Neonatal Jaundice – Optimizing Phototherapy

An initiative of ETAT+ Trainers

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CENTER FOR PUBLIC HEALTH & DEVELOPMENT
Saving Lives Through Innovation

NEST360°

saving children's lives
ETAT+
Emergency Triage Assessement and Treatment plus admission

Outline

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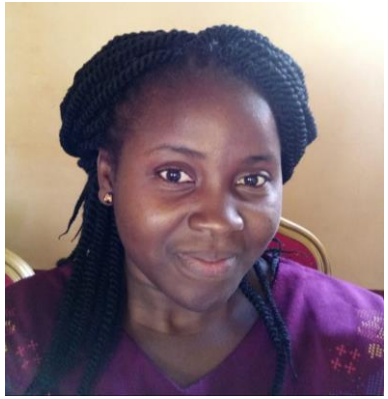
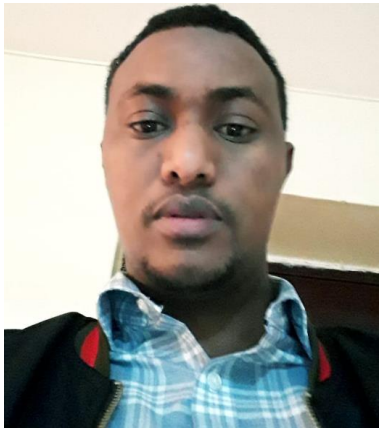
Dr. Rachael Kanguha
(Host)



Dr. Hildy Nvonako
Introduction



Dr. Abdullahi Hassan
Bilirubin metabolism and encephalopathy

Dr. Sylvia Mwathi
Prevention and management

Samson Tamba
Providing phototherapy and monitoring

Edith Gicheha
Providing phototherapy and monitoring

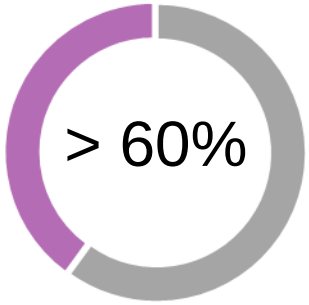
Introduction

Introduction

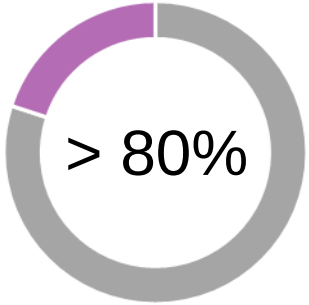
Jaundice is a yellowish discoloration of the **skin**, **sclerae**, and **mucous membranes** caused by tissue deposition of pigmented bilirubin

Neonatal jaundice - usually observed in **first week** of life when **total serum bilirubin** level reaches

86 micromol/L (5 mg/dL)[1].



Term neonates[2]



Preterm neonates[2]

1.Willy T, Hansen R. Core Concepts . Bilirubin Metabolism.NeoReviews: 2010;11(6).
*2.Bhutani VK, et al .Predischarge screening for severe neonatal hyperbilirubinemia identifies infants who need phototherapy. J Pediatr. 2013;**162**(3):477–482*

High levels of haemoglobin leading to high levels of bilirubin

At birth

Intrauterine environment
– relatively hypoxic

- Foetal Hb has enhanced oxygen binding capacity
- High Hb at term (Hb 19.3 +/- 2.2g/dl)

Extrauterine environment
- high oxygen concentration

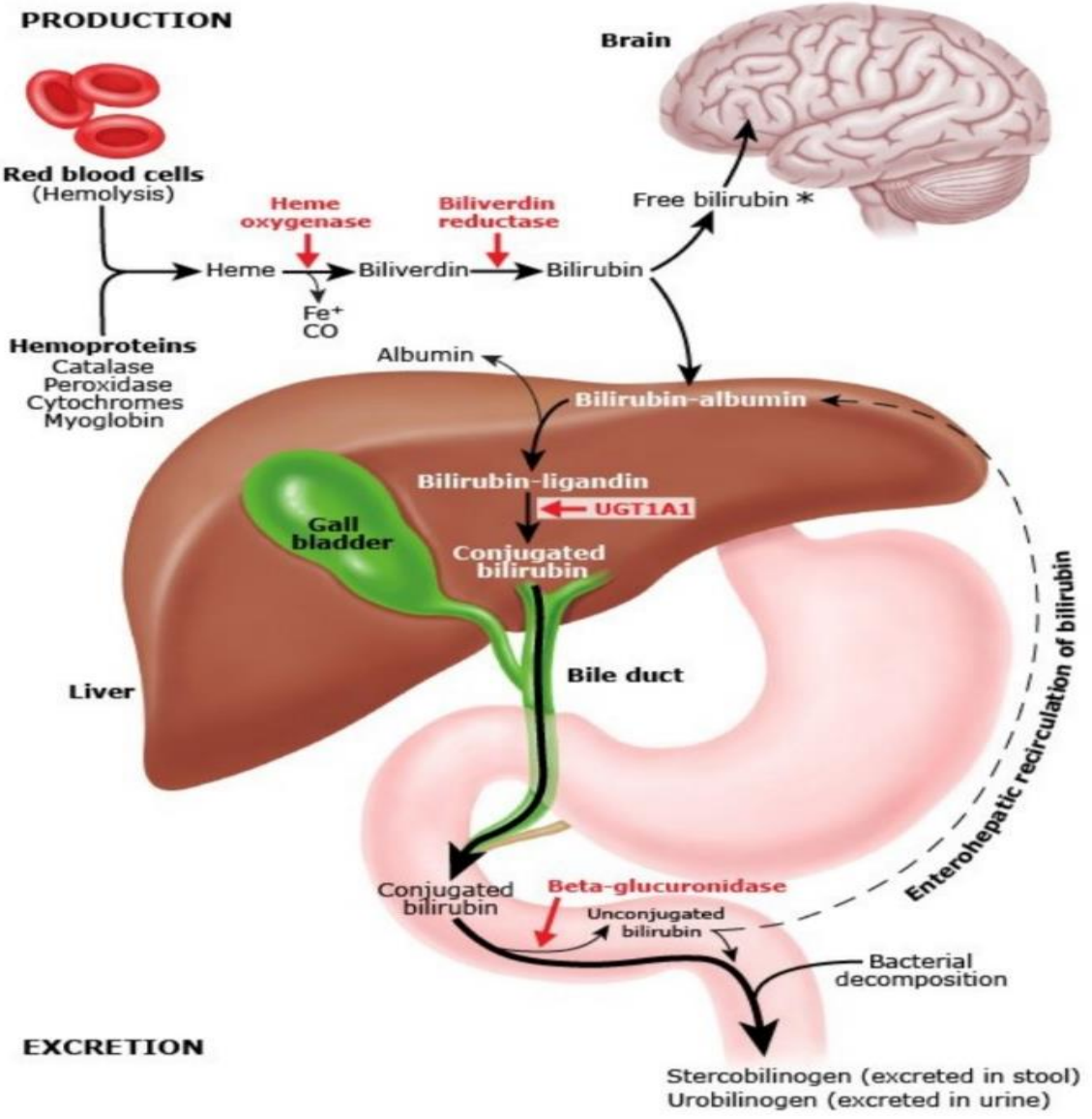
- Lower Hb
- Increase in adult Hb

Anemia and Polycythemia in the Newborn Erica Hyman Kates, Jacqueline S. Kates Pediatrics in Review Jan 2007, 28 (1) 33-34; DOI: 10.1542/pir.28-1-33

Physiological Jaundice

- Bilirubin is generated by sequential catalytic degradation of heme
- Mediated by
1. Heme oxygenase
2. Biliverdin reductase

80% from hemoglobin
20% from other hemoproteins
Neonate produces 8.5mg/kg/day of bilirubin



Care of the jaundiced neonate, Stevenson DK, Maisels MJ, Watchko JF (Eds), McGraw Hill Companies, New York 2012

Mechanisms of Unconjugated Hyperbilirubinaemia

Rapid and excessive RBCs breakdown

↓

Increased production of bilirubin

Decreased bilirubin clearance

↓

Accumulation of unconjugated bilirubin

Increased enterohepatic circulation

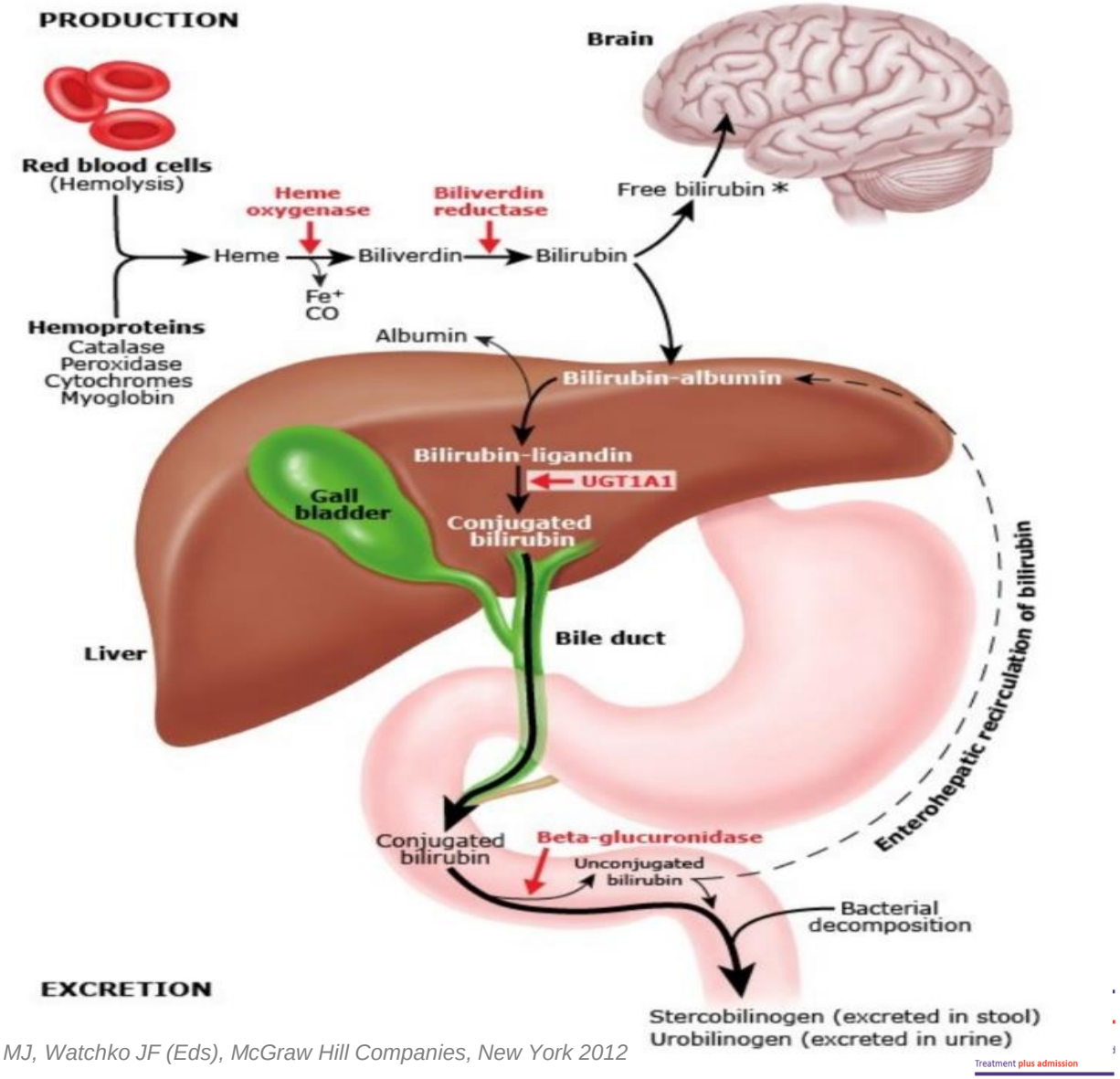
↓

Increased deconjugation of conjugated bilirubin

Willy T, Hansen R. Core Concepts . Bilirubin Metabolism.NeoReviews: 2010;11(6).

What can go wrong in the Bilirubin metabolism?

- Increased heme catabolism
- Hypoalbuminemia
- Reduced uptake
- Reduced conjugation
- Increased enterohepatic circulation



Care of the jaundiced neonate, Stevenson DK, Maisels MJ, Watchko JF (Eds), McGraw Hill Companies, New York 2012

Types of Indirect Hyperbilirubinaemia

Physiological

- Otherwise healthy newborns
- Develops - 2nd to 4th day of life
- TSB rarely exceeds **205 micromol/L** (12mg/dL)

Preterm neonates

- Peaks from day 5 – 6 of life
- Resolves after birth within first 3 weeks of life

Term neonates

- Peaks on day 3
- Resolves after birth within first 2 weeks of life

Non - Physiological

- Associated signs & symptoms of pathologic process
- Develops within 24 hours of birth
- Rapid progression, TSB rising at **>85micromol/L/24hr**
- Persists beyond 2 weeks of life

Preterm neonates

- TSB ranges btw **170 - 238micromol/L**

Term neonates

- TSB exceeds **205micromol/L**

Dennery PA, Seidman DS, Stevenson DK. Neonatal hyperbilirubinemia. N. Engl. J. Med. 2001 Feb 22;344(8):581-90

Risk Factors of Indirect Hyperbilirubinaemia

Maternal Factors

- Blood group (Group O & Rh Negative)
- Maternal diabetes
- Race (Asians & Native Americans)
- Genetic (G6PD Deficiency)
- Previous jaundiced baby

Fetal Factors

- Prematurity
- Male sex
- Cephalohematoma
- Breastfeeding
- Infections

*Stevenson DK, et al. Prediction of hyperbilirubinemia in near-term and term infants. J Perinatol. 2001;**21**(Suppl 1):S63–S72, S83–S87*

Indirect Hyperbilirubinaemia- Investigations

✓Complete blood count
✓Reticulocyte count
✓Blood grouping
✓Coombs test

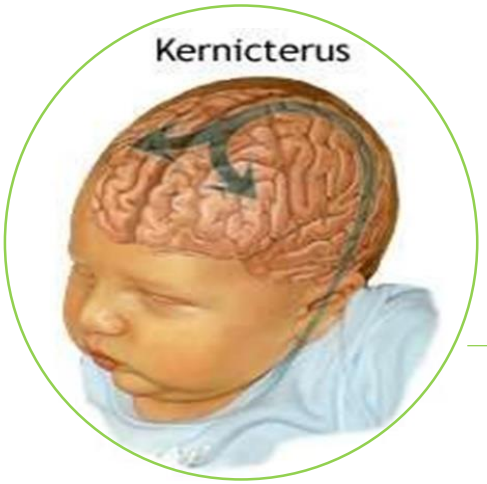
✓Total and direct bilirubin levels
❑ Liver function tests – AST & ALT
- GGT & ALP
- Prothrombin time & Albumin

❑ Septic screen if signs of infection

Pan DH, Rivas Y. Jaundice: Newborn to Age 2 Months. Pediatr Rev. 2017 Nov;38(11):499-510.

Why worry about high levels of unconjugated bilirubin ?

Bilirubin Encephalopathy

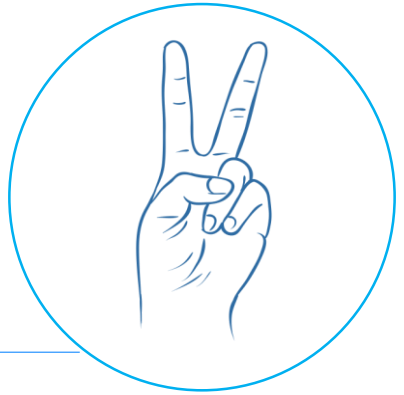


Kernicterus or bilirubin encephalopathy

is a neurologic syndrome resulting from the deposition of unconjugated bilirubin in the basal ganglia and brainstem nuclei

Bilirubin encephalopathy occurs in 2 forms:

1. Acute bilirubin encephalopathy
2. Chronic bilirubin encephalopathy



Karimzadeh P, Fallahi M, Kazemian M, Taslimi Taleghani N, Nouripour S, Radfar M. Bilirubin Induced Encephalopathy. Iran J Child Neurol. 2020;14(1):7-19.

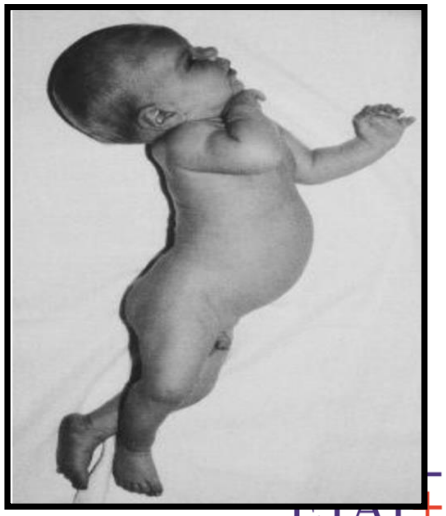
Signs of acute and chronic bilirubin encephalopathy

Acute form

- **Phase 1 (first 1–2 days):** decreased alertness, poor feeding, hypotonia and weak Moro
- **Phase 2 (middle of first week):** irritability, hypertonia of extensor muscles, opisthotonos / retrocollis
- **Phase 3 (after the first week):** hypotonia, apnoea

Chronic form

- **First year**: hypotonia, hyperreflexia, delayed motor skills, obligatory tonic neck reflexes
- **After first year**: sensorineural hearing loss, upward gaze, dental enamel hypoplasia, movement disorders (dystonia and athetosis),



Usman F, Diala UM, Shapiro SM, Le Pichon JB, Slusher TM. Acute bilirubin encephalopathy and its progression to kernicterus: current perspectives. Research and Reports in Neonatology. 2018;8:33-44 https://doi.org/10.2147/RRN.S125758

Risk factors for bilirubin encephalopathy

Research and Reports in Neonatology

Dovepress
open access to scientific and medical research

Open Access Full Text Article

REVIEW

Acute bilirubin encephalopathy and its progression to kernicterus: current perspectives

1. High total serum bilirubin levels
2. Hemolysis
3. Preterm infants
4. Acidosis
5. Sepsis
6. Hypercarbia
7. Hypoxia
8. Asphyxia
9. Dehydration

Danger signs

- Poor feeding
- Lethargy
- Fever
- Irritability
- seizures

Usman F, Diala UM, Shapiro SM, Le Pichon JB, Slusher TM. Acute bilirubin encephalopathy and its progression to kernicterus: current perspectives. Research and Reports in Neonatology. 2018;8:33-44 https://doi.org/10.2147/RRN.S125758

Phototherapy

Enhancing conversion of the lipid soluble unconjugated bilirubin to harmless water soluble bilirubin

Lipid soluble ; can cross the blood brain barrier

Breakdown of Rbc and hemoglobin → Unconjugated bilirubin → Brain

No intervention

Kernicterus

Bilirubin encephalopathy

Phototherapy

Converts

1. Structural isomerization
2. Photo isomerization
3. Photo oxidation

Water soluble isomers

Easily excreted in urine and feaces

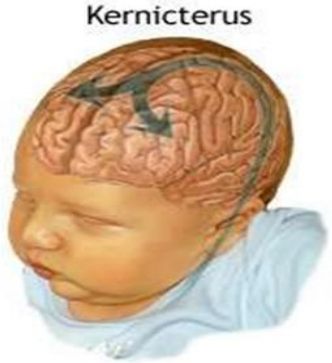
Jasprova J, Dal Ben M, Vianello E, Goncharova I, Urbanova M, Vyroubalova K, et al. (2016) The Biological Effects of Bilirubin Photo isomers. PLoS ONE 11(2): e0148126. doi:10.1371/journal.pone.0148126

Why worry about high levels of unconjugated bilirubin

Goals of phototherapy

Main purpose of treatment of hyperbilirubinemia is to prevent encephalopathy.

Kernicterus is a devastating, permanently disabling neurologic condition resulting from bilirubin neurotoxicity[2]



This requires **timely** detection , diagnosis and appropriate management[1]

Mothers should be shown how to recognize jaundice very early and seek timely health care
Best time to teach mothers – antenatal period

Olusanya et al. Management of late-preterm and term infants with hyperbilirubinaemia in resource-constrained settings. BMC Pediatr. 2015;15:39.Okolie F, South-Paul JE, Watchko JF. Combating the Hidden Health Disparity of Kernicterus in Black Infants: A Review JAMA Pediatr. 2020;

Primary prevention and early detection

Prevention

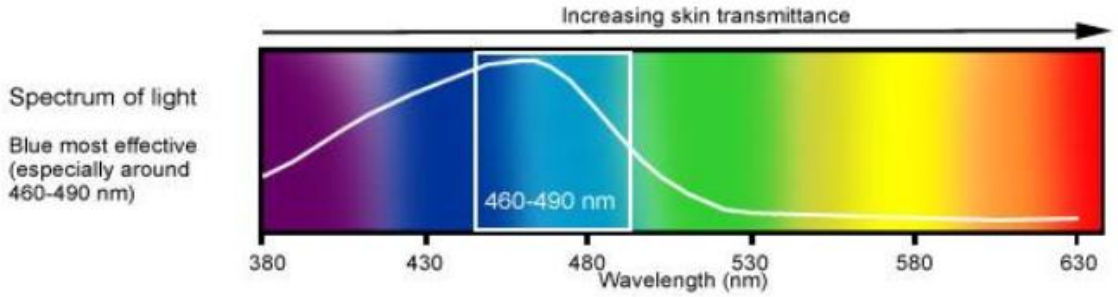
- **Educate PG women** on recognition of NNJ[1].
- Determine mother's **blood type and timely** provision of anti-D globulin[1].
- **Pre-discharge counselling** of mothers
- Good **lactational support**[2]

Early detection

- Examine newborns within **24hrs** and in the following 2 days.
- Caregivers be encouraged to **look** for jaundice
- **Monitoring** of high risk infants
- Ongoing **HCW training** on S/S of acute bilirubin encephalopathy, **timely referral**

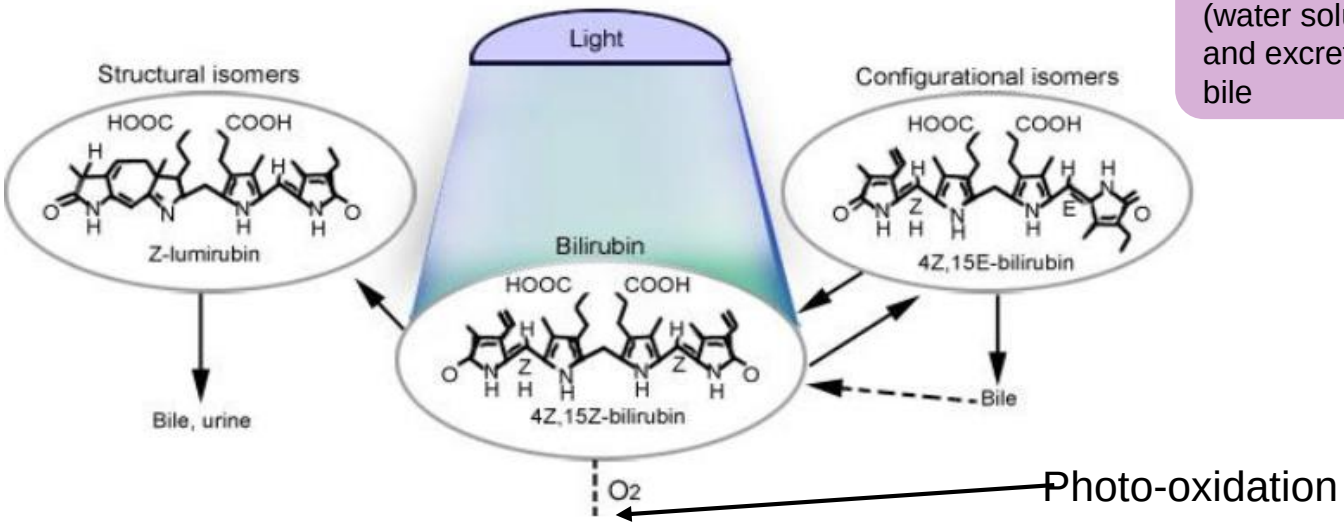
Bhutani VK, Zipursky A, Blencowe H, Khanna R, Sgro M, Ebbesen F, et al.Neonatal hyperbilirubinemia and Rhesus disease of the newborn: incidenceand impairment estimates for 2010 at regional and global levels. PediatrRes. 2013;74 Suppl 1:86–100. [1]
Academy of Breastfeeding Medicine Protocol Committee. ABM clinical protocol #22: guidelines for management of jaundice in the breastfeeding infant equal to or greater than 35 weeks' gestation. Breastfeed Med. 2010;5:87–93.[2]

Mode of action of action



Conversion to lumirubin through photo-isomerization and excreted in the bile and urine

Photo isomerized (water soluble) and excreted in bile



Rate of clearance depends on urination

Bilirubin absorbs light optimally in the blue-green range **430-490nm**

Phototherapy for Jaudice uptodate may 01, 2018 Taylor L Sawyer, DO, Med, FAAP, FACOP

Principles of Phototherapy

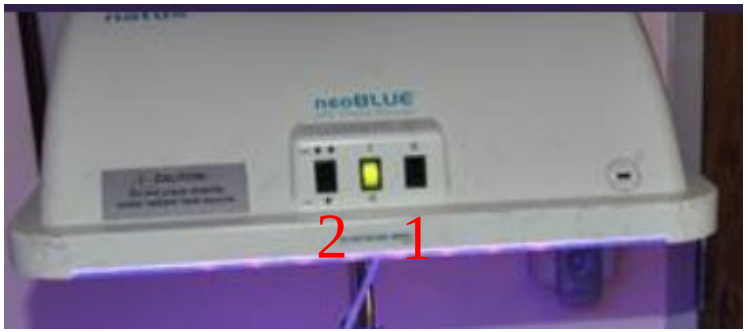
Standard Phototherapy irradiance 25-30 μW/cm^2/nm.

Intensive phototherapy- irradiance 30-35 μW/cm^2/nm

- Treatment of significant hyperbilirubinemia.
- Dose depends on **wave length** , **the irradiance and average** spectral irradiance.
- Delivered by light-emitting diode (LED), fibreoptic or fluorescent lamps or tubes or bulbs.
- **Wavelengths of 430-490nm and blue-green range**
- Irradiance is the amount of **energy flowing out the light** received by a surface per unit area.
- Higher spectral irradiance- faster **decline** in the bilirubin levels

Vandborg PK, M HB, Greisen G, Ebbesen F. Dose-response relationship of phototherapy for hyperbilirubinemia. Pediatrics[1] 2012;130(2):e352-e7[1] Olusanya BO, Ogunlesi TA, Kumar P, et al. Management of late-preterm and term infants with hyperbilirubinaemia in resource-constrained settings. BMC Pediatr. 2015;15:39. Published 2015 Apr 12. doi:10.1186/s12887-015-0358-z

Principles of Phototherapy



- Conversion to isomers and lumirubin excreted in the urine and bile.
- Maximize BSA exposed to phototherapy - diaper only and eyes must be covered
- Maintain hydration and urine output
- Intensive phototherapy can be achieved with modern devices by simply adjusting level of irradiance on the device
- ✖ Not indicated in conjugated hyperbilirubinemia will develop

  “Bronze baby syndrome”

Phototherapy for JaundiceUpdated: May 01, 2018
•Author: Taylor L Sawyer, DO, MEd, FAAP, FACOP; Chief Editor: Dharmendra J Nimavat, MD, FAAP

Risk factors for Encephalopathy

- ***These will determine when and how to treat***

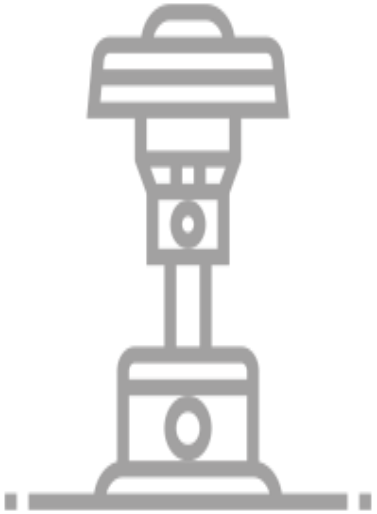
- ABO incompatibility [2]
- RhD isoimmunization [2]
- G6PD deficiency [1]
- Prematurity [2]
- Exclusively breastfeeding[2]
- Albumin <3.0g/dL
- Asphyxia
- Significant lethargy
- Temperature instability
- Acidosis
- Infection

Infants are designated as higher risk because of the potential negative effects of the conditions listed on albumin binding of bilirubin, the blood–brain barrier, and the susceptibility of the brain cells to damage by bilirubin. Lower thresholds are used to initiate treatment.

Kuzniewicz MW, Wickremasinghe AC, Wu YW, et al. Incidence, etiology, and outcomes of hazardous hyperbilirubinemia in newborns. Pediatrics. 2014;134(3):504-509. doi:10.1542/peds.2014-0987[1]*Wallenstein MB, Bhutani VK. Jaundice and kernicterus in the moderately preterm infant. Clinics in Perinatology 2013;40:679-88*[2]

Intensified phototherapy

- Consider intensified phototherapy to treat if the serum bilirubin is:



1. Rising rapidly **>8.5 µmol/l** per hour
2. Is **50 µmol/l below threshold** for which exchange transfusion is indicated after 72 hours or more since birth
3. Continues to rise or does not fall **within 6 hours** of starting phototherapy.

Do not interrupt intensive phototherapy for feeding , but continue administering enteral feeds using the NGT . If indicated IV fluids

Expect ↓ 34 µmol/l within 6 hrs

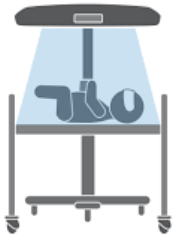
https://www.nice.org.uk/guidance/cg98/evidence/addendum-pdf-2490921037file:///C:/Users/Lenovo/Downloads/KPA%20PROTOCAL%20(E.%20WEB%20FEb%2024th(4)%20(1).pdf
Olusanya et al. Management of late-preterm and term infants with hyperbilirubinaemia in resource-constrained settings. BMC Pediatr. 2015

Role of filtered sunlight

Filtered sunlight

- Do not use unfiltered sunlight
- Risks- UV radiation, hyperthermia and sun burn[1].
- Role of **filtered sunlight**
- Film canopies
- Filter out most Ultraviolet A,B and C and infrared (heat) radiation
- Only passes **400-520 nm** therapeutic blue light.

Phototherapy



- Conventional phototherapy is 8-10uW/cm^2/nm
- Filtered sunlight provides above **the threshold of intensive phototherapy**(at least 30W/cm^2/nm)^2

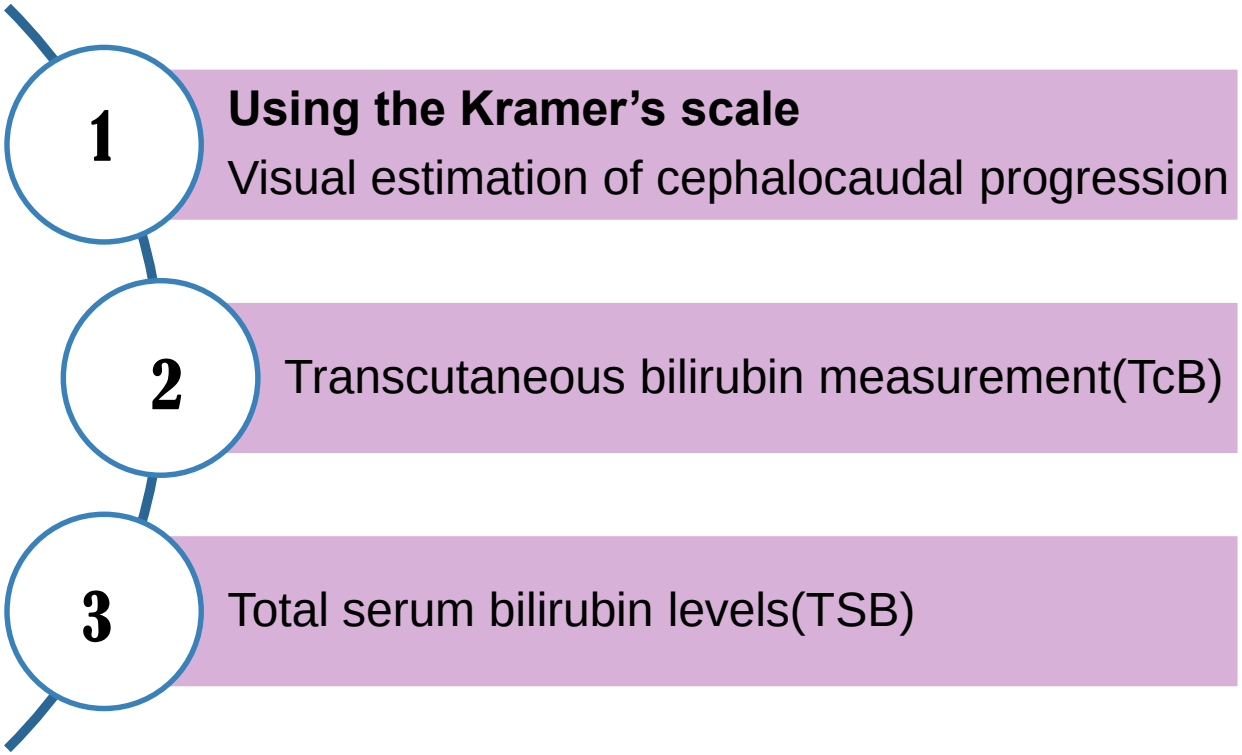
Filtered sunlight is noninferior to conventional phototherapy for the treatment of neonatal hyperbilirubinemia[2]

Harrison S, Nowak M, Devine S, Saunders V, Smith A, Buettner P. An intervention to discourage Australian mothers from unnecessarily exposing their babies to the sun for therapeutic reasons. J Trop[1] Pediatr 2013;59:403-6Slusher TM, Olusanya BO, Vreman HJ, et al. A Randomized Trial of Phototherapy with Filtered Sunlight in African Neonates. N Engl J Med. 2015;373(12):1115-1124.[2] doi:10.1056/NEJMoa1501074

Assessment of hyperbilirubinemia

Assessment of hyperbilirubinaemia

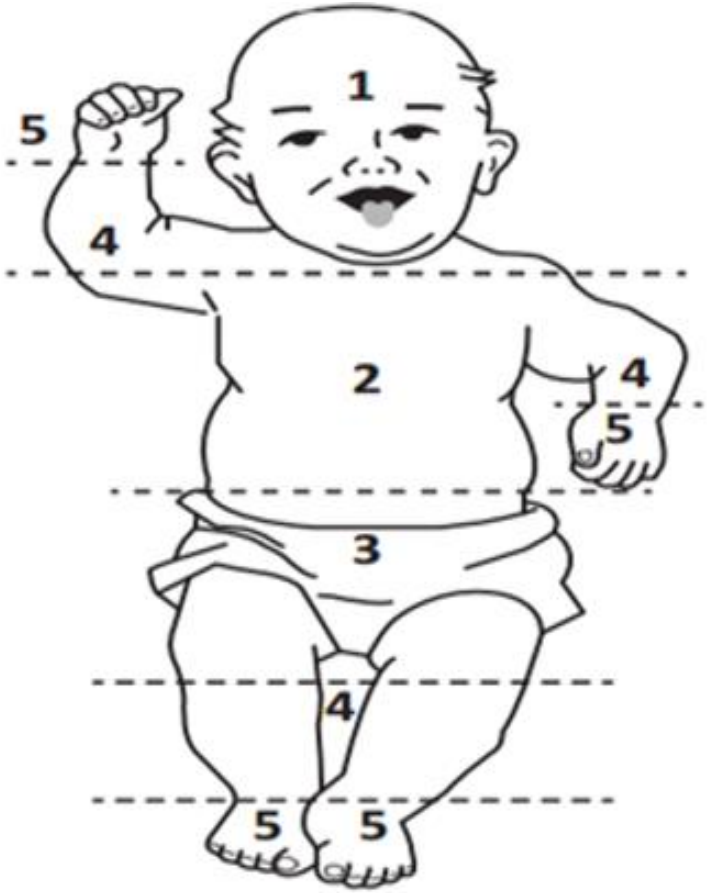
Assessment can be done in three ways:



Objective assessment by means of a TcB or TSB measurement

Kramer's scale

The **Kramer's scale** is based on a 1969 study of 108 full term infants which found that bilirubin concentrations. were correlated to five specific dermal zones. At 24 and 48 hours, the infant's skin was blanched using thumb.



Area of body	levels	Range of serums bilirubin µ*mol/l*
Head and neck	1	68-133
Upper trunk(above umbilicus)	2	85-204
Lower trunk and thighs(below umbilicus	3	136-272
Arms and lower legs	4	187-306
Palms and soles	5	≥306

Check baby in bright and preferably natural light

Kramer LI. Advancement of Dermal Icterus in the Jaundiced Newborn. Am J Dis Child. 1969;118(3):454–458. doi:10.1001/archpedi.1969.02100040456007

Transcutaneous bilirubin levels

- Based on **optical spectroscopy**

Advantages

- Non invasive- sternum or forehead
- Immediate results / prescreening
- Less costly
- Viable alternative.

Disadvantages

- Affected by gestational age and skin colour.
- TcB **overestimates in dark skin colour.**
- **Not recommended if**:
  - Jaundice is prolonged or conjugated hyperbilirubinemia , Baby on phototherapy or had phototherapy
  - Baby had an exchange transfusion

If TcB ≥ 250 µmol/l or ≤ 50 µmol/l /L below threshold for phototherapy measure the TSB.

Okwundu CI, Uthman OA, Suresh G, et al Transcutaneous bilirubinometry versus total serum bilirubin measurement for newborns. Mabogunje CA, Imosemi DO, Emokpae AA. Transcutaneous bilirubin nomograms in African neonates. PLoS One. 2017;12(2):e0172058. Published 2017 Feb 13. Cochrane Database of Systematic Reviews 2017, Issue 5. Art. No.: CD012660. DOI:[2] McGillivray A, Polverino J, Badawi N, Evans N. Image source https://philipsproductcontent.blob.core.windows.net/assets/20170616/f722df04b6ce4e7dad79a7940147347a.pdf

3.Total serum bilirubin levels

TSB-Gold standard for diagnosing hyperbilirubinaemia

Do TSB within 2 hours for any baby with suspected or obvious jaundice:

- *First 24 hours of life*
- *Gestational age of less than 35 weeks*

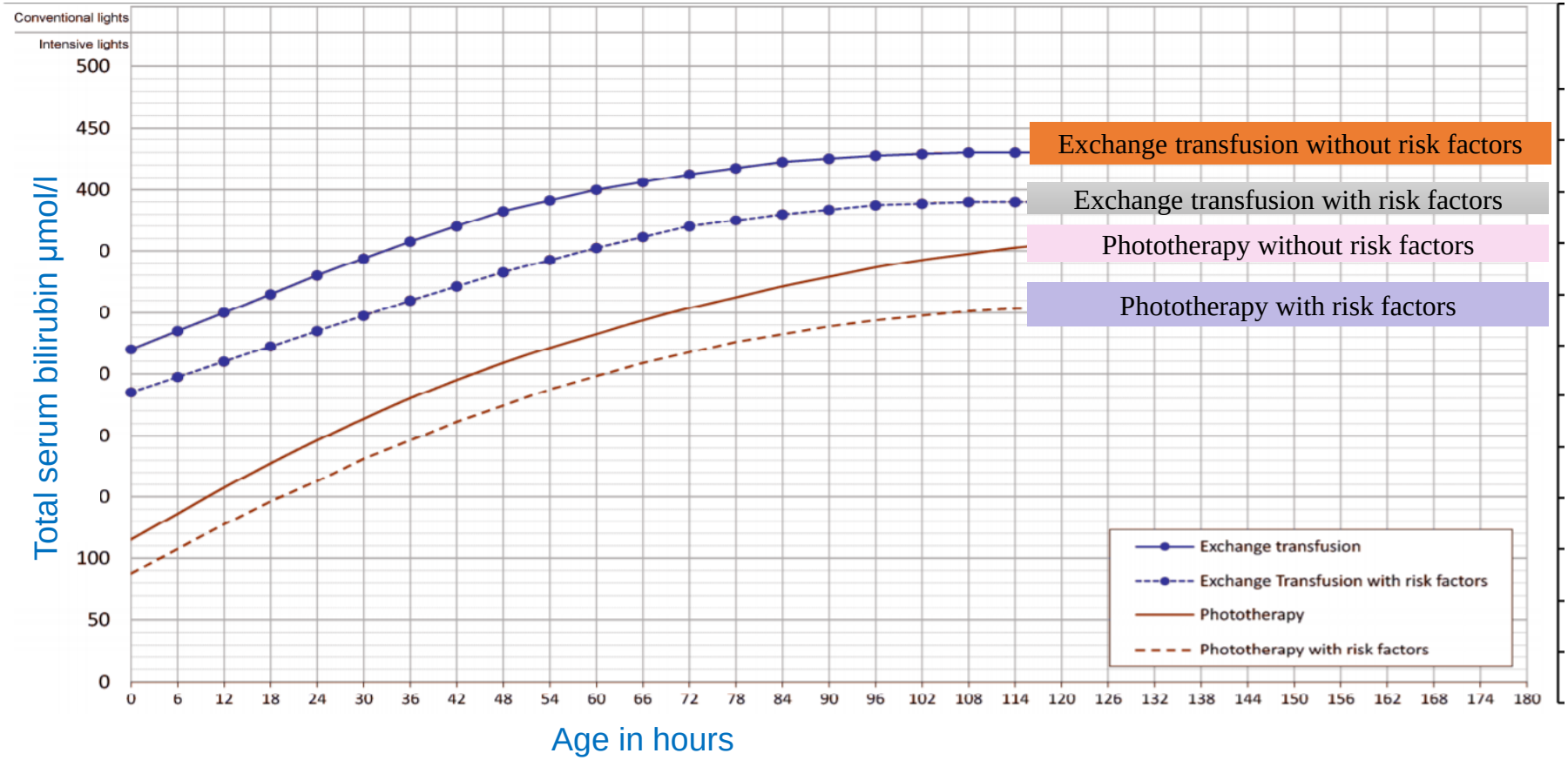
- Repeat within 6-24 hours in all babies when levels are 1- 50 µ*mol/l* below phototherapy threshold

- For monitoring babies under phototherapy:
- TSB 4–6 hourly until the rise of serum bilirubin is controlled, then 12–24 hourly.
- Guides on when to stop phototherapy
  - *Stop when TSB is greater than 50 µmol/l below line and*
  - *Recheck in 12–24 hours-for rebound hyperbilirubinemia*

Visual estimation leads to errors esp. in darker skin tones or those receiving phototherapy

Olusanya BO, Ogunlesi TA, Kumar P, et al. Management of late-preterm and term infants with hyperbilirubinaemia in resource-constrained settings. BMC Pediatr. 2015;15:39. Published 2015 Apr 12. doi:10.1186/s12887-015-0358-z

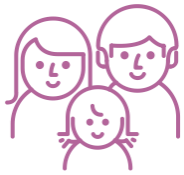
Nomogram: Jaundice management for baby greater than 38 weeks gestation



In presence of risk factors (sepsis, haemolysis, acidosis or asphyxia, danger signs)- use the lower line

Source: Queensland Clinical Guidelines Neonatal jaundice: F17.7-2-V5-R22

Care of baby on phototherapy



- Family centered care

- Place the baby in a supine position,
- Turn 2-3 hrly.
- To maximize area of skin nurse baby with only a diaper of correct size.

- Eye protection and routine eye care during phototherapy.

- Encourage mothers to breastfeed 3 hourly(8 feeds), and cuddle the baby for 30min every 3 hours.

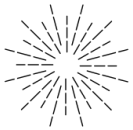
Monitor temperature and hydration

- At least alternate day weight
- Assessing wet nappies.

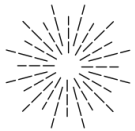
Bhutani VK; Committee on Fetus and Newborn; American Academy of Pediatrics. Phototherapy to prevent severe neonatal hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. Pediatrics. 2011;128(4):e1046-e1052. doi:10.1542/peds.2011-1494[2]

Monitoring phototherapy

Effectiveness depends on ability to convert bilirubin to water soluble products , periodically monitor[1] spectral irradiance according to manufacturers recommendations.

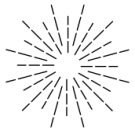


Measure dose during phototherapy using a **light meter** that measure in the 425–475 nm or 400–480 nm band wavelength.



Measure at the infant's skin directly below the center of the phototherapy unit **Make several measures in different locations** on baby and average these.

Strength of phototherapy over the surface of the baby may vary and **spectral irradiance may differ on different areas** of the baby



Achieve the **targeted irradiance**.

Source: Queensland Clinical Guidelines Neonatal jaundice: F17.7-2-V5-R22
Olusanya BO, Ogunlesi TA, Kumar P, et al. Management of late-preterm and term infants with hyperbilirubinaemia in resource-constrained settings. BMC Pediatr. 2015;15:39. Published 2015 Apr 12. doi:10.1186/s12887-015-0358-z[1]

Evidence on phototherapy

Nutrition and Iv fluids

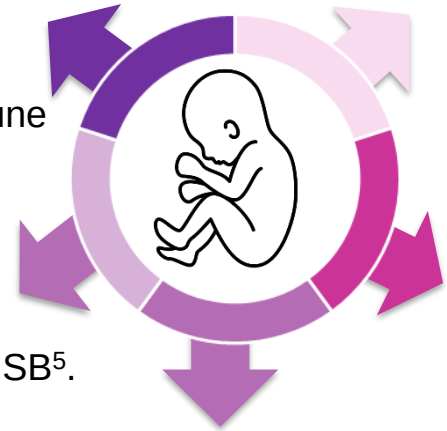
not recommended

Prophylactic treatment

consider in significant alloimmune haemolytic disease (e.g. RhD)

Use of light reflectance

May result in greater decline in SB[5].



Distance -spectral irradiance increases as the distance decreases typical 10-15 cm (check manufacturer's instructions)

Different light sources reduce TSB levels at similar rates in both terms and preterms. Blue green light is more effective.[7]

Probiotics are not routine[4]

Lower thresholds for initiation in ELBWs-reduces profound impairment[7]

Intensive phototherapy

A linear dose-response relationship (effect is proportional to dose)[3]no additional efficacy above 35uw/cm^2/nm[8]

Lai NM, Ahmad Kamar A, Choo YM,. Fluid supplementation for neonatal unconjugated hyperbilirubinaemia. Cochrane Database of Systematic Reviews 2017, Armanian AM, Jahanfar S, Feizi A, Prebiotics for the prevention of hyperbilirubinaemia in neonates. Cochrane Database of Systematic Reviews 2019,. Clark M. Clinical update: Understanding jaundice in the breastfed infant. Community Practitioner 2013;86(6):42-5[1] Van Rostenberghe H, Ho JJ, Lim CH, Abd Hamid IJ. Use of reflective materials during phototherapy for newborn infants with unconjugated hyperbilirubinaemia. Cochrane Database of Systematic Reviews 2020

Stopping phototherapy

Discontinue phototherapy when TSB reduces by **more than 50umol/l** below treatment threshold .

1. Rebound hyperbilirubinaemia
   - Repeat TSB in 12-24 hours[4].
2. If baby had haemolytic jaundice or other early onset jaundice and is discharged before 3–4 days
   - Organize follow up TSB 24 hours after discharge

American Academy of Pediatrics. Management of hyperbilirubinaemia in the newborn infant 35 weeks or more of gestation. Pediatrics 2004;114(1):297-316.[1] Chang PW, Kuzniewicz MW, McCulloch CE, Newman TB. A clinical prediction rule for rebound hyperbilirubinemia following inpatient phototherapy. Pediatrics 2017;139(3)2 Wong R, Bhutani VK. Patient education: Jaundice in newborn infants (Beyond the Basics). 3http://guidance.nice.org.uk/CG98/treatmentthresholdgraph/xls/English[4]

Complications of phototherapy

Short term complications

Interference with maternal–infant bonding[1]

Skin rash

Diarrhea[1]

Hypothermia (LED light) if not in thermoneutral environment

Small increased risk for seizures (approximately 1-2 infants per 10,000 treated)

No increase in incidence of total cancer and type 1 DM,

Muchowski KE. Evaluation and treatment of neonatal hyperbilirubinemia. Am Fam Physician. 2014;89(11):873-8781
Kahveci H, Phototherapy causes a transient DNA damage in jaundiced newborns. Drug ChemToxicol. 2013;36(1):88–92
Newman TB, Wickremasinghe AC, Walsh EM, Grimes BA, McCulloch CE, Kuzniewicz MW. Retrospective Cohort Study of Phototherapy and Childhood Cancer in Northern California. Pediatrics. 2016;. Phototherapy and Risk of Type 1 Diabetes. Pediatrics. 2016;138(5):e20160687. doi:10.1542/peds.2016-0687

Providing Phototherapy

Phototherapy – Light Sources

Fluorescent lights

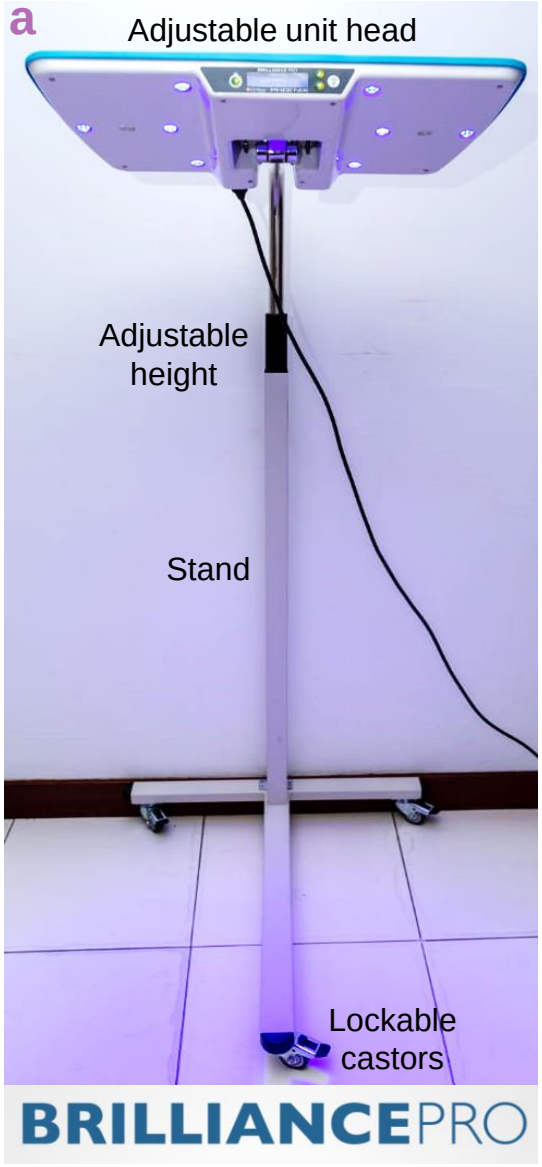
LED lights

	Fluorescent Lights	Light Emitting Diode (LED)
Heat Generated	More heat	Little heat
Durability	1000 -1500hrs	Longer than 3000hrs
Energy Consumption	High	Less by half

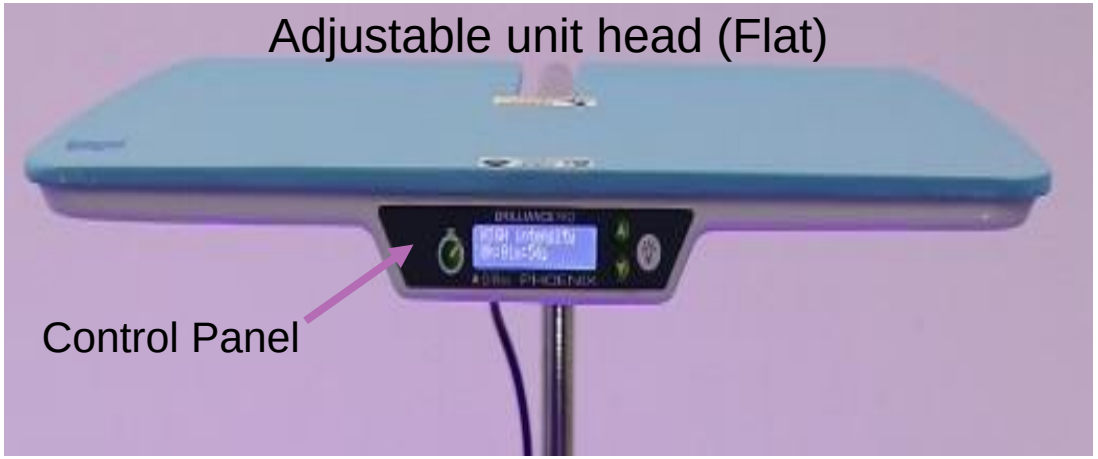
Vassilios F., Michele M., Antonio., Bo S., Dorret I. B., Gavino F., Antonio G. "Phototherapy in the newborn: what's new?" Journal of Pediatric and Neonatal Individualized Medicine 2015;4(2):e040255 doi: 10.7363/040255

Phototherapy – Lights

a



b



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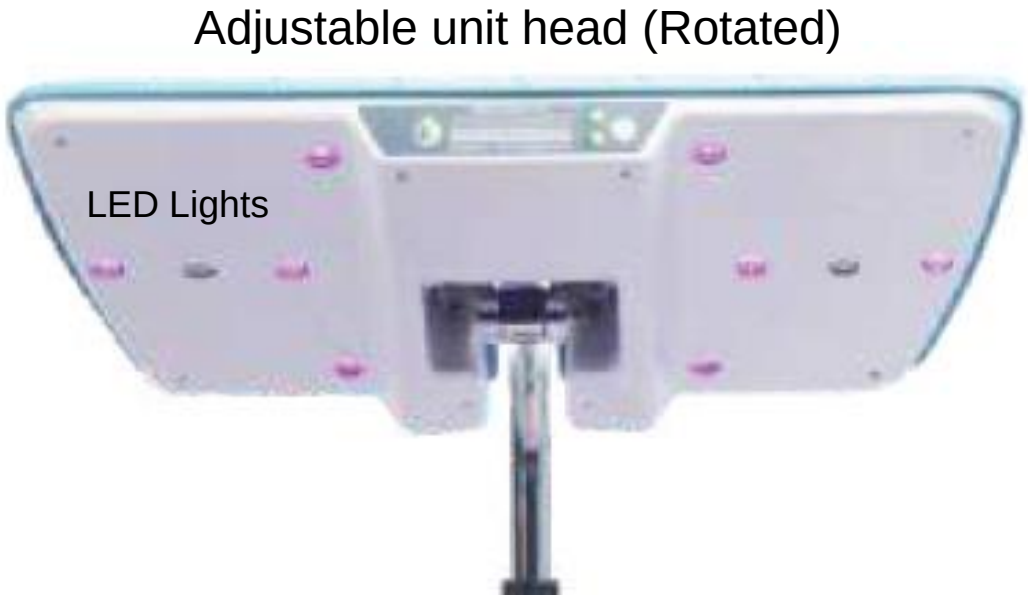

Image source: NEST Clinical Modules [www.nest360⁰.org](http://www.nest360.org)

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Phototherapy – Lights

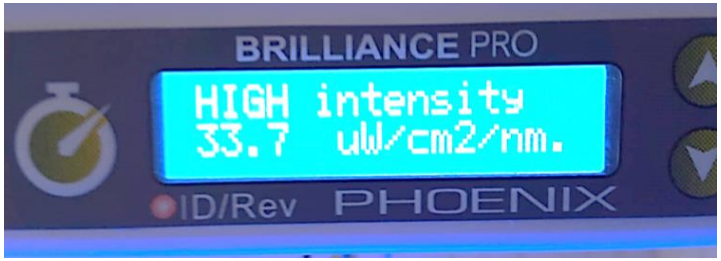
a

Timer

Therapy mode buttons

b

c



d Adjustable unit head (Back view)

Power cable

Light meter port & cable

Light meter & cable

Image source: NEST Clinical Modules www.nest360⁰.org

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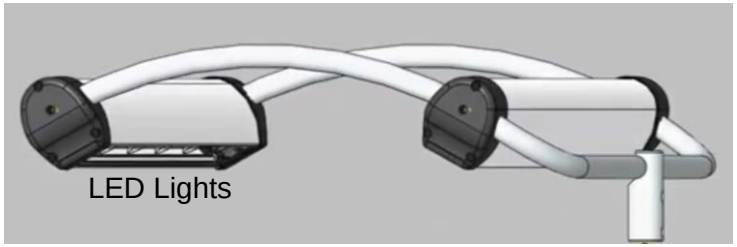
Phototherapy – Lights

a

Image source: NEST Clinical Modules www.nest360⁰.org

b



c

Control Panel

1	On/Off Button	Press this button to turn Colibri Phototherapy display and functions on and off.
2	Therapy Mode Button	Press this button to switch between standard and intensive therapy mode.
3	Display	Shows therapy mode and treatment time.

d

Light Meter

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Determining which Therapy to use

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Phototherapy – Determining Use

Before initiating phototherapy;

1. Assess neonate for jaundice
2. Measure total serum bilirubin (TSB) levels for patients with jaundice
3. Determine if TSB levels are within phototherapy threshold using available nomograms

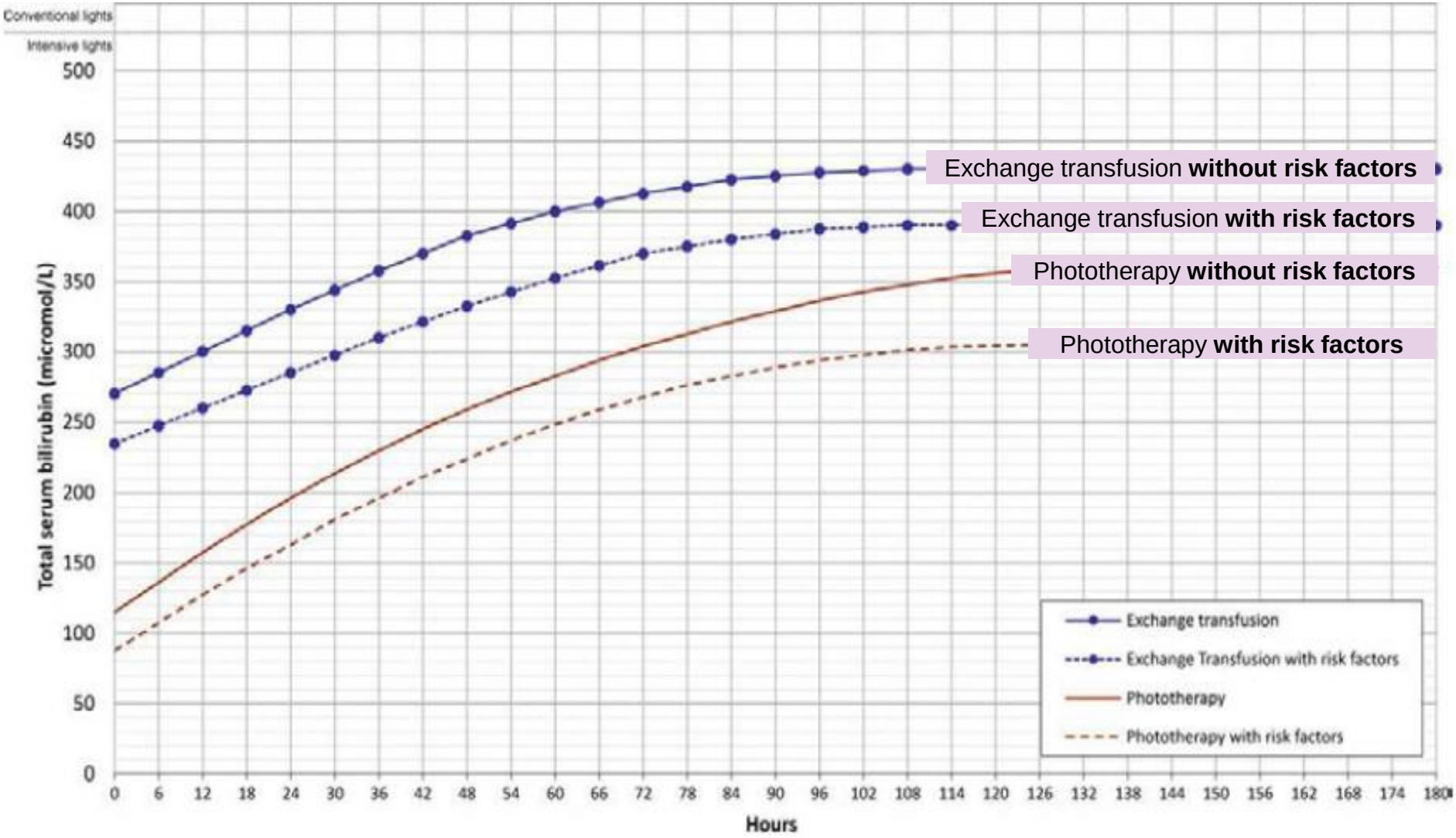
Nomograms determine phototherapy threshold based on the neonate's;

1. **Total serum bilirubin**
2. **Postnatal age (hours)**
3. **Gestation**
4. **Weight (for those less than 35 weeks)**
5. **Presence of risk factors**

Nomograms determine need for phototherapy & irradiance mode to use

Phototherapy – Nomograms

Nomogram A: Jaundice Management for a baby greater than 38 weeks gestation

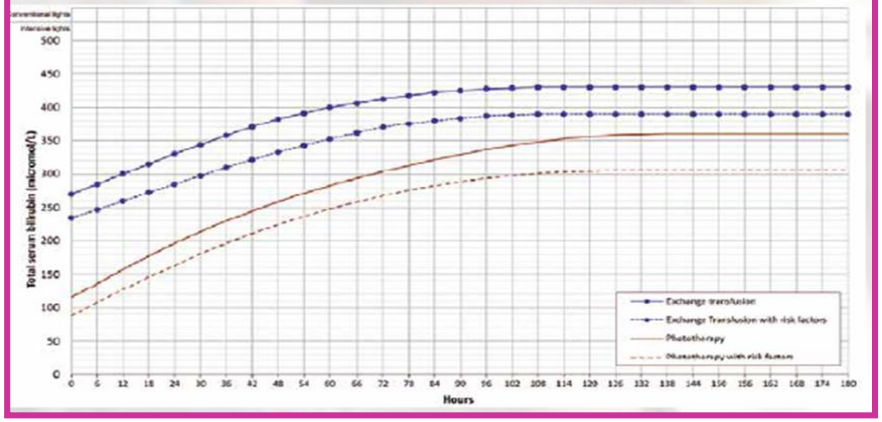


Queensland Clinical Guideline: Neonatal jaundice June 2019

Phototherapy – Nomograms

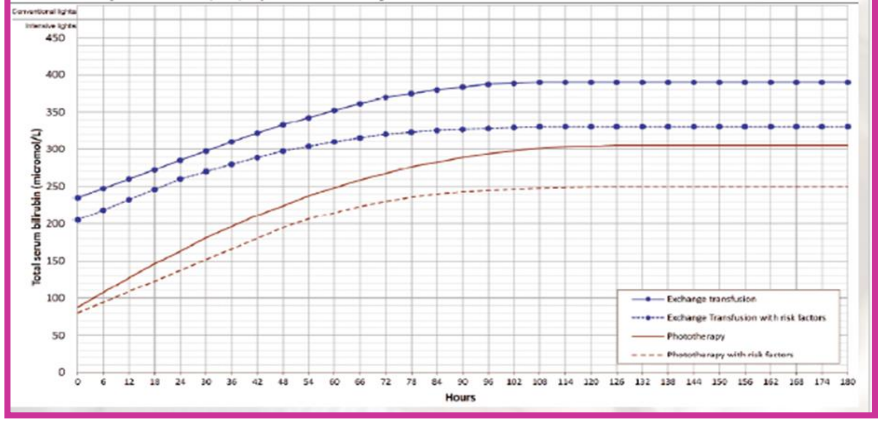
Nomogram A: Jaundice management for baby greater than 38 weeks gestation

In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.



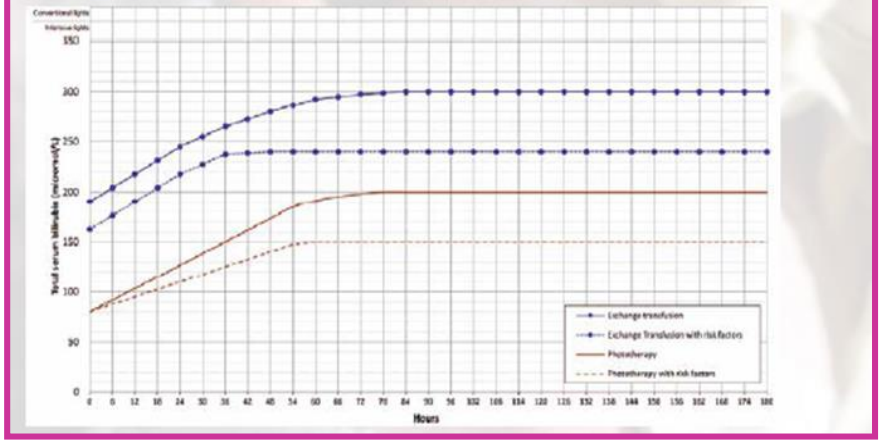
Nomogram B: Jaundice management for baby more than 35 but less than 37 completed weeks gestation

In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.



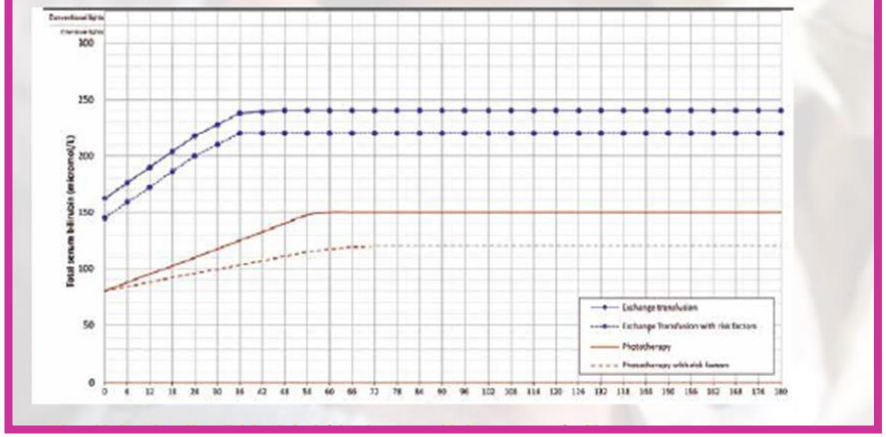
Nomogram D: Jaundice management for baby less than 35 weeks gestation 1500 g to 1999 g birth weight

In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.



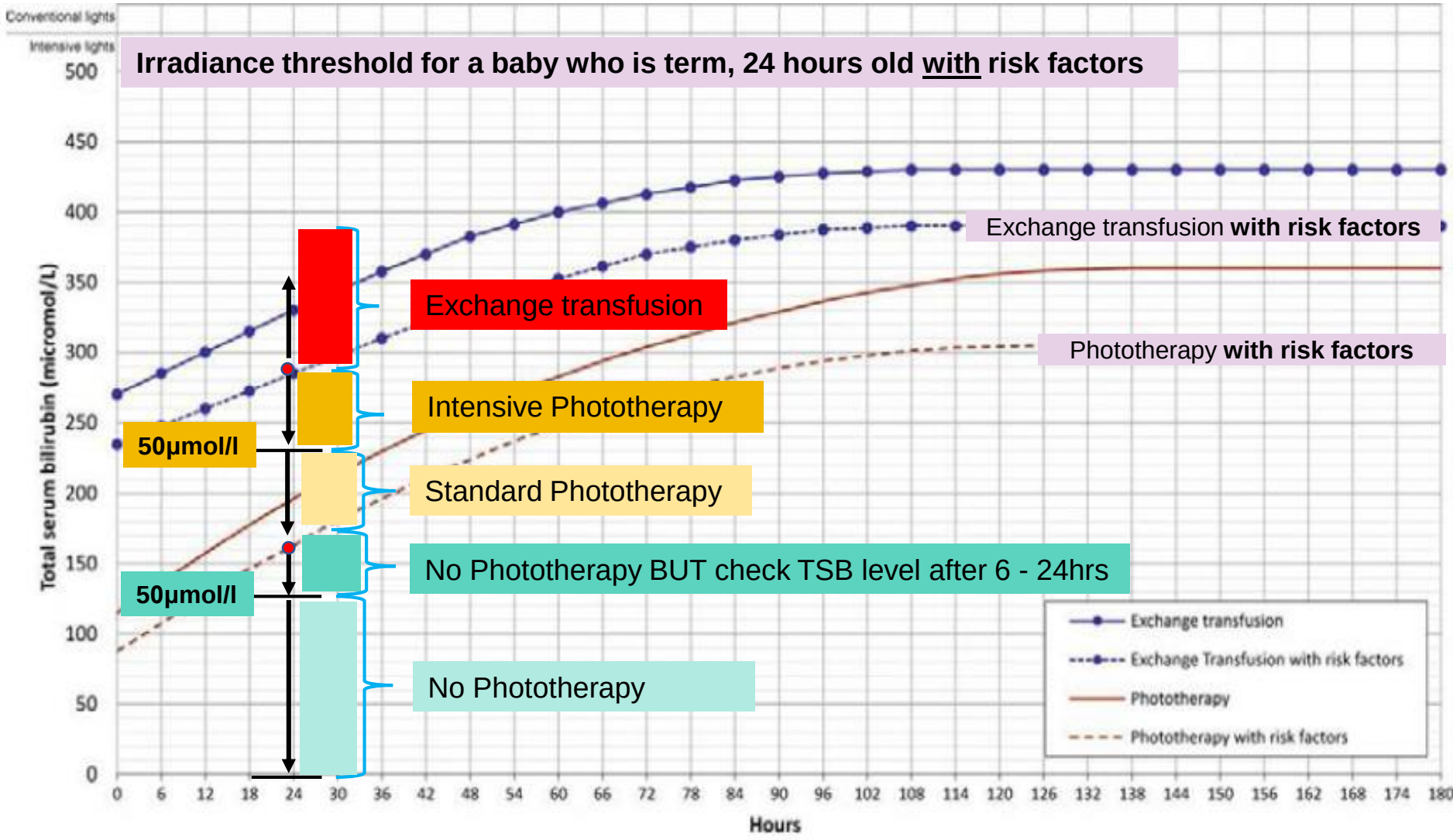
Nomogram F: Jaundice management for baby less than 35 weeks gestation 1000 g to 1499 g birth weight

In the presence of risk factors (sepsis, haemolysis, acidosis or asphyxia) use the lower line.



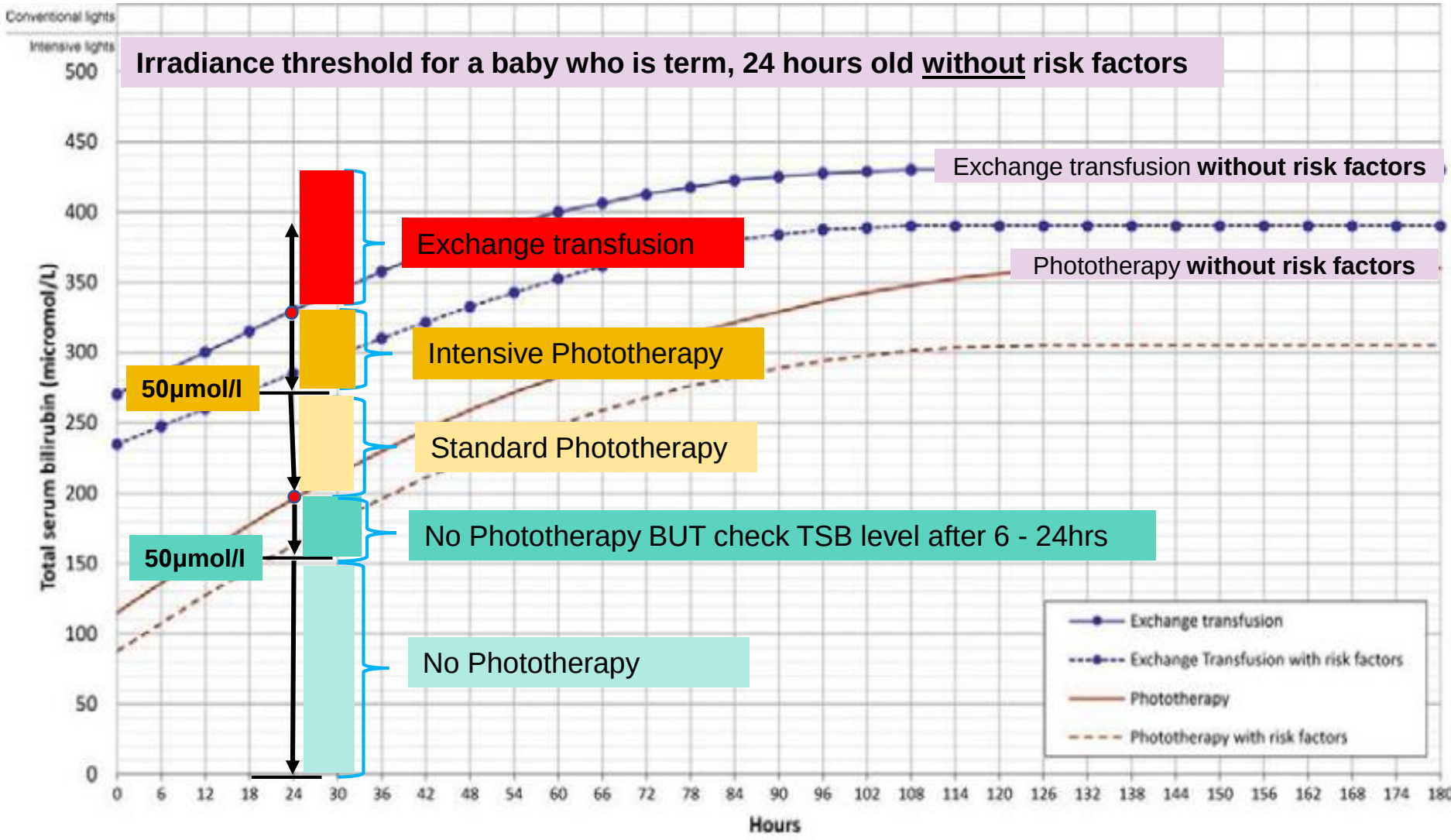
Using Nomograms

Nomogram A: Jaundice Management for a baby greater than 38 weeks gestation



Using Nomograms

Nomogram A: Jaundice Management for a baby greater than 38 weeks gestation



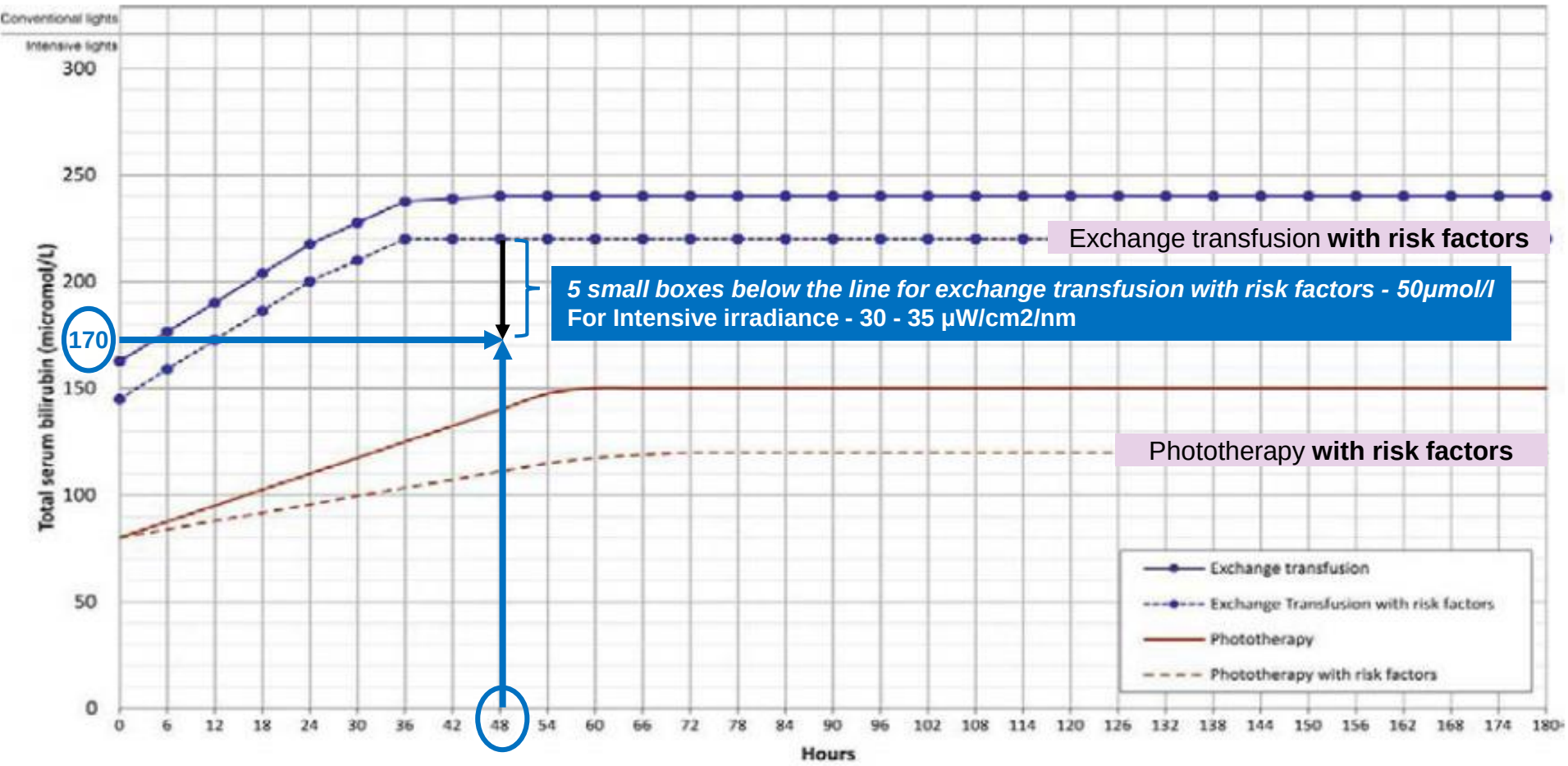
Using TSB to determine treatment

>50umol/l below phototherapy level	Observe the baby. There is no likely risk of developing kernicterus
<50umol/l below phototherapy level	Repeat TSB levels within 6 - 24 hours.
At phototherapy level	Initiate Standard phototherapy
<50umol/l below exchange level	Commence intensive phototherapy to lower TSB level and avoid exchange transfusion
At & above exchange transfusion level	Commence exchange transfusion. Initiate intensive phototherapy as you prepare

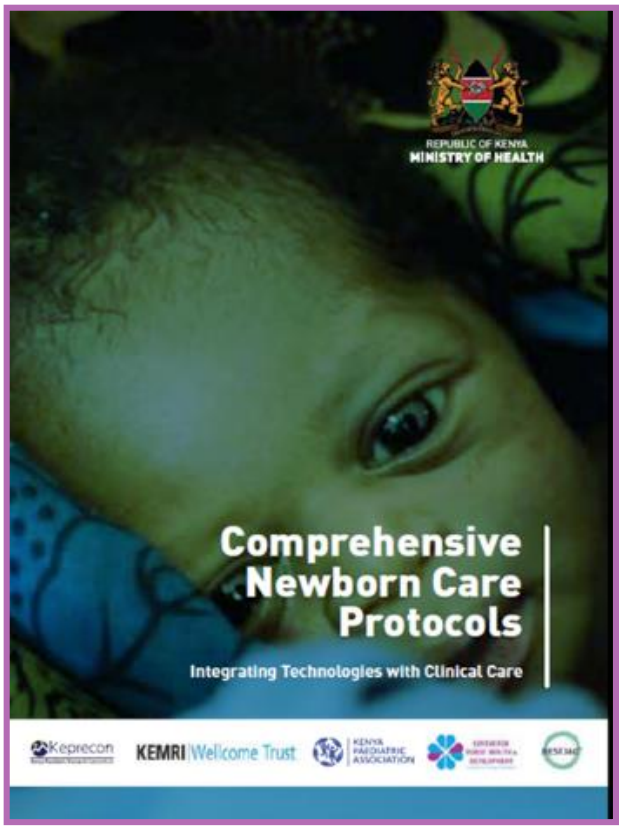
Using Nomograms – Scenario

Scenario: *Baby J, Birthweight - 1100gms, Gestation 30 weeks, Jaundiced, TSB - 170µmol/l at 48 hours of age. Has Respiratory Distress Syndrome*

Nomogram E: Jaundice Management for a baby less than 35 weeks gestation 1000 - 1499gm birth weight



Assess severity of jaundice and give correct treatment



Examine every baby for jaundice : sclera, gum, palm and sole of feet

Must Measure bilirubin within 2hrs in baby with:
- Jaundice on 1st day of life
- Jaundice on sole and palms
- Jaundice in preterms <35 weeks
- Jaundice plus any danger sign
- Any jaundice in a baby with history of a sibling who had jaundice that required exchange transfusion or phototherapy
- Jaundice in baby with Rh incompatibility
- Any jaundiced neonate in NBU

Investigate for causes of jaundice

Serum bilirubin below level of phototherapy

Serum bilirubin 1–50µmol/l below the level of phototherapy. Repeat after 24hrs

Serum bilirubin above level phototherapy but below the level of exchange transfusion

Serum bilirubin below level of exchange transfusion by more than 50µmol/l

Standard Phototherapy irradiance 25-30 µW/cm²/nm.

Encourage short breastfeeding, & bonding breaks (less than 30min every 3hrs) Do not give additional fluids/feeds . Monitor adequacy of feeding by assessing wet diapers and alternate day weight.
Monitor vital signs

Serum bilirubin level of exchange transfusion

Phototherapy irradiance 30-35 µW/cm²/nm. Prepare for exchange transfusion

Serum bilirubin below level of exchange transfusion by less than 50µmol/l

Intensive Phototherapy irradiance 30-35 µW/cm²/nm.

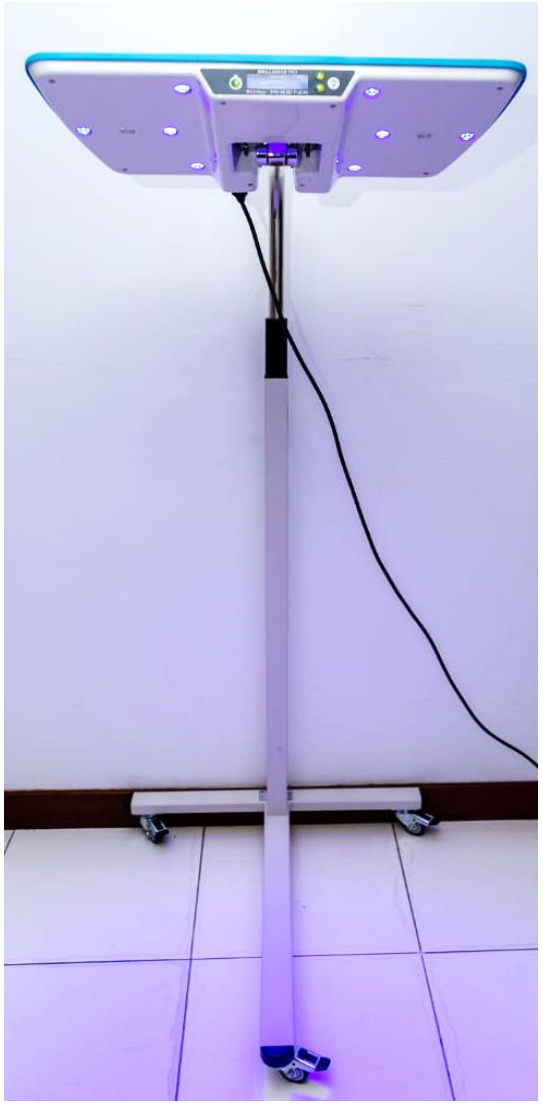
Feed via NGT or IV & Lactation support
Monitor adequacy of feeding by assessing wet diapers and alternate day weight.
Monitor vital signs

Check serum bilirubin level 6 hrs after starting phototherapy
Check bilirubin level every 12hrs if level stable or falling

Initiating Phototherapy

Phototherapy – Requirements

Phototherapy lamp



Light meter

Cot/Incubator/Radiant warmer

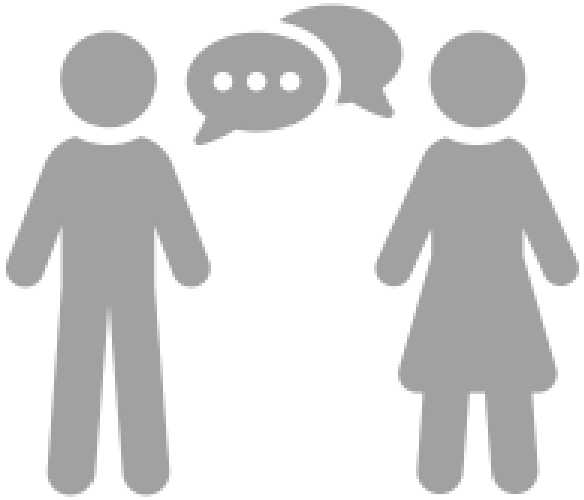
Room Thermometer

Eye shields

Linen

Images source: NEST Clinical Modules [www.nest360⁰.org](http://www.nest360.org)

Phototherapy – Family Centered Care



Discuss with the mother/caregiver the:

- Need for, action & outcomes of phototherapy
- Need to cover eyes
- Need to expose as much skin as possible
- Feeding plan
- Need for periodic assessment & blood sampling
- Potential complications

Standard phototherapy - Short Breast feeding session (30min) 3hourly

Intensive phototherapy - Nasal Gastric tube feeding with expressed breast milk

Vassilios F., Michele M., Antonio., Bo S., Dorret I. B., Gavino F., Antonio G. "Phototherapy in the newborn: what's new?" Journal of Pediatric and Neonatal Individualized Medicine 2015;4(2):e040255 doi: 10.7363/040255

Eileen M., Eileen T., regina K. 2018.Phototherapy nursing guideline. Ret. From https://www.olchc.ie/Healthcare-Professionals/Nursing-Practice-Guidelines/Phototherapy-2018.pdf

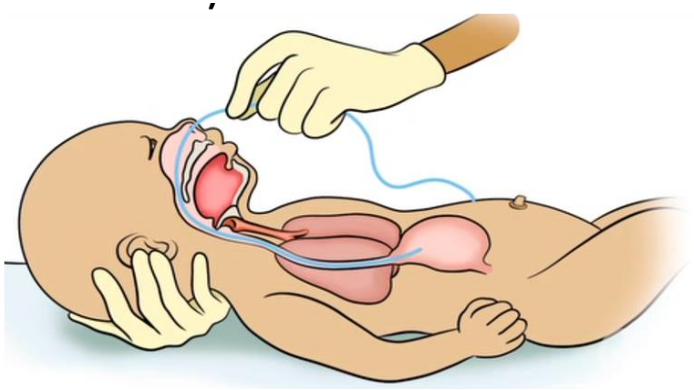
Phototherapy – Preparing the Baby

1. Ensure hand hygiene

2. Prepare cot & warm environment

3. Assess vitals & risk factors

4. Remove all the baby's clothes



5. Insert NG tube if Indicated

Phototherapy for neonatal jaundice (N.D.) Ret .From https://www.rch.org.au/rchcpg/hospital_clinical_guideline_index/Phototherapy_for_neonatal_jaundice/
Images source: NEST Clinical Modules www.nest360^{0}.org

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Phototherapy – Preparing the Baby

6. Cover the baby's eyes with an eye mask/shield

7. Ensure the eye mask/ shield is snuggly fit and place baby in the center of the cot/incubator/radiant warmer

Phototherapy for neonatal jaundice (N.D.) Ret .From https://www.rch.org.au/rchcpg/hospital_clinical_guideline_index/Phototherapy_for_neonatal_jaundice/
Images source: NEST Clinical Modules www.nest360^{0}.org

Phototherapy – Preparing the Machine

1. Position the lights above the baby's cot/incubator/radiant warmer

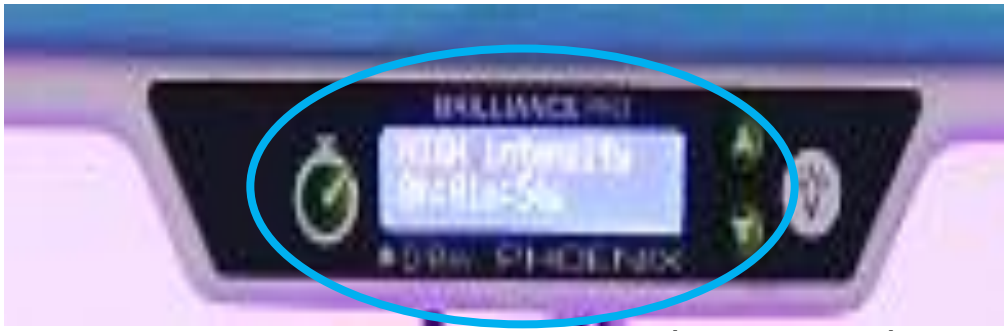
2. Plug power cable and light meter cable on the machine and turn on the machine.

Ensure the lights cover the baby's entire body

Images source: NEST Clinical Modules www.nest360⁰.org

Phototherapy – Preparing the Machine

a

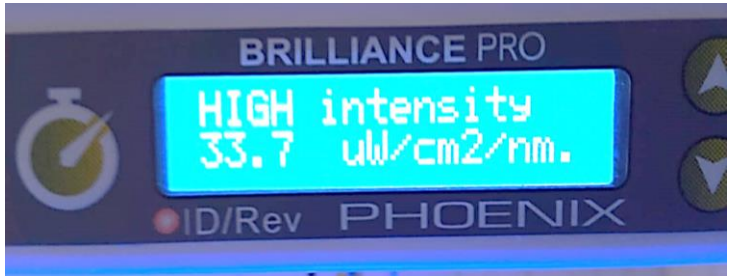


Timer

Therapy mode buttons

b

c



3. Select the irradiance mode (standard or intensive)
4. Adjust the height of the lamp to desired irradiance
5. Reset patient therapy time to zero and initiate phototherapy

Images source: NEST Clinical Modules www.nest360⁰.org

Phototherapy – Irradiance

Always use the light meter to measure desired Irradiance

Standard irradiance - 25 - 30 μW/cm^2/nm

Intensive irradiance - 30 - 35 μW/cm^2/nm

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http://pediatrics.aappublications.org/content/128/4/e1046 & Image source: The Firefly phototherapy user manual

Monitoring during Phototherapy

Phototherapy – Monitoring

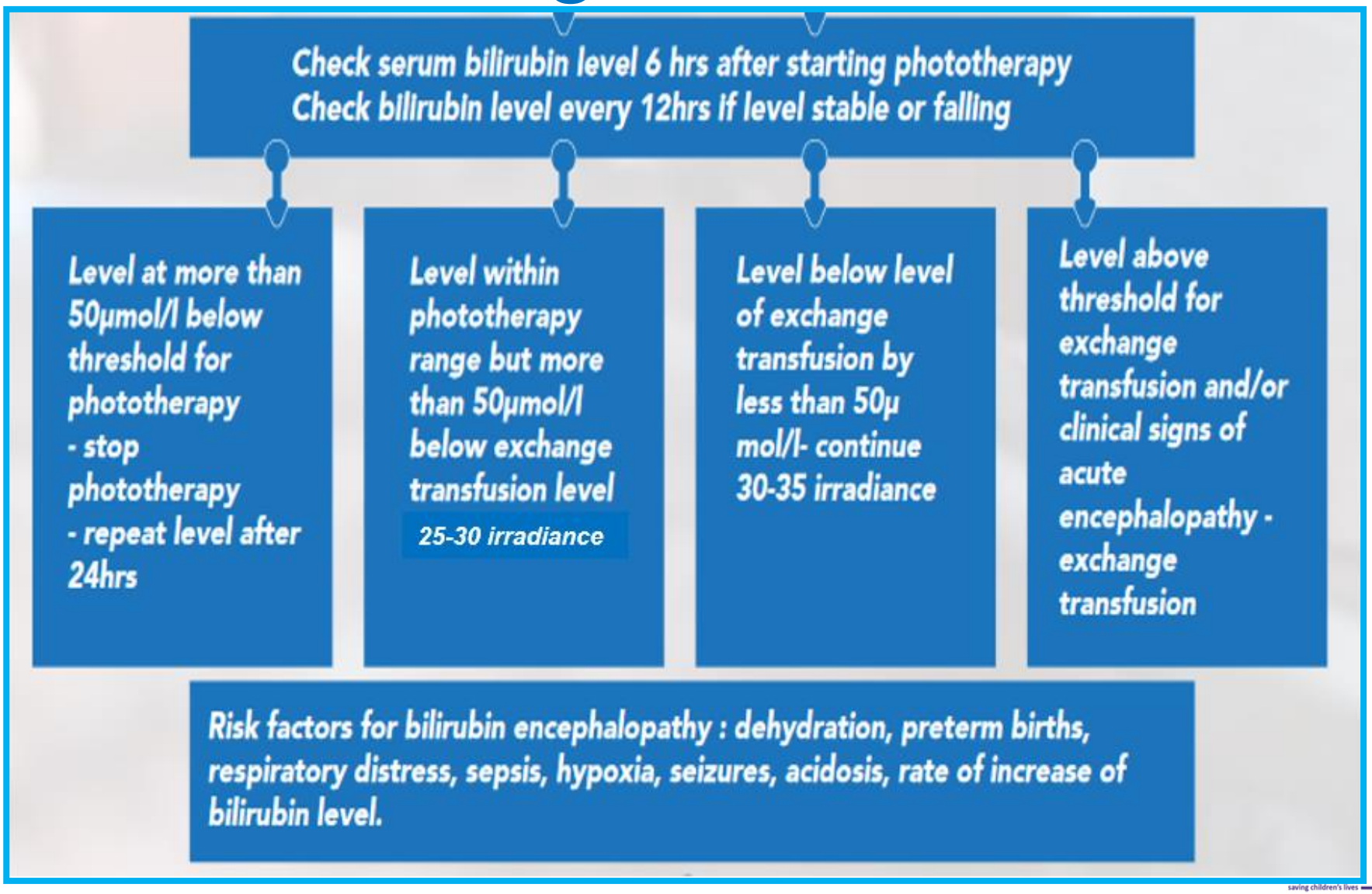
Skin Exposure
Expose as much skin as possible

Eye Care
Ensure the eyes are well covered

1. Monitor vitals every 3 hours - Temp
2. Maintain 3 hourly breastfeeding (BF) for standard therapy or NGT feeding for intensive therapy
3. Reposition the baby every 3 hours
4. Monitor urine output - Four or more wet nappies per day
5. Weigh the baby on alternate days
6. Check for potential signs of bilirubin encephalopathy – lethargy, poor feeding, seizures, vomiting
7. Watch out for potential complications
8. Repeat total serum bilirubin level 6 hrs after starting phototherapy

Vassilios F., Michele M., Antonio., Bo S., Dorret I. B., Gavino F., Antonio G. "Phototherapy in the newborn: what's new?" Journal of Pediatric and Neonatal Individualized Medicine 2015;4(2):e040255 doi: 10.7363/040255 & Eileen M., Eileen T., regina K. 2018.Phototherapy nursing guideline. Ret. From https://www.olchc.ie/Healthcare-Professionals/Nursing-Practice-Guidelines/Phototherapy-2018.pdf
http://pediatrics.aappublications.org/content/128/4/e1046

Monitoring bilirubin levels



http://pediatrics.aappublications.org/content/128/4/e1046 & Queensland Clinical Guideline: Neonatal jaundice June 2019

Summary

- High bilirubin level can cause irreversible brain damage.
- Chief rationale of treating newborn jaundice is the prevention of kernicterus
- Screening and early recognition of risk factors for bilirubin encephalopathy is important in prevention of kernicterus
- Adjust irradiance depending on the serum bilirubin level