

Hyperbilirubinemia in the Neonate

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Connecticut Children's

MAGNET RECOGNIZED

BEST CHILDREN'S HOSPITAL

What is a Clinical Pathway?

An evidence-based guideline that decreases unnecessary variation and helps promote safe, effective, and consistent patient care.

Objectives of Pathway

- To decrease variation in the care of neonates admitted for hyperbilirubinemia
- To triage admission processes including when to directly admit to medical/surgical floors vs. Neonatal Intensive Care Unit
- To standardize breastfeeding support during admission, including pumping, when to supplement, and lactation consultation for all breastfeeding infants
- To encourage continuation of exclusive breastfeeding
- To decrease unnecessary use of intravenous therapies
- To guide care involving phototherapy, and decrease delay in initiation of phototherapy
- To standardize laboratory monitoring and decrease unnecessary rebound total serum bilirubin testing
- To ensure Vitamin D supplementation, when indicated

Why is Pathway Necessary?

- Neonates requiring readmission for treatment of hyperbilirubinemia patients are a vulnerable low volume though high risk population
- In 2022 the APP released updates from the original 2004 guidelines for the care of infants ≥ 35 weeks gestation
- Primary goal of care is the prevention of kernicterus/bilirubin neurotoxicity; a permanent disabling neurological condition
- Reducing variation in care such as feeding support, laboratory assessments, and phototherapy treatment is essential to providing high value and equitable care for this vulnerable population
- Maximizing nutrition and initiating lactation support at the start of the admission are essential parts of care often overlooked for these patients

Updates to Pathway 2025

- Updated admission considerations to include TSB value close to phototherapy threshold and rate of rise is >/= 0.2 mg/dL/hour or > 5 mg/dL in 24 hours
- Clarified DAT (direct coombs) vs type and “screen” (indirect coombs) interpretation
- Added consideration for using high risk nomogram lines if there is a high suspicion for hemolytic process
- Added consideration to maximize treatment by continuing phototherapy to until patient is ready to leave the hospital if a rebound level in not necessary

What is Neonatal (Indirect) Hyperbilirubinemi

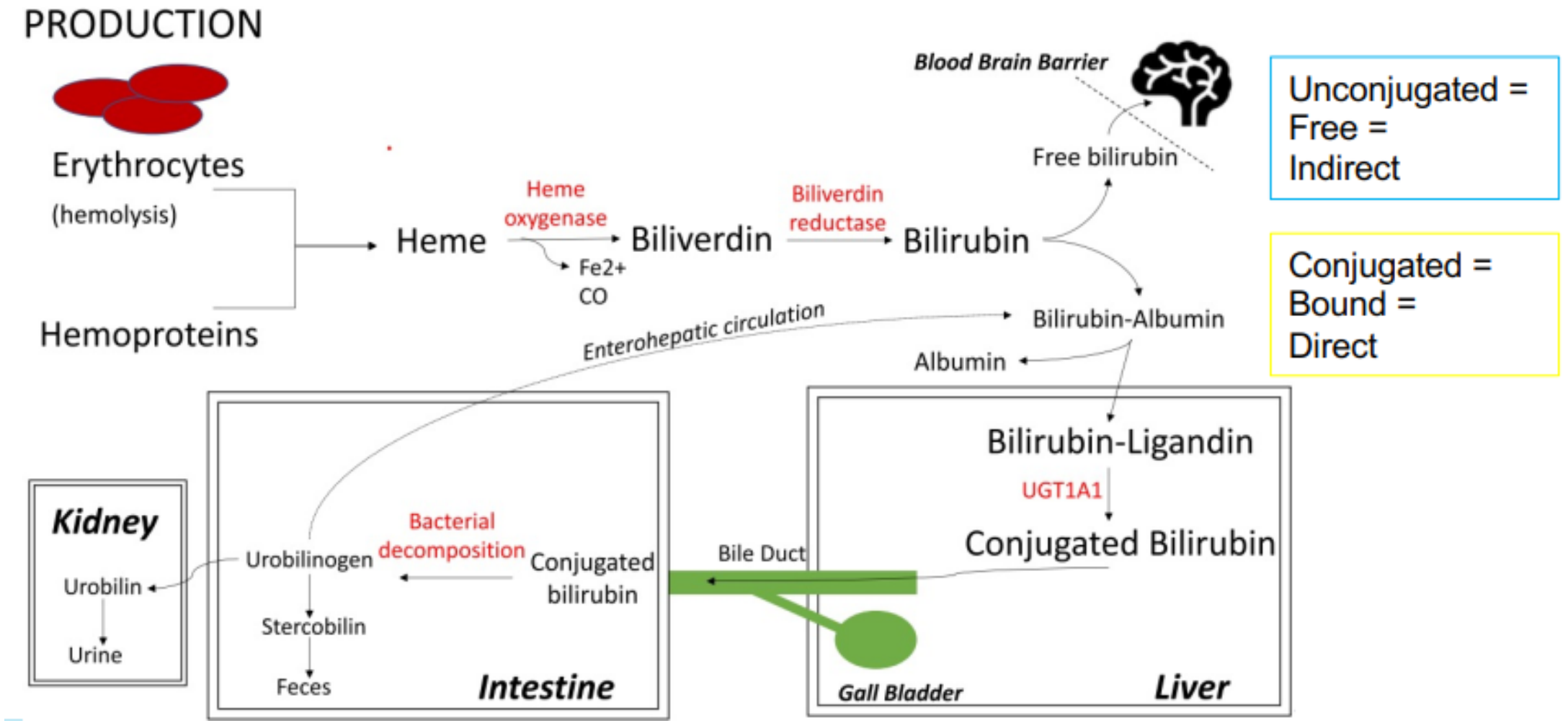
- More than 80% of neonates will have some degree of jaundice
- Neonatal Hyperbilirubinemia is nearly a universal condition in the newborn
- Clinical Manifestations
    - yellowing of skin, sclera, mucous membranes (jaundice)
- Biochemical Manifestations
    - Increased total serum bilirubin (TSB) as a result of an elevated indirect serum bilirubin
- Requires a consistent approach to screening and treatment
- The mainstay of treatment is NUTRITION and PHOTOTHERAPY (when indicated)



Kemper, A. R., et al. (2022).

Gallois, Sarathy, & Staude (2022)

Bilirubin Metabolism



Gallois, Sarathy, & Staude (2022)

What's the big deal?

- Bilirubin is a cell toxin
- High free unconjugated bilirubin can be deposited in the tissues, including the brain
- Bilirubin neurotoxicity and kernicterus are preventable consequences brain damage caused by bilirubin deposition in the brain

This is the Hyperbilirubinemia in the Neonate Clinical Pathway – **Navigation page**

Navigation page provides quick clicking to admission algorithm, ED management, inpatient management, and helpful appendices

We will be reviewing each component of the pathway in the following slides.



CLINICAL PATHWAY:
Hyperbilirubinemia in the Neonate

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

Inclusion criteria: newborns already discharged from birth hospital or who remain in NICU AND are ≤14 days old, born at ≥35 wk gestation, previously suspected/known indirect hyperbilirubinemia with suspected/known need for phototherapy
Exclusion Criteria: >14 days old, <35 wk gestation at birth, suspected sepsis, signs of hyperbilirubinemia neurotoxicity (hypertonia, arching, retrocollis, opisthotonos, fever, high pitched cry)

Phase of Care Navigation Links

- Admission Algorithm
- Emergency Department
- Inpatient Management

Appendices and Feeding Log

- Appendix A: Phototherapy Nomograms
- Appendix B: Exchange Transfusion Nomograms
- Appendix C: Etiologies and Risk Factors
- Appendix D: Admitting RN Tips and Tricks
- Appendix F: Feeding Log

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Hyperbilirubinemia in the Neonate Clinical Pathway

Please review these updated inclusion and exclusion criteria:

- Newborns already discharged from birth hospital or who remain in NICU AND …rest of criteria remain the same

Inclusion criteria: newborns already discharged from birth hospital or who remain in NICU AND are ≤14 days old, born at ≥35 wk gestation, previously suspected/known indirect hyperbilirubinemia with suspected/known need for phototherapy
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Appendices and Feeding Log

- Appendix A: Phototherapy Nomograms
- Appendix B: Exchange Transfusion Nomograms
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- Appendix D: Admitting RN Tips and Tricks
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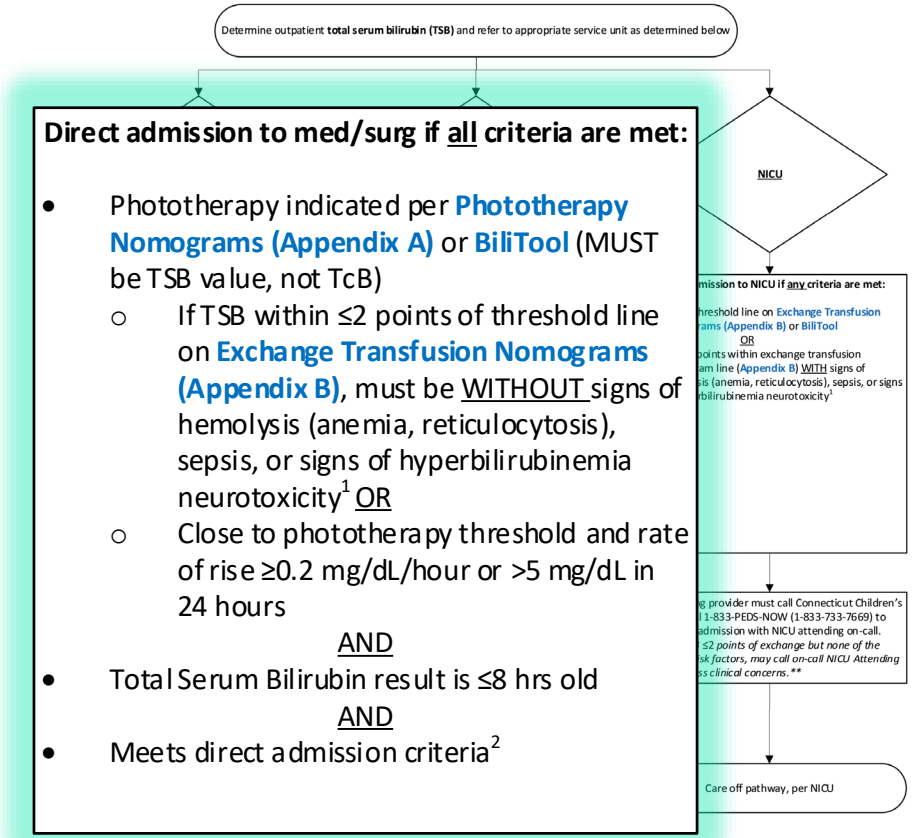
This is the Hyperbilirubinemia in the Neonate Clinical Pathway. – **Admission Algorithm**

- Admission algorithm helps determine if patient requires admission, and if may be direct admission to med/surg vs. requires ED visit vs. requires direct admission to NICU
  - Many patients can avoid the ED and be directly admitted!
- Admission criteria are based on current bilirubin nomograms and patient's risk for hemolysis
  - Gestational age is accounted for in each nomogram (no risk factors & 1 or more risk factors)
- Also consider admission if close to phototherapy line AND rate of rise is >/= 0.2 mg/dL/hour or > 5 mg/dL in 24 hours
- Considering using high risk line if there is high concern for hemolytic process

CLINICAL PATHWAY:

Hyperbilirubinemia Admission Algorithm

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.



[1]Signs of Hyperbilirubinemia Neurotoxicity
- Hypertonia
- Arching
- Retrocollis
- Opisthotonos
- Fever
- High pitched cry

[2]Direct admission criteria:
- Patient has TSB within 8 hours of admission
- Patient seen in last 24 hours by referring service
- Patient has accepting attending
- Patient stable to be on med/surg unit without medical attention for 30 minutes

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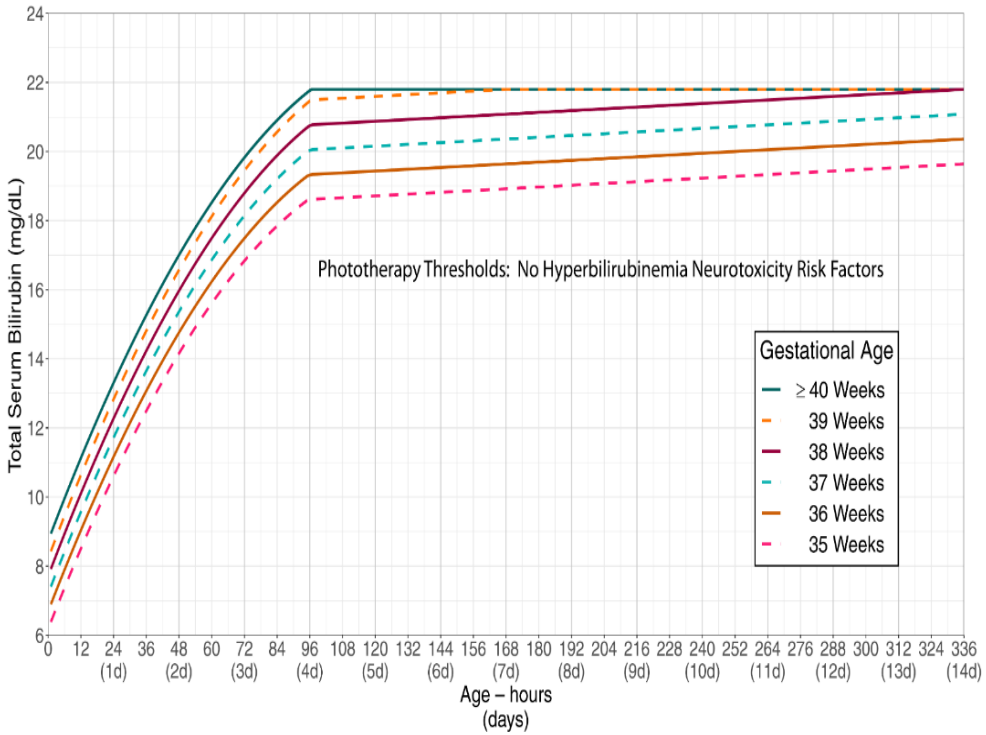
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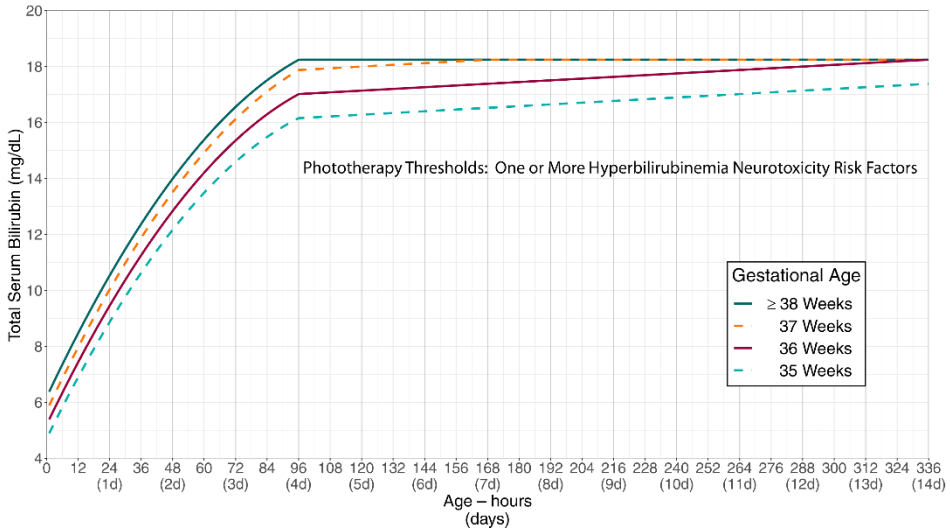
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Phototherapy Nomograms

- Phototherapy Thresholds: No Hyperbili Neurotoxicity Risk Factors



- Phototherapy Thresholds: One or More Hyperbili Neurotoxicity Risk Factors



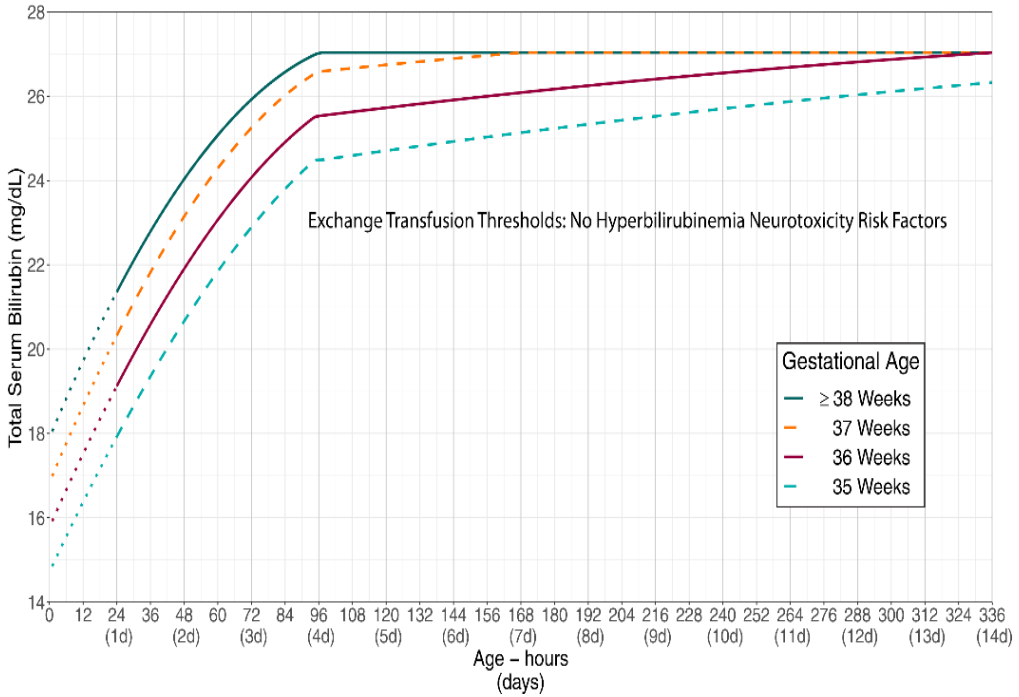
Hyperbilirubinemia Neurotoxicity Risk Factors:

Albumin <3.0 g/dL; isoimmune hemolytic disease, glucose-6-phosphate dehydrogenase (G6PD) deficiency, or other hemolytic conditions; sepsis; or any significant clinical instability in the previous 24 hours. Gestational age accounted for within in nomogram.

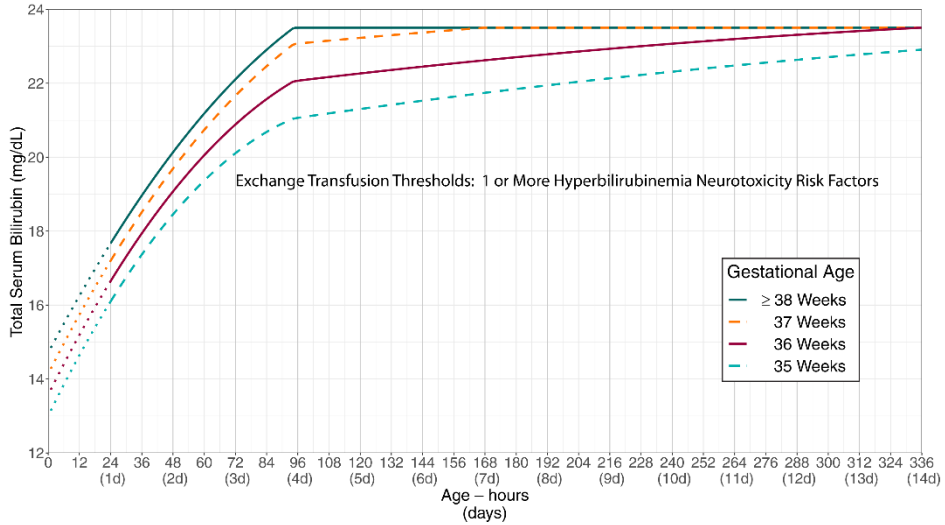
Adapted from: Kemper, A. R., et al. (2022). Clinical Practice Guideline Revision: Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation. *Pediatrics*, *150*(3), e2022058859.

Exchange Transfusion Nomograms

- Exchange Transfusion Thresholds: No Hyperbili Neurotoxicity Risk Factors



- Exchange Transfusion Thresholds: One or More Hyperbili Neurotoxicity Risk Factors



Hyperbilirubinemia Neurotoxicity Risk Factors:

Albumin <3.0 g/dL; isoimmune hemolytic disease, glucose-6-phosphate dehydrogenase (G6PD) deficiency, or other hemolytic conditions; sepsis; or any significant clinical instability in the previous 24 hours. Gestational age accounted for within in nomogram.

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This is the Hyperbilirubinemia in the Neonate Clinical Pathway. **– Emergency Room Management**

We will be reviewing each component in the following slides.

CLINICAL PATHWAY:

Hyperbilirubinemia Emergency Room Management

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Inclusion criteria: newborns already discharged from birth hospital or who remain in NICU AND are ≤14 days old, born at ≥35 wk gestation, previously suspected/known indirect hyperbilirubinemia with suspected/known need for phototherapy
Exclusion Criteria: >14 days old, <35 wk gestation at birth, suspected sepsis, signs of hyperbilirubinemia neurotoxicity[1]

Determine appropriate admission service (MS Floor vs NICU) based on outpatient bilirubin (Admission Algorithm):

If patient sent to ED:

- **Triage RN**: ESI level 2 (acute)
- **ED RN:**
  - Obtain sample for total and direct serum bilirubin and POCT glucose via heel stick, regardless of need for additional labs or IV access (includes patients w/prior result <8 hrs old)
  - Place infant on bili blanket STAT

[1]**Signs of Hyperbilirubinemia Neurotoxicity**

- Hypertonia
- Arching
- Retrocollis
- Opisthotonos
- Fever
- High pitched cry

Initial Provider Assessment

Clinical history/physical exam:

- Gestational Age
- Current age in hours
- Mother's blood type (infant's blood type if mother type O, Rh negative, or antibody +)
- Birthweight, current weight, and percent loss of birthweight
- Method and frequency of feeding
- Stool and urine output
- Signs/level of dehydration

Hyperbilirubinemia Evaluation for Treatment:

- Consider etiologies and risk factors for neonatal hyperbilirubinemia (Appendix C)
- Determine if there is pathologic **rate of rise (≥0.2 mg/dL/hour or >5 mg/dL in 24 hours)**
- Determine threshold for phototherapy and exchange transfusion using BiliTool or Phototherapy Nomograms (Appendix A) and Exchange Transfusion Nomograms (Appendix B)
  - If hemolytic anemia is strongly suspected, consider using high risk line on nomogram

Laboratory: consider additional labs as clinically indicated

- **CBC w diff, reticulocyte count, peripheral smear, DAT** (if not known), **type and screen** (of note, the screen is an indirect coombs and not the same test as the DAT): if mother/infant blood types unknown, early-onset jaundice (first 24 hrs after birth), phototx or exchange transfusion during birth hospitalization, bilirubin levels within 2 mg/dL of threshold in 1st 48 hrs of life, rapidly rising TSB levels (increasing by ≥0.2 mg/dL per hour), ABO incompatibility regardless of DAT result, family hx inherited hemolytic disorder
- **G6PD:** if clinical concern for hemolysis and DAT negative, or if early onset hyperbili and persistent beyond first week of life, familial or racial or ethnic risk
- **Electrolytes, POCT urine dip for specific gravity:** if concern for moderate or severe dehydration
- **Additional labs considerations (if clinically indicated)**: liver panel and albumin; blood, urine, CSF cultures/counts

FEN/GI:

- Initiate home feeding
- **Provide breastfeeding mothers with breast pump, kit**, and pumping instructions if prolonged ED stay
- Attempt enteral repletion of hydration (PO or NG)
- IV hydration only if severe dehydration or electrolyte abnormalities

Phototherapy NOT indicated per Phototherapy Nomograms (Appendix A) **OR** NOT close to phototherapy threshold with rate of rise ≥0.2 mg/dL/hour or >5 mg/dL in 24 hours
AND
Well-appearing without other indication for admission

→ Discharge with close follow up

Discharge Instructions:

- Continue feedings on demand with goal of 10-12 feedings per day. Follow up with PCP 1 day after discharge
- Continue feeding, supplementing feedings, and pumping as recommended by Primary Care Team

Phototherapy indicated per Phototherapy Nomograms (Appendix A) or BiliTool (MUST be TSB value, not TcB) close to phototherapy threshold with rate of rise ≥0.2 mg/dL/hour or >5 mg/dL in 24 hours

If TSB within ≤2 points of threshold line on Exchange Transfusion Nomograms (Appendix B) or BiliTool, must be WITHOUT signs of hemolysis, sepsis, or signs of bilirubin neurotoxicity[1]

→

- Admit to Med/Surg on Pediatric Hospital Medicine
- Continue care per Inpatient Management of Hyperbilirubinemia (page 4)

Start intensive phototherapy in ED if boarder or awaiting inpatient bed placement for >2 hours

Total serum bilirubin ≤2 points of nomogram line on Exchange Transfusion Nomograms (Appendix B) or BiliTool WITH signs of hemolysis (anemia, reticulocytosis), sepsis, or signs of bilirubin neurotoxicity[1]

If TSB within 2 points of exchange, but none of above risk factors, may call to discuss case with NICU attending

→

- Admit to NICU
- Care off pathway
- Refer to Exchange Transfusion Nomograms (Appendix B) or BiliTool

Start intensive phototherapy immediately in ED if there will be a wait for a NICU bed

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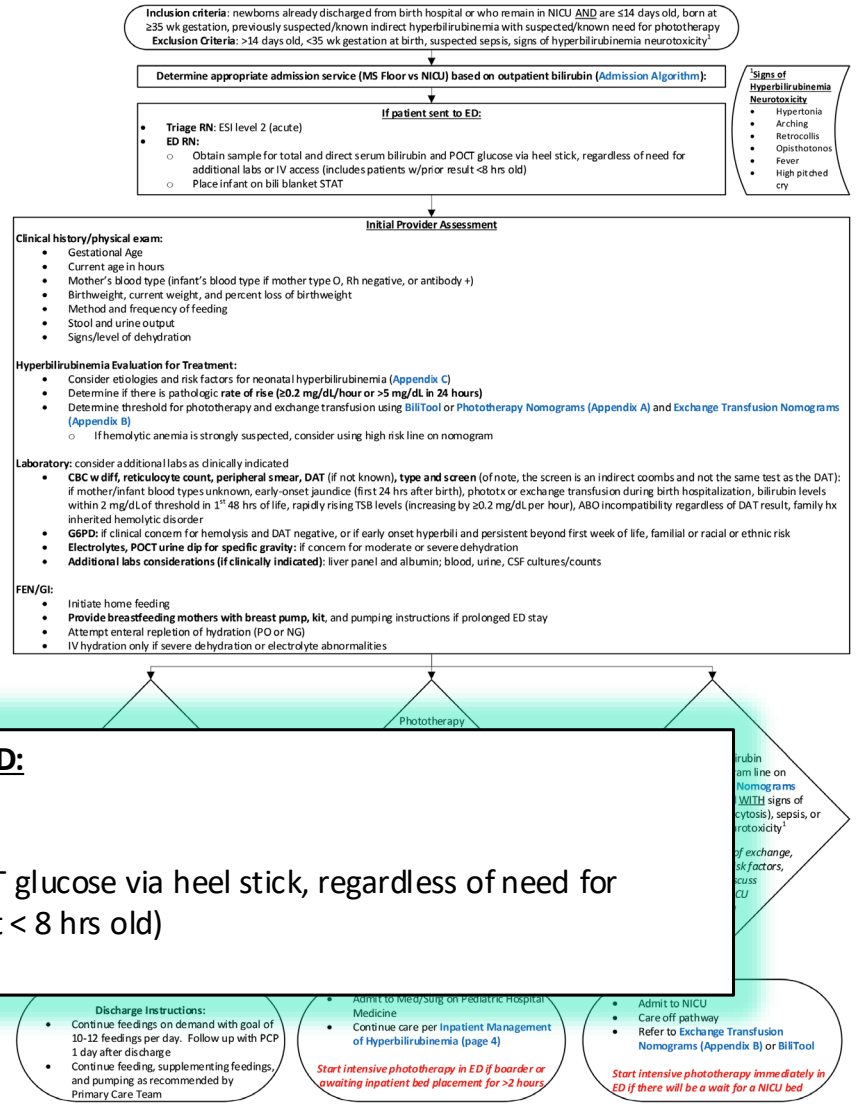
Hyperbilirubinemia in the Neonate Clinical Pathway. –**Emergency Management**

Delay in initiation of phototherapy must be avoided

- ED RN to obtain total and direct serum bilirubin & POCT glucose by heal stick upon rooming
- Start patient on **biliblanket STAT** while labs are pending

CLINICAL PATHWAY:
Hyperbilirubinemia Emergency Room Management

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.



If patient sent to ED:

- **Triage RN**: ESI level 2 (acute)
- **ED RN:**
  - Obtain sample for total and direct serum bilirubin and POCT glucose via heel stick, regardless of need for additional labs or IV access (includes patients w/prior result < 8 hrs old)
  - Place infant on bili blanket STAT

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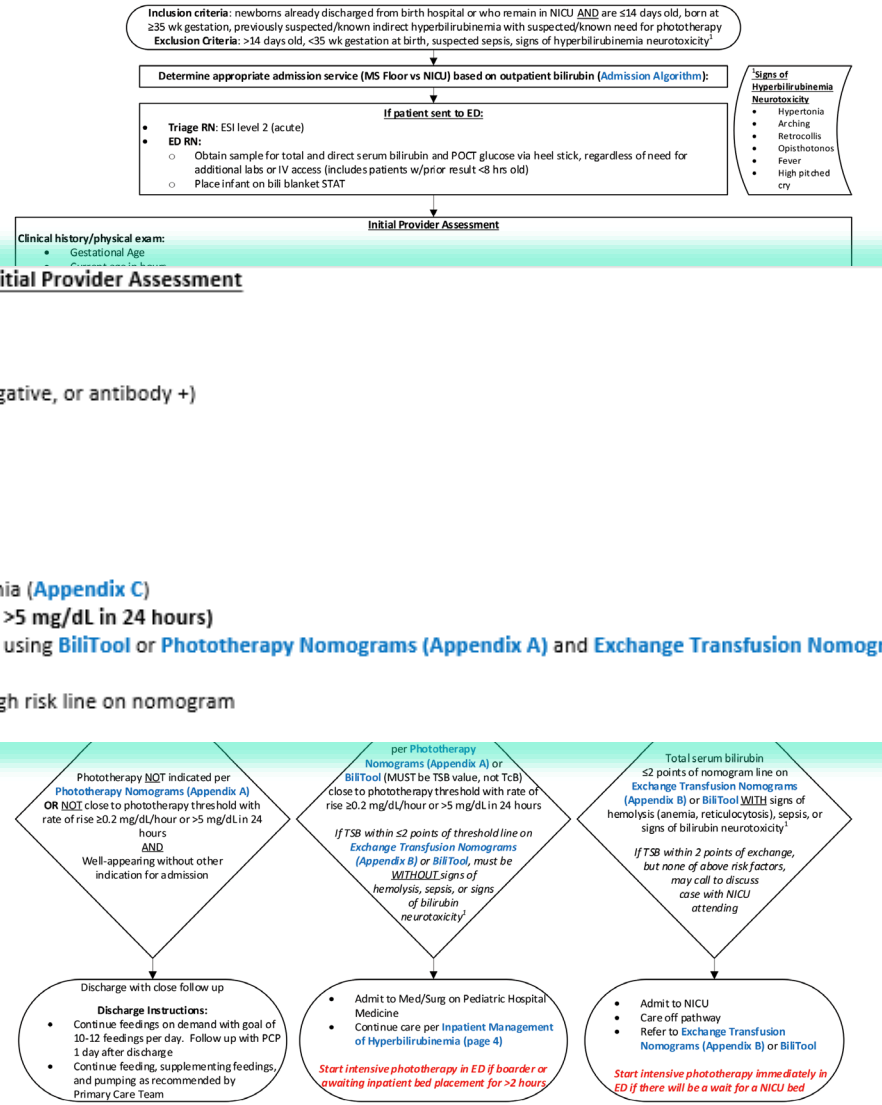
Hyperbilirubinemia in the Neonate Clinical Pathway. – **Emergency & Inpatient Management**

Initial provider assessment

- Critical clinical history & physical exam are included
  - essential to determine phototherapy and exchange transfusion criteria
- Determine treatment threshold with BiliTool.org or AAP nomograms 2022
- Must also consider if there is a pathological rate of rise ≥ 0.2mg/dL/hour or > 5 mg/dL in 24 hours
- Determine most likely etiology to guide treatment. Refer to Appendix C for guidance on etiologies and risk factors

CLINICAL PATHWAY:
Hyperbilirubinemia Emergency Room Management

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Hyperbilirubinemia in the Neonate Clinical Pathway. – **Appendix C: Etiologies and Risk Factors**

Etiologies of Hyperbilirubinemia

Increased Bilirubin Production

- **Hemolytic Disease**
  - Isoantibodies
    - ABO
    - Rh
    - Minor antibodies
  - Enzyme defects
    - Glucose-6-phosphate deficiency
    - Pyruvate kinase deficiency
  - Structural defects
    - Spherocytosis
    - Ellipotocytosis
- **Birth trauma**
  - Scalp hematoma
  - Excessive bruising
- **Polycythemia**

Other or Combined Etiologies

- **Family history of inherited hemolytic disorders**
- **Prematurity**
- **Metabolic disorder**
  - Hypothyroidism
  - Galactosemia
- **Infection**
  - Urinary tract infection
  - Sepsis
- **Breastfeeding (non-breastfeeding/starvation jaundice)**
- **Drugs**
  - Sulfisoxazole
  - Streptomycin
  - Benzyl alcohol
  - Chloramphenicol

Decreased Bilirubin Excretion

- **Biliary obstruction**
  - Biliary atresia
  - Choledochal cyst
  - Dubin-Johnson syndrome
  - Rotor syndrome

Impaired Bilirubin Conjugation

- Gilbert syndrome
- Crigler-Najjar syndrome I and II
- Human milk jaundice

Risk Factors to Consider

Risk Factors for Development of Significant Hyperbilirubinemia for Infants ≥35 Weeks Gestation

- Lower gestational age (i.e., risk increases with each week <40 weeks)
- Jaundice observed in first 24 hours after birth
- Predischarge from birth hospital TcB or TSB close to phototherapy threshold
- Phototherapy before birth hospital discharge
- Blood group incompatibility
  - Positive direct antiglobulin test
  - Other hemolytic disease (G6PD)
  - Elevated ETCO2
- Parent or sibling requiring phototherapy or exchange transfusion
- Family history or genetic ancestry suggestive of inherited red blood cell disorders, including G6PD
- Scalp hematoma or significant bruising
- Down syndrome
- Macrosomic infant of a diabetic mother

Risk Factors for Hemolysis

- Early onset jaundice (within 1st 24 hours after birth)
- Requirement for phototherapy or exchange transfusion during the birth hospitalization
- Near-threshold bilirubin levels within the first 48 hours after birth (within 2 mg/dL of phototherapy threshold
- Rapidly rising TSB levels (increasing by ≥0.3 mg/dL per hour in the 1st 24 hours or ≥0.2 mg/dL per hour thereafter or 5 mg/dL in 24 hours)
- ABO incompatibility, regardless of DAT
- Familial or racial or ethnic history of inherited hemolytic disorder

Adapted from: Kemper, A. R., et al. (2022). Clinical Practice Guideline Revision: Management of Hyperbilirubinemia in the Newborn Infant 35 or More Weeks of Gestation. *Pediatrics*, *150*(3), e2022058859.

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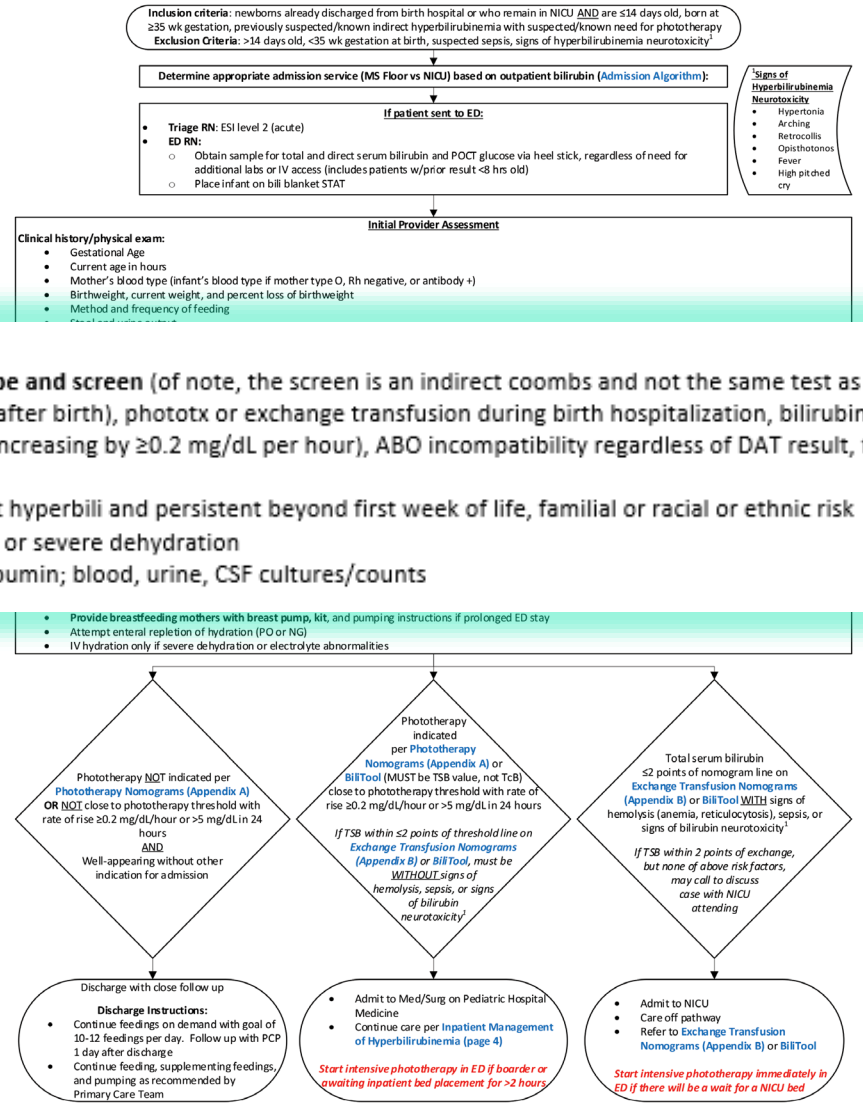
Initial Laboratory

- Guidance for evaluating patient's risk for hemolysis and appropriate labs to obtain
- Added clarification between DAT (direct coombs) and "screen" (indirect coombs) results
- Included clarification for which patients to screen for G6PD
- Clarified additional lab considerations

CLINICAL PATHWAY:

Hyperbilirubinemia Emergency Room Management

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Laboratory: consider additional labs as clinically indicated

- **CBC w diff, reticulocyte count, peripheral smear, DAT** (if not known), **type and screen** (of note, the screen is an indirect coombs and not the same test as the DAT): if mother/infant blood types unknown, early-onset jaundice (first 24 hrs after birth), phototx or exchange transfusion during birth hospitalization, bilirubin levels within 2 mg/dL of threshold in 1st 48 hrs of life, rapidly rising TSB levels (increasing by ≥0.2 mg/dL per hour), ABO incompatibility regardless of DAT result, family hx inherited hemolytic disorder
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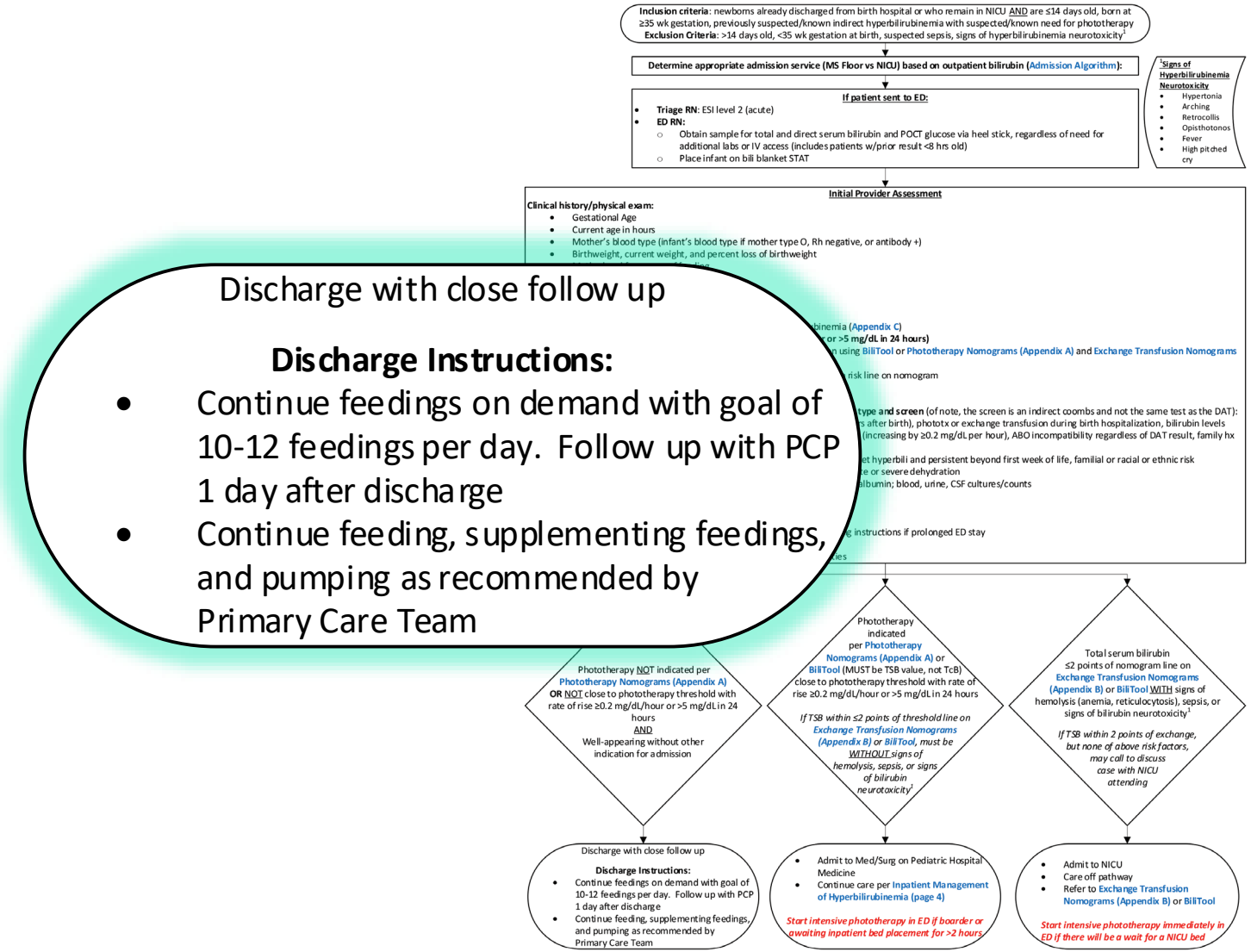
If meets criteria for discharge from ED

- Critical to provide appropriate post discharge feeding and pumping guidance to caregivers
- Ensure timely post discharge follow up with primary care provider

CLINICAL PATHWAY:

Hyperbilirubinemia Emergency Room Management

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Discharge with close follow up

Discharge Instructions:

- Continue feedings on demand with goal of 10-12 feedings per day. Follow up with PCP 1 day after discharge
- Continue feeding, supplementing feedings, and pumping as recommended by Primary Care Team

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This is the Hyperbilirubinemia in the Neonate Clinical Pathway. – **Inpatient Management**

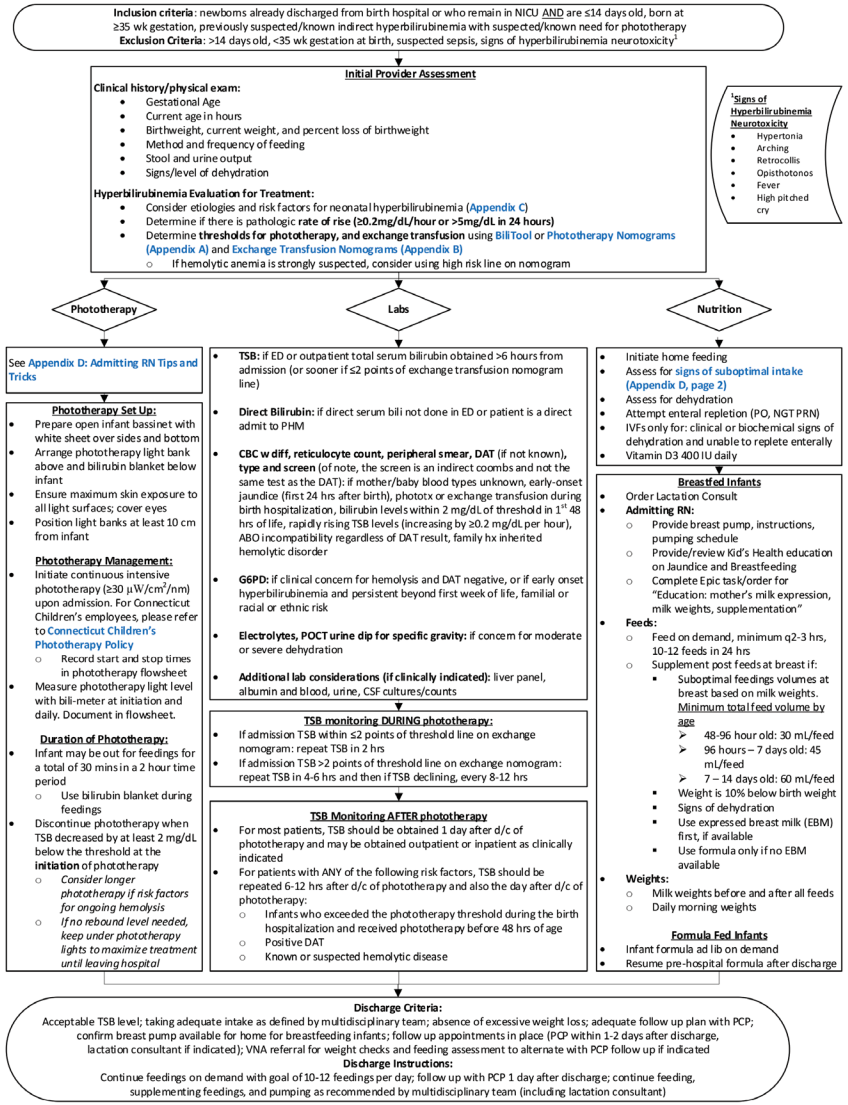
Inpatient algorithm also pulls out initial provider assessment, important H&P details, risk factors, and initial laboratory guidance which is the same as the ED content

We will review the additional inpatient management content on the next few slides

CLINICAL PATHWAY:

Hyperbilirubinemia Inpatient Management

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Appendix D provides additional tips and tricks for nurses

- Setting up for admission
- Setting up phototherapy
- Where to obtain equipment at CT Children's Hartford campus
- Admitting RN responsibilities

Appendix D: Admitting Nurse Tips and Tricks

Obtaining Equipment

- **During regular Equipment Depot hours:** Submit a standard work request to have equipment delivered from Equipment Depot
- **After hours:** Sets may be signed out directly from the Equipment Depot. Please ensure all required fields are completed on the sign-out form, including the set number (1 or 2).

EQUIPMENT	LOCATION
Open Bassinet	MS6, MS7, MS8 bed storage area
Overhead Phototherapy Lights	Equipment Depot
Bilirubin Blanket	Equipment Depot
Bilimeter (radiometer)	Equipment Depot
Gray Carry Case for Bilimeter	Equipment Depot
Breast Pump	Equipment Depot
Breast Pump Supplies	MS6, MS7, MS8 Omni
Bilirubin Blanket Disposable Pad Covers	MS6 and MS7 Omni
Purple eye shields	MS6 and MS7 Omni
Milk weight scale	MS6, MS7, MS8 Clean Storage Room
White linen	MS6, MS7, MS8 Clean Storage Room

Setting up for Admission:

- Gather equipment listed in the table above
- White sheet should be covering all sides of open bassinet, and infant placed on top of sheet
- Bilirubin blanket should be placed in bassinet and will be beneath infant, overhead lights above
- Overhead lights slide underneath cot
- Overhead lights should **not be less than 35 cm from the infant** as per manufacturer recommendations

RN Responsibilities Upon Patient Admission:

1. **Phototherapy and Bilirubin Labs Tips**
    - Obtain Total Serum Bilirubin if >2 hours since last obtained and then start phototherapy
        - Must turn off bili lights while obtaining labs as the lights can affect the blood sample. Please turn them back on once sample is collected.
    - Prep infant:
        - Infant is only wearing a diaper to maximize skin to light exposure
        - Purple eye shields in place on infant

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Setting up phototherapy

SEE APPENDIX D for details re new giraffe light setup

- White sheet to cover bottom and all sides of open cot
- Biliblanket below infant
- Light bank above infant
- Ensure maximum skin exposure to all light surfaces



New giraffe lights must be at least 35 cm above the patient. This will be updated in the pathway shortly, but is correct in Appendix D

CLINICAL PATHWAY:

Hyperbilirubinemia Inpatient Management

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Phototherapy

Initial Provider Assessment

- ...gy/physical exam:
  - ...al Age
  - ...tus
  - ...ght weight, and percent loss of birthweight
  - ...and frequency of feeding
  - ...stool and urine output
  - Signs/level of dehydration

Hyperbilirubinemia Evaluation for Treatment:

- Consider etiologies and risk factors for neonatal hyperbilirubinemia (Appendix C)
- Determine if there is pathologic **rate of rise (≥0.2mg/dL/hour or >5mg/dL in 24 hours)**
- Determine **thresholds for phototherapy, and exchange transfusion** using **BiliTool** or **Phototherapy Nomograms** ...s (Appendix B)
  - ...sider using high risk line on nomogram

[1]**Signs of Hyperbilirubinemia Neurotoxicity**
- Hypertonia
- Arching
- Retrocollis
- Opisthotonos
- Fever
- High pitched cry

See **Appendix D: Admitting RN Tips and Tricks**

...Labs

- ...um bilirubin obtained >6 hours from ...s of exchange transfusion nomogram

Phototherapy Set Up:

- Prepare open infant bassinet with white sheet over sides and bottom
- Arrange phototherapy light bank above and bilirubin blanket below infant
- Ensure maximum skin exposure to all light surfaces; cover eyes
- Position light banks at least 10 cm from infant

Phototherapy Management:

- Initiate continuous intensive phototherapy (≥30 μW/cm²/nm) upon admission. For Connecticut Children's employees, please refer to **Connecticut Children's Phototherapy Policy**
  - Record start and stop times in phototherapy flowsheet
- Measure phototherapy light level with bili-meter at initiation and daily. Document in flowsheet.

Duration of Phototherapy:

- Infant may be out for feedings for a total of 30 mins in a 2 hour time period
  - Use bilirubin blanket during feedings
- Discontinue phototherapy when TSB decreased by at least 2 mg/dL below the threshold at the **initiation** of phototherapy
  - *Consider longer phototherapy if risk factors for ongoing hemolysis*
  - *If no rebound level needed, keep under phototherapy lights to maximize treatment until leaving hospital*

- **Direct Bilirubin:** if direct serum bili not done in ED or patient is a direct admit to PHM
- **CBC w diff, reticulocyte count, peripheral smear, DAT** (if not known), **type and screen** (of note, the screen is an indirect coombs and not the same test as the DAT): if mother/baby blood types unknown, early-onset jaundice (first 24 hrs after birth), phototx or exchange transfusion during birth hospitalization, bilirubin levels within 2 mg/dL of threshold in 1st 48 hrs of life, rapidly rising TSB levels (increasing by ≥0.2 mg/dL per hour), ABO incompatibility regardless of DAT result, family hx inherited hemolytic disorder
- **G6PD:** if clinical concern for hemolysis and DAT negative, or if early onset hyperbilirubinemia and persistent beyond first week of life, familial or racial or ethnic risk
- **Electrolytes, POCT urine dip for specific gravity:** if concern for moderate or severe dehydration
- **Additional lab considerations (if clinically indicated):** liver panel, albumin and blood, urine, CSF cultures/counts

TSB monitoring DURING phototherapy:

- If admission TSB within ≤2 points of threshold line on exchange nomogram: repeat TSB in 2 hrs
- If admission TSB >2 points of threshold line on exchange nomogram: repeat TSB in 4-6 hrs and then if TSB declining, every 8-12 hrs

TSB Monitoring AFTER phototherapy

- For most patients, TSB should be obtained 1 day after d/c of phototherapy and may be obtained outpatient or inpatient as clinically indicated
- For patients with ANY of the following risk factors, TSB should be repeated 6-12 hrs after d/c of phototherapy and also the day after d/c of phototherapy:
  - Infants who exceeded the phototherapy threshold during the birth hospitalization and received phototherapy before 48 hrs of age
  - Positive DAT
  - Known or suspected hemolytic disease

Nutrition

- Initiate home feeding
- Assess for **signs of suboptimal intake (Appendix D, page 2)**
- Assess for dehydration
- Attempt enteral repletion (PO, NGT PRN)
- IVFs only for: clinical or biochemical signs of dehydration and unable to replete enterally
- Vitamin D3 400 IU daily

Breastfed Infants

- Order Lactation Consult
- **Admitting RN:**
  - Provide breast pump, instructions, pumping schedule
  - Provide/review Kid's Health education on Jaundice and Breastfeeding
  - Complete Epic task/order for "Education: mother's milk expression, milk weights, supplementation"
- **Feeds:**
  - Feed on demand, minimum q2-3 hrs, 10-12 feeds in 24 hrs
  - Supplement post feeds at breast if:
    - Suboptimal feedings volumes at breast based on milk weights. Minimum total feed volume by age
      - 48-96 hour old: 30 mL/feed
      - 96 hours – 7 days old: 45 mL/feed
      - 7 – 14 days old: 60 mL/feed
    - Weight is 10% below birth weight
    - Signs of dehydration
    - Use expressed breast milk (EBM) first, if available
    - Use formula only if no EBM available
- **Weights:**
  - Milk weights before and after all feeds
  - Daily morning weights

Formula Fed Infants

- Infant formula ad lib on demand
- Resume pre-hospital formula after discharge

Discharge Criteria:
Acceptable TSB level; taking adequate intake as defined by multidisciplinary team; absence of excessive weight loss; adequate follow up plan with PCP; confirm breast pump available for home for breastfeeding infants; follow up appointments in place (PCP within 1-2 days after discharge, lactation consultant if indicated); VNA referral for weight checks and feeding assessment to alternate with PCP follow up if indicated
Discharge Instructions:
Continue feedings on demand with goal of 10-12 feedings per day; follow up with PCP 1 day after discharge; continue feeding, supplementing feedings, and pumping as recommended by multidisciplinary team (including lactation consultant)

RETURN TO THE BEGINNING

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Hyperbilirubinemia in the Neonate Clinical Pathway. **–Inpatient Management**

Phototherapy

- Defined intensive phototherapy dose: ≥ 30 μW/cm²/nm
- Tips on setting up, maintaining, and monitoring intensive phototherapy added
- Consider maximizing phototherapy treatment by continuing until patient is ready to leave the hospital if a rebound test in not indicated prior to discharge
- Consider using high risk phototherapy line if there is high suspicion for hemolytic process

Phototherapy

See **Appendix D: Admitting RN Tips and Tricks**

Phototherapy Set Up:

- Prepare open infant bassinet with white sheet over sides and bottom
- Arrange phototherapy light bank above and bilirubin blanket below infant
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Duration of Phototherapy:

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  - *Consider longer phototherapy if risk factors for ongoing hemolysis*
  - *If no rebound level needed, keep under phototherapy lights to maximize treatment until leaving hospital*

CLINICAL PATHWAY:

Hyperbilirubinemia Inpatient Management

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

Inclusion criteria: newborns already discharged from birth hospital or who remain in NICU AND are ≤14 days old, born at ≥35 wk gestation, previously suspected/known indirect hyperbilirubinemia with suspected/known need for phototherapy
Exclusion Criteria: >14 days old, <35 wk gestation at birth, suspected sepsis, signs of hyperbilirubinemia neurotoxicity[1]

Initial Provider Assessment

Clinical history/physical exam:
- Gestational Age
- Current age in hours
- Birthweight, current weight, and percent loss of birthweight
- Method and frequency of feeding
- Stool and urine output
- Signs/level of dehydration

Hyperbilirubinemia Evaluation for Treatment:
- Consider etiologies and risk factors for neonatal hyperbilirubinemia (Appendix C)
- Determine if there is pathologic **rate of rise (≥0.2mg/dL/hour or >5mg/dL in 24 hours)**
- Determine **thresholds for phototherapy, and exchange transfusion** using **BiliTool** or **Phototherapy Nomograms (Appendix A)** and **Exchange Transfusion Nomograms (Appendix B)**
  - If hemolytic anemia is strongly suspected, consider using high risk line on nomogram

[1]**Signs of Hyperbilirubinemia Neurotoxicity**
- Hypertonia
- Arching
- Retrocollis
- Opisthotonos
- Fever
- High pitched cry

Phototherapy

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Labs

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CT Children's phototherapy policy applies only to the NICU – this will be removed from this pathway

Management of phototherapy

- Goal irradiance dose is ≥ 30 µW/cm²/nm
- Recording start and stop times of treatment on phototherapy flow sheet is essential
- Measuring phototherapy irradiance/light level with bili-meter ensures proper light dose



CLINICAL PATHWAY:
Hyperbilirubinemia Inpatient Management

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Phototherapy Set Up:
- Prepare open infant bassinet with white sheet over sides and bottom
- Arrange phototherapy light bank

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Formula Fed Infants
- Infant formula ad lib on demand
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supplementing feedings, and pumping as recommended by multidisciplinary team (including lactation consultant)

See **Appendix D: Admitting RN Tips and Tricks**

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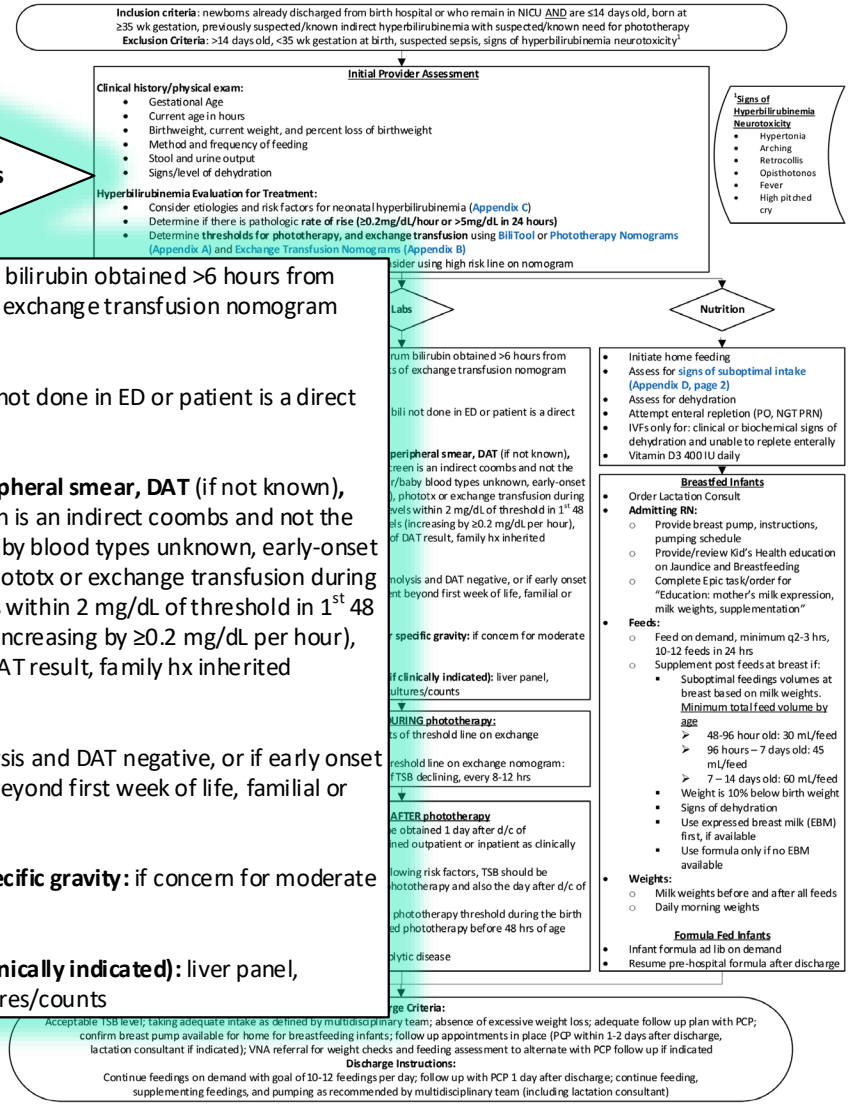
Initial Laboratory

- Guidance for evaluating patient's risk for hemolysis and appropriate labs to obtain
- Added clarification between DAT (direct coombs) and "screen" (indirect coombs) results
- Included clarification for which patients to screen for G6PD
- Clarified additional lab considerations

CLINICAL PATHWAY:

Hyperbilirubinemia Inpatient Management

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Labs

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- **Additional lab considerations (if clinically indicated):** liver panel, albumin and blood, urine, CSF cultures/counts

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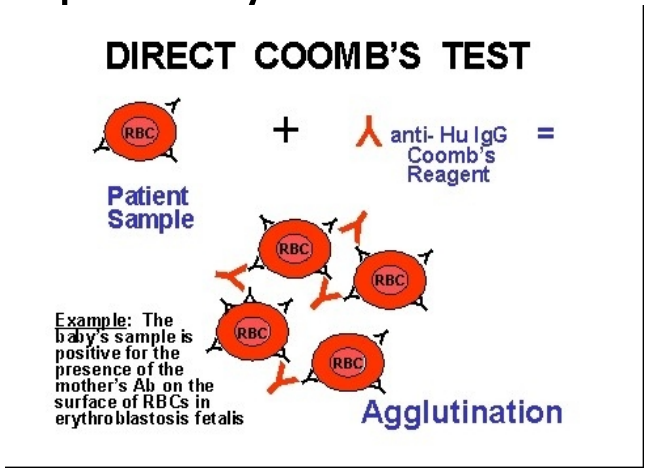
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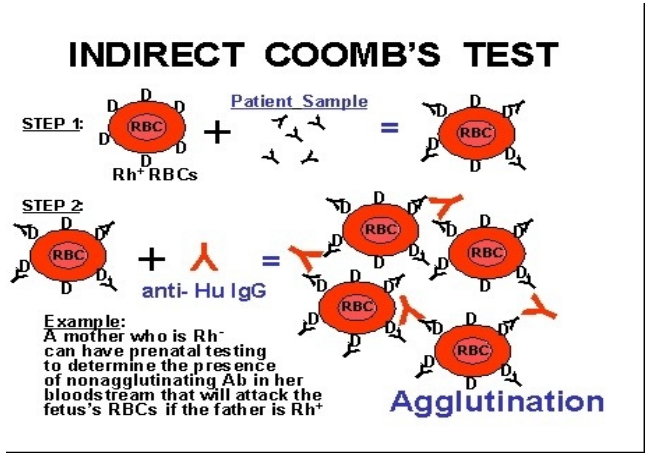
Interpreting Direct vs Indirect Coombs

- Direct Coombs (DAT)
  - Direct Antiglobulin Test (DAT)
  - Looking for “foreign” antibodies that are already adhered to the infant’s red blood cells as a potential cause for hemolysis
  - Antibody-mediated hemolysis
  - Direct Coombs (DAT) must be interpreted separately from Indirect Coombs (screen)

- Indirect Coombs (“screen”)
  - Screen part of type and screen
    - Frequently referred to as antibody screen, which is different than DAT
    - More clinically relevant when evaluating the mother’s blood
    - Identifies a long list of minor antibodies
    - Not all antibodies detected are clinically significant, so identifying which are present is helpful

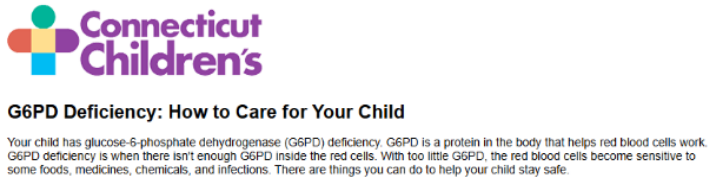


From <https://med.stanford.edu/newborns/professional-education/jaundice-and-phototherapy/the-coombs--test.html>



G6PD

- X linked RBC disorder causing hemolytic anemia of varying phenotype
- Enzyme that catalyzes the initial step in a process that protects RBCs against oxidative injury
- Often DAT (Direct Coombs) negative due to different process driving hemolysis
- Cornerstone of management is to avoid oxidative stress to RBCs
- Treat neonatal jaundice like any other neonatal jaundice
- Avoidance of drugs, chemicals, and foods known to trigger hemolysis
- Genetic counseling and prenatal testing
- If patient is G6PD positive, include CT Children's Kid's Health Document: "G6PD Deficiency: How to Care for Child" as attachment to discharge instructions



Connecticut Children's

G6PD Deficiency: How to Care for Your Child

Your child has glucose-6-phosphate dehydrogenase (G6PD) deficiency. G6PD is a protein in the body that helps red blood cells work. G6PD deficiency is when there isn't enough G6PD inside the red cells. With too little G6PD, the red blood cells become sensitive to some foods, medicines, chemicals, and infections. There are things you can do to help your child stay safe.

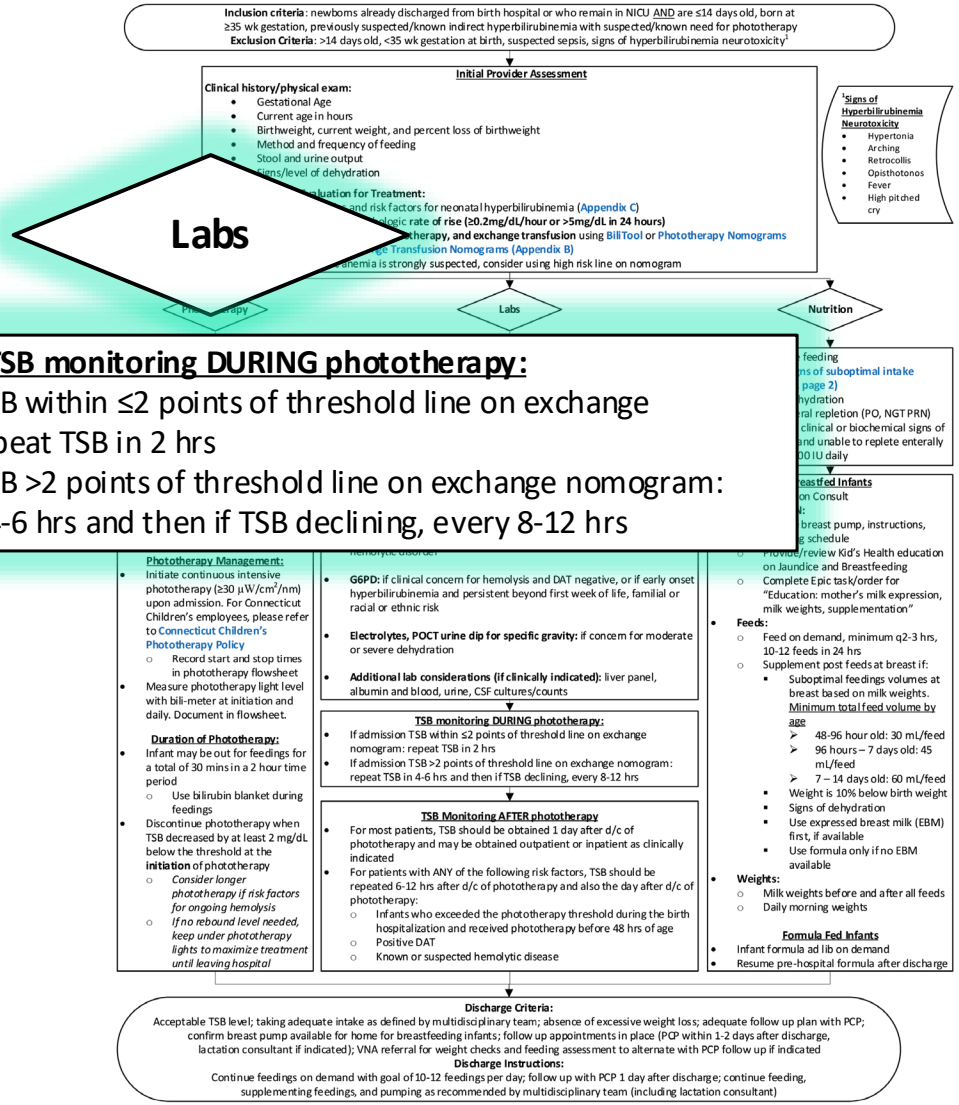
TSB monitoring DURING phototherapy

- Ensure effective decline in TSB with treatment
- Distance for exchange tx line determines next TSB timing
- Once TSB is declining, AND > 2 points from exchange threshold can repeat ~ every 6-12 hours

CLINICAL PATHWAY:

Hyperbilirubinemia Inpatient Management

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TSB monitoring DURING phototherapy:

- If admission TSB within ≤2 points of threshold line on exchange nomogram: repeat TSB in 2 hrs
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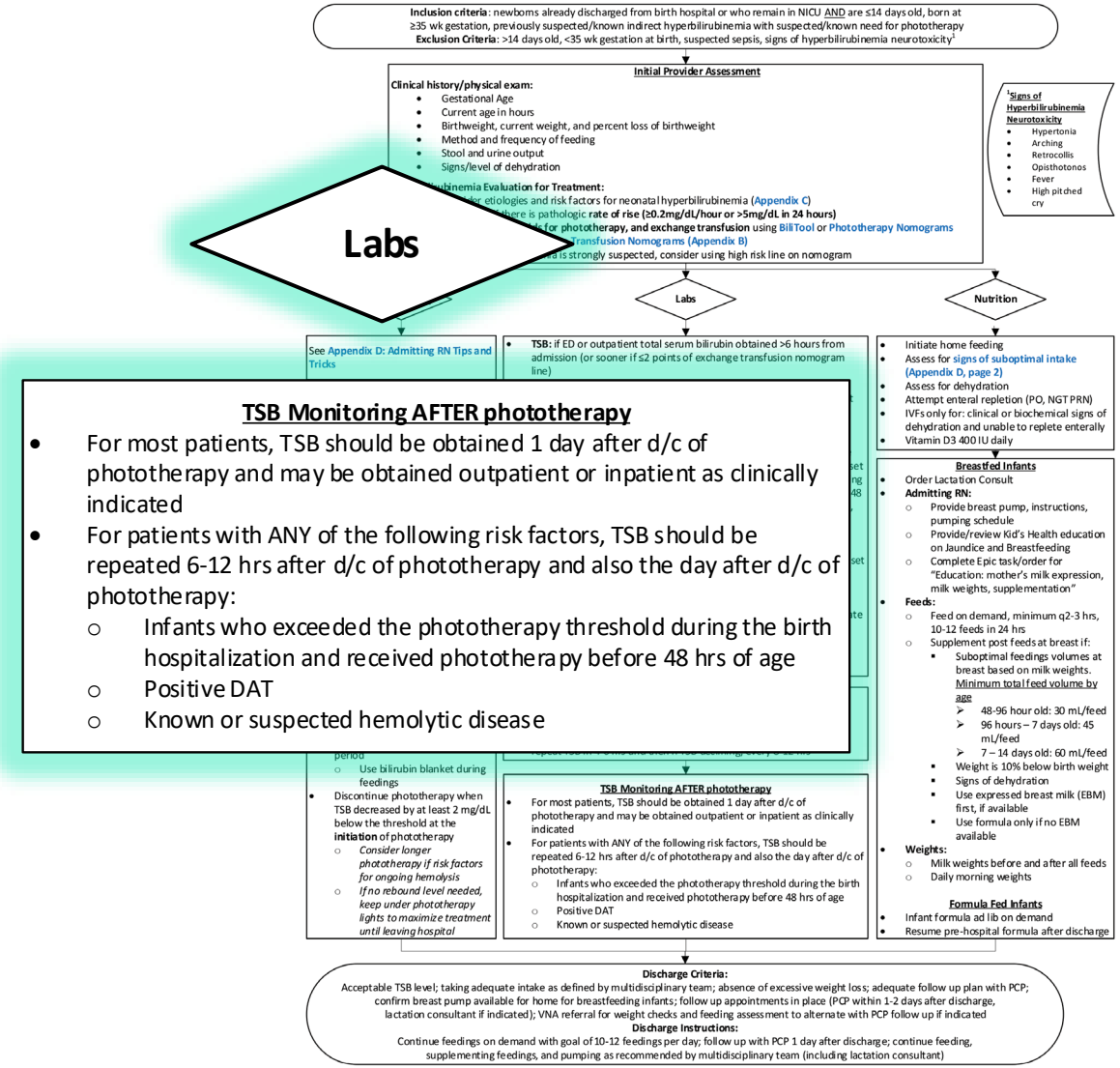
TSB monitoring AFTER phototherapy

- For most patients a repeat TSB 1 day after stopping phototherapy is appropriate
- Can be obtained as outpatient or inpatient, as clinically indicated
- Criteria for when to consider TSB 6-12 hours after phototherapy discontinued included

CLINICAL PATHWAY:

Hyperbilirubinemia Inpatient Management

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Nutrition

- Nutrition optimization is essential for hyperbilirubminemia treatment
- Goal feeding volumes based on age have been added to guide supplementation
- Lactation support for breastfeeding patients is integral to feeding optimization
- Goal breastfeeding is at least 10-12 time per day (minimum every 2-3 hours)

Nutrition

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- Assess for dehydration
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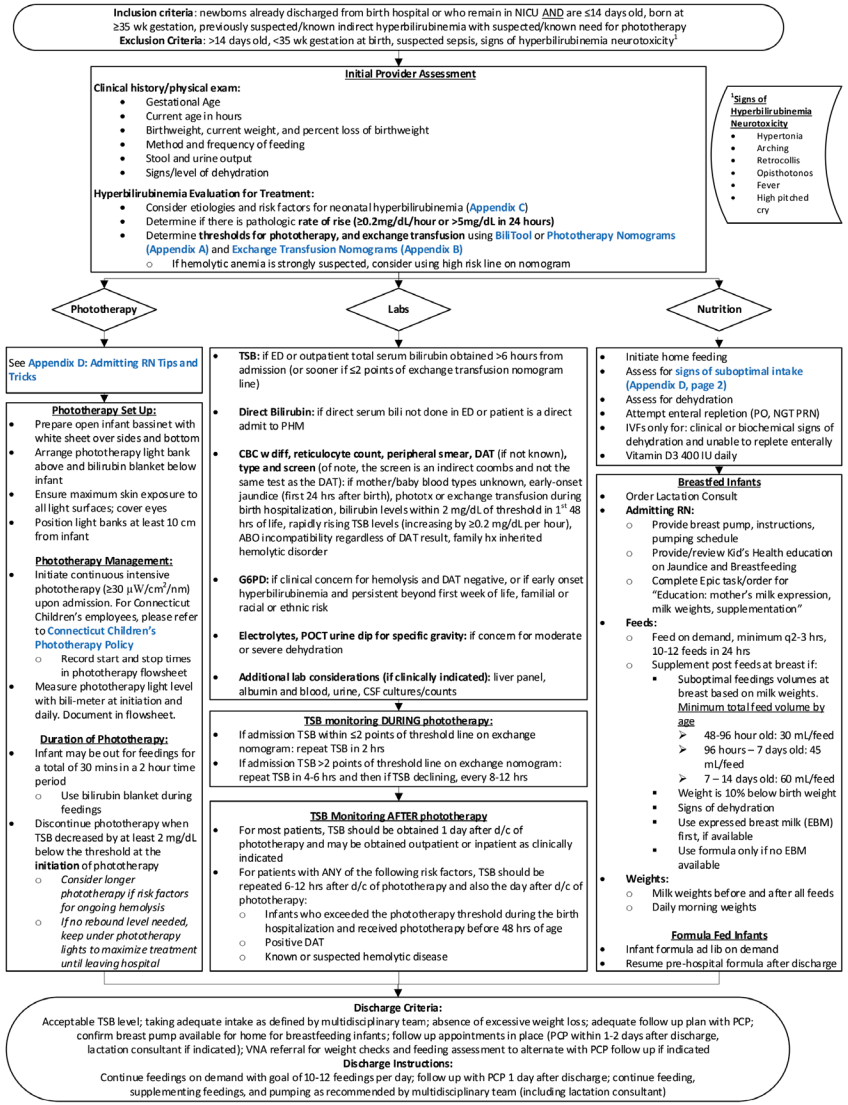
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Importance of Enteral Feeding

- Enteral feeding allows optimal excretion of bilirubin via bile and intestinal route
- Consider Nasogastric feedings if there are feeding difficulties
- Inadequate feeding results in increased intestinal resorption of bilirubin and higher unconjugated bilirubin levels (“increased enterohepatic circulation”)
- Meconium is a reservoir of unconjugated bilirubin
  - Poor passage of stool = more absorption of unconjugated bilirubin

Appendix D page 9 also provides additional tips and tricks for nurses

- Admitting RN responsibilities
  1. Tips for phototherapy and labs
  2. Breastfeeding and nutritional support to provide upon arrival (pump and pump kit, instructions for pumping, milk weight scale, provide feeding log)
  3. Guidance for how to assess for suboptimal intake



RN Responsibilities Upon Admission:

1. **Phototherapy and Bilirubin Labs Tips**
   - Obtain Total Serum Bilirubin if >2 hours since last and then start phototherapy
   - Start continuous intensive phototherapy (≥30 µW/cm²/nm) with lights above and bilirubin blanket beneath patient - when infant arrives
   - Adjusting the phototherapy dose
     - Measure the irradiance (light intensity) of the phototherapy with the Bili-meter
     - Loosen the height adjustment clamp on the stand and adjust the height of the phototherapy unit to achieve an irradiance goal of at least **≥30 µW/cm²/nm**
     - Minimum clearance between the lower edge of the phototherapy lamp and the patient is at least 30 cm per manufacturer guidelines
     - Infant is only wearing a diaper to maximize skin to light exposure
     - Purple eye shields in place on infant
     - Light intensity level should be checked at initiation of phototherapy and at least once a day with bili-meter. **Goal intensity is ≥30 µW/cm²/nm**. (blanket meter is tan, overhead light meter is blue)
   - Document on "Phototherapy Flowsheet": start, stop, and any phototherapy documentation items in this flow sheet
2. **Breastfeeding and Nutrition Support Upon Patient Arrival**
   - **Breast pump and pumping kit**
     - Instruct breastfeeding mother on **use of the pump** and to **pump after all feedings**
     - Complete/document completion of this order/task by clicking "done" in Epic
   - **Milk weight scale**
     - Instruct mother on how to weigh the baby pre- and post- feedings
     - **Milk weights** are to be done for **all feedings** at breast and recorded on flow sheet
   - **Provide mother a breastfeeding log (Appendix E)**
   - **Document** that breast pump, pumping kit, pumping instructions, milk weight scale, and feeding log were given to mother
   - Print off "**Breastfeeding and Jaundice**" patient hand out from **Kids Health** and review with mother
   - **Assess feedings** at breast for **suboptimal intake**
     - Goal total feed volume by age
       - 48-96 hour old: 30 mL/feed
       - 96 hours – 7 days old: 45 mL/feed
       - 7 – 14 days old: 60 mL/feed
     - Ineffective latch and/or suck
     - Sleepy and difficulty to wake for feedings
     - Delayed milk supply
     - Laboratory abnormalities (hypoglycemia)
     - Uric acid crystals in urine
     - <4 stools on day 4 or meconium stools on day 5

CONTACTS: JILL HERRING, APRN | MARY LUSSIER, RN, IBCLC | ILANA WAYNIK, MD | KRISTIN WELCH, MD

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Measuring feedings at Breast with Milk Weight Scale

Milk Weight Scale

- Use before and after feedings at breast
  - 1 gram = ~1 mL breast milk
- Assists in assessing supply
- Help determine potential need to supplement
- Every feeding at breast & recorded on flow sheet



Use of IV Fluids

- Most infants with hyperbilirubinemia do not require IV fluids
- IVFs may decrease infant's desire to take oral feedings, and thus prolong jaundice
- Consider use of nasogastric tube in place of IVFs, if unable to take adequate PO intake, as clinically appropriate
- Consider IVF if evidence of moderate dehydration:
  - Hemodynamic instability
  - Moderate to severe electrolyte abnormalities
  - Unable to correct these factors enterally

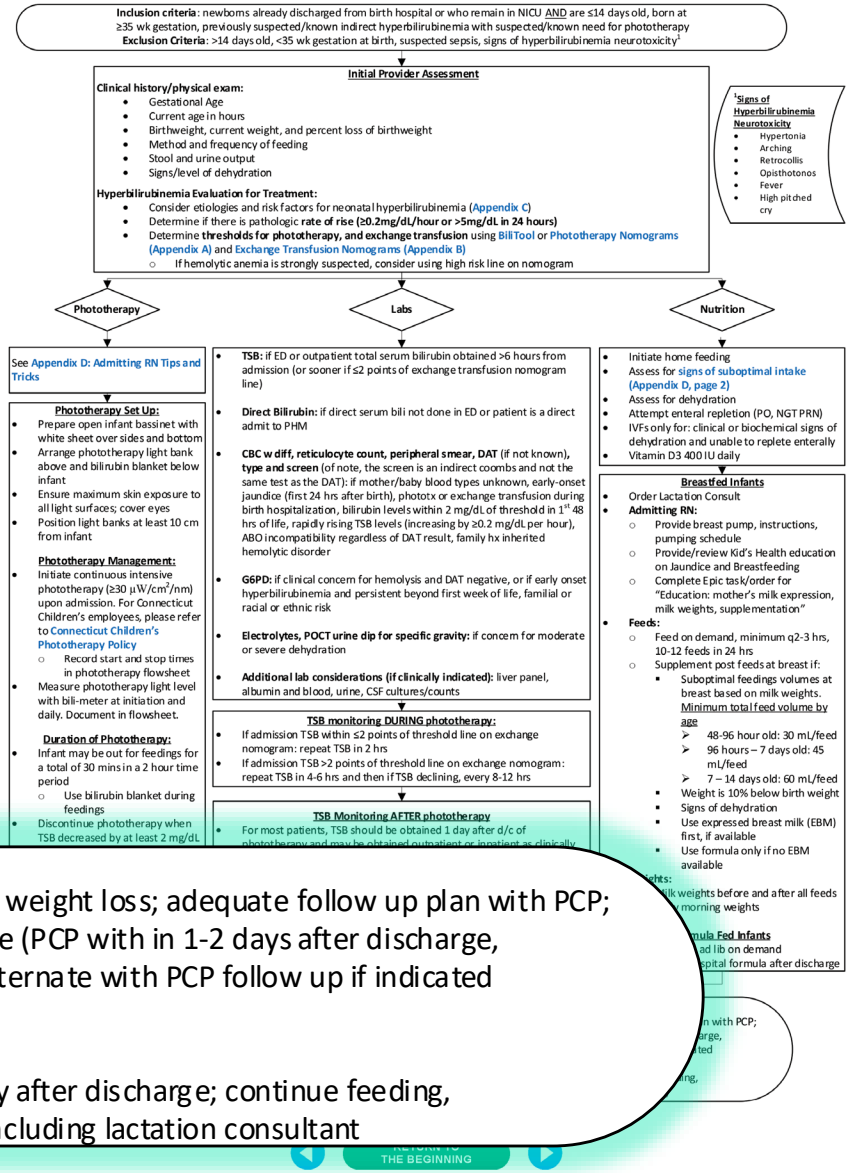
CLINICAL PATHWAY:

Hyperbilirubinemia Inpatient Management

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

Discharge Criteria:

- Infant medically stable with an acceptable TSB level
- For most patients TSB level at least 2 pts below the threshold at the initiation of phototherapy is acceptable (consider longer phototx for patients with high suspicion of hemolytic process
- Oral intake and weight are appropriate
- Appropriate follow up services in place: PCP, lactation, VNA as needed



Discharge Criteria:

Acceptable TSB level; taking adequate intake as defined by multidisciplinary team; absence of excessive weight loss; adequate follow up plan with PCP; confirm breast pump available for home for breastfeeding infants; follow appointments in place (PCP with in 1-2 days after discharge, lactation consultant if indicated); VNA referral for weight checks and feeding assessment to alternate with PCP follow up if indicated

Discharge Instructions:

Continue feedings on demand with goal of 10-12 feedings per day; follow up with PCP 1 day after discharge; continue feeding, supplementing feedings, and pumping as recommended by multidisciplinary team including lactation consultant

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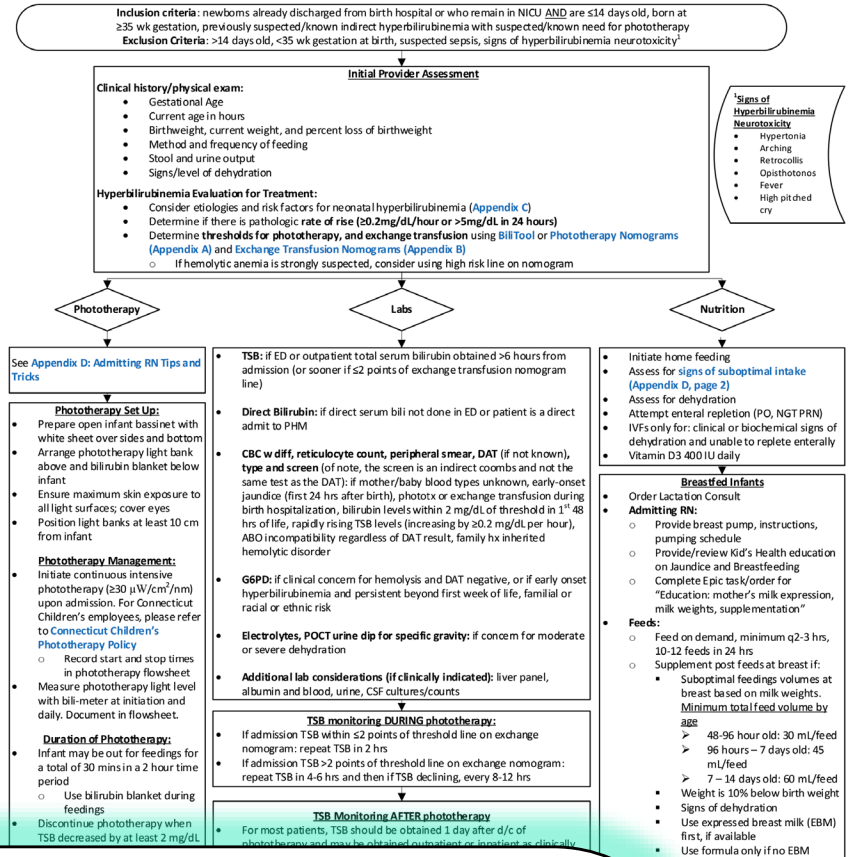
CLINICAL PATHWAY:

Hyperbilirubinemia Inpatient Management

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

Discharge Instructions:

- Ensure family is given a feeding plan to support continued feeding optimization
  - Includes guidance for supplementing and when it would be appropriate to stop supplementing
  - Goal feeding 10-12 times per day
- PCP follow up 1 day after discharge



Inclusion criteria: newborns already discharged from birth hospital or who remain in NICU AND are ≤14 days old, born at ≥35 wk gestation, previously suspected/known indirect hyperbilirubinemia with suspected/known need for phototherapy
Exclusion Criteria: >14 days old, <35 wk gestation at birth, suspected sepsis, signs of hyperbilirubinemia neurotoxicity[1]

Initial Provider Assessment

Clinical history/physical exam:
- Gestational Age
- Current age in hours
- Birthweight, current weight, and percent loss of birthweight
- Method and frequency of feeding
- Stool and urine output
- Signs/level of dehydration

Hyperbilirubinemia Evaluation for Treatment:
- Consider etiologies and risk factors for neonatal hyperbilirubinemia (Appendix C)
- Determine if there is pathologic **rate of rise (≥0.2mg/dL/hour or >5mg/dL in 24 hours)**
- Determine **thresholds for phototherapy, and exchange transfusion** using BiliTool or Phototherapy Nomograms (Appendix A) and Exchange Transfusion Nomograms (Appendix B)
  - If hemolytic anemia is strongly suspected, consider using high risk line on nomogram

[1]Signs of Hyperbilirubinemia Neurotoxicity
- Hypertonia
- Arching
- Retrocollis
- Opisthotonos
- Fever
- High pitched cry

Phototherapy

See Appendix D: Admitting RN Tips and Tricks

Phototherapy Set Up:
- Prepare open infant bassinet with white sheet over sides and bottom
- Arrange phototherapy light bank above and bilirubin blanket below infant
- Ensure maximum skin exposure to all light surfaces; cover eyes
- Position light banks at least 10 cm from infant

Phototherapy Management:
- Initiate continuous intensive phototherapy (≥30 μW/cm²/nm) upon admission. For Connecticut Children's employees, please refer to Connecticut Children's Phototherapy Policy
  - Record start and stop times in phototherapy flowsheet
- Measure phototherapy light level with bili-meter at initiation and daily. Document in flowsheet.

Duration of Phototherapy:
- Infant may be out for feedings for a total of 30 mins in a 2 hour time period
  - Use bilirubin blanket during feedings
- Discontinue phototherapy when TSB decreased by at least 2 mg/dL

Labs
- **TSB:** if ED or outpatient total serum bilirubin obtained >6 hours from admission (or sooner if ≤2 points of exchange transfusion nomogram line)
- **Direct Bilirubin:** if direct serum bili not done in ED or patient is a direct admit to PHM
- **CBC w diff, reticulocyte count, peripheral smear, DAT** (if not known), **type and screen** (of note, the screen is an indirect coombs and not the same test as the DAT): if mother/baby blood types unknown, early-onset jaundice (first 24 hrs after birth), phototx or exchange transfusion during birth hospitalization, bilirubin levels within 2 mg/dL of threshold in 1st 48 hrs of life, rapidly rising TSB levels (increasing by ≥0.2 mg/dL per hour), ABO incompatibility regardless of DAT result, family hx inherited hemolytic disorder
- **G6PD:** if clinical concern for hemolysis and DAT negative, or if early onset hyperbilirubinemia and persistent beyond first week of life, familial or racial or ethnic risk
- **Electrolytes, POCT urine dip for specific gravity:** if concern for moderate or severe dehydration
- **Additional lab considerations (if clinically indicated):** liver panel, albumin and blood, urine, CSF cultures/counts

TSB monitoring DURING phototherapy:
- If admission TSB within ≤2 points of threshold line on exchange nomogram: repeat TSB in 2 hrs
- If admission TSB >2 points of threshold line on exchange nomogram: repeat TSB in 4-6 hrs and then if TSB declining, every 8-12 hrs

TSB Monitoring AFTER phototherapy
- For most patients, TSB should be obtained 1 day after d/c of phototherapy and may be obtained outpatient or inpatient as clinically

Nutrition
- Initiate home feeding
- Assess for signs of suboptimal intake (Appendix D, page 2)
- Assess for dehydration
- Attempt enteral repletion (PO, NGT PRN)
- IVFs only for: clinical or biochemical signs of dehydration and unable to replete enterally
- Vitamin D3 400 IU daily

Breastfed Infants
- Order Lactation Consult
- **Admitting RN:**
  - Provide breast pump, instructions, pumping schedule
  - Provide/review Kid's Health education on Jaundice and Breastfeeding
  - Complete Epic task/order for "Education: mother's milk expression, milk weights, supplementation"
- **Feeds:**
  - Feed on demand, minimum q2-3 hrs, 10-12 feeds in 24 hrs
  - Supplement post feeds at breast if:
    - Suboptimal feedings volumes at breast based on milk weights. Minimum total feed volume by age
      - 48-96 hour old: 30 mL/feed
      - 96 hours – 7 days old: 45 mL/feed
      - 7 – 14 days old: 60 mL/feed
    - Weight is 10% below birth weight
    - Signs of dehydration
    - Use expressed breast milk (EBM) first, if available
    - Use formula only if no EBM available

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morning weights

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RETURN TO THE BEGINNING

Discharge Criteria:

Acceptable TSB level; taking adequate intake as defined by multidisciplinary team; absence of excessive weight loss; adequate follow up plan with PCP; confirm breast pump available for home for breastfeeding infants; follow appointments in place (PCP with in 1-2 days after discharge, lactation consultant if indicated); VNA referral for weight checks and feeding assessment to alternate with PCP follow up if indicated

Discharge Instructions:

Continue feedings on demand with goal of 10-12 feedings per day; follow up with PCP 1 day after discharge; continue feeding, supplementing feedings, and pumping as recommended by multidisciplinary team including lactation consultant

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Review of Key Points

- Clear admission and treatment criteria
- Optimization of feeding and nutrition is critical
- Appropriate set up and dose of phototherapy are essential
- Appropriate lab evaluation for at risk populations guides phototherapy duration and need for closer rebound testing, as well as other long term monitoring needs
- Consider longer phototherapy treatment/lower TSB level to discontinue therapy if there is a high suspicion for a hemolytic process
- Consider maximizing treatment by continuing phototherapy until patient is ready to leave the hospital if no rebound level is needed prior to discharge
- Close follow up with PCP after discharge is a must

Quality Metrics

- % Patients with pathway order set
- % Patients with breastfeeding education performed
- % Patients with lactation consult obtained < = 24 hours of arrival
- % Patients with phototherapy start time documented
- Average time (minutes) from arrival to phototherapy start time
- % Patients with phototherapy intensity > 30
- % Families reporting breastfeeding continued at 1 week
- % Families reporting breastfeeding continued at 1 month
- % Families unable to be reached at 1 week
- % Families unable to be reached at 1 month
- Readmissions within 30 days (all cause)
- ALOS (days), IP/OBS

Pathway Contacts

- Jill Herring, APRN
  - Pediatric Hospital Medicine
- Ilana Waynik, MD
  - Pediatric Hospital Medicine
- Mary Lussier, RN, IBCLC
  - Lactation
- Kristin Welch, MD
  - Pediatric Emergency Medicine

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Thank You!

About Connecticut Children's Clinical Pathways Program

The Clinical Pathways Program at Connecticut Children's aims to improve the quality of care our patients receive, across both ambulatory and acute care settings. We have implemented a standardized process for clinical pathway development and maintenance to ensure meaningful improvements to patient care as well as systematic continual improvement. Development of a clinical pathway includes a multidisciplinary team, which may include doctors, advanced practitioners, nurses, pharmacists, other specialists, and even patients/families. Each clinical pathway has a flow algorithm, an educational module for end-user education, associated order set(s) in the electronic medical record, and quality metrics that are evaluated regularly to measure the pathway's effectiveness. Additionally, clinical pathways are reviewed annually and updated to ensure alignment with the most up to date evidence. These pathways serve as a guide for providers and do not replace clinical judgment.