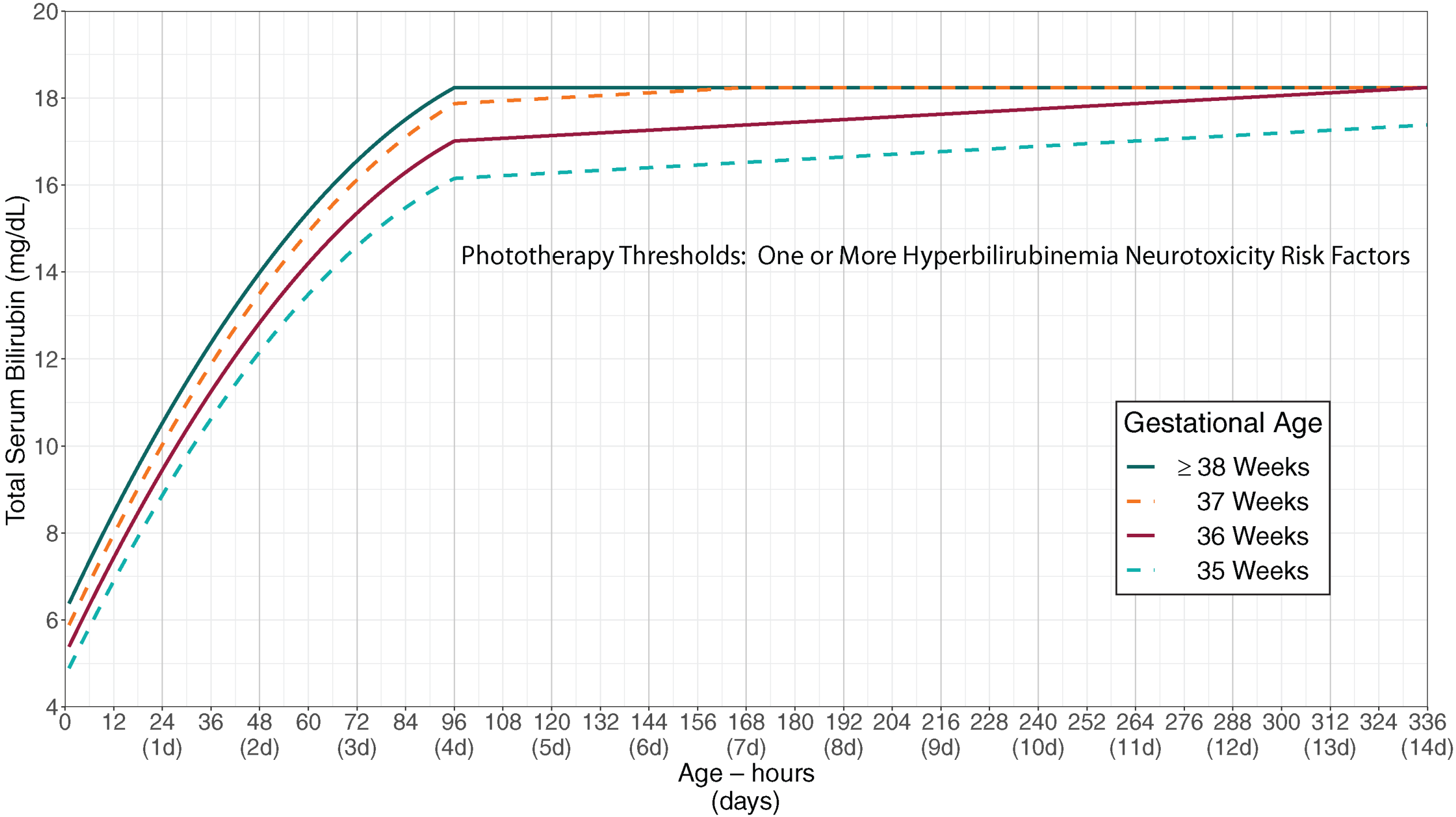
- How to check bilirubin
  - Look at the baby (super unreliable)
    - If appears jaundiced within 24h of birth, must check bili immediately
  - Transcutaneous bili (TCB)
    - Must wait 24+ hours from last use of phototherapy
    - Margin of error ~3 pts
  - Total serum bili (TSB – gold standard, use for treatment decisions)
    - What about direct? Don't subtract, if rising consider obstructive processes

https://viaglobalhealth.com/product/handheld-rapid-test-jaundice-meter-mbj20/

Assessment and Monitoring

- Check all babies at 24-48h
  - TCB OK for basic screens
    - Must check TSB if within 3 mg/dL of light level OR TCB ≥15 mg/dL
  - Can consider rate of rise if multiple levels available
    - ≥0.3 mg/dL per hour in first 24h or ≥0.2 mg/dL per hour after 24h is consider abnormal, should screen for hemolysis
  - Use the difference between TCB/TSB and light level to determine follow-up
- Note: If a breastfed baby comes back at 3-4 weeks of age with hyperbili OR at 2w of age when formula fed, check total + direct bili


Phototherapy Thresholds: No Hyperbilirubinemia Neurotoxicity Risk Factors
Total Serum Bilirubin (mg/dL)
24
22
20
18
16
14
12
10
8
6
Age – hours
(days)
0
12
24 (1d)
36
48 (2d)
60
72 (3d)
84
96 (4d)
108
120 (5d)
132
144 (6d)
156
168 (7d)
180
192 (8d)
204
216 (9d)
228
240 (10d)
252
264 (11d)
276
288 (12d)
300
312 (13d)
324
336 (14d)
Gestational Age
≥ 40 Weeks
39 Weeks
38 Weeks
37 Weeks
36 Weeks
35 Weeks


Phototherapy Thresholds: One or More Hyperbilirubinemia Neurotoxicity Risk Factors
Total Serum Bilirubin (mg/dL)
20
18
16
14
12
10
8
6
4
0
12
24 (1d)
36
48 (2d)
60
72 (3d)
84
96 (4d)
108
120 (5d)
132
144 (6d)
156
168 (7d)
180
192 (8d)
204
216 (9d)
228
240 (10d)
252
264 (11d)
276
288 (12d)
300
312 (13d)
324
336 (14d)
Age – hours (days)
Gestational Age
≥ 38 Weeks
37 Weeks
36 Weeks
35 Weeks

Starting Treatment

- If TSB ≥ light level, check exchange transfusion chart and start phototherapy
  - Select patients qualify for home photo
    - Gestational age ≥38 weeks
    - ≥48 hours old
    - Clinically well with adequate feeding
    - No known hyperbilirubinemia neurotoxicity risk factors
    - No previous phototherapy
    - TSB concentration no more than 1 mg/dL above the phototherapy treatment threshold
    - An LED-based phototherapy device will be available in the home without delay
    - TSB can be measured daily
- If TSB ≤ light level, DON'T start phototherapy*
- If TSB remains within 2 points of light level at day 7, consider pathologic causes of jaundice, can consider treatment even if not at light level

Monitoring success of phototherapy

- In the hospital
  - after starting lights, check next TSB within 12 hours
  - Rechecks based on the presence of neurotoxicity risk factors, rate of rise, and TSB
  - Other labs: check H/H (or CBC), DAT in babies of mothers with + antibody screen or if mom was O+/anything-
  - Check for G6PD if TSB increases despite phototherapy
- If doing home phototherapy, MUST check daily

Stopping Phototherapy

- Can stop phototherapy when TSB had decreased by at least 2 mg/dL below the light level where you STARTED phototherapy
  - Can prolong phototherapy if there are risk factors for rebound hyperbilirubinemia
    - <38 weeks, <48 hours old at start of phototherapy, presence of hemolytic disease

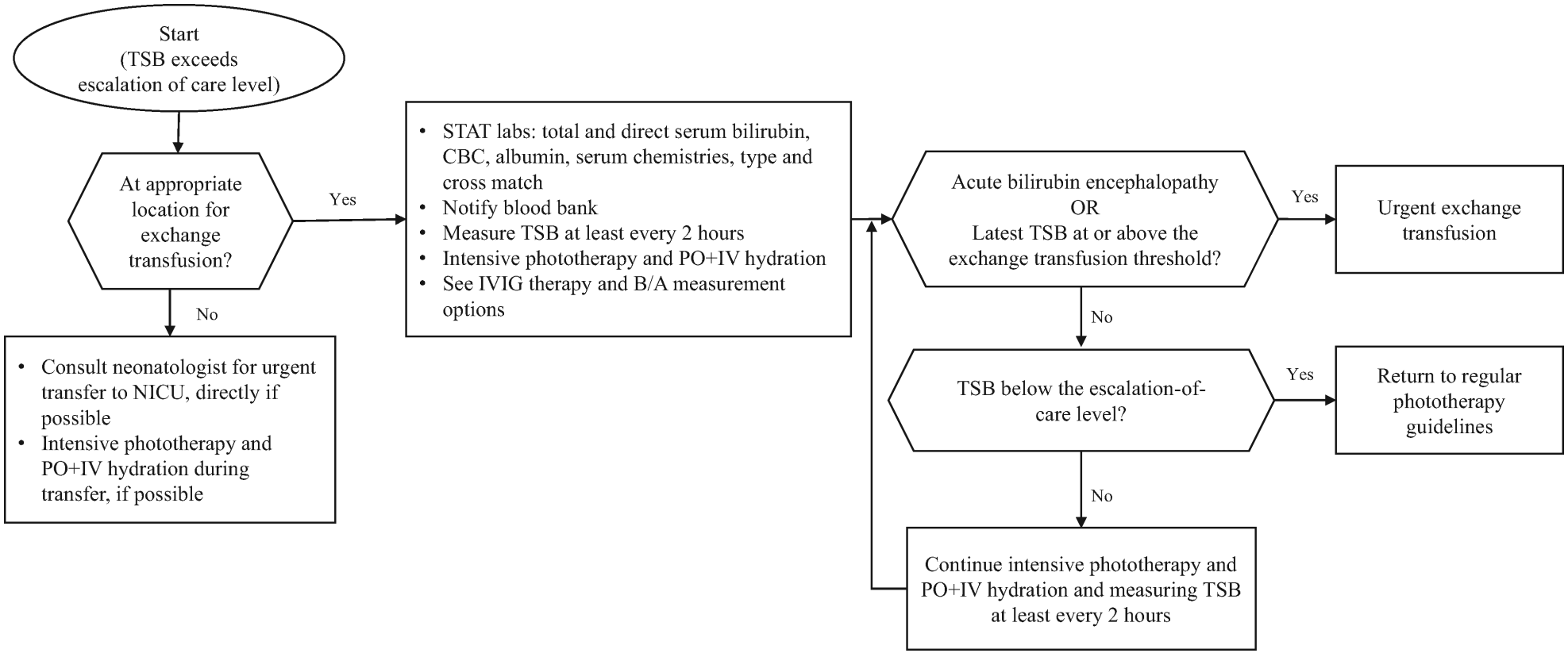
- Example:
  - Start lights when TSB was 18 with light level was 17. Can stop when TSB is <15 IF no risk factors present

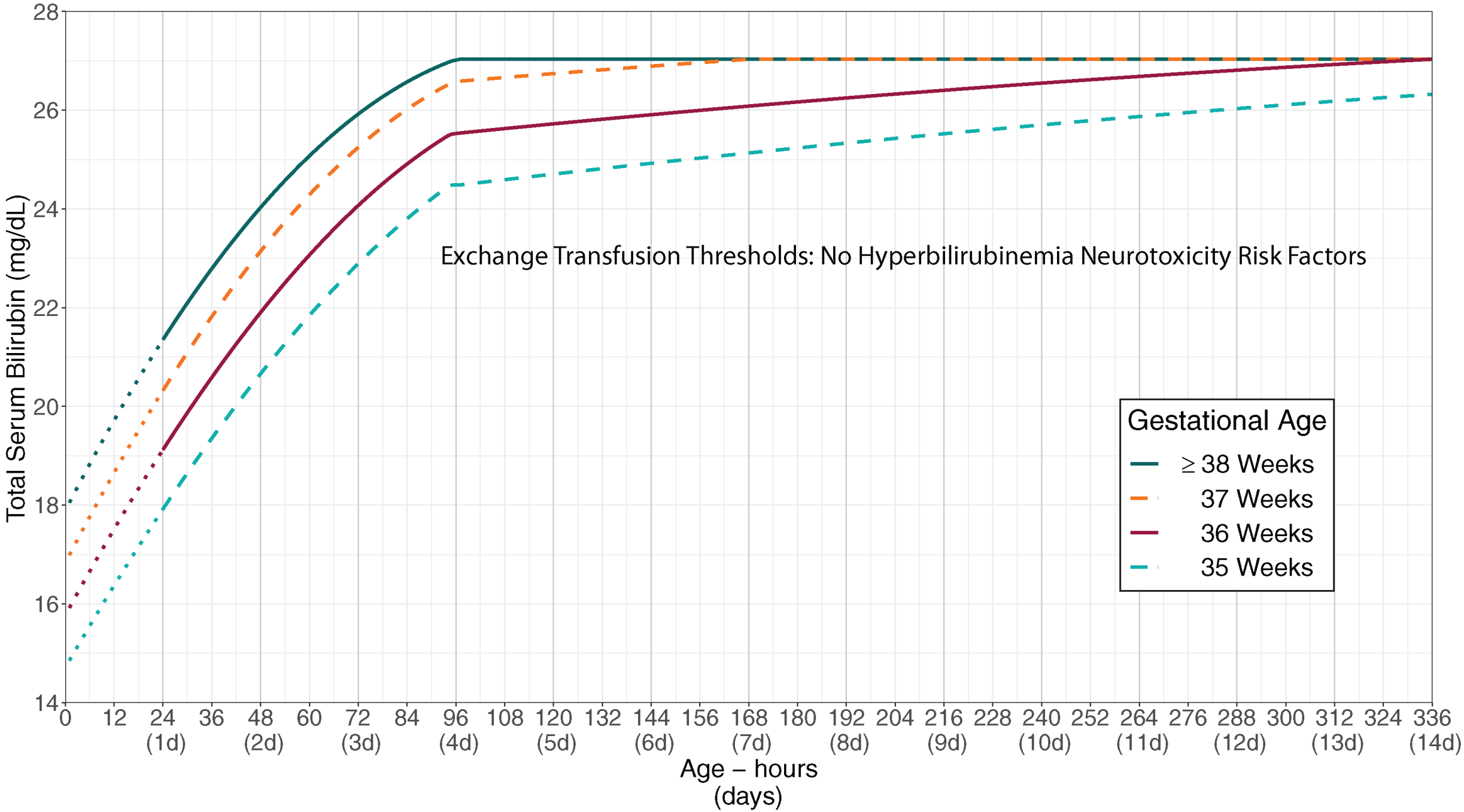
Follow-up after Lights

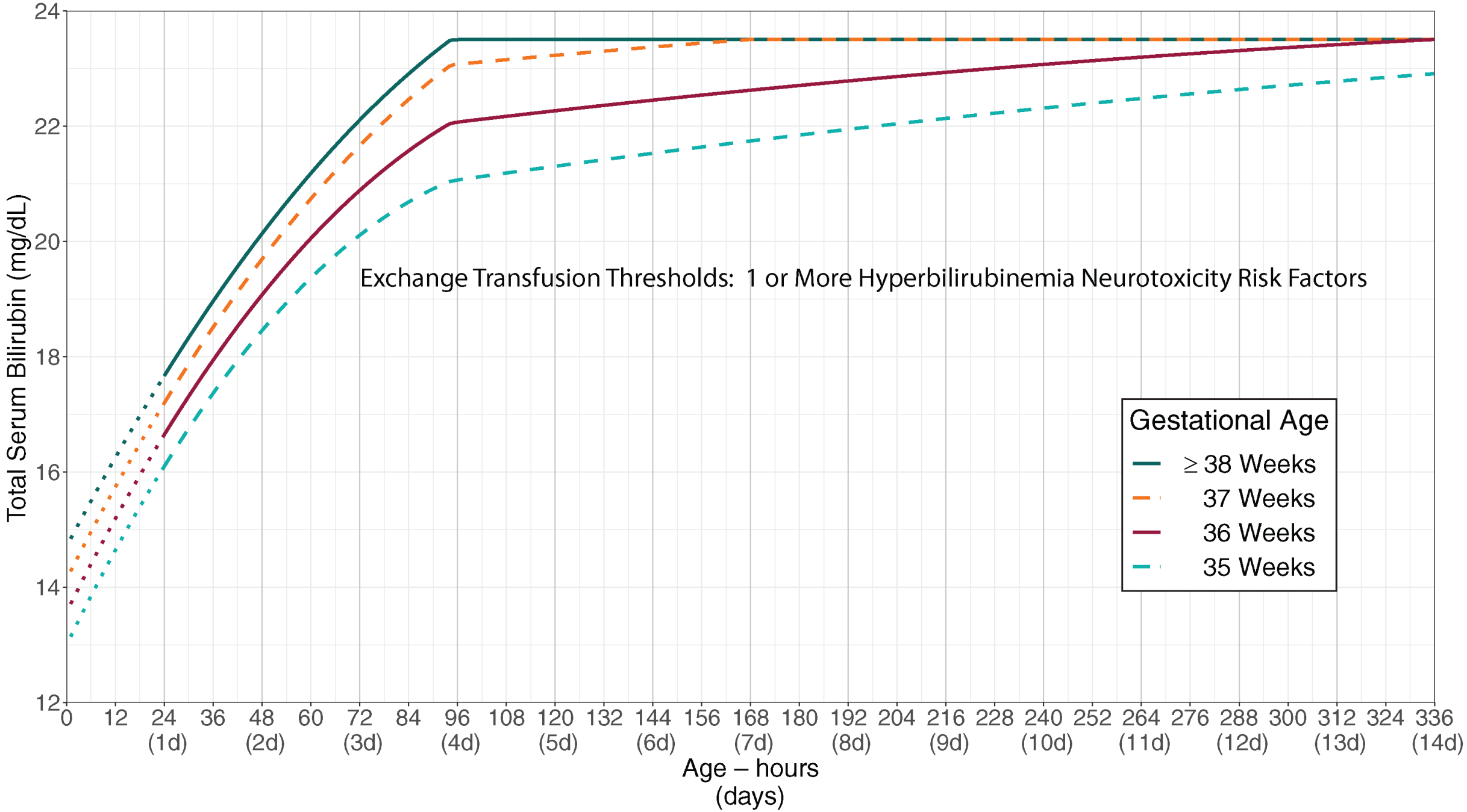
- Infants at significant risk of rebound should have TSB rechecked 6-12 hours after lights discontinued as well as following day
  - Risk factors: <48 hours old at start of lights, + DAT, known/suspected hemolytic disease
- Infants without significant risk factors who received lights at birth hospital, check next day
- Infants who received phototherapy during initial birth hospitalization and were READMITTED for lights should have bili checked next day after 2nd round of phototherapy discontinuation
- Infants readmitted for lights who did NOT receive phototherapy during birth hospitalization should be rechecked 1-2 days later OR clinical follow-up
  - (PCP can decide if they want to recheck based on assessment and presence of risk factors)

Escalation of Care

- Escalation of care threshold = 2 mg/dL below exchange transfusion threshold




Exchange Transfusion Thresholds: No Hyperbilirubinemia Neurotoxicity Risk Factors
Total Serum Bilirubin (mg/dL)
28
26
24
22
20
18
16
14
0
12
24 (1d)
36
48 (2d)
60
72 (3d)
84
96 (4d)
108
120 (5d)
132
144 (6d)
156
168 (7d)
180
192 (8d)
204
216 (9d)
228
240 (10d)
252
264 (11d)
276
288 (12d)
300
312 (13d)
324
336 (14d)
Age – hours
(days)
Gestational Age
≥ 38 Weeks
37 Weeks
36 Weeks
35 Weeks


Exchange Transfusion Thresholds: 1 or More Hyperbilirubinemia Neurotoxicity Risk Factors
Total Serum Bilirubin (mg/dL)
24
22
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Gestational Age
≥ 38 Weeks
37 Weeks
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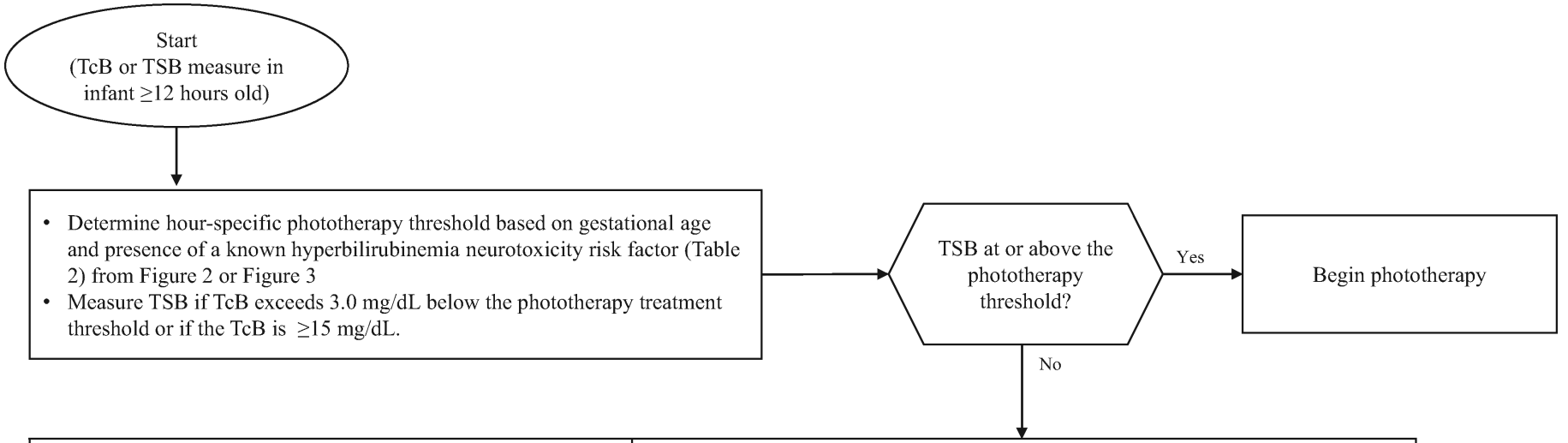
204
216 (9d)
228
240 (10d)
252
264 (11d)
276
288 (12d)
300
312 (13d)
324
336 (14d)
Age – hours
(days)

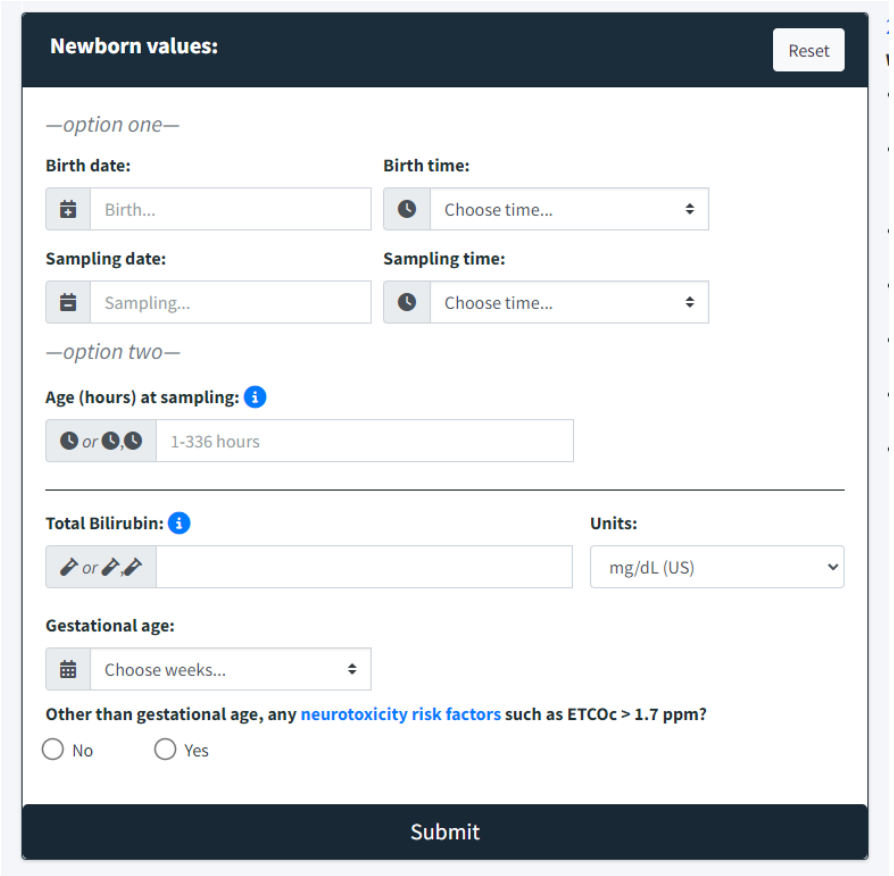
Follow-up after discharge



Phototherapy threshold minus TcB or TSB		Discharge Recommendations
0.1-1.9 mg/dL	Age <24 hours	Delay discharge, consider phototherapy, measure TSB in 4 to 8 hours
	Age≥24 hours	Measure TSB in 4 to 24 hours[a] Options: • Delay discharge and consider phototherapy • Discharge with home phototherapy if all considerations in the guideline are met • Discharge without phototherapy but with close follow-up
2.0-3.4 mg/dL	Regardless of age or discharge time	TSB or TcB in 4 to 24 hours[a]
3.5-5.4 mg/dL	Regardless of age or discharge time	TSB or TcB in 1-2 days
5.5-6.9 mg/dL	Discharging <72 hours	Follow-up within 2 days; TcB or TSB according to clinical judgment[b]
	Discharging ≥72 hours	Clinical judgment[b]
≥7.0 mg/dL	Discharging <72 hours	Follow-up within 3 days; TcB or TSB according to clinical judgment[b]
	Discharging ≥72 hours	Clinical judgment[b]

How to Operationalize

Bilitool.org



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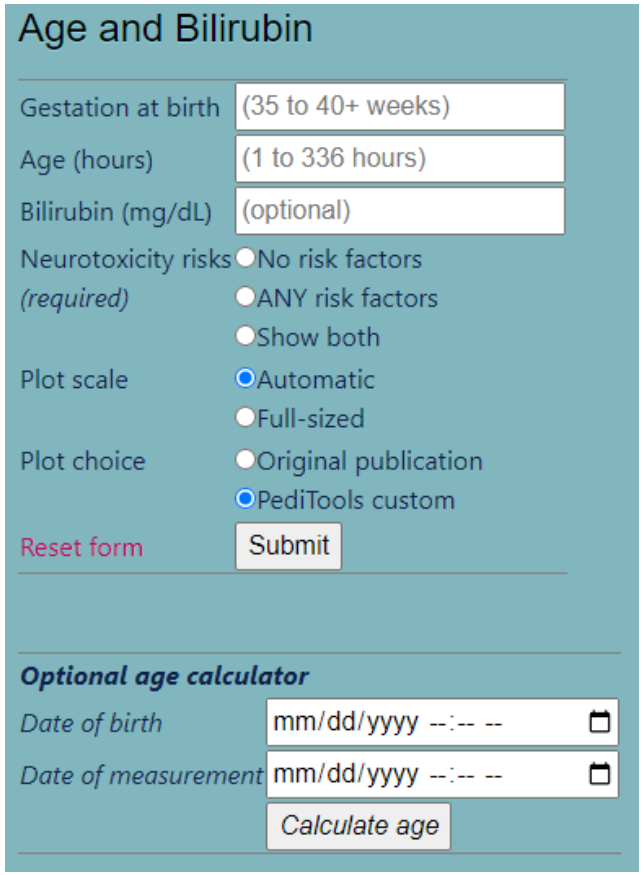
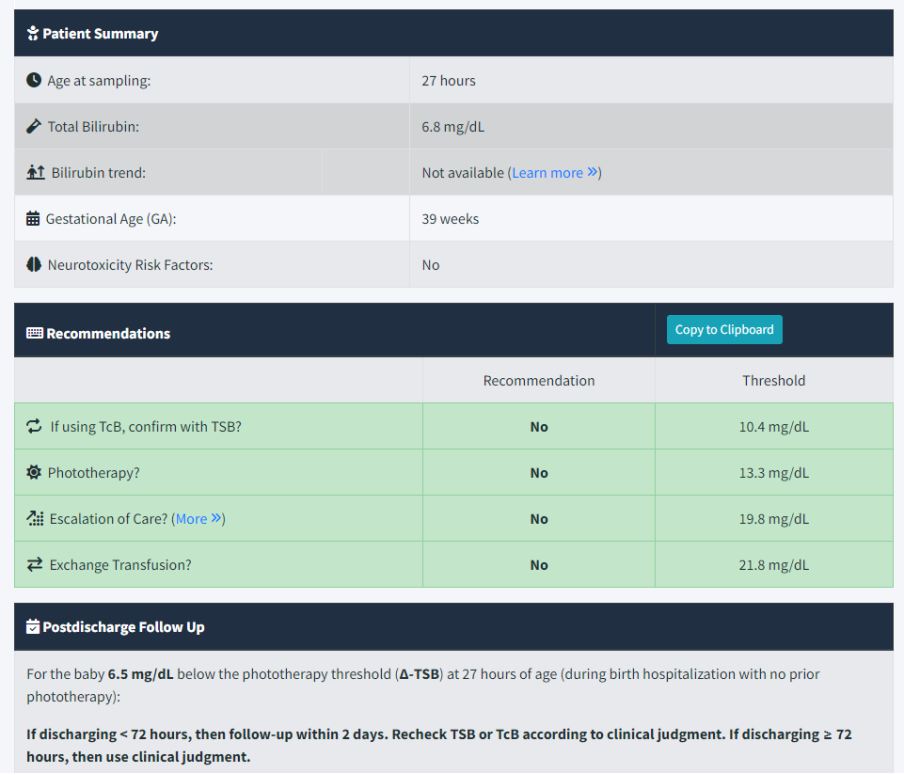


How to Operationalize

Bilitool.org



Patient Summary

Age at sampling:	27 hours
Total Bilirubin:	6.8 mg/dL
Bilirubin trend:	Not available (Learn more »)
Gestational Age (GA):	39 weeks
Neurotoxicity Risk Factors:	No

Recommendations Copy to Clipboard

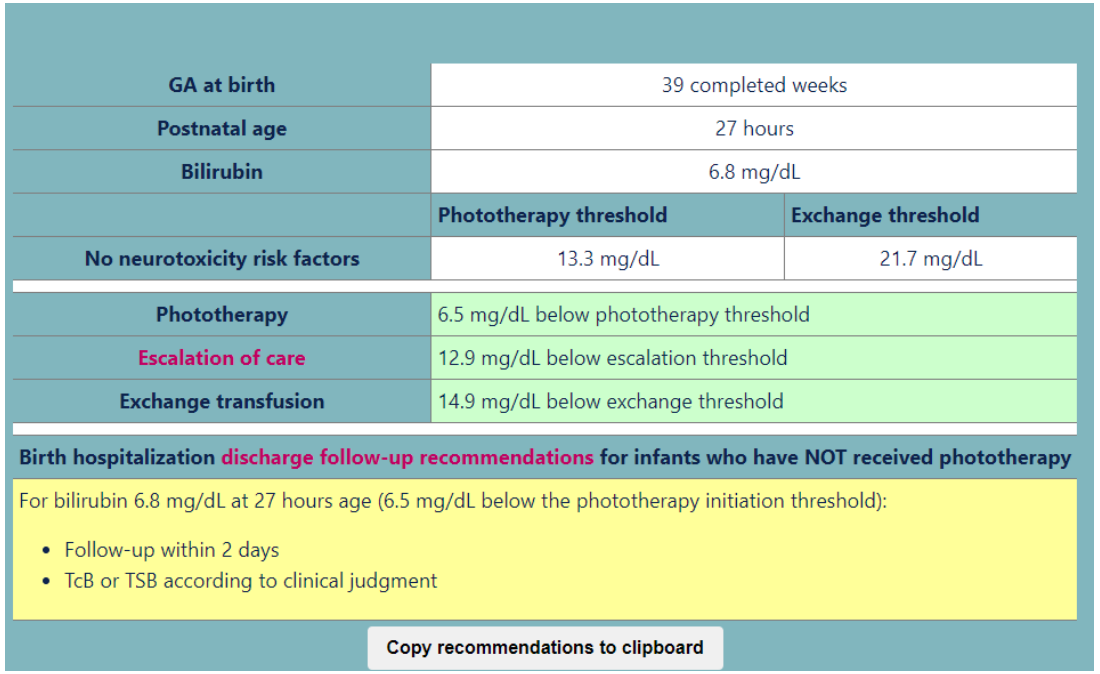
	Recommendation	Threshold
If using TcB, confirm with TSB?	**No**	10.4 mg/dL
Phototherapy?	**No**	13.3 mg/dL
Escalation of Care? (More »)	**No**	19.8 mg/dL
Exchange Transfusion?	**No**	21.8 mg/dL

Postdischarge Follow Up

For the baby **6.5 mg/dL** below the phototherapy threshold (**Δ-TSB**) at 27 hours of age (during birth hospitalization with no prior phototherapy):

If discharging < 72 hours, then follow-up within 2 days. Recheck TSB or TcB according to clinical judgment. If discharging ≥ 72 hours, then use clinical judgment.

Peditools.org



GA at birth	39 completed weeks	
Postnatal age	27 hours	
Bilirubin	6.8 mg/dL	
	Phototherapy threshold	**Exchange threshold**
No neurotoxicity risk factors	13.3 mg/dL	21.7 mg/dL

Phototherapy	6.5 mg/dL below phototherapy threshold
Escalation of care	12.9 mg/dL below escalation threshold
Exchange transfusion	14.9 mg/dL below exchange threshold

Birth hospitalization discharge follow-up recommendations for infants who have NOT received phototherapy

For bilirubin 6.8 mg/dL at 27 hours age (6.5 mg/dL below the phototherapy initiation threshold):

- Follow-up within 2 days
- TcB or TSB according to clinical judgment

Copy recommendations to clipboard

Learning Objectives

By the end of this presentation, learners will be able to

1. Contrast the differing management strategies for neonatal fever based on patient age

2. Identify which infants are at risk of hyperbilirubinemia and bilirubin-induced neurotoxicity

3. Formulate a management strategy for an infant with hyperbilirubinemia

Thank you!

Questions? Critiques? Compliments?

Feel free to email me at tmike@akronchildrens.org