Summer 8-10-2018

Implementation of a Transcutaneous Bilirubinometer on a Postpartum Unit at a Magnet Community Hospital

Riley O'Connell
rgoconnell@dons.usfca.edu

Implementation of a Transcutaneous Bilirubinometer on a Postpartum Unit at a Magnet Community Hospital

Riley G. O'Connell

University of San Francisco – Orange County

Abstract

A common clinical concern for all newborns in the first few days of life is the risk of hyperbilirubinemia. Hyperbilirubinemia if left untreated can lead to permanent hearing loss, neurological dysfunction, and even irreversible brain damage called kernicterus. Bilirubin monitoring and early intervention can prevent these adverse events from occurring. Best practice recommends the use of transcutaneous bilirubin (TcB) monitoring on all term, low-risk newborns (≥ 38 weeks gestation at birth) at 24-hours of life. Replacing total serum bilirubin (TSB) draws through a heel stick, with TcB assessments leads to utilization of evidence-based practice. The transcutaneous bilirubinometer is a non-invasive, effective way to monitor bilirubin levels for all full term, low-risk newborns.

Implementation of TcB assessment on a postpartum unit involved the creation of new policies and procedures (Appendix A) to instruct staff how to intervene with intermediate and high-risk newborns. Various risk factors influence a newborns risk of developing hyperbilirubinemia including: gestational age at birth, race, breastfed vs. bottle fed, prenatal care, and infection (Jaundice & Kernicterus, 2016). A standard of work (Appendix B), nomogram (Appendix C), and algorithms (Appendix D) were created for postpartum Registered Nurses to reference. These documents allow nurses to determine what interventions are necessary based on a neonate's bilirubin level and age. In-service staff education was provided by the Clinical Nurse Leader (CNL) students to educate nurses on the use of the Dräger Jaundice Meter (JM)-105. Nurse's confidence and competency in using the transcutaneous bilirubinometer was measured before and after in-service staff education through confidence scale surveys (Appendix E). Due to time constraints, post-test data has not been completed but the results are expected to show improved nurse confidence and competency in use of the Dräger JM-105. Following ten weeks

of policy and procedure creation and in-service staff education, successful implementation of transcutaneous bilirubin monitoring was exhibited.

Literature Review

A study completed by Jones et al. (2017) found that bilirubin monitoring should be conducted using transcutaneous bilimeters, ideally on a newborn's sternum using the Dräger JM-105 device. This study gathered data from 176 patients and measured five bilirubin levels on each newborn. The measurements taken were a TcB on the back and sternum using both the Dräger JM-105 and Bilichek device. Those four TcB measurements were compared to a TSB bilirubin level drawn within 30 minutes. The results concluded that TcB measurements taken on the sternum using the Dräger JM-105 correlated most accurately to TSB levels, with a Pearson correlation value of $r = 0.93$. The findings concluded that TcB measurements are adequate and should replace TSB collections on full term newborns, with no prior history of phototherapy treatment. The study mentions that while TSB is the most accurate way to measure bilirubin levels, heel sticks are painful, stressful for the parents, time consuming, and can lead to long term consequences such as osteomyelitis, skin infections, and calcium depositions at the heel stick site (Jones et al., 2017). As well, the study notes that the cost of the Dräger JM-105 is approximately $7,000, which will result in cost-savings over time after implementation. Jones et al. (2017) recommends newborn nurseries and outpatient settings to use the Dräger JM-105 to screen bilirubin levels and only draw TSB when the TcB is within 3 mg/dL of the phototherapy treatment threshold for age.

Research conducted by Kumra et al. (2017) concluded that TcB and TSB values showed no bilirubin level disparities based on collection method. The study measured both TcB and TSB bilirubin levels on 58 newborns at a mean age of four days old at an outpatient pediatric clinic.

With a p-value of 0.01, findings concluded that a transcutaneous bilirubinometer is efficient and reliable, with TcB values highly correlated to TSB levels. As well, no difference between TcB and TSB discrepancies were found amongst races, specifically among Caucasian and African American newborns. Kumra et al. (2017) highlighted that risks associated with severe hyperbilirubinemia include hearing loss, neurological dysfunction, and kernicterus which are all preventable outcomes. When drawing TSB blood samples, there is often a wait time for lab work-up to take place. This potential wait may cause a delay of care which could lead to progression of hyperbilirubinemia without necessary intervention. This study recommends and advocates for widespread use of transcutaneous bilirubinometer devices as effective screening tools.

A study completed by Mishra et al. (2009) found that transcutaneous bilirubinometry reduces the need for TSB assessment, making it a cost-saving initiative. Hyperbilirubinemia is a common, often harmless condition that affects 80% of newborns in their first few days of life (Jones et al. 2017). This study observed 617 jaundiced late-preterm and term Indian neonates. The study concluded that use of a TcB meter lowered the need for blood draws by 34%. Mishra et al. (2009) stated that routine use of a transcutaneous bilirubinometer reduces the need for TSB draws resulting in significant cost-savings.

Research completed by Maisels, DeRidder, Kring, and Balasubramaniam (2009), showed support for the use of a Dräger JM-103 device to screen newborns for hyperbilirubinemia. The study concluded that predischarge TcB measurements should be combined with the newborn's gestation to be plotted on a nomogram to assess risk of developing hyperbilirubinemia. If a newborn's predischarge bilirubin value falls into the intermediate or high-risk zones, interventions to consider are: TSB draw, delaying discharge, and possible phototherapy

treatment. Another important factor to consider when assessing a newborn's hyperbilirubinemia risk is feeding method. The study highlights that newborns who are adequately and exclusively breastfed are at decreased risk of developing neonatal jaundice. Maisels et al. (2009) collected data from 11,456 newborns and concluded that predischarge TcB measurements should be combined with gestational age to predict subsequent hyperbilirubinemia risk.

Researchers Chawla, Jain, Kaur, Sinhmar, and Guglani (2013) sought to evaluate the accuracy of TcB measurement in preterm low-birth-weight (LBW) neonates. The study collected TSB and TcB measurements on 256 neonate's foreheads, sternums, and abdomens. The study found that all TcB measurements showed adequate correlation, with the most accurate location being the forehead. The study discusses that LBW preterm infants are at increased risk of hyperbilirubinemia and bilirubin-induced brain damage. As well, hyperbilirubinemia is one of the most common morbidities in preterm neonates. Consequently, preterm LBW newborns need more frequent bilirubin assessments. Repeated TSB draws have proven to be painful, time consuming, and more expensive. Replacement of TSB with TcB measurements leads to reduction in invasive blood tests, decreased health costs, and instant bilirubin evaluation. Chawla et al. (2013) found that including preterm neonates in TcB measurement has the potential to reduce TSB via heel sticks by up to 40%. Similar to prior studies the researchers claim that TcB measurements should not be used on neonates during or after phototherapy treatment due to lack of accuracy. The study concluded that TcB measurements should be performed on preterm neonates born at ≥28 weeks of gestation.

Microsystem Assessment

Purpose

Implementation of a transcutaneous bilirubinometer onto an in-patient postpartum unit is utilization of evidence-based practice. This change of practice was determined to deliver best care, while maintaining patient safety as the top priority. TSB draws are painful for neonates, stressful for parents, and can lead to delays in care (Jones et al., 2017). Implementing the Dräger JM-105 resulted in application of best practice for newborns. Research conducted by Jones et al. (2017) found that the Dräger JM-105 yielded more accurate results, when compared with similar transcutaneous bilirubinometers. As well, utilization of TcB monitoring is a non-invasive measure that ensures accurate neonatal bilirubin screenings. Evidence-based practice should continually be advanced especially with the Dräger JM-105 being a non-invasive, cost-saving initiative.

Patients

In 2017, St. Jude Medical Center had 2,380 babies born on their labor and delivery unit (Facts & Statistics, 2017). Two to four hours after giving birth, the postpartum mother and newborn were transferred to the postpartum unit. An expected length of stay for a postpartum mother and her newborn following a vaginal delivery was one day. While, a postpartum mother and her newborn following a cesarean birth had an average stay of three days.

The primary patient population surrounding St. Jude Medical Center is 34.7% Latino, 33.8% White, and 26.5% Asian. Of the patient population, 53.4% speak only English at home; while, 21.1% do not speak English very well. The median household income is $78,307. The patient population has a teenage birth rate of 16.7% (teens aged 15 to 19 years old). While, 89.9% of expectant mothers receive first trimester prenatal care (St. Jude, 2017).

Professionals

The postpartum nursing staff is comprised of bedside Registered Nurses, Charge Nurses, Lactation Consultants, a Clinical Coordinator, Nurse Manager, and Executive Director of Maternal & Newborn Services. The unit staffs approximately four to six bedside Registered Nurses each day and night shift, in addition to a Charge Nurse. The postpartum nurses typically have a patient load of three to five couplets (mother and newborn). The postpartum nursing staff all hold advanced degrees of Bachelor's or Master's of Science in Nursing. Additionally, many of the nurses working on the postpartum unit are certified Maternal Newborn Nurses.

Processes

Collection of a transcutaneous bilirubin using the Dräger JM-105 is a straightforward procedure. Each night the Charge Nurse calibrates the Dräger JM-105 and marks completion in the resource binder that sits beside its charging dock. Before a bedside nurse uses the Dräger JM-105, calibration completion within the past 24 hours is checked. Next, the nurse cleans the light probe with an alcohol swab. The nurse will ensure that the infant is calm and then presses the light probe onto the newborn's sternum. After pressing the light probe three times continuously an average bilirubin value will appear on the screen. That TcB value is charted into MediTech. Additionally, the nurse will utilize BiliTool to assess the neonate's risk zone based on bilirubin value and age. Interventions are outlined in the policy and procedure, standard of work, and algorithms based on hyperbilirubinemia risk zone.

Patterns

The postpartum unit utilizes cluster care to complete necessary newborn nursing actions at 24-hours of life such as: TcB, California mandated metabolic disease heel stick, CHD screen, and vital signs. This cluster care is completed in the nursery room away from the patient's room.

These tasks are completed by the Registered Nurse assigned to care for the newborn or Charge Nurse lending a helping hand.

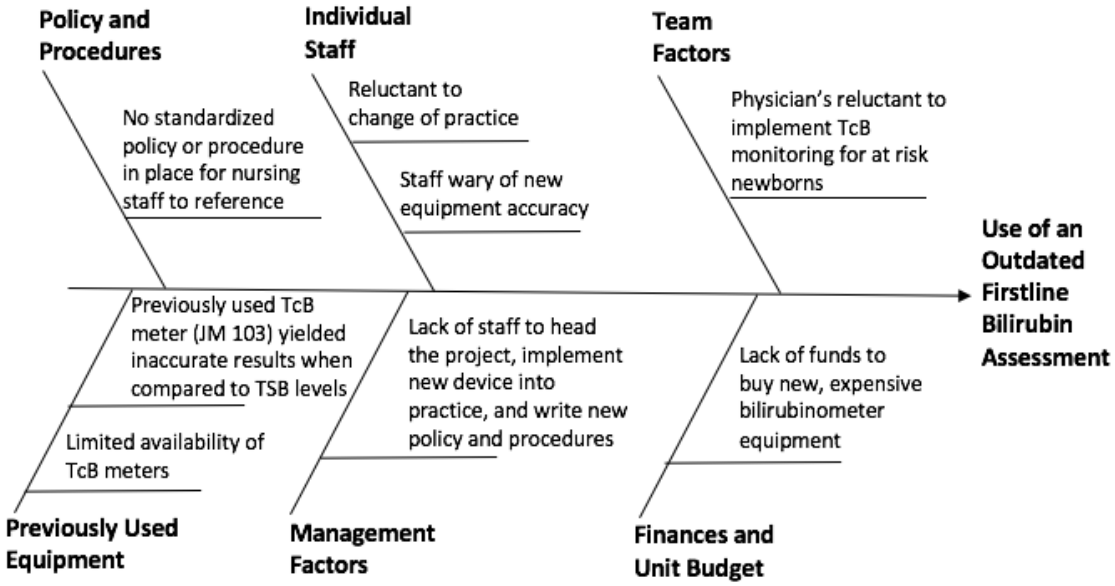
Root-Cause Analysis

A root-cause analysis (Figure 1) was conducted to analyze the various aspects that led to the Magnet, community hospital's use of outdated bilirubin assessments. Over two years ago, the postpartum unit purchased the Dräger JM-103 but did not complete an official roll out of the device. Nursing leadership neither updated policies and procedures nor completed proper in-service education. The Dräger JM-103 was placed in the nursery in close proximity to TSB collection supplies, which lead to nursing staff usage. Due to lack of knowledge on proper use of the Dräger JM-103, it led to faulty bilirubin value collections, resulting in a general distrust of transcutaneous bilirubin monitoring.

A change in practice involves many hoops to jump through with limited resources. Eventually the postpartum unit invested in an updated model and purchased two Dräger JM-105 devices. However, lack of nursing leadership to lead the project left the new device useless on the unit. As well, the tasks of completing the updated policies and procedures, standard of work, algorithms, nomogram, and in-service staff education resulted in a daunting project for nursing leadership. With the introduction of CNL students the proper steps towards implementation were conducted and successful operation was shown.

Figure 1

Root-Cause Analysis to Determine TcB Implementation Determinants



Implementation

Transcutaneous bilirubin assessment is an evidence-based practice to monitor bilirubin levels in full term newborns. Prior to implementation, the CNL students conducted a literature review and found overwhelming support for TcB assessment as a first line screening method for hyperbilirubinemia. The first step towards implementation was a meeting between CNL students, the Clinical Coordinator, and Executive Director of Maternal & Newborn Services of the postpartum unit. A ten-week collaborative timeline was created to ensure timely completion and agreed upon expectations. The CNL students conducted a microsystem assessment to understand the factors that lead to the lack of change to TcB monitoring. The community hospital was reluctant to change due to various factors outlined in the root-cause analysis such as: finances, resources, and nurse distrust. Accordingly, CNL students created policies and procedures, standard of work, nomogram, and algorithms to be implemented onto the unit. These documents were created to ensure successful implementation of the Dräger JM-105 and guide nurses on

necessary interventions for intermediate and high-risk newborns. Official approval and sign off on the documents to go into practice is required by six separate hospital leaders and is currently in the process of being officially implemented. Six in-service staff education sessions were conducted to teach the postpartum Registered Nurses on the use of the Dräger JM-105, charting expectations, use of the algorithms and nomogram, and policy and procedure changes. A pre and post-test was created to measure each nurse's confidence and competency using the Dräger JM-105 before and after the in-service staff education. Due to time constraints, post-test data has not been completed yet. However, successful implementation of the TcB meter was shown by all postpartum nurses measuring 24-hour bilirubin levels using the Dräger JM-105.

Cost Analysis

In 2017, the labor and delivery unit at the Magnet community hospital delivered 2,380 newborns or approximately 200 neonates each month (Facts & Statistics, 2017). At the end of last year, the postpartum unit purchased two Dräger JM-105 devices for a total cost of $16,680 or $8,340 each. The cost of a TSB on a newborn is $153 per draw (Hospital Chargemasters, 2017). Prior to implementation of the Dräger JM-105, the hospital was spending approximately $30,600 each month on TSB blood draws. In 2017, if we assume that each newborn only received one TSB draw, it resulted in the hospital spending $364,140 exclusively on TSB draws. However, intermediate and high-risk hyperbilirubinemia newborns require more frequent bilirubin assessments making the total annual TSB spending estimate low. The two Dräger JM-105 devices cost the hospital a one-time cost of $16,680. The implementation of TcB monitoring results in a cost-saving monthly initiative of 45% on bilirubin assessment. After the first month, the cost-savings can reach up to 50% with few or lack of any TSB measurements.

Discussion

Neonatal jaundice effects 80% of newborns within the first few weeks of life (Jones et al. 2017). This common condition is often harmless yet can have permanent adverse outcomes if left untreated. Irreversible hearing loss, neurological dysfunction, and kernicterus are preventable yet, debilitating outcomes if hyperbilirubinemia interventions are not implemented (Kumra et al., 2017). The old standard practice of drawing TSB on all newborns is invasive, painful, time consuming, and stressful. The lab work-up completed once a TSB is drawn takes time and can result in delays of care and the potential progression of hyperbilirubinemia. As well, Jones et al. (2017) mentions that repeated heel sticks for intermediate or high-risk newborns can lead to osteomyelitis, infection, and calcium deposits at the injection site.

Implementation of a transcutaneous bilirubinometer on a postpartum unit at a Magnet community hospital proved successful after creation of improved policies and procedures and in-service staff education. Previous studies have shown support for the accuracy of transcutaneous bilirubinometers, specifically the Dräger JM-105 to screen term newborns for hyperbilirubinemia. The CNL students conducted a thorough literature review and found overwhelming support that TcB is current evidence-based practice. This change of practice improved patient care delivery by providing instantaneous bilirubin value results that allowed nurses to utilize immediate necessary hyperbilirubinemia interventions. The use of a TcB meter is a non-invasive practice that does not compromise patient safety. In addition, the Dräger JM-105 is a cost-saving initiative that requires an upfront one-time cost with a quick return on investment. Proper TcB implementation proved successful to provide an effective change of practice that resulted in utilization of evidence-based practice and improved care delivery for newborns.

Nursing Relevance

Implementation of a transcutaneous bilirubinometer gives postpartum Registered Nurses instant bilirubin results. Instantaneous bilirubin values allows for immediate hyperbilirubinemia care to take place and grants nurses the ability to deliver best care practices. Due to the cost-saving aspect of a transcutaneous bilirubinometer, nurses have more autonomy in screening their newborn patients. For example, if a postpartum nurse has a neonate with various risk factors for neonatal jaundice, the TcB meter allows for more frequent monitoring, without increased healthcare costs. The Dräger JM-105 improves care delivery and increases nurse autonomy in their individual nursing practice.

CNL Relevance

CNLs are the driving force behind implementation of evidence-based practices and cost-saving initiatives within a microsystem. The CNL students wore many hats in this process including: risk anticipator, systems analyst, outcomes manager, and educator. Creating this change of practice was utilization of evidence-based practice to deliver non-invasive, safe neonatal jaundice screening. The cost-savings this best practice created will be immediate and long lasting. Implementation of a transcutaneous bilirubinometer proved to be a simple, yet effective improvement in care delivery. In the future, CNLs should recommend utilization of bilirubin screening through the use of a transcutaneous bilirubinometer as an accurate, cost-efficient, and evidence-based practice.

Recommendations

The process improvement shown on this postpartum unit should be replicated on additional postpartum units, outpatient clinics, and Pediatrician offices. Widespread use of transcutaneous bilirubinometers will result in the use of evidence-based practice on all newborns. Prior research conducted by Chawla et al. (2013) shows support for the use of TcB meters on

preterm LBW newborns. However, research on preterm LBW neonates is limited. Future studies should be completed to ensure accuracy on these preterm and LWB neonates that are at an increased risk of developing hyperbilirubinemia. Finally, more research should focus on bilirubin disparities amongst race to ensure accuracy for all patient populations.

References

Chawla, D., Jain, S., Kaur, G., Sinhmar, V., & Guglani, V. (2013). Accuracy of transcutaneous bilirubin measurement in preterm low-birth-weight neonates. European Journal of Pediatrics, 173(2), 173-179. doi:10.1007/s00431-013-2142-0

Facts & Statistics - St. Jude Medical Center. (2017). Retrieved August 2, 2018, from https://www.stjudemedicalcenter.org/about-us/facts-and-statistics/

Hospital Chargemasters. (2017). Retrieved August 2, 2018, from https://www.oshpd.ca.gov/chargemaster/default.aspx

Jaundice & Kernicterus. (2016, November 14). Retrieved August 1, 2018, from https://www.cdc.gov/ncbddd/jaundice/hcp.html

Jones, D. F., Mcrea, A. R., Knowles, J. D., Lin, F., Burnette, E., Reller, L. A., & Lohr, J. A. (2017). A Prospective Comparison of Transcutaneous and Serum Bilirubin Within Brief Time Intervals. Clinical Pediatrics, 56(11), 1013-1017. doi:10.1177/0009922817701170

Kumra, T., Weaver, S. J., Prather, K., Garnepudi, L., Bartlett, E. L., & Crocetti, M. (2017). Correlation of Transcutaneous and Serum Bilirubin Measurements in the Outpatient Setting. Clinical Pediatrics, 57(2), 231-234. doi:10.1177/0009922817693302

Maisels, M. J., Deridder, J. M., Kring, E. A., & Balasubramaniam, M. (2009). Routine transcutaneous bilirubin measurements combined with clinical risk factors improve the prediction of subsequent hyperbilirubinemia. Journal of Perinatology, 29(9), 612-617. doi:10.1038/jp.2009.43

Mishra, S., Chawla, D., Agarwal, R., Deorari, A., Paul, V., & Bhutani, V. (2009). Transcutaneous bilirubinometry reduces the need for blood sampling in neonates with

visible jaundice. Acta Paediatrica, 98(12), 1916-1919. doi:10.1111/j.1651-2227.2009.01505.x

St. Jude Medical Center 2017 Community Health Assessment Report. (2017). Retrieved August 2, 2018, from https://www.stjudemedicalcenter.org/documents/Community-Benefit/SJMC-CHNA-FY17.pdf

Appendix A

St. Jude Medical Center Policy and Procedure on TcB & TSB collection and Phototherapy

St. Jude Policy - Neonatal Jaundice Risk Screening: TcB & TSB collection, Phototherapy

I. PURPOSE

To outline universal bilirubin screening so that newborns at risk for severe hyperbilirubinemia are identified, evaluated, and treated, when necessary.

II. POINTS TO EMPHASIZE

1. Risk Screening (TcB & TSB collection)
2. Phototherapy

III. POLICY

1. Risk Screening (TcB & TSB collection)
   - A. Assess for hyperbilirubinemia risk factors. Risk factors include
     - a. Gestational age of 38 weeks or less
     - b. Inadequate breastfeeding
     - c. Dehydration
     - d. Cephalohematoma or significant bruising
     - e. Previous sibling who received phototherapy
     - f. Macrosomic infant of diabetic mother
     - g. East Asian descent
     - h. Maternal-infant blood incompatibilities (Rh, ABO)
     - i. Positive Coomb's test
     - j. Glucose 6 Lactose Dehydrogenase (G6PD) deficiency
   - B. Newborns of mothers with blood type O or Rh negative will have cord blood screening initiated at time of delivery.
   - C. All newborns will be monitored on an on-going basis while in the hospital for signs of clinical jaundice with appropriate follow-up assessment and notification of the newborn licensed provider (LP).
   - D. TcB measurement will be used as a way to screen for jaundice. Gestational age should be considered when evaluating risk, as risk is increased in the pre-term and late pre-term infant. (See attached Table A-C)
   - E. A TSB level will be used to confirm a TcB screen value that falls on or above the Intermediate High-Risk level on the risk screening tool, as adjusted for gestational age.
   - F. Check a TcB measurement on all infants at 24 hours of age and day of discharge and chart on the hour-specific bilirubin risk screening tool. (Anytime the transcutaneous meter registers a bilirubin at or above 15 mg/dl, or the level places the infant at the 75th percentile or above on the nomogram, draw a serum TSB level to verify results.) Document results.
   - G. Obtain a bilirubin level using a TcB or send a blood sample to the lab for a total serum appearing significantly jaundiced regardless of age.

H. Notify the licensed provider immediately for any infant with values >75th percentile as plotted on the risk screening tool, and request phototherapy orders, as warranted.
I. Ensure a follow up appointment is scheduled with their licensed provider for breastfed infants within 48 to 72 hours from discharge.

2. Phototherapy
   A. Assess for need of phototherapy (can only start with a physician order).
   B. Discontinue TcB measurements once phototherapy is initiated.
   C. Remove all clothing except for diaper.
   D. Encourage breastfeeds 8-12 times per day with early lactation intervention as needed. Formula fed newborns should be fed every 2-3 hours.
   E. Monitor voids and stools.
   F. Assess eyes for edema and discharge when eye protection removed. Change eye protectors per manufactures guidelines.
   G. Measure irradiance with radiometer for each light source in use every shift. Notify Biomed immediately if out of range. (minimum is 30/W/cm^2/nm)
   H. Draw serum bilirubin levels with phototherapy lights off.
   I. Parent education provided using verbal and/or written methods includes but is not limited to:
      a. Neonatal jaundice causes and treatment
      b. Safe use of phototherapy equipment
      c. Correct use of eye protection
      d. Encourage infant's caregivers to maximize time under phototherapy for effective treatment.
      e. Need for follow-up with newborn licensed provider
      f. Discharge instructions

IV. PROCEDURE:

1. Risk Assessment (TcB &TSB collection)
   A. Perform TcB at 24 and 36 hours of age (or sooner if jaundice noted) and plot using bilirubin risk screening tool. If newborn is ≤ 38 weeks gestation repeat TcB at discharge, plotting using the bilirubin risk screening tool.

Age of Newborn	TcB	TSB
24 hours	If ≥ 6.5mg/dl draw TSB	Notify physician if ≥ 8 mg/dl
36 hours	If ≥ 8.5mg/dl draw TSB	Notify physician if ≥ 11 mg/dl
At time of discharge (only if ≤ 38 weeks gestation)	Notify physician if High Intermediate Risk or crossing zones	Per physician order

   B. Notify the licensed provider:
      a. Immediately if the rise in TSB level > 0.5 mg/dl per hour
      b. Signs/Symptoms of possible acute bilirubin encephalopathy noted
         i. Lethargy

ii. Hypotonia
iii. Poor such
iv. Stupor
v. Irritability
vi. Hypertonia manifested by backward arching of neck and trunk
vii. High pitched cry

C. Document bilirubin in infant's medical record.

2. Phototherapy
   A. Physician order required to start phototherapy via hospital approved equipment.
   B. Newborn eye protection must be in place while under phototherapy unless newborn is being held and positioned so eyes cannot be exposed to the light.
      a. Do not use tape. Eye protection should be tight enough to stay in place.
      b. Remove eye protection during feeds and encourage eye contact.
   C. Perform physical assessment at least every 12 hours and PRN.
   D. Obtain vital signs 30-60 minutes after initiation of phototherapy.
   E. Obtain temperature every 4 hours and PRN.
   F. Document the following in the medical record:
      a. Risk factors
      b. Physical assessments
      c. Communication with newborn licensed provider
      d. Phototherapy specific
         i. Type of phototherapy initiated and time
         ii. Irradiance levels of each phototherapy device used every shift
         iii. Eye protection used and assessment of eyes
         iv. Newborn temperature
         v. Date and time phototherapy discontinued
         vi. Education provided to parents

V. RELATED FORMS:

1. Hyperbilirubinemia Risk Assessment Algorithm

VI. REFERENCES:

I. Allen, M. (2015). Hyperbilirubinemia: Identification and management in the healthy term and late preterm infant, (3rd ed.). Washington DC: AWHONN.

II. American Academy of Pediatrics: Subcommittee on Hyperbilirubinemia (2004, July). Management of hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. Pediatrics, 114(1), 297-316. doi: 10.1542/peds.114.1.297

III. American Academy of Pediatrics and the American College of Obstetricians and Gynecologists. (2012). Guidelines for perinatal care (7th ed.). Washington D.C: Author

IV. Bhutani V.K., & the Committee on Fetus and Newborn. (2011, October/reaffirmed 2014, September). Phototherapy to prevent sever neonatal hyperbilirubinemia in the newborn infant 35 or more weeks of gestation. Pediatrics, 128(4), 1046-1052. doi: 10.1542/peds.2011-1494

V. Pediatric Nursing Procedures, 2nd ed., 2008

VI. Simpson, K.R., Creehan, P.A., (Eds.)(2014). Perinatal nursing (4th ed.). Philadelphia, PA: Wolters Kluwer Lippincott Williams & Wilkins.

Appendix B

Standard of Work on Dräger JM-105 Use

Process Name: Dräger set-up and user instructions **SW Owner:**
Created By:

Date Created:
Revision date:

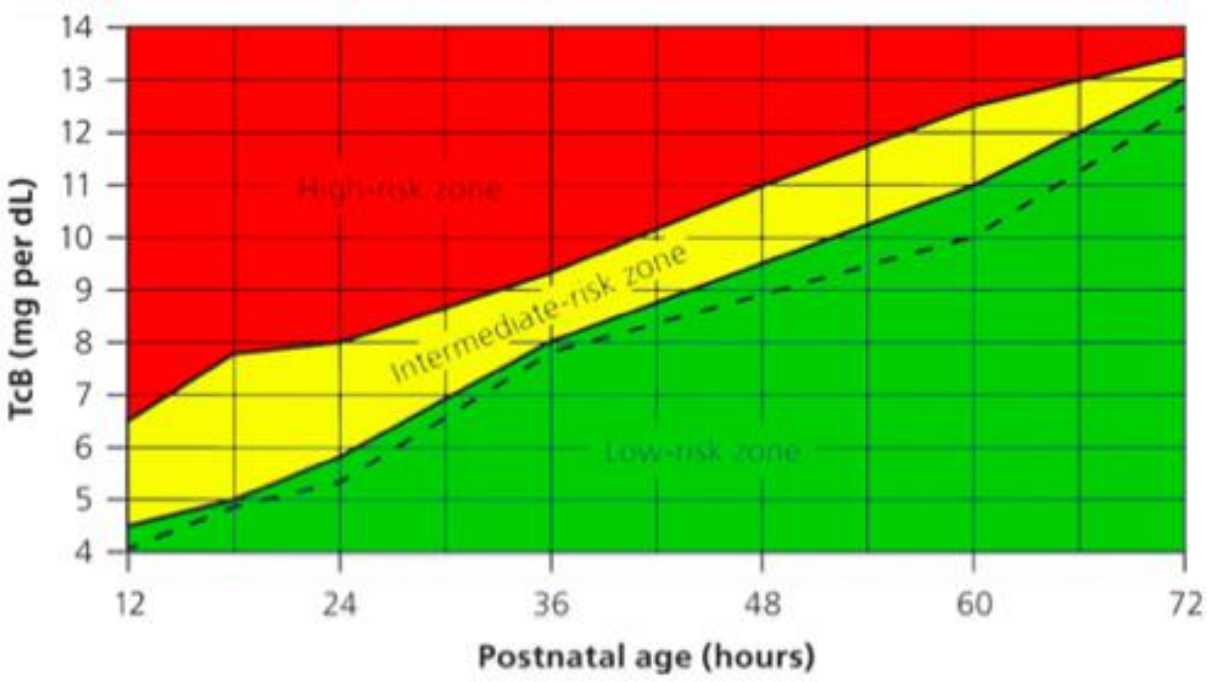
KEY POINTS :

#	Tasks	Responsible Person / Role	Time needed to perform task	Expected Outcome/ Deliverable
Step 1	Device set-up and maintenance			
	1. Remove meter from docking station 2. Hold reset button while switching the on button with other hand until CHE appears 3. Wait for a green light 4. Open calibration slot on docking station 5. Press meter down with screen facing forward until you see a flash of light 6. Display screen will show a value. Make sure it falls within calibration range 7. On the main screen, use the down arrow to scroll to CONFIGURE and press OK. 8. Scroll to AVERAGE and press OK. Select 3 and press OK. 9. This will change the default number of readings to N3 10. Return device to docking station with screen facing forward	Charge Nurse	<5 min	Meter will be ready for use
Step 2	Operation of device			
	1. Collect necessary equipment 2. Explain testing procedure to parents 3. Swab meter tip with alcohol and allow to air dry 4. Check patient's skin site (use only the neonates sternum) - must be free from bruising, birthmarks, hematomas or excessive hairiness 5. Ensure meter is on, if not, turn on and wait for the green READY light	Primary Nurse	5-10 min	Accurate measurement will be obtained

	6. Select MENU, select Measure and Press OK. The letters AVE N3 should appear 7. On calm newborn, lightly press probe onto sternum, tip must be held flat until you see a flash of light. 8. Repeat 3 times, waiting for the green READY light each time 9. Average bilirubin value will appear after three consecutive measurements 10. Clean device and return to docking station			
Step 3	Documentation			
	1. Chart bilirubin value in MediTech, referencing BiliTool for risk zone	Primary Nurse	<5 min	Medical record will be updated with most recent TcB results

Appendix C

Nomogram to Determine Newborn Hyperbilirubinemia Risk Zone



Appendix D

Figure 1

Gestational age ≥ 38 weeks with NO risk factors

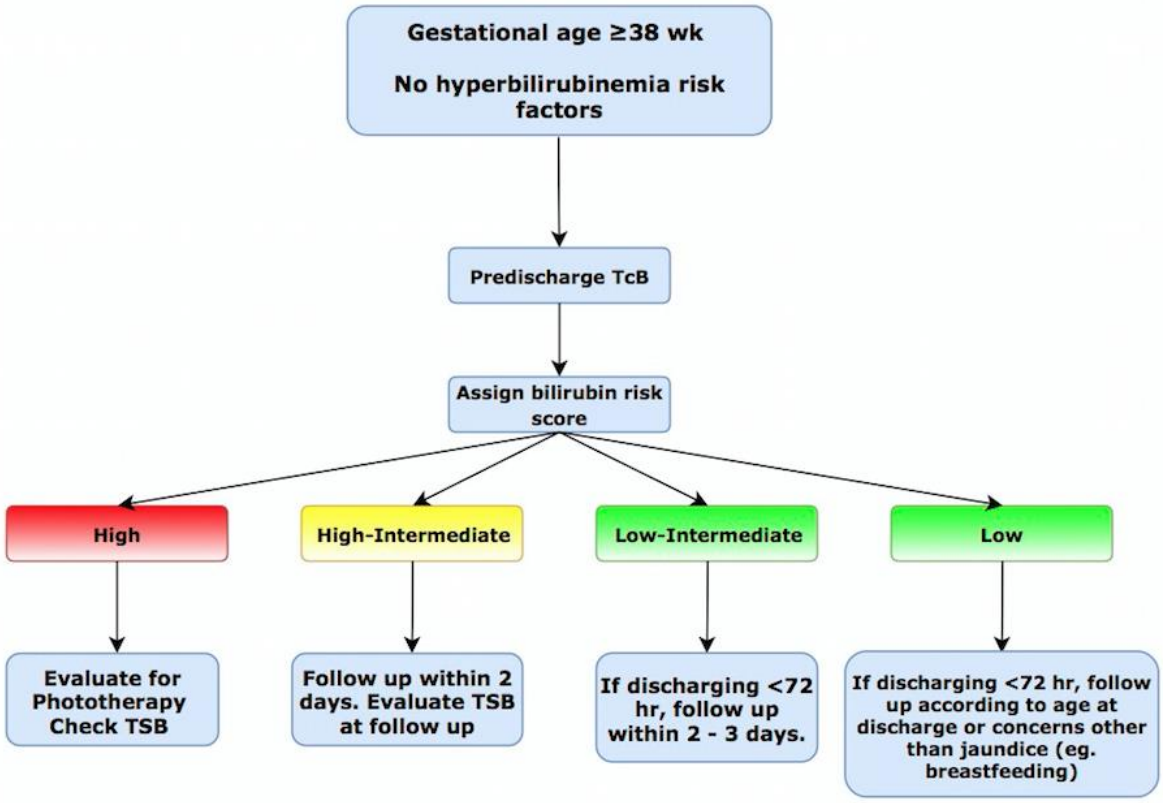


Figure 2

Gestational Age 35-37 weeks with NO risk factors

and/or

Gestational Age ≥ 38 weeks WITH risk factors

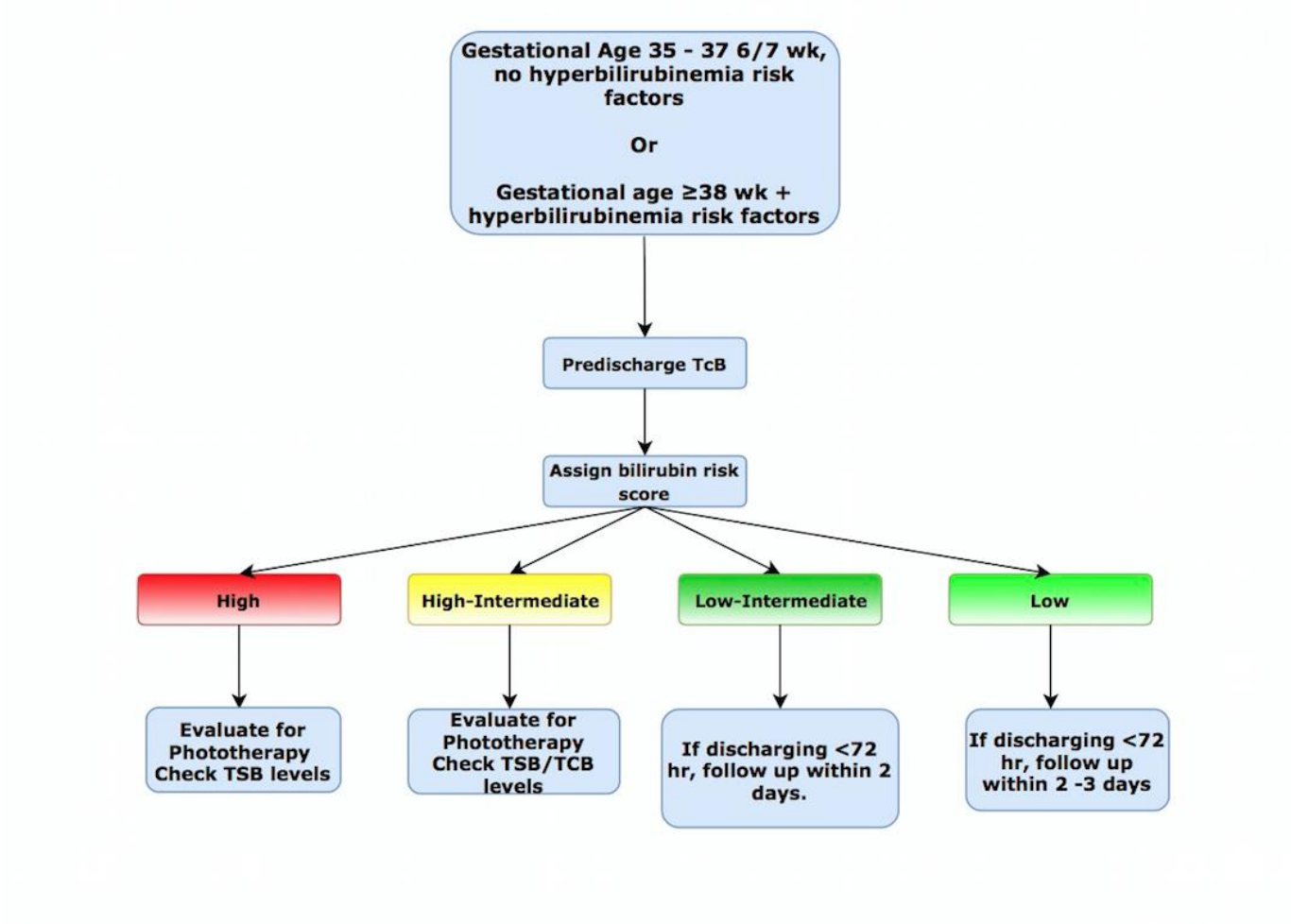
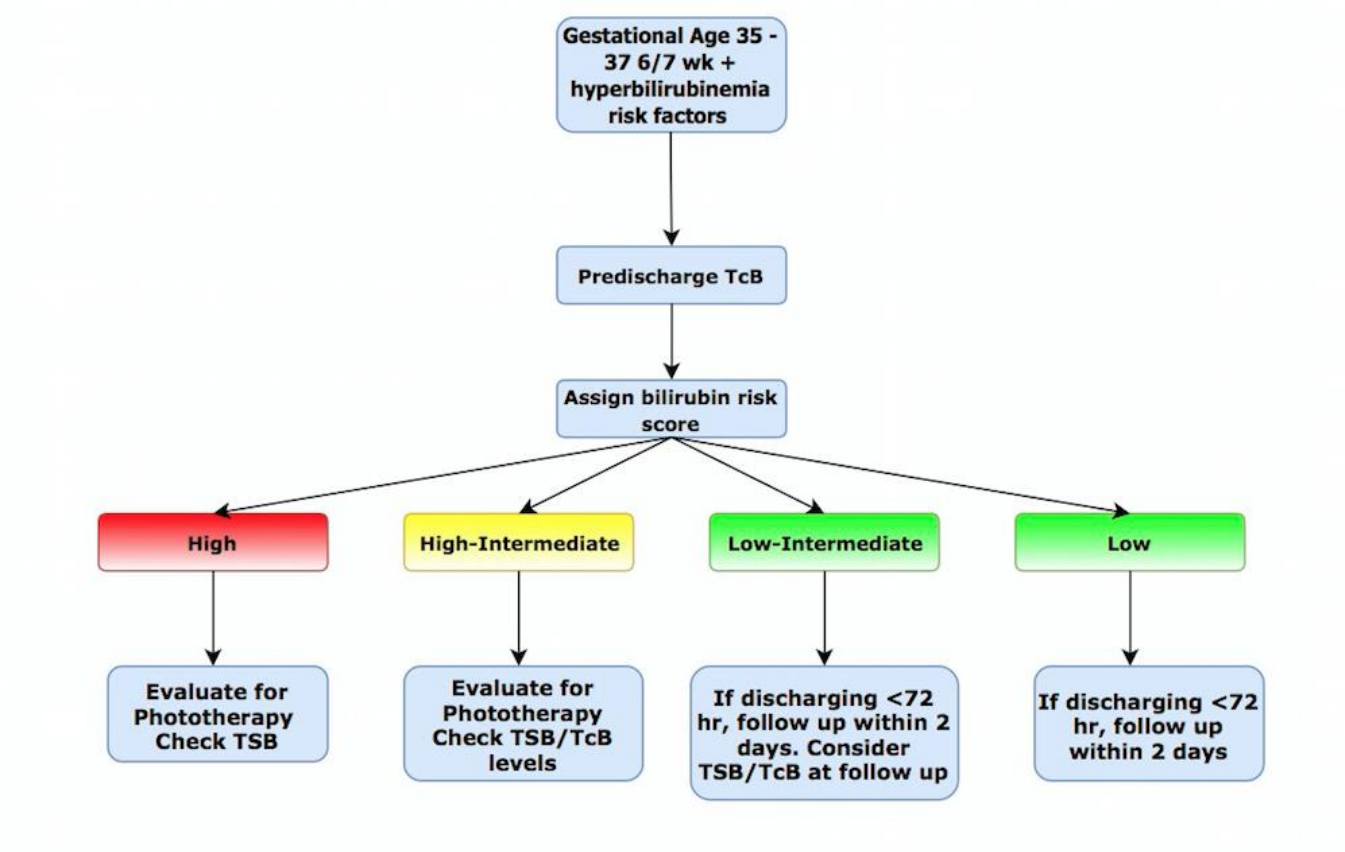


Figure 3

Gestational Age 35-37 6/7 weeks WITH risk factors



Appendix E

Confidence Scale Questions to Determine Nurse Dräger JM-105 Competency

Initial Self-Evaluation (Pre-Test)

Rate yourself on a scale of 1 to 5, with **5** having the **most** and **1** having the **least** amount of confidence in understanding the new hospital policy. *All answers are submitted anonymously.*

5=Extremely Confident 4=Confident 3=Neutral 2=Somewhat Confident 1= Not confident at all

1. How confident do you feel about using a transcutaneous bilirubin meter (TcB) on a newborn?
   5 4 3 2 1

2. How confident do you feel about using the TcB device itself, including set-up and maintenance?
   5 4 3 2 1

3. How familiar are you with St. Jude's policy on Neonatal Jaundice Assessment & Screening?
   5 4 3 2 1

4. How confident do you feel about identifying newborns who are at risk for hyperbilirubinemia based on risk factors alone?
   5 4 3 2 1

5. How confident do you feel about locating policy resources such as BiliTool and Standard Work documents?
   5 4 3 2 1

Post-Test Evaluation

After having completed the HealthStream learning module, rate yourself on a scale of 1 to 5, with **5** having the **most** and **1** having the **least** amount of confidence in understanding the new hospital policy. *All answers are submitted anonymously.*

5=Extremely Confident 4=Confident 3=Neutral 2=Somewhat Confident 1= Not confident at all

1. How confident do you feel about using a transcutaneous bilirubin meter (TcB) on a newborn?
   5 4 3 2 1

2. How confident do you feel about using the TcB device itself, including set-up and maintenance?
   5 4 3 2 1

3. How familiar are you with St. Jude's policy on Neonatal Jaundice Assessment & Screening?
   5 4 3 2 1

4. How confident do you feel about identifying newborns who are at risk for hyperbilirubinemia based on risk factors alone?
   5 4 3 2 1

5. How confident do you feel about locating policy resources such as BiliTool and Standard Work documents?
   5 4 3 2 1