# PULSE OXIMETRY SCREENING FOR DETECTION OF CRITICAL CONGENITAL HEART DISEASES IN NEWBORNS

## Introduction

The incidence of moderate to severe congenital heart disease is estimated to be 6/1000 live births with duct dependent critical congenital heart diseases (CCHDs) being present in 2-3/1000 live births1. The CCHDs that are of concern include, hypoplastic left heart syndrome, pulmonary atresia (with intact septum), tetralogy of Fallot, total anomalous pulmonary venous return, transposition of the great arteries, tricuspid atresia and truncus arteriosus[2]. Cardiovascular malformations account for 6-10% of all infant deaths and 20-40% of deaths caused by congenital malformation[3]. Pulse oximetry non-invasively checks the oxygen saturation of the baby. Low values could indicate the presence of a serious congenital heart diseases.

## What is the advantage of the test?

Pulse oximetry can assist in detecting some critical congenital heart diseases (CCHD) that are not detected clinically or by antenatal anomaly scans. Even if anomaly scanning was available up to 50% of CCHDs are missed[4]. In the first 24-48 hours babies with CCHDs could still appear to be pink, with no murmurs and have palpable femoral pulses in the presence of coarctation. Studies have shown that even after anomaly scanning and clinical examination of the baby, upto one third of babies with CCHDs are not detected prior to discharge[4]. These CCHDs could result in cardiovascular collapse, severe metabolic acidosis and death in rapid sequence after discharge. Early detection can reduce the risk of these and provide an opportunity for timely interventions[5].

In addition to detecting CCHDs pulse oximetry screening has incidentally detected respiratory compromise and poor perfusion due to sepsis [6,7]

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## What are the limitations of the test?

However it is important to note that although pulse oximetry can detect an additional number of babies with CCHD who would be missed with only antenatal ultrasound and clinical examination, upto 8-10% of CCHDs are still not detected prior to discharge [3,6,7]. Parents have to be made aware of this. The usefulness of pulse oximetry screening will be potentially greater in our country than in those countries where antenatal anomaly scanning is available.

## DOING THE PULSE OXIMETRY SCREENING TEST [2,11,12]

### How is the test performed?

### Equipment

A pulse oximeter consists of a sensor and a monitor. The sensor consists of a photodetector and a source of light (red and infra-red). The test involves putting a sensor on the baby's hand and foot in order to obtain an indirect measurement of the oxygenation of baby's blood. The differential absorption of red and infrared light by oxyhaemoglobin and deoxyhaemoglobin is the basis on which a value is obtained for oxygen saturation.

A motion tolerant pulse oximeter, that reports functional oxygen saturation, which has been validated for use in low perfusion conditions and has 2 percent root-mean-square accuracy should be used.

It is absolutely imperative that a sensor/probe suitable for newborns is used as adult probes will not have good contact and therefore will not give accurate values.

The probes used should be those recommended for that particular machine by the manufacturer and a sensor not recommended for that particular instrument should not be used to ensure accurate results.

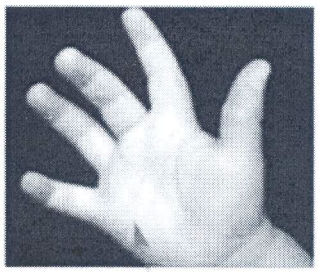
There are variations in calibration curves between manufacturers/and even different brands from the same manufacturer the same instrument should be used to take the two measurements in the same baby.

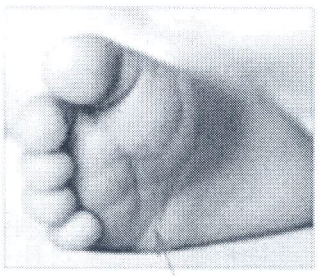
The results from a pulse oximeter can be affected by the patient/sensor interface – therefore correct alignment of the sensor and light source is important as well as the site used being well perfused and free of artefacts such as extraneous lights (phototherapy), motion and venous congestion. In cases of poor perfusion due to low environmental temperature rewarming of the baby including local rewarming will help in obtaining an accurate reading.

When using reusable probes they should be cleaned in between babies with a suitable substance recommended by the manufacturer. It should not be immersed in any liquid.

### Probe placement

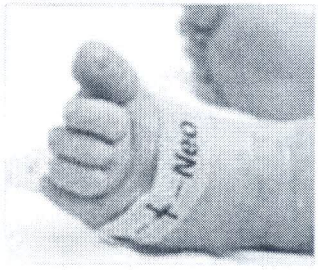
In this screening test oxygen saturation would be recorded from two sites – right hand and a foot. The outside fleshy areas of the hand and foot should be chosen.

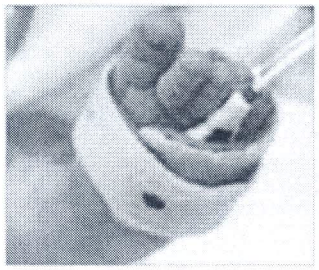




Right hand application site  Foot application site

The photodetector portion of the probe should be placed on the fleshy portion and the light emitter on the top of the hand or foot directly opposite the photodetector. Secure the probe using the recommended adhesive or foam tape; it is not advisable to use standard tape of securing the probe.





**Other practical points include:**

- Not holding the probe in place as it can interfere with the reading
- Take the reading on the foot first as babies can get very fussy when trying to open up the fingers and place a probe on the palm
- The test can be done while the baby is nursing – this will help in calming a crying baby whose movements are interfering with the reading.

**Who will do the test and when?**

Pulse oximetry test can be performed by a nursing officer or a medical officer. The findings should be recorded on the neonatal examination record.

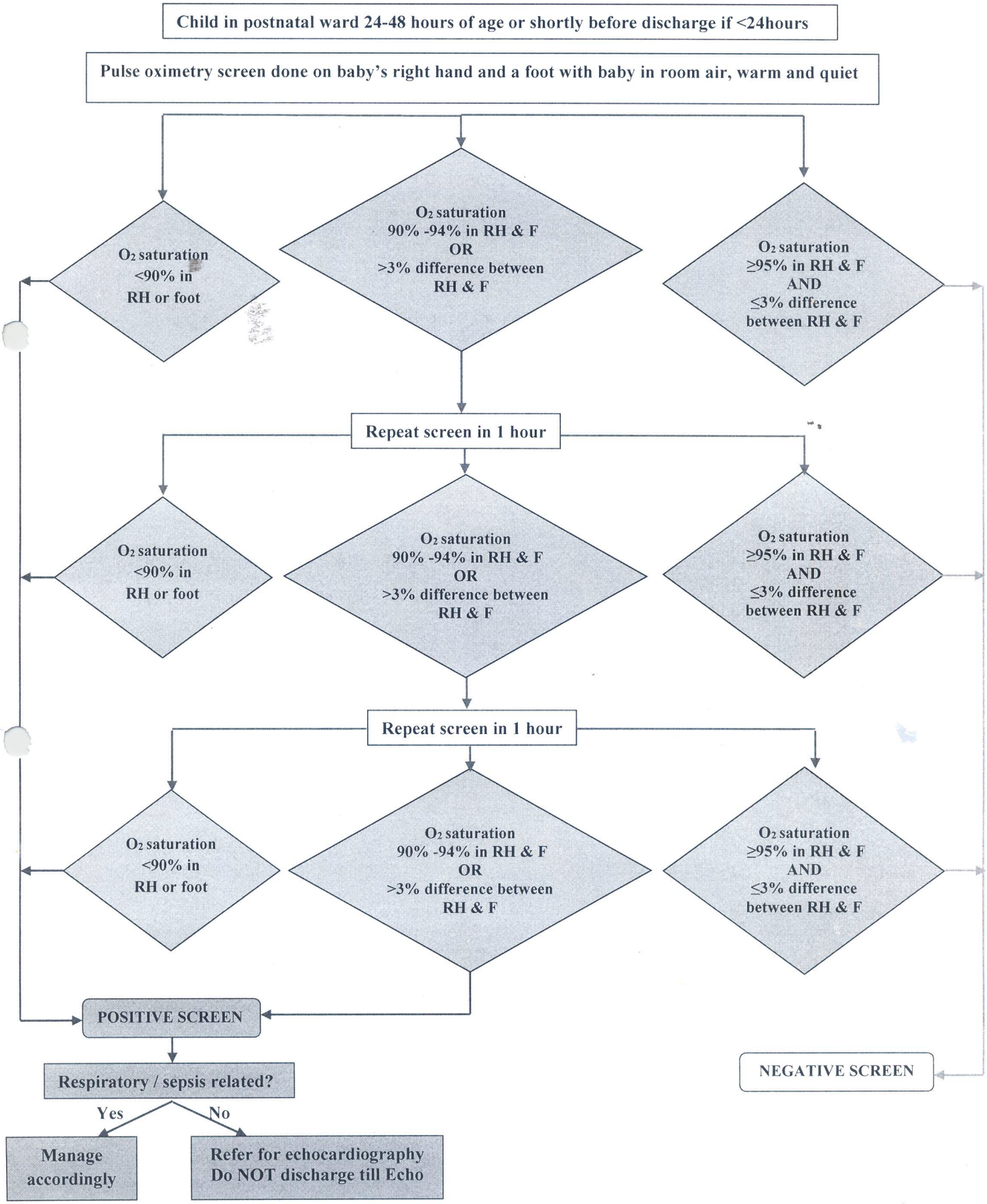
The test should be done after 24 hours (on 2nd day of life), to reduce false positive rate. If however the mother is being discharged before that and the baby is otherwise fit to be discharged, the test can be done on discharge.

**Informing parents**

Parents should be informed that:

1. This test is being done to screen for critical congenital heart diseases (non-critical congenital heart diseases can still be present and manifest later, eg' ASD /VSD)
2. Even if the baby has a negative result on the test the baby might still have a critical congenital heart disease
3. If the baby has a positive result on the test, the baby cannot be discharged until a cause for low SPO2 has been identified. An echocardiogram is required to rule out CCHD unless any other cause has been identified. Baby may require admission to the neonatal unit for observation and management

# Algorithm


Child in postnatal ward 24-48 hours of age or shortly before discharge if <24hours
Pulse oximetry screen done on baby's right hand and a foot with baby in room air, warm and quiet
O2 saturation <90% in RH or foot
O2 saturation 90% -94% in RH & F OR >3% difference between RH & F
O2 saturation ≥95% in RH & F AND ≤3% difference between RH & F
Repeat screen in 1 hour
O2 saturation <90% in RH or foot
O2 saturation 90% -94% in RH & F OR >3% difference between RH & F
O2 saturation ≥95% in RH & F AND ≤3% difference between RH & F
Repeat screen in 1 hour
O2 saturation <90% in RH or foot
O2 saturation 90% -94% in RH & F OR >3% difference between RH & F
O2 saturation ≥95% in RH & F AND ≤3% difference between RH & F
POSITIVE SCREEN
NEGATIVE SCREEN
Respiratory / sepsis related?
Yes
No
Manage accordingly
Refer for echocardiography Do NOT discharge till Echo

## References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