Clinical Pathway Handbook for Hyperbilirubinemia in Term and Late Pre-Term Infants (≥35 weeks)

Provincial Council for Maternal & Child Health &
Ministry of Health and Long-Term Care

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Ontario

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List of Abbreviations

AAP America Academy of Pediatrics

CEAG Clinical Expert Advisory Group

CPS Canadian Paediatric Society

DAT Direct Anti-Globulin Test

HCP Health Care Provider

NICE National Institute for Clinical Evidence

TcB Transcutaneous Bilirubin

TSB Total Serum Bilirubin

1.0 Introduction

1.1 Purpose

This clinical handbook has been created to serve as a compendium of the evidence-based rationale and clinical consensus for Hyperbilirubinemia in Term and Late-Pre-Term Infants (≥ 35 weeks).

This document has been prepared for informational purposes only. This document does not mandate health care providers to provide services in accordance with the recommendations included herein. The recommendations included in this document are not intended to take the place of the professional skill and judgment of health care providers.

1.2 Key Objectives of the Clinical Handbook

The key objectives of this Clinical Pathway are to:

- Ensure all newborns receive bilirubin screening between 24-72 hours of life (if not clinically indicated and performed earlier)
- Ensure infants receive systematic bilirubin monitoring as per the treatment graph and risk nomograms recommended by evidence-based guidelines
- Utilize health care resources responsibly through avoidance of unnecessary/excessive testing, timely discharge, appropriate outpatient follow-up and minimization of preventable readmission
- Reduce the incidence of severe hyperbilirubinemia and acute bilirubin encephalopathy

1.3 Development of the Clinical Pathway

This Clinical Pathway was developed by a Clinical Expert Advisory Group (CEAG) composed of both clinical experts and researchers in the field of hyperbilirubinemia. Members included paediatricians, neonatologists, family physicians, advance practice nurses, midwives, researchers and analysts from across the province. See Section 6 for the list of membership.

2.0 Description of the Clinical Pathway for Hyperbilirubinemia in Term and Late-Pre-Term Infants (≥ 35 weeks)

2.1 Population Group

Hyperbilirubinemia in the newborn, also referred to as neonatal jaundice, is a result of the diminished ability to conjugate and excrete an excess of bilirubin in the blood of the neonate (Mosby, 2009). Hyperbilirubinemia is a common condition affecting approximately 60% of term and 80% of pre-term babies in the first week of life (National Institute for Health and Clinical Excellence, 2010); (American Academy of Pediatrics Provisional Committee for Quality Improvement and Subcommittee on Hyperbilirubinemia, 2004). In most of these infants the condition will resolve without any need for intervention. However, for some, there is a risk of developing severe hyperbilirubinemia which can lead to acute bilirubin encephalopathy (kernicterus). Severe hyperbilirubinemia has been on the rise in North America and Europe, with increasing frequency in term and near-term infants (Manning D, 2007). This is a troublesome finding as severe hyperbilirubinemia is largely preventable.

As mentioned above, the diagnosis of hyperbilirubinemia is one that affects a large number of neonates. Hyperbilirubinemia is often mild and can be managed without medical intervention. Medical intervention is required for serious cases of hyperbilirubinemia, some of which can be prevented when early screening and systematic monitoring are in place.

Population Definition

Defining a population for the management of paediatric hyperbilirubinemia can be likened to an inverted triangle. The screening process starts will *all* infants born, and then funnels down to those infants who are diagnosed with hyperbilirubinemia and require/receive treatment. This clinical pathway can be applied to newborns born at 35 weeks gestation and above.

3.0 Best practices Guiding the Implementation of the Clinical Pathway for Hyperbilirubinemia in Term and Late Pre-Term Infants (≥35 weeks)

3.1 Definition of Best Practices

To date there have been at least four national guidelines for the treatment of hyperbilirubinemia in term or near-term infants:

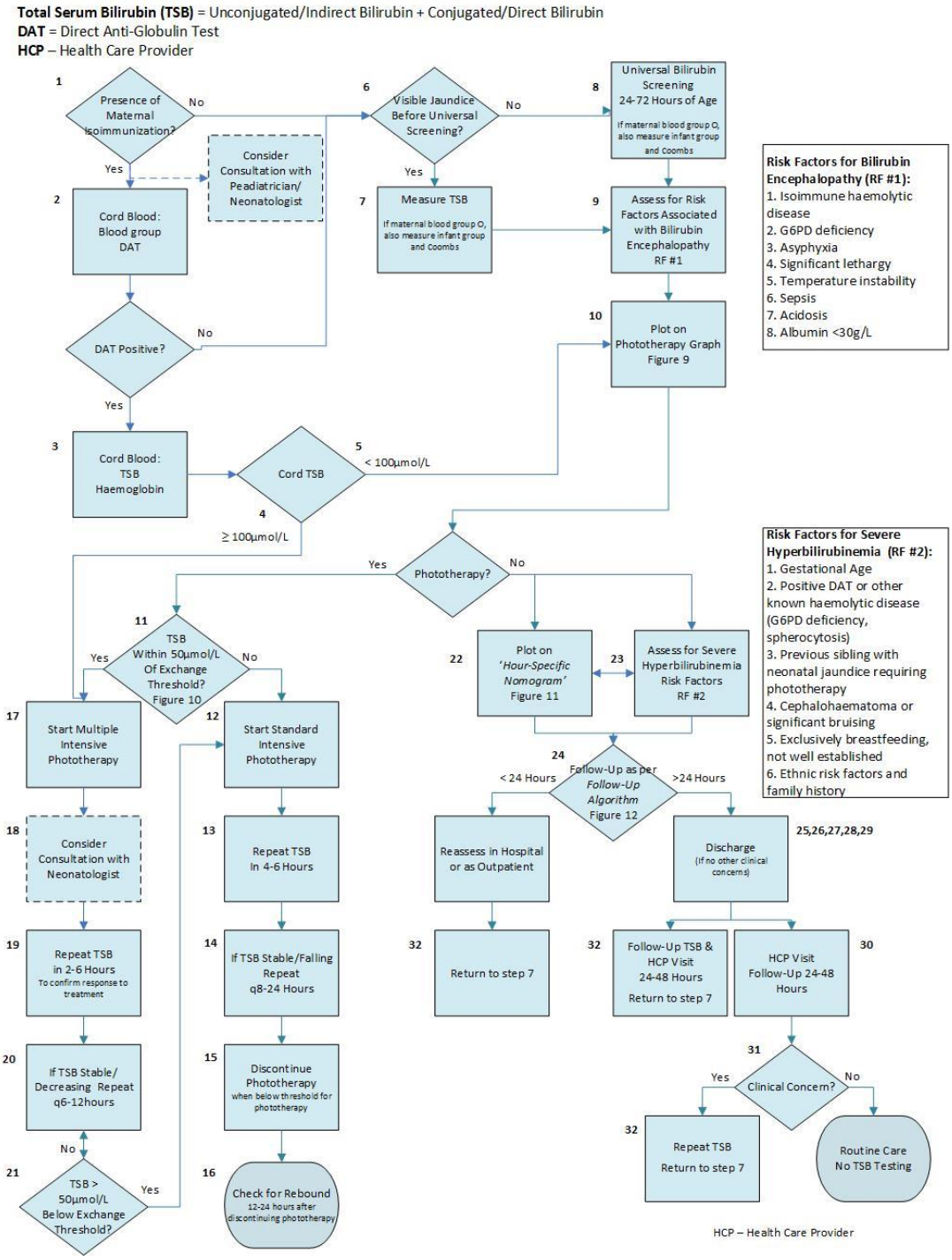
- American Academy of Pediatrics (AAP) (American Academy of Pediatrics Subcommittee on Hyperbilirubinemia, 2004)
- Canadian Paediatric Society (CPS) (Canadian Paediatric Society, Fetus and Newborn Committee, 2007)
- UK National Institution for Health and Clinical Evidence (NICE) (National Institute for Health and Clinical Excellence, 2010), and
- Italian guidelines for management and treatment of hyperbilirubinaemia of newborn infants ≥ 35 weeks' gestational age (Task Force for Hyperbilirubinaemia of the Italian Society of Neonatology, 2014).

These guidelines are currently the recommended practice for managing hyperbilirubinemia in their respective countries.

The proposed clinical pathway for the management of hyperbilirubinemia in term and late-pre-term infants has been informed by these guidelines, the evidence informing them and the expert opinion of the CEAG. Where further evidence was required it was sought in a systematic manner. Where evidence was not available the CEAG based their recommendations on the consensus of the group. Another literature search was conducted as part of a refresh process in 2016-17. All relevant studies identified for the period between September of 2013 and April of 2016 were reviewed by the CEAG to determine whether there were any evidence-based updates to the clinical pathway. Additionally, a rapid review on screening for hyperbilirubinemia was published in 2017 (Bhardwaj K, 2017) and reviewed by the CEAG.

3.2 Clinical Pathway for the Management of Hyperbilirubinemia in Term and Late Pre-Term Infants (≥35 weeks)

This pathway uses Total Serum Bilirubin (TSB) measurement. If using Transcutaneous Bilirubin (TcB) measurement, refer to the recommendations regarding *Transcutaneous Bilirubin Screening* on page 20.



Clinical Pathway Instructions and Recommendations

Legend:

AAP = American Academy of Pediatrics Guidelines

CPS = Canadian Paediatric Society Guidelines

NICE = National Institute for Clinical Evidence Guidelines

For a description of the levels of evidence used in each guideline, please see Appendix A.

	Instructions	Recommendations	Support For Recommendations
UNIVERSAL SCREENING			
1	**Identify newborns of mothers with red cell antibodies (isoimmunization)**	- All mothers should be tested for blood type (ABO and Rh(D)) and screened for red cell antibodies during pregnancy - If mother not tested during pregnancy, cord blood should be sent for blood group and DAT - Significance of various antibodies differs - Consultation with a neonatologist or paediatrician suggested due to risk of bilirubin encephalopathy	AAP Guidelines (Quality B: benefits exceed harms), CPS Grade D) CPS
2	**Newborns of mothers with red cell antibodies should have blood group evaluation and direct anti-globulin test (DAT)**	- Significance of various antibodies differs - Further evaluation, closer follow-up and earlier therapy may be required - Consultation with a paediatric haematologist or neonatologist suggested	CPS
3	**Measure cord blood for haemoglobin and TSB**	- Measurement of haemoglobin and bilirubin from cord blood suggested as part of initial evaluation for DAT positive infants of mothers with red cell antibodies	CEAG Consensus
4	**If cord TSB level ≥ 100µmol/L**	- Critical value, suggestive of need for exchange transfusion - Multiple intensive phototherapy should be initiated without delay, while continuing pathway **(Step # 17)** and initiating consult **(Step #18)**	NICE
5	**If cord TSB level <100µmol/L**	- Plot bilirubin on ***Phototherapy Graph*** **(Figure 1, Step # 10)**, using time = 0 hours - Isoimmunization is a risk for bilirubin encephalopathy - If gestation 35-37+6 weeks, use the "high risk" line (lowest position on graph, brown line) - If gestation 38 weeks or more, use the "medium risk" line (middle position on graph, blue line)	
6	**Clinically assess for jaundice**	- If visibly jaundiced at 24 hours of age	

	Instructions	Recommendations	Support For Recommendations
	routinely during newborn care	or less, do a blood smear, blood group screen, DAT, and test for G6PD deficiency - Jaundice might appear clinically at any time in the newborn period - Jaundice in the first 24 hours is more likely to be significant/pathologic, so multiple clinical assessments in the first 24 hours are recommended - Clinical assessment of jaundice should continue at every well newborn check through the newborn period, before and after universal bilirubin screening - In case of early discharge (prior to 24 hours) or births outside of hospital, parents need to be made aware of the potential for jaundice and understand when to contact health care provider prior to universal bilirubin screening at 24-72 hours.	AAP (Quality D: benefits vs harms exceptional) (8-12 hours) NICE (every opportunity in the first 72 hours) CPS (repeatedly in the first 24 hours, at a minimum 24-48 hours) CEAG Consensus CEAG Consensus
7	**Measure TSB in all newborns who appear clinically jaundiced in their first 24 hours of life, include blood group and DAT if mother's blood group is O (if not done previously)**	- Further evaluation may be required to determine etiology of early jaundice (see **Step# 6**) - Blood group and DAT useful in assessing risk for haemolysis and risk factor for severe hyperbilirubinemia	AAP (Quality C benefits exceed harms), CPS (Grade D), NICE
8	**If not required earlier because of clinical jaundice, TSB should be obtained (CPS Grade C) at the same time as newborn screening (between 24-72hours of age), include blood group and DAT if mother's blood group is O**	- For early discharge babies, arrangements should be made for outpatient bilirubin measurement - Blood group and DAT useful in assessing risk for haemolysis and risk factor for severe hyperbilirubinemia	CEAG Consensus
9	**Assess for presence of any Bilirubin Encephalopathy Risk Factors (RF #1)**	- **Bilirubin Encephalopathy Risk Factor (RF #1)** determination, along with gestational age, is used to identify the low/medium/high treatment threshold lines on the ***Phototherapy Graph*** **(Figure 1)** - Assess for: 1. Isoimmune haemolytic disease *Blood group evaluation and DAT Recommended* 2. G6PD deficiency *At risk infants (ethnic origin, family history) and infants with severe jaundice should be screened for G6PD*	AAP (Reproduced in CPS) CPS (Grade D)

	Instructions	Recommendations	Support For Recommendations
		deficiency 3. Asphyxia *Apgar 0-3 beyond 5 min AND cord pH<7.0* 4. Significant lethargy *Impacting on feeding ability and not clearly related to maternal/neonatal medications* 5. Temperature instability *Requiring external warming at time of measurement* 6. Sepsis *On antibiotics for clinical signs of sepsis, not simply because of maternal GBS status* 7. Acidosis *Current status, not isolated low cord pH* 8. Albumin <30g/L *If measured for clinical reasons*	
10	**Plot TSB on *Phototherapy Graph* (Figure 1) to determine need for phototherapy**	- Determination of treatment line depends on gestational age at birth as well as presence of **Bilirubin Encephalopathy Risk Factors (RF #1)** from **Step #9**. - Use the "high risk" line (lowest position on the graph, brown line) for 35-37 weeks plus 6 days gestation and one or more risk factors from **Step #9** - Use the "medium risk" line (middle position on graph, blue line) for 35-37 weeks plus 6 days gestation and NO risk factors from **Step #9** OR baby was born at 38 weeks or greater gestation and one or more of the risk factors from **Step #9**. - Use the "low risk" line (highest position on the graph, green line) if baby was born at 38 weeks or greater gestation and has NO risk factors from **Step #9** - Plot on ***Phototherapy Graph* (Figure 1)** using TSB (unconjugated +	AAP (Reproduced in CPS) AAP

	Instructions	Recommendations	Support For Recommendations
		conjugated) and age in hours at the time that the bilirubin was measured.	
	PHOTOTHERAPY – YES		
11	**If phototherapy indicated determine if TSB is within 50µmol/L of the exchange transfusion line on *Exchange Transfusion Graph* (Figure 2)**	- Plot TSB bilirubin on ***Exchange Transfusion Graph*** **(Figure 2)** and refer to same risk line as was used for the ***Phototherapy Graph*** **(Figure 1)**	NICE
12	**If no in Step #11, start Standard Intensive Phototherapy**	- Use dose of 30 uW/cm^2/nm minimum - Irradiance does not need to be measured every time but regular calibration checks of equipment are required according to manufacturer's instructions - Expose maximal skin surface to the lights - Diaper may be left on - Using clinical judgment, short breaks (up to 20-30 minutes q3h) for breastfeeding and other care may be allowed - If using a phototherapy blanket it should remain in place during breaks for feeding and care - Continue lactation and breastfeeding support - Weigh baby daily and monitor urine and stool output - Supplementation of breastfed infants with water or dextrose water is not recommended. - If supplementation is considered, preference is expressed breast milk	AAP, CPS (Grade D) AAP AAP, CPS, NICE AAP, CPS AAP(Quality C: benefits exceed harms), CPS (Grade A), NICE, CEAG Consensus CEAG Consensus NICE NICE, CEAG Consensus AAP, CPS (Grade B), NICE CEAG Consensus
13	**Repeat TSB in 4-6 hours**	- Use clinical judgment including consideration of **Severe Hyperbilirubinemia Risk Factors (RF #2)** and height of TSB to determine patient specific timing of repeat	AAP, NICE
14	**If TSB is stable/falling continue to repeat TSB q8-24 hours while on phototherapy**	- Use clinical judgment considering **Severe Hyperbilirubinemia Risk Factors (RF #2)** , response to therapy and height of TSB to determine patient specific timing of repeat	CEAG Consensus, considering: NICE (q6-12hr)
15	**Discontinue phototherapy when TSB is below threshold**		CEAG Consensus

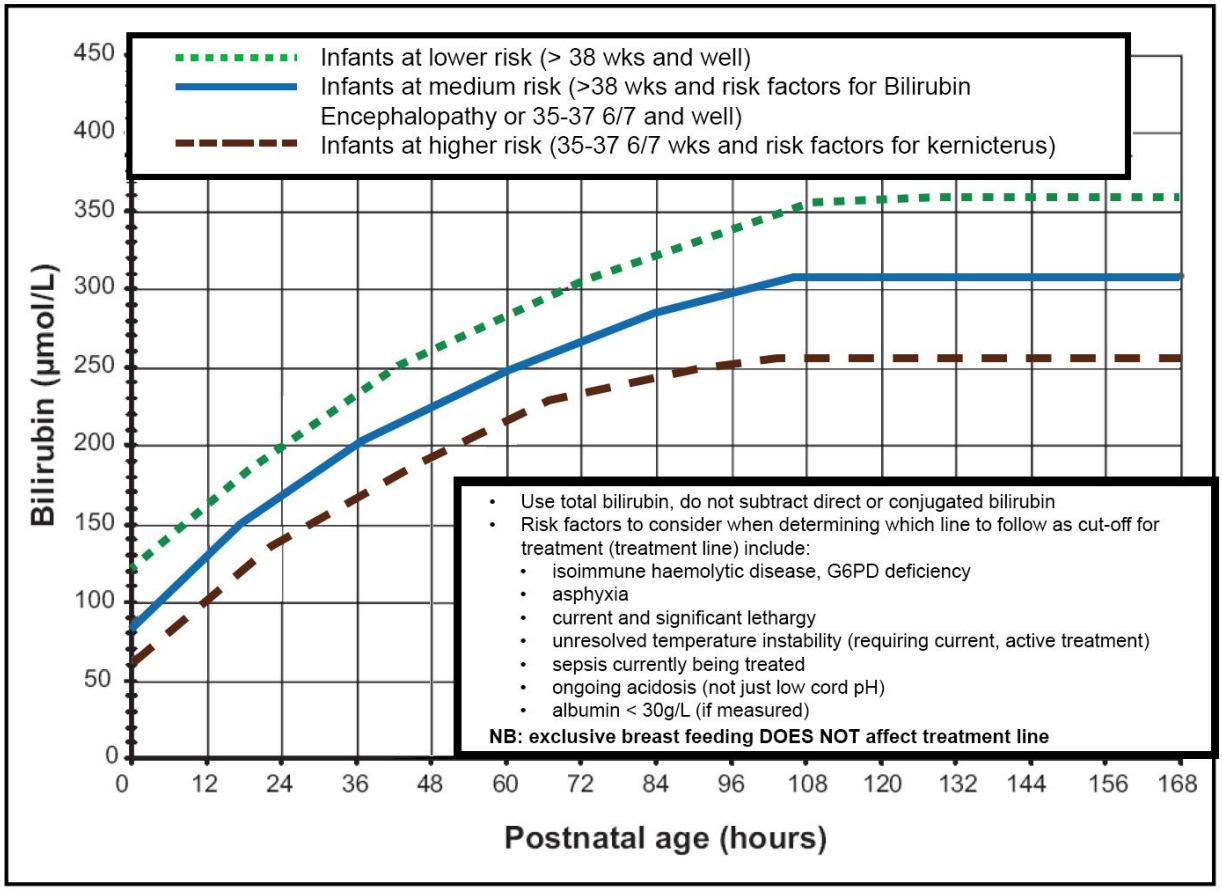
	Instructions	Recommendations	Support For Recommendations
	for phototherapy initiation		
16	**Check TSB for rebound 12-24 hours after discontinuing phototherapy**	- Patient does not need to remain in hospital if outpatient follow-up can be ensured.	CEAG Consensus, considering: NICE (12-18 hr) AAP (clinical assessment or repeat TSB within 24 hours)
17	**If YES in Step #11, start Multiple Intensive Phototherapy**	- Add a phototherapy blanket under the infant to increase exposed surface area (i.e. double surface phototherapy) - Remove diaper - Do not interrupt phototherapy for feeding or other care - Supplemental fluids, oral or IV, should be administered in infants at elevated risk of requiring an exchange transfusion - Continue lactation/feeding support - Weigh baby daily and monitor urine and stool output	CPS AAP, CPS AAP, NICE CPS (Grade A) NICE NICE, CEAG Consensus
18	**Consider immediate consult with neonatologist (CPS Grade B)**	- IVIG or exchange transfusion may be indicated - Exchange transfusion should only be performed in tertiary level NICUs	AAP(Quality B: Benefits Exceeds Harms, Quality D: Benefits vs Harms Exceptional), CPS (Grade A), NICE AAP (Quality D: Benefits vs Harms Exceptional), CPS
19	**Repeat TSB in 2-6 hours to confirm response to treatment**	- Use clinical judgment including considering **Severe Hyperbilirubinemia Risk Factors (RF #2)** and height of TSB to determine patient-specific timing of repeat test	CPS , NICE (4-6 hrs)
20	**If TSB stable or decreasing continue to repeat q6-12h**	- Use clinical judgment **Severe Hyperbilirubinemia Risk Factors (RF #2)** , response to therapy and height of TSB to determine patient specific timing of repeat	NICE
21	**When TSB is more than 50µmol/L below exchange transfusion threshold return to Step # 12**		NICE
PHOTOTHERAPY – NO			
22	**If phototherapy not indicated, plot the TSB on the *Hour-Specific Nomogram* (See Figure 3)**	- Use the infant's age in hours at the time of blood draw - Use TSB (unconjugated + conjugated) - If (high-intermediate zone) and mom blood type O do a blood group screen and Coombs test	AAP, CPS (Grade D) CPS (Grade B)
23	**Assess for presence of any**	- The following risk factors are used to	AAP (Quality C: Benefits

	Instructions	Recommendations	Support For Recommendations
	Severe Hyperbilirubinemia Risk Factors (RF #2)	determine timing of repeat testing and clinical follow-up in **Step #24** : 1. Gestational age < 38 weeks (the lower the gestational age, the greater the risk) 2. Positive DAT or other known haemolytic disease (G6PD deficiency, spherocytosis) 3. Previous sibling with neonatal jaundice requiring phototherapy 4. Cephalohaematoma or significant bruising 5. Exclusive breastfeeding, particularly if infant is not feeding effectively and weight loss is excessive (> 8-10% weight loss from birth weight) 6. Ethnic risk factors refer to populations with a higher risk of g6pd deficiency. These include those of east or west Asian decent as well as Mediterranean and Middle Eastern populations. It is also important to collect a full family history.	Exceeds Harms) CPS AAP, CPS, NICE, Maisels (Maisels MJ, 2009) AAP, Maisels AAP, CPS, NICE AAP, CPS AAP, CPS, NICE Maisels AAP, CPS, Maisels
24	**Consult *Follow-Up Algorithm* (Figure 4) for management and follow-up according to pre-discharge TSB**	- Use algorithm to determine: - If repeat TSB measurement is indicated - Recommended timing of repeat TSB - Recommended timing of clinical follow-up	Maisels
25	**Arrange follow-up TSB measurement, if indicated**	- Setting of follow-up may vary depending on community resources. Refer to recommendations regarding *Community Follow-Up Care and Monitoring*, page 40	CPS AAP (Quality-C: Benefits Exceed Harms), NICE, Maisels
26	**If appropriate follow-up cannot be ensured in the presence of elevated risk for developing severe hyperbilirubinemia, delay discharge**	- Discharge should be delayed until appropriate follow-up can be ensured or the period of greatest risk has passed (72-96 hours).	AAP (Quality-D: Benefits vs Harms Exceptional)
27	**Provide lactation evaluation and support for all breastfeeding mothers**		CPS (Grade D) Maisels
28	**Any infant discharged before**	- Health care provider conducting	CPS (Grade D)

	Instructions	Recommendations	Support For Recommendations
	24 hours should be assessed by an HCP within 24 hours	the assessment needs to have access to testing and treatment facilities.	
29	**The infant's parent/guardian should be provided with written and verbal instructions regarding the infant's follow-up and the timing of that follow-up** (Refer to recommendations regarding *Discharge Documentation*, page 21)	- Include general information regarding jaundice, the importance of repeat TSB (if indicated) and clinical follow-up.	Adapted from AAP (Quality D: Benefits vs Harms Exceptional)
30	**The follow-up assessment should include** - Infant's weight and % change from birth weight - Adequacy of intake - Pattern of voiding and stooling - Presence or absence of visible jaundice	- Expectations: - Weight loss should be no more than 10% of birth weight - 4 to 6 wet diapers and 3 to 4 stools per day by the fourth day - Stools in breastfed infants should have changed from meconium to mustard yellow - Consider observing breastfeeding to assess effectiveness	AAP (Grade C)
31	**Clinical judgment should be used to determine the need for TSB measurement**	- If there is any doubt about the degree of jaundice, the TSB level should be measured. - Visual estimation of bilirubin levels can lead to errors, especially in darkly pigmented infants.	AAP (Grade C)
32	**Any repeat TSB measurements should be plotted in this algorithm in same manner as the initial TSB**	- To determine the need for phototherapy, need for further TSB measurements, and timing of clinical follow-up	

Related Figures

Figure 1: Phototherapy Graph



Adapted with permission from the Champlain Maternal Newborn Regional Program (Champlain Maternal Newborn Regional Program, 2012)

Figure 2: Exchange Transfusion Graph

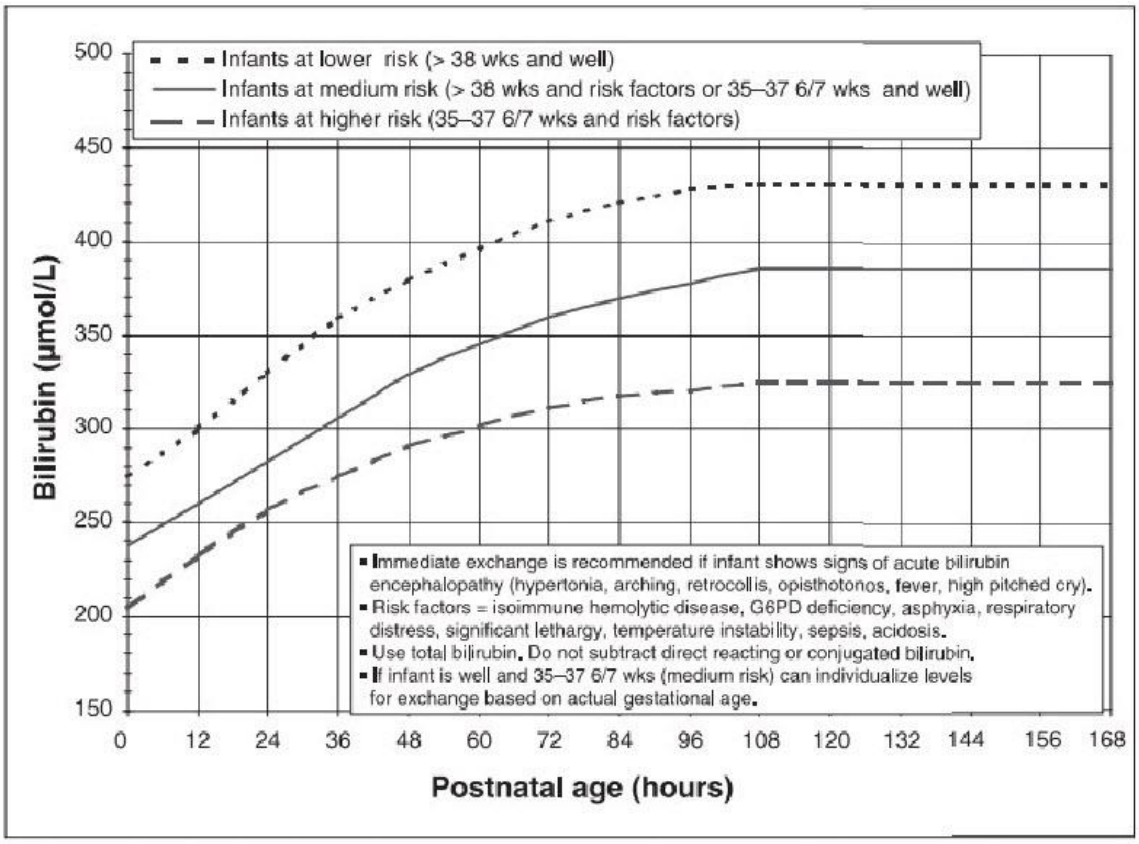
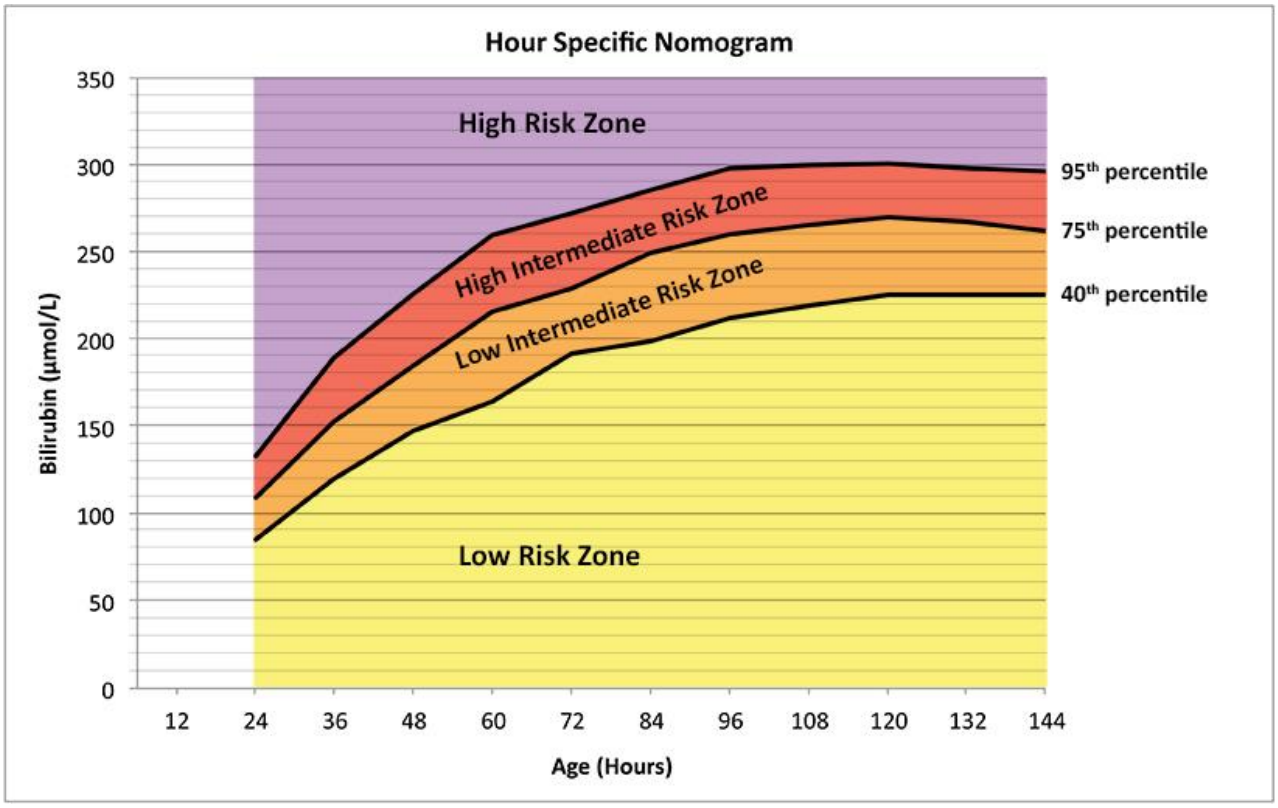


Figure 3) *Guidelines for exchange transfusion in infants of 35 or more weeks' gestation. These guidelines are based on limited evidence and the levels shown are approximations. Exchange transfusions should be used when the total serum bilirubin (TSB) concentration exceeds the line indicated for each category*

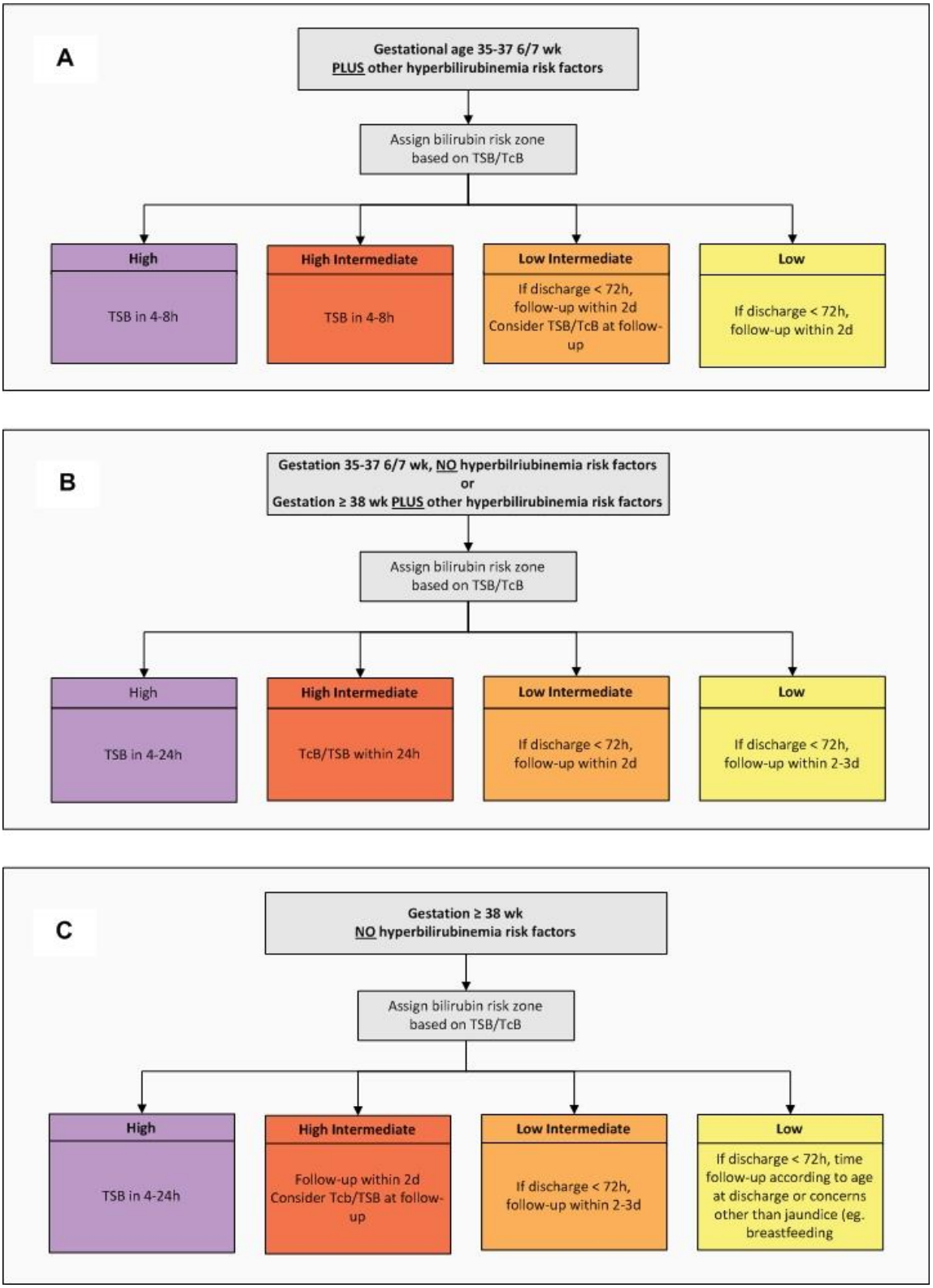
Reproduced with permission from the Canadian Paediatric Society, (Canadian Paediatric Society, Fetus and Newborn Committee, 2007)

Figure 3: Hour Specific Nomogram



Based on data from Stevenson et al. (Stevenson DK, 2001)

Figure 4: Follow-Up Algorithm



Modeled on Maisels' Algorithm (Maisels MJ, 2009), reflecting the findings of the Clinical Expert Advisory Group.

Other Considerations and Recommendations

Early Discharge

This clinical pathway should in no way deter health care providers from facilitating early discharge for appropriate patients who wish it. For asymptomatic babies, the optimal timing of the screening bilirubin is between 24 and 72 hours of life, however, this does not mean that babies must remain in hospital for 24 hours. Health care providers have the option to provide/arrange for transcutaneous bilirubin measurement in the home, collection and appropriate transport of a serum bilirubin sample along with the newborn screen performed in the home or referral of patients to an appropriate outpatient laboratory or facility for screening.

Home Phototherapy

The CEAG considered whether a program of home phototherapy would be advantageous in treating hyperbilirubinemia. In 2017, the CEAG reviewed The Maternal-Child Screening Committee's Severe Hyperbilirubinemia Task Force's published Rapid Review on Severe Hyperbilirubinemia (Bhardwaj K, 2017), which looked at this evidence. Based on the evidence reviewed to-date, and the experience of CEAG members with such programs in the community, the CEAG determined that there is insufficient evidence to recommend a home phototherapy program as a core part of this Clinical Pathway or standard of care. While lacking strong evidence to recommend this service, there also does not appear to be strong evidence of harm associated with such programs and the CEAG can see potential benefits to a home phototherapy program in some circumstances. Such a program has the potential to save costs and address gaps in communities where accessing follow-up care could be burdensome to families. If skilled blood sampling for the neonate cannot be offered in the home, many of the benefits of home phototherapy would be negated. These recommendations are unchanged based on the updated literature review.

- The CEAG therefore recommends that in any community implementing a home phototherapy program, a planned evaluation is essential.

Transcutaneous Bilirubin Screening

The CEAG would like to note that both total serum bilirubin (TSB) and transcutaneous bilirubin (TcB) are acceptable methods of bilirubin screening. The published Rapid Review on Severe Hyperbilirubinemia by the Maternal-Child Steering Committee (Bhardwaj K, 2017), found that there is generally a good correlation between TcB and TSB measures. In addition, it has found that TcB is relatively easy to perform, time saving, pain free for the infant and spares blood. Once the initial cost of the machine is accounted for, TcB can be less expensive than TSB depending on the model of machine used. It should be noted, however, that the accuracy of the TcB machine is dependent on regular maintenance and upkeep, thus a quality assurance program would need to be ensured.

If centres choose to use TcB for hyperbilirubinemia screening, the CEAG makes the following recommendations:

- The initial screening TcB should be done PRIOR to the time of the Newborn Screen so that, should a TSB be required, it can be done at the time of the Newborn Screen thus avoiding two blood draws
- If the TcB result is within 50 µmol/L of the phototherapy treatment line, a TSB should be performed immediately. This is recognized to be conservative, however, the evidence of correlation between TcB and TSB is variable and the TcB tends to underestimate TSB to a greater degree at higher (more dangerous) values
- A quality assurance program must be implemented and include calibration and return of the units to the manufacturer for quality assurance as required by the manufacturer's recommendations
- TcB may not be used during or following phototherapy treatment, TSB is required
- **Use of TcB does not replace lab availability and it cannot be used without available laboratory backup**

These recommendations are unchanged based on the updated literature review.

Community Follow-Up Care and Monitoring

Infants discharged and requiring a visit to their health care provider for follow-up would be provided with the right care in the right place via a visit to their primary care provider, a follow-up clinic, or a community health care provider. Routine follow-ups do not usually require the consultation of a paediatiric specialist and should not generally take place in an Emergency Department, although this tends to happen frequently.

- The CEAG therefore recommends, where possible, the use of community health care resources to follow-up infants once discharged. Where community health care resources are not available and infants must return to the hospital, or other acute care facility, the CEAG recommends that protocols be in place to expedite the testing and to avoid infants waiting in general waiting rooms where they may be exposed to risk of infection.

Weekend and Community Lab Access

Access to lab services that will undertake blood work on weekends in the community is currently a major impediment to ensuring the timely screening and monitoring of bilirubin required to deliver the right care, at the right time, in the right place. In addition, most labs have limited experience taking blood samples from newborns.

- In communities where a blended model of hospital and community-based services are available, the CEAG recommends that the community-based services must meet the following criteria:
    - Skilled in obtaining blood from infants
    - Use appropriate pain management
    - Have the ability to deliver lab results within two hours of the blood draw

- Given the early discharge practices of maternal units, the need for standard testing in the newborn (newborn screening, hearing testing, bilirubin) and the fact that many community based services do not operate seven days per week, PCMCH should be asked to convene a task

group that will make recommendations about the best way to achieve consistent high quality testing and timely results reporting in Ontario.

Discharge Documentation

It is important that the health care providers who will be undertaking the follow-up care of the infant be aware of their patient's "bilirubin journey" and any actions taken while in hospital.

- CEAG therefore recommends that, upon discharge, the infant's parents or guardian be provided with materials that document their child's screening and treatment history so that this can be shared with subsequent health care providers (HCP) in order to facilitate care. It is expected that this will decrease the number of repeat bilirubin tests performed after discharge as HCPs will be able to see the trend of values. Refer to section 3.3 for more details.

3.3 Clinical Pathway Documentation

For implementation, the CEAG recommends the clinical pathway and associated graphs/figures be made available as easily reproduced tools for use by front line clinicians.

In addition the CEAG recommends that the plotting of the TSB levels on the *Phototherapy Graph,* the *Hour-Specific Nomogram,* details pertaining to the action and outcome of any treatment decisions (and who they were made by), and the proposed follow-up plan be documented. This information about the infant's "bilirubin journey" should then be provided to parents or guardians either on the discharge summary, or separately once the final bilirubin measure has been taken, as this information is important for infant follow-up care in the community. Examples of suggested discharge summaries will be made available.

3.4 Patient Outcomes

The Clinical Pathway on Management of Hyperbilirubinemia in Term and Late-Pre-Term Infants will improve patient outcomes by ensuring universal screening of all newborns, standardizing the timing of repeat testing, improving the understanding of patient risk and subsequently ensuring that the appropriate risk line is used to determine the need for phototherapy, encouraging creative resource use to facilitate community follow-up after discharge, improving communication between in hospital and community care providers and reminding health care providers when consultation with a paediatrician or neonatologist may be required.

4.0 Implementation of Best Practices

Implementation of best practices to ensure standardized and optimal patient care delivery

Organizations and communities will be able to identify the most appropriate health care provider for the various parts of the pathway for their situation. Of particular importance, successful implementation will require the development of partner relationships with all involved in the pathway (both within the hospital and between the hospital and community health care providers). In developing these relationships, roles and responsibilities should be clearly articulated and agreements should be drawn up if/as necessary, i.e. between inpatient units and community providers or other hospital units/clinics providing care.

Roles of the clinicians and multi-disciplinary teams in implementing the best practices

Clinicians and multi-disciplinary teams will be critical in implementing the Clinical Pathway. Their role is to determine the best way to implement the Clinical Pathway in their unique environment, comparing current practice to the ideal and ensuring optimal environments for care. Team members can include (but are not limited to), perinatal nurses, lactation consultants, midwives and physicians. Much of the screening can be done by nursing staff (provided they have medical directives to order bilirubin screening) until the infant can be seen by a physician.

5.0 What Does It Mean For Multi-Disciplinary Teams?

Implication for multidisciplinary teams

Implementation of the Clinical Pathway should not have a dramatic impact for those organizations that currently follow the Canadian Paediatric Society's (CPS) guidelines for management of hyperbilirubinemia. In some organizations, however, there may be a significant change in clinician work flow if the Clinical Pathway's clinical pathway differs significantly from their current practice:

- Education may be required for clinicians not familiar with the use of the treatment graph or nomographs.
- There may be a change in physician/clinician responsibilities and in referral and consultation patterns as the pathway suggests moving towards follow-up care in community health settings. Community health care providers will likewise be impacted if this recommendation to move follow-up care to them is a change for a given community.
- This may be a change in process for out-of-hospital births (home birth and birth centres)
- There will be either more blood tests, in centres not already doing universal screening, or fewer blood tests, in centres not following standardized recommendations for repeat testing. This will have a direct impact on nursing, phlebotomy services and labs.
- The Clinical Pathway funding should reduce specialist consultation for the interpretation of bilirubin results. Although this is more appropriate practice it will decrease fee-for-service income for some paediatricians.

Alignment with clinical practice

The Clinical Pathway care pathway is in alignment with the guidelines for the management of hyperbilirubinemia published by the CPS. Additional details intended to guide clinical practice are provided by the expert opinion of the CEAG. Use of the Clinical Pathway will therefore promote further standardization of practice across hospital settings, reducing the areas for possible practice variance not addressed by the guidelines.

Impact on current clinical practice

For those that do follow the CPS guidelines the change should not be dramatic, however, there may be changes regarding work flow and responsibilities for some health care providers.

In hospitals and out-of-hospital birth settings that do not follow the CPS guidelines the implementation of this Clinical Pathway may be a significant change in clinical practice and may require change management strategies and education regarding the use of the nomograph and treatment graphs in order for it to be successful. There may also be changes to documentation following the recommendation for screening information to be provided to the patient's parent or guardian.

6.0 Membership

Provincial Council for Maternal and Child Health Paediatric Hyperbilirubinemia Clinical Pathway Refresh 2016/17 Clinical Expert Advisory Group			
Name	**Title**	**Organization**	**LHIN**
Pervez Z. Faruqi	Paediatrician	Chatham-Kent Health Alliance	1
Paul Dick	Paediatrician, Chief of Paediatrics	Grey Bruce Health Services	2
Tamar Packer	Family Physician, Medical Director, Newborn Care	St. Joseph's Healthcare Hamilton	4
Andrea Temple	RN, Manager, Paediatrics/NICU	William Osler health System	5
Jane Healey	Paediatrician	Trillium Health Partners	6
Elliot Archer	Program Manager	Trillium Healthcare Partners	6
Roxana Kobuta	Analyst	Trillium Healthcare Partners	6
Michael Sgro	Paediatrican	St Michael's Hospital	7
Vibhuti Shah	Neonatologist	Mout Sinai Health System	7
Charmaine van Schaik	Paediatrician, Chief of Paediatrics	Southlake Regional Health Centre	8
Angie Stein	RN, Birthing Centre (BORN Lead)	Rouge Valley Health System	9
Robert Connelly	Neonatologist	Kingston General Hospital/ Hotel Dieu Hospital	10
JoAnn Harrold	Neonatologist **Chair**	Children's Hospital of Eastern Ontario	11
Liz Darling	Midwife	Ottawa	11
Andrea Mills	Midwife	Royal Victoria Hospital, Barrie	12
Angie Wiwczor	Nurse Practitioner, Family Child Program	Health Sciences North	13
Linsey Mutch	Paediatrician	North Bay Regional Health	13
Sandy Dunn	RN, PhD Knowledge Translation Specialist	BORN Ontario	
Julian Little	Professor and Chair, Dept. of Epidemiology & Community Medicine (Canada Research Chair in Human Genome Epidemiology)	Maternal-Child Screening Committee	
Riffaat Mamdani	Program Consultant, Child Development Unit	Ministry of Children and Youth Services	
Jeni Millian	Client Services Manager	South West Community Care Access Centre, London Office	
Secretariat			
Doreen Day	Senior Project Manager	PCMCH	
Anna Bucciarelli	Senior Project Manager	PCMCH	

Provincial Council for Maternal and Child Health Paediatric Hyperbilirubinemia QBP (2015) Clinical Expert Advisory Group			
Name	**Title**	**Organization**	**LHIN**
Pervez Z. Faruqi	Paediatrician	Chatham-Kent Health Alliance	1
Paul Dick	Paediatrician, Chief of Paediatrics	Grey Bruce Health Services	2
Charlotte Etue	CNS, Childbirth Program, NICU **Co-Chair**	Grand River Hospital	3
Tamar Packer	Family Physician, Medical Director, Newborn Care	St. Joseph's Healthcare Hamilton	4
Andrea Temple	RN, Manager, Paediatrics/NICU	William Osler health System	5
Jane Healey	Paediatrician	Trillium Health Partners	6
Luca Simonetto	Senior Analyst, Strategy Management Office	Trillium Health Partners	6
Michael Sgro	Paediatrician	St. Michael's Hospital	7
Vibhuti Shah	Neonatologist	Mount Sinai Hospital	7
Charmaine van Schaik	Paediatrician, Chief of Paediatrics	Southlake Regional Health Centre	8
Robert Connelly	Neonatologist	Kingston General Hospital/ Hotel Dieu Hospital	10
JoAnn Harrold	Neonatologist **Co-Chair**	Children's Hospital of Eastern Ontario	11
Liz Darling	Midwife	Ottawa	11
Andrea Mills	Midwife	Royal Victoria Hospital, Barrie	12
Angie Wiwczor	Nurse Practitioner, Family Child Program	Health Sciences North	13
Linsey Mutch	Paediatrician	North Bay Regional Health	13
Sandy Dunn	RN, PhD Knowledge Translation Specialist	BORN Ontario	
Julian Little	Professor, School of Epidemiology, Public Health and Preventive Medicine (Canada Research Chair in Human Genome Epidemiology)	Maternal-Child Screening Committee	
Riffaat Mamdani	Program Consultant, Child Development Unit	Ministry of Children and Youth Services	
Secretariat			
Marilyn Booth	Executive Director	PCMCH	
Doreen Day	Senior Project Manager	PCMCH	

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Appendix A – Description of Levels of Evidence

Organization	Canadian Paediatric Society (CPS)	
Guideline Name	Guideline for Detection, Management and Prevention of Hyperbilirubinemia in Term and Late Preterm Newborn Infants	
Evidence Grading Method	Oxford Centre for Evidence-Based Medicine – Levels of Evidence (Centre for Evidence Based Medicine, 2013)	
Grades	A: Consistent level 1 studies	1a – SR (with homogeneity) of RCTs 1b – Individual RCT (with narrow confidence interval) 1c – All or none
	B: Consistent level 2 or 3 studies	2a – SR (with homogeneity) of cohort studies 2b – Individual cohort study 2c – "Outcomes" research 3a – SR (with homogeneity) of case-control studies 3b – Individual case-control studies
	C: Level 4 studies	4 – Case-series (and poor quality cohort and case-control studies)
	D: Level 5 evidence or troublingly inconsistent or inconclusive studies of any level	Expert opinion without explicit critical appraisal or based on physiology, bench research or "first principles"

Organization	American Academy of Pediatrics (AAP)	
Guideline Name	Management of Hyperbilirubinemia in the Newborn Infant 25 or More Weeks of Gestation	
Evidence Grading Method	AAP Steering Committee on Quality Improvement and Management (American Academy of Pediatrics Steering Committee on Quality Improvement and Management, 2004)	
Grades	A: Well designed, RCTs or diagnostic studies on relevant populations	Preponderance of Benefit or Harm: Strong Recommendation Balance of Benefit and Harm: Option
	B: RCTs or diagnostic studies with minor limitations overwhelmingly consistent evidence from observational studies	Preponderance of Benefit or Harm: Strong Recommendation/ Recommendation Balance of Benefit and Harm: Option
	C: Observational studies (case control and cohort design	Preponderance of Benefit or Harm: Recommendation Balance of Benefit and Harm: Option
	D: Expert opinion case reports, reasoning from first principals	Preponderance of Benefit or Harm: Option Balance of Benefit and Harm: No Recommendation
	X: Exceptional situations where validating studies cannot be performed and there is clear preponderance of benefit or harm	Preponderance of Benefit or Harm: Strong Recommendation/ Recommendation

Organization	National Institute for Clinical Evidence (NICE)	
Guideline Name	Neonatal Jaundice	
Evidence Grading Method	NICE Clinical Guideline Development Methods (National Institute for Clinical Evidence, 2013) **Used to rate studies, but not to assign a grade to a recommendation**	
	For Intervention Studies	
	1++	High-quality meta-analyses, systematic reviews of randomized controlled trials (RCTs), or RCTs with a very low risk of bias
	1+	Well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias
	1-	Meta-analyses, systematic reviews of RCTs, or RCTs with a high risk of bias
	2++	High-quality systematic reviews of case–control or cohort studies; high-quality case–control or cohort studies with a very low risk of confounding, bias or chance and a high probability that the relationship is causal
	2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias or chance and a moderate probability that the relationship is causal
	2-	Case–control or cohort studies with a high risk of confounding, bias or chance and a significant risk that the relationship is not causal
	3	Non-analytical studies (e.g. case reports, case series)
	4	Expert opinion, formal consensus
	For Diagnostic Tests	
	Ia	Systematic review (with homogeneity) of level-1 studies
	Ib	Level-1 studies
	II	Level-2 studies systematic reviews of level-2 studies
	III	Level-3 studies systematic reviews of level-3 studies
	IV	Consensus, expert committee reports or opinions and/or clinical experience without explicit critical appraisal; or based on physiology, bench research or 'first principles'

Appendix B - Performance Evaluation Metrics

The following are the proposed evaluation metrics for the pediatric Clinical Pathway on Management of Hyperbilirubinemia in Term and Late Pre-Term Infants (≥ 35 weeks). The metrics refer to the population as defined in Section 2 of this handbook.

	Evaluation Metric	Domain	Relevance	Rationale	Feasibility/ Data Source
1	Percent infants receiving a bilirubin measurement in the first 72 hours of life	Effectiveness	Clinicians Administrators LHINs	To determine if the Clinical Pathway is being followed. With the Clinical Pathway in place, all babies (100%) should receive bilirubin testing in the first 72 hours of life.	BORN BIS
2a	Percent infants with severe hyperbilirubinemia	Effectiveness	Clinicians Administrators LHINS	Infants with severe hyperbilirubinemia are likely those who were missed by bilirubin screening/the Clinical Pathway. This indicator will be most useful/prevalent in cases of readmission.	BORN BIS (for measures during initial hospital stay) Capture of bilirubin measures during readmit visit (i.e. via DAD)
2b	Percent infants with critical hyperbilirubinemia	Effectiveness	Clinicians Administrators LHINS	See 2a. In addition, if linked with readmissions can be used for monitoring and tracking	BORN BIS
3	Percent infants who require phototherapy	Appropriateness	Administrators LHINS	To determine baseline numbers of infants requiring phototherapy	BORN BIS
4a	Length of Stay	Appropriateness	Administrators LHINS	To determine the initial LOS of infants who develop hyperbilirubinemia during their birth hospitalization prior to discharge	DAD BORN
4b	Total Hospital Days LOS	Effectiveness Appropriateness	Administrators LHINS	To determine total LOS associated with a diagnosis of hyperbilirubinemia. Can also be a proxy for complex/serious cases, or those who may not have followed the Clinical Pathway	DAD DAD linked with BORN
5a	Number of readmissions within 14 days of birth for hyperbilirubinemia	Integration	Administrators LHINS	To determine total number of hospital admissions associated with a diagnosis of hyperbilirubinemia which may indicate proper use of the Clinical Pathway	DAD?
5b	Number of readmissions within 14 days of birth for	Integration	Administrators LHINS	To determine total number of hospital admissions associated with a diagnosis of	DAD?

	Evaluation Metric	Domain	Relevance	Rationale	Feasibility/ Data Source
	severe hyperbilirubinemia			severe hyperbilirubinemia which may indicate failure of the system/cases that were missed by the Clinical Pathway	
6	Per case direct cost	Efficiency	Administrators LHINS	To determine if costs are coming in at par with Clinical Pathway	Ontario Case Costing Initiative (OCCI) Database
7	Percent infants requiring exchange transfusion or IVIG for hyperbilirubinemia	Effectiveness	Clinicians Administrators LHINS	Infants requiring exchange transfusion or IVIG therapy represent the most severe cases and may representing failure of the system/ Clinical Pathway	BORN BIS
8	Percent exclusive Breastfeeding versus Supplementation during phototherapy	Appropriateness	Patients Clinicians Administrators	A measure of variation in practice across hospitals	BORN?
9a	Number of ED visits within 14 days of discharge	Effectiveness Integration Appropriateness	Clinicians Administrators	To determine ED resource utilization by this population	NACRS linked with DAD or BORN BIS
9b	Number of walk-in clinic or other clinic visits within 14 days of discharge	Effectiveness Integration	Clinicians Administrators	To determine walk-in clinic resource utilization by this population	OHIP Billing Data This indicator would only capture physician visits, not clinic or nursing visits.
10	Number of follow-up physician visits or repeat visits?	Integration Appropriateness	Administrators LHINS	To determine where patients are going for follow-up visits. May also determine physician over-use in areas where multidisciplinary or nurse-led clinics/services are available	OHIP Billing Data


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