**Clinical Practice Guideline**
**March 2018**

# Pulse Oximetry Screening for Critical Congenital Heart Disease in Newborns

## Overview:

Congenital heart defects are malformations of the heart or major blood vessels that occur before birth. Many of these newborns show no signs of clinical deterioration in the first days of life and thus may be discharged from hospital before signs of disease are detected. Congenital heart defects account for 27% of infant deaths caused by birth defects and are responsible for more deaths than any other type of malformation.

One quarter of infants with a congenital heart defect will be diagnosed with critical congenital heart disease (CCHD), a life threatening condition requiring surgery or catheter intervention in the first year of life. Presentation of CCHD can be sudden and catastrophic with the closing of the ductus arteriosus and physiologic changes in the heart after birth. Early recognition of CCHD can help to ensure timely intervention and treatment and reduce morbidity and mortality.

The measurement of blood oxygen saturation levels can lead to early detection and diagnosis of CCHD. Once detected, many heart defects can be surgically repaired with 85% survival to adulthood. Pulse oximetry is a low-cost, non-invasive and painless test that can be performed by the bedside clinician prior to discharge from hospital. Pulse oximetry screening may identify 20-25% of CCHD cases not identified by prenatal ultrasound screening or physical assessment.

## Purpose:

To provide a guideline for pulse oximetry screening (POS) of healthy term and late preterm newborn infants prior to discharge as an additional assessment tool to detect possibility of CCHD.

## Guideline:

1. POS is an adjunct to prenatal ultrasound and post-natal physical examination to increase the detection of CCHD.
2. All healthy term and late preterm infants ($34^{+0}$ weeks' gestation and greater) should be screened for CCHD between 24-36 hours of age.
3. If discharge is to occur before 24 hours of age, infants should have POS performed as close to the time of discharge as possible.
4. Infants prenatally diagnosed with CCHD will not require POS for CCHD.
5. Infants requiring supplemental oxygen will be screened when supplemental oxygen has been discontinued for a period of 24 hours and infant is still less than 7 days old.
6. The Most Responsible Physician (MRP) is responsible for reviewing screening results and signing POS form prior to discharge.

## Procedure

Pulse oximetry screening will be completed by staff who have been educated in the use of the Pulse Oximetry Screening for CCHD Algorithm (Appendix A), the CCHD Evaluation Chart (Appendix B) and trained to perform pulse oximetry monitoring.

Pulse Oximetry screening should be done using motion-tolerant pulse oximeters that report functional oxygen saturation and cleared by the FDA for use in newborns.

- Disposable or reusable probes may be used.
- Use manufacture-recommended pulse oximeter-probe combinations.
- Perform pulse oximetry on infant between 24 and 36 hours of age. Screening between 24 and 36 hours of age allows for flexibility, such that testing can be incorporated into the daily schedule and not need to be completed overnight or early in the morning, when a positive result could impact workload and resources.
- For infants discharged before 24 hours of age, perform pulse oximetry as near to the time of discharge as possible.

- Perform test when baby is alert but quiet, preferably following a feeding but before the infant has returned to sleep. The infant must be relatively quiet with minimal motion activity to ensure an accurate reading.
- Measure pulse oximetry on right hand (pre-ductal) and either right or left foot (post-ductal).
- Measurements are obtained one immediately after the other.
- Ensure good pulse waveform and signal strength with correlation to the pulse rate (on equipment where waveform technology is available).
- If waveform technology is unavailable, the pulse oximetry probe must be kept in place for a minimum of 1-2 minutes to ensure accuracy. Heart rate measurement on the pulse oximeter must be correlated by auscultation of the apex.
- **Once a reliable signal is obtained, monitor readings for 30 seconds and record the highest oxygen saturation obtained during that interval for each site (right hand and one foot).**
- Interpret results according to *Pulse Oximetry Screening for CCHD Algorithm* **(Appendix A)** and *CCHD Evaluation Chart* **(Appendix B).**
- Document results on form or mode of documentation approved for use within respective health authority.

**FIRST SCREEN**

- Between 24 to 36 hours of age or
- Shortly before discharge if less than 24 hours of age

**Pulse oximetry result:**

**Greater than or equal to 95% in right hand OR either foot with a less than or equal to 3% difference between right hand and foot:**

- Infant has **PASSED**, no further follow up needed.

**Between 90-94% in right hand AND either foot OR greater than 3% difference between right hand and foot:**

- **REPEAT** screen in one hour

**Less than 90% in right hand OR either foot:**

- **REFER** – immediate physician assessment required.

**First Screen result:**

| | |
|---|---|
| Oxygen saturation is greater than or equal to 95% in the right hand or either foot **AND** with less than or equal to 3% difference in oxygen saturation between the right hand and foot. | **PASS** |
| Oxygen saturation is 90-94% on both extremities (right hand and either foot) **OR** the pulse oximetry difference in oxygen saturation is greater than 3% between the right hand and either foot. | **REPEAT IN 1 HR** |
| Oxygen saturation is less than 90% in the right hand **OR** either foot at any stage of the screening | **REFER** |

**SECOND SCREEN** (one hour following first screening if indicated)

**Pulse oximetry result:**

**Greater than or equal to 95% in right hand OR either foot with a less than or equal to 3% difference between right hand and foot:**

- Infant has **PASSED**, no further follow up needed.

**Between 90-94% in right hand AND either foot OR greater than 3% difference between right hand and foot:**

- **REPEAT** screen in one hour

**Less than 90% in right hand OR either foot**

- **REFER** – immediate physician assessment required

**Second Screen ONE HOUR LATER (IF INDICATED BY INITIAL SCREEN) result:**

| | |
|---|---|
| Oxygen saturation is greater than or equal to 95% in the right hand or either foot **AND** with less than or equal to 3% difference in oxygen saturation between the right hand and foot. | **PASS** |
| Oxygen saturation is 90-94% on both extremities (right hand and either foot) **OR** the pulse oximetry difference in oxygen saturation is greater than 3% between the right hand and either foot. | **REPEAT IN 1 HR** |
| Oxygen saturation is less than 90% in the right hand **OR** either foot at any stage of the screening | **REFER** |

**THIRD SCREEN:** (one hour following second screening if indicated)

**Result:**

**Greater than or equal to 95% in right hand OR either foot with a less than or equal to 3% difference between right hand and foot:**

- Infant has **PASSED**, no further follow up needed.

**Between 90-94% in right hand AND either foot OR greater than 3% difference between right hand and foot:**

- **REFER** – immediate physician assessment required

**Less than 90% in right hand OR either foot**

- **REFER** – immediate physician assessment required

**Third Screen ONE HOUR LATER (IF INDICATED BY THE SECOND SCREEN) result:**

| | |
|---|---|
| Oxygen saturation is greater than or equal to 95% in the right hand or either foot **AND** with less than or equal to 3% difference in oxygen saturation between the right hand and foot. | **PASS** |
| Oxygen saturation is 90-94% on both extremities (right hand and either foot) **OR** the pulse oximetry difference in oxygen saturation is greater than 3% between the right hand and either foot. | **REFER** |
| Oxygen saturation is less than 90% in the right hand **OR** either foot at any stage of the screening | **REFER** |

**Summary of results**:

Screen is considered a **PASS** (no further screening required) if:

a) Oxygen saturation is greater than or equal to 95% in right hand **OR** either foot with less than or equal to a 3% difference in oxygen saturation between right hand and foot.

Screen is considered **a REFER** (further evaluation required) if:

a) Oxygen saturation is less than 90% in right hand or either foot at any stage of screening.
b) Oxygen saturation is between 90% and 94% on both extremities for three consecutive measures each separated by one hour.
c) There is greater than a 3% difference in oxygen saturation between the right hand and either foot on three consecutive measures each separated by one hour.
d) There is a combination of (b) and (c) on three consecutive measures each separated by one hour.

**Management of a REFER result**

**NURSING**

- Immediately notify MRP of newborn with a REFER result on pulse oximetry screen.
- Obtain vital signs including:
  - heart rate(HR)
  - respiratory rate (RR) and assessment of work of breathing
  - axilla temperature
  - four (4) limb blood pressure including mean BP
- initiate continuous pre-ductal pulse oximetry monitoring

**Most Responsible Physician (MRP)**

- Following notification, clinical assessment by MRP required as soon as possible.
- Clinical evaluation should include:
  - assessment of perfusion
  - palpation/assessment of femoral and brachial pulses
  - CXR
  - Blood gas analysis
- If a non-cardiac explanation for hypoxemia is not identified following a complete examination, CCHD must be excluded. Consultation with Neonatologist on call at the Janeway Children's Health and Rehabilitation Centre is strongly recommended.
- Determine course of action based on consultation and resources available.
- Continuous pulse oximetry monitoring and vital signs with clinical assessment at a minimum of every 4 hours recommended until neonatal transport if indicated.

**References:**


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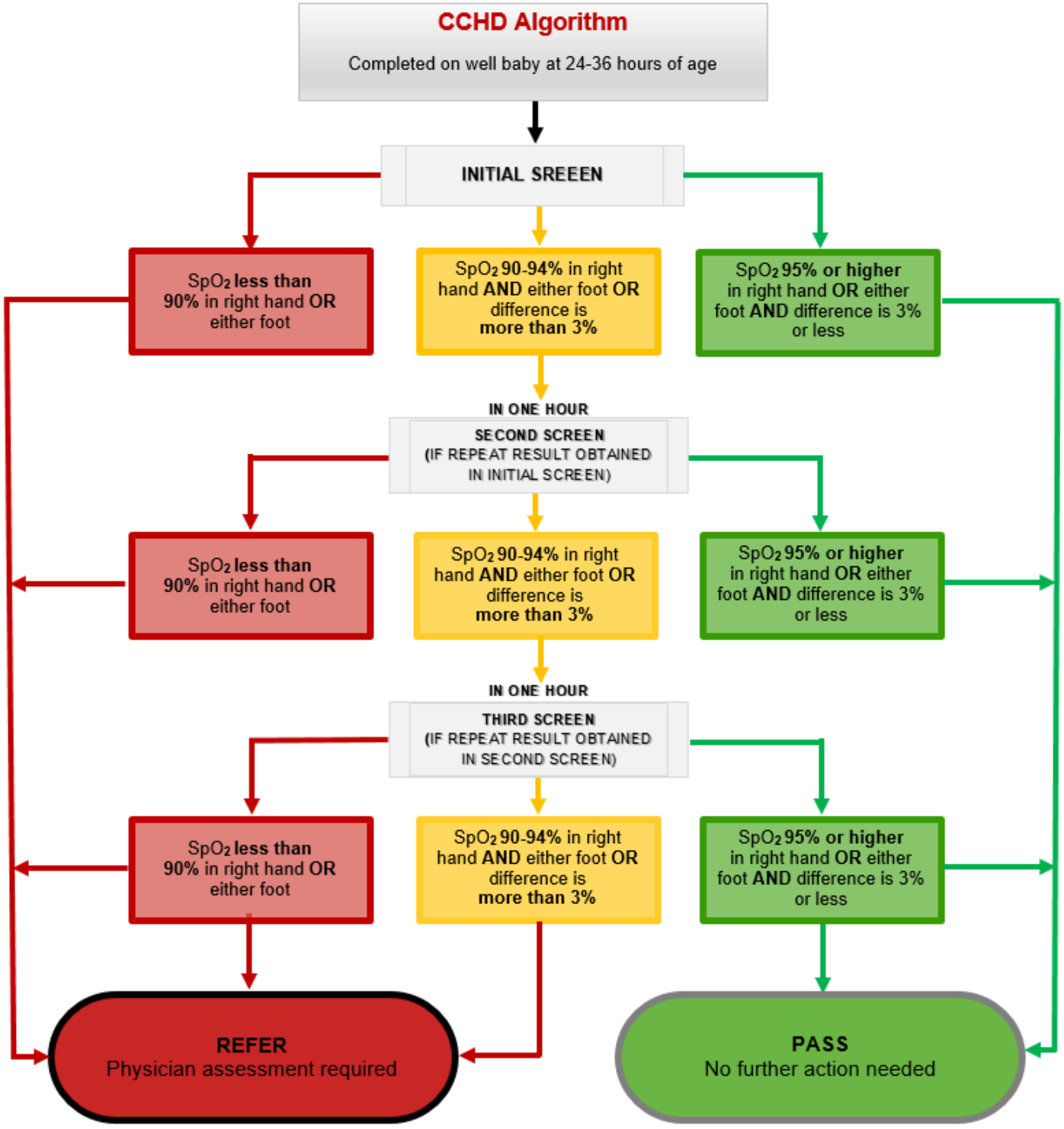
## APPENDIX A: Pulse Oximetry Screening for CCHD Algorithm

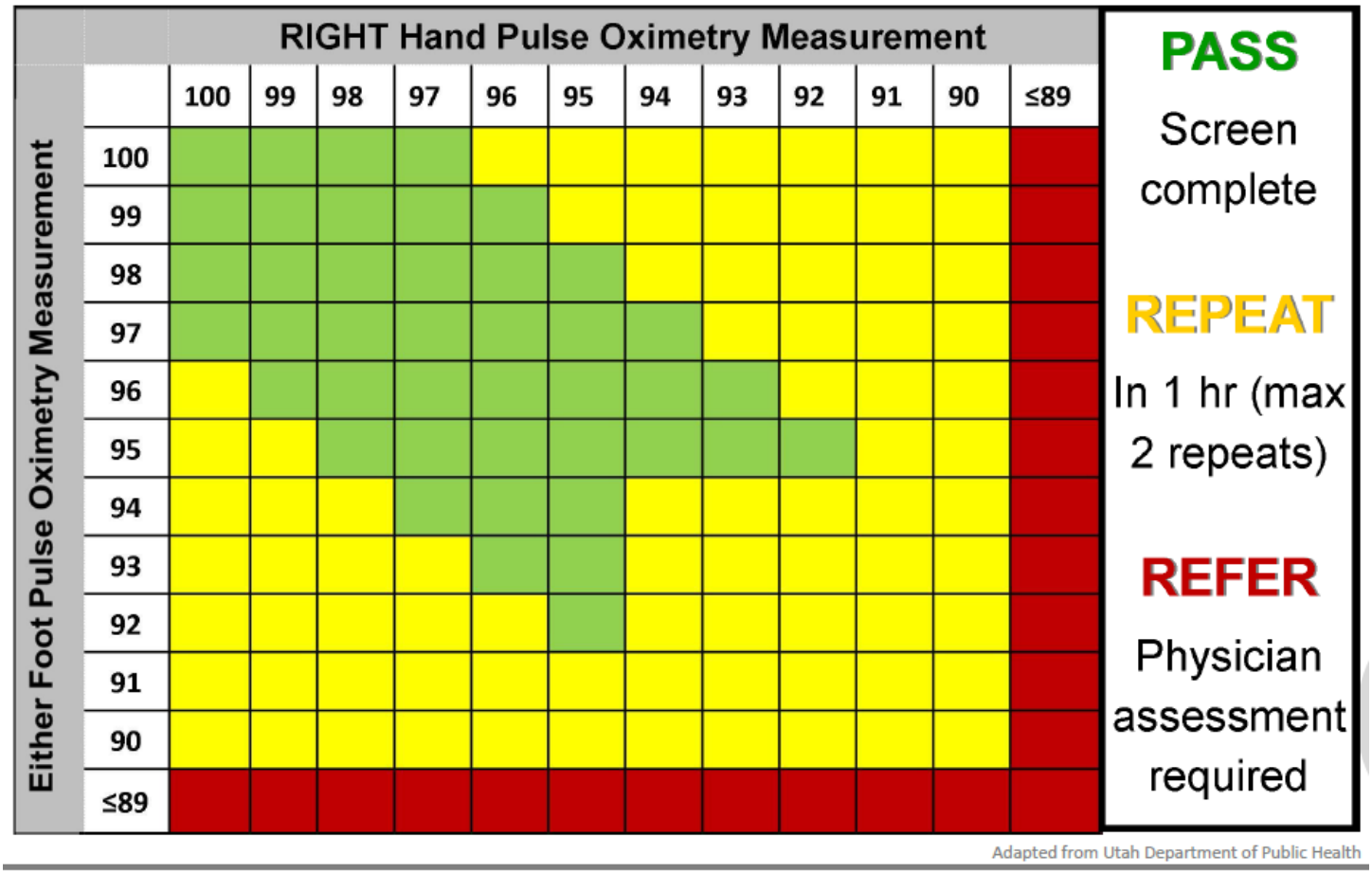



**Adapted with permission from Newborn Screening Ontario**

**APPENDIX B: Pulse Oximetry Screening Evaluation Chart**

The following chart compliments the Algorithm (Appendix A):

1. Follow the pre-ductal or right hand value across the top.
2. Follow the post-ductal or either foot value along the left side.
3. Find the intersecting point and note the color of the box for the result of the screen.




**Results:**

- **Green** means **PASS.** Screen in complete.
- **Yellow** means **REPEAT** in one hour unless this is the third screen, then **REFER**
- **Red** is an immediate **REFER** – notify the Most Responsible Physician for immediate clinical assessment.