

Pulse Oximetry Screening in Newborns to Enhance the Detection Of Critical Congenital Heart Disease

Frequently Asked Questions

Current Recommendation:

The current recommendation from the **Canadian Cardiovascular Society (CCS)**, **Canadian Pediatric Cardiology Association (CPCA)**, and the **Canadian Pediatric Society (CPS)** is that pulse oximetry screening should be routinely performed in all healthy newborns to enhance the detection of critical congenital heart disease (CCHD) in Canada.

CCHD are those heart conditions that require surgical intervention during the first few weeks of life. Pulse oximetry is widely available, non-invasive, and easy to perform. Implementing pulse oximetry screening on newborns, in addition to prenatal ultrasound and a newborn physical assessment, equates best practice for detecting CCHD.

The Reproductive Care Program of Nova Scotia has been working with physicians from IWK Pediatric Cardiology and Neonatology to support the implementation of pulse oximetry screening for all healthy newborns in Nova Scotia based on the protocol outlined in the **2016 CCS/CPCA Position Statement on Pulse Oximetry Screening in Newborns to Enhance Detection of Critical Congenital Heart Disease**.

* Providers are cautioned that this is a screening test only, and a normal screen does not rule out all forms of cardiovascular disease and does not eliminate the need for ongoing cardiac assessments as part of newborn care.

Performing the screening test

What babies should be screened?

All newborns should be considered for screening at 24 hours of age. Babies with a prenatal diagnosis of congenital heart disease would be excluded from screening. If a baby is admitted to the nursery or intensive care for a period, the oxygen saturation should be rechecked at 24 hours. If a baby remains in nursery or NICU at 24-36 hours, screening would be done if clinically appropriate.

Why screen the hand and foot?

Screening the hand and foot increases the sensitivity of detecting CCHD. The oxygen saturation in the pre-ductal (right hand) and post-ductal (either foot) sites represent the degree of right to left shunting across a patent ductus arteriosus, which is common in many types of CCHD. Pulse oximetry screening of two limbs is much more helpful for early detection of these variances.

Does it matter which limb – right hand or either foot – is screened first?

No, you can screen either the right hand or either foot first, followed by screening of the second limb. And, you do not need to screen the two limbs simultaneously. Results will not be affected.

Will this added step increase the staff time required for screening?

Two limb screening has been reported to add up to one minute to perform in comparison to one limb only. All other aspects to performing the screening, such as collecting the necessary equipment and documentation, remain the same. In centers that are currently providing one limb screening, staff likely won't see a substantial change in the time required.

What if a mother and newborn are discharged before 24 hours?

Screening is recommended between 24–36 hours. Screening earlier than 24 hours increases the false positive rate because a low saturation, in the absence of other signs of respiratory distress or compromise, could be from the transitional circulation and not CCHD.

In planning for a family who wishes for discharge prior to 24 hours of age, it is better to screen the newborn prior to discharge than to miss the opportunity for early identification of CCHD. Therefore, a newborn should be offered pulse oximetry screening before an early discharge. A normal result prior to 24 hours is considered a normal, or passed, screen.

If the patient is discharged without screening, the family should be provided with information to return directly to the emergency department if they notice any signs of cyanosis or shortness of breath.

Should babies be screened with a planned home delivery?

Yes, screening should be included as part of the newborn care in a way that fits best with the current care processes for planned home deliveries. If screening is done prior to 24 hours the same considerations for false positive results described above would apply. Screening could also be timed with a follow up visit that occurs between 24-48 hours. If a newborn fails the screening test, care providers should make an urgent consult to a physician for assessment and follow-up using the same processes currently in place for an unwell newborn (ex. access through the emergency department).

Interpreting the results

If screening on one limb (right hand or either foot) yields an abnormal result (<90%), is it necessary to carry out the screening on the second limb?

Yes. While an abnormal result on one limb is a failed screen and warrants further evaluation, having results from both limbs is an important part of the overall assessment.

Why does a normal screen depend on two measurements: a saturation of at least 95% and the difference between the right hand and one lower limb saturation?

Many types of CCHD present with above normal variation between the pre- and post-ductal saturations, even with both values above 95%. Evaluating only one limb would miss some newborns with CCHD. In particular, with coarctation of the aorta (COA), which remains one of the most common lesions to be missed with all detection methods, a lower oxygen saturation value may be seen in the foot versus the hand.

As long as there is $\leq 3\%$ difference between the SpO₂ values in the two limbs AND one of the values is $\geq 95\%$, the result is normal. An interpretation table has been developed to help with understanding results.

		RIGHT HAND												
		%	100	99	98	97	96	95	94	93	92	91	90	89
ONE FOOT	100	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	99	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	98	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	97	PASS	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	96	REPEAT	PASS	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	95	REPEAT	REPEAT	PASS	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	FAIL
	94	REPEAT	REPEAT	REPEAT	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	93	REPEAT	REPEAT	REPEAT	REPEAT	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	92	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	91	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	90	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
89	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	

Ref: Wong, K. et al. (2017). CCS/CPCA position statement on pulse oximetry screening in newborns to enhance detection of critical congenital heart disease.

PASS = Normal

REPEAT = Borderline

FAIL = Abnormal

89	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL
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The specific oxygen saturation values are important in interpreting the results. Let's consider the following

		RIGHT HAND												
		%	100	99	98	97	96	95	94	93	92	91	90	89
ONE FOOT	100	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	99	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	98	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	97	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	96	REPEAT	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	FAIL
	95	REPEAT	REPEAT	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	FAIL
	94	REPEAT	REPEAT	REPEAT	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	93	REPEAT	REPEAT	REPEAT	REPEAT	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	92	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	91	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	90	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	89	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL

scenarios:

- If, for example, the SpO2 for both limbs is between 90-94% - the screening result is BORDERLINE (on a first or second screening) and the test should be repeated.

		RIGHT HAND												
		%	100	99	98	97	96	95	94	93	92	91	90	89
ONE FOOT	100	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	99	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	98	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	97	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	96	REPEAT	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	FAIL
	95	REPEAT	REPEAT	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	FAIL
	94	REPEAT	REPEAT	REPEAT	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	93	REPEAT	REPEAT	REPEAT	REPEAT	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	92	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	91	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	90	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	89	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL

- If, for example, the two limb results are 96% and 93% - the screening result is NORMAL. Rationale: $\geq 95\%$ in right hand or foot, and $\leq 3\%$ different between the two values.

		RIGHT HAND												
		%	100	99	98	97	96	95	94	93	92	91	90	89
ONE FOOT	100	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	99	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	98	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	97	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	FAIL
	96	REPEAT	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	FAIL
	95	REPEAT	REPEAT	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	REPEAT	REPEAT	FAIL
	94	REPEAT	REPEAT	REPEAT	PASS	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	93	REPEAT	REPEAT	REPEAT	REPEAT	PASS	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	92	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	PASS	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	91	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	90	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	REPEAT	FAIL
	89	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL	FAIL

- If, for example the two limb results are 97% and 93% - the screening result is BORDERLINE (on a first or second screening). Rationale: the difference between the two values is $>3\%$.
- Any SpO2 value $<90\%$, at any time, is automatically **ABNORMAL**. Further assessment is required by the most responsible health care provider, as determined by your facility.

If a healthy newborn, who otherwise appears well, has one borderline screen and the repeat screen is normal, is a third screen required?

No, a third screen is not required in this scenario. If a newborn has a normal result on any of the first, second, or third screening there is no further follow up required. As long as the newborn appears well, continue with normal newborn care.

I am concerned about a newborn who has borderline results on the first and second testing, then passes with normal values on the third testing. Should I trust only one normal screen?

The purpose of repeat screening is to allow more time for the baby's circulation to adapt to the extra-uterine environment. Pulmonary vascular resistance in a newborn falls over time which is why screening is recommended between 24-36 hours of life to reduce the number of false positive screens. The screening protocol recommended by the Canadian Cardiovascular Society (CCS) and Canadian Pediatric Cardiology Association (CPCA), which has been endorsed by the Canadian Pediatric Society (CPS), has been well studied and has a very low rate of false negatives (meaning newborns with a normal screening result who are later diagnosed with a congenital heart defect).

Monitoring of a Baby Awaiting Retest

What type of monitoring is required for a baby with a borderline screening during the hour they are awaiting repeat screening?

As long as the baby appears well, the baby can receive routine care with mother. If at any time the baby has any concerning signs or symptoms the family should notify their care provider and normal facility protocols should be followed for newborn care.

Providing families with information about the three-step screening process, which allows time for normal newborn transition, should help alleviate any concerns they may have about borderline screening results.

Monitoring and Follow Up of Abnormal Results

What is the most appropriate course of action in caring for a newborn with an abnormal result?

Any newborn with an abnormal result/failed screen requires a comprehensive assessment by the most responsible health care provider. The current practices for managing an abnormal screen have been working well. The main benefit of a screening protocol with improved sensitivity is to better identify those babies with cyanosis due to a congenital heart defect that was not diagnosed prenatally.

There are different provider groups and resources in each health care center/regional hospital. It is important to have a follow up plan that would make the most sense within the care context for each site, including who would be the most appropriate provider to assess babies with abnormal screens. IWK Pediatric Cardiology is available to discuss any screening results or individual cases to advise on how to proceed with management and referral. Newborn care providers should call the IWK and ask for the Pediatric Cardiologist on call.

Documenting Results

Where do I document screening results?

Screening results should be documented on the Newborn Admission/Discharge form (RCP/08). The date and time screening was completed, along with the result as "PASS", "REFERRED", "DECLINED", or "NOT CLINICALLY APPROPRIATE", can be recorded in the area under Newborn Screening for "Other Test Results". Additional documentation, as needed, to communicate further monitoring, symptoms, care, family education or follow-up should follow hospital policies and meet minimum documentation standards.



RCP will begin to collect information about Pulse Oximetry/CCHD Screening in the Atlee Perinatal Database in April 2018. The Newborn Admission/Discharge Form (RCP/08) will have minimal revisions before that time support documentation of screening results and information collection.

Additional Concerns

Will screening pick up all cases of CCHD?

Newborns with normal screening results are unlikely to have one of the twelve CCHD lesions that have been found to be detectable with pulse oximetry screening; but normal pulse oximetry screening does not exclude ALL forms of congenital heart disease. The false negative rate is low but could occur in a newborn that does not begin to decompensate until the closure of the ductus arteriosus. It is very important not to ignore other clinical findings that could point to a heart problem (ex. a harsh murmur, or increased work of breathing) even after a normal screening result. While not relevant during the first few days of life while in hospital, screening is not meant to and will not detect a newborn with a large ventricular septal defect that could lead to heart failure during the first few weeks of life. This highlights the importance of ongoing assessments for signs of cardiac disease as part of normal newborn care.

Will a false positive screen add additional stress on families?

The rate of false positive screens is very low at 2-12 per 10,000 newborns and is greatly reduced with the timing of screening performed between 24-36 hours of age. For perspective, in Nova Scotia the average number of births each year is less than 9,000 so there could be as low as one false positive screening in a given year.

It is also important to note that abnormal pulse oximetry results could detect other causes of hypoxemia requiring intervention, such as infections and respiratory disorders. Families should be reassured that with any suspect result, reliable assessments by the most appropriate practitioners and follow up plan will provide their newborn with the best care for timely interventions if needed.

Can a family refuse screening?

Families have the right to refuse any care offered while admitted to your facility. The care provider should ensure the family has been fully informed about the purpose and process of screening. Though the incidence of CCHD is low, if not detected early there is a risk of circulatory collapse and increased morbidity and mortality. Approximately 70% of defects are diagnosed during the antenatal period by ultrasound, but the remaining cases are identified in neonates. This non-invasive screening would help identify early signs of disease and lead to more timely intervention and improved outcomes for those who need it.

If a family does make a fully informed decision to refuse screening, they should be provided with information to return directly to the emergency department if they notice any signs of cyanosis or shortness of breath.

If I have other questions or concerns, who do I ask?

For questions about hospital specific policies and processes related to CCHD screening – contact the unit managers and clinical leads within your facility.

For general questions or concerns related to implementation and ongoing evaluation of the screening protocol within your facility – the Perinatal Nurse Consultants at RCP are available for support.



Phone: 902-470-6798

Email: rcp@iwk.nshealth.ca



For questions and concerns specific to the care of a newborn with concerning screening results or symptoms – contact the IWK Pediatric Cardiologist on call.

IWK Switchboard: 902-470-8888