

THAMES VALLEY & WESSEX NEONATAL OPERATIONAL DELIVERY NETWORK

TV & Wessex Pulse Oximetry Screening guideline

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| Related documents | <p><u>References:</u></p> <ol style="list-style-type: none"> 1. Ewer A et al (2011) Pulse oximetry screening for congenital heart defects in newborn infants (PulseOx): a test accuracy study. <i>The Lancet</i>; 378: 785-94. 2. Thangaratinam S et al (2007) Accuracy of pulse oximetry in screening for congenital heart disease in asymptomatic newborns: a systematic review. <i>Arch Dis Child Fetal Neonatal Ed</i>, 92: F176-180. 3. Thangaratinam S et al (2012) Pulse oximetry screening for critical congenital heart defects in asymptomatic newborn babies: a systematic review and meta-analysis. <i>The Lancet</i>, 379: 2459-64. 4. Granelli A et al (2009) Impact of pulse oximetry screening on the detection of duct dependent congenital heart disease: a Swedish prospective screening study in 39 821 newborns. <i>British Medical Journal</i>; 338: a3037. 5. Wren C, Richmond S, Donaldson L (2000) Temporal variability in the birth prevalence of cardiovascular malformations. <i>Heart</i>; 83: 414-419. 6. Wren C, Richmond S, Donaldson L (1999) Presentation of congenital heart disease in infancy: implications for routine examination. <i>Arch Dis Child Fetal Neonatal Ed</i>; 80: F49-53. |

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| Implications of race, equality & other diversity duties for this document | This guideline must be implemented fairly and without prejudice whether on the grounds of race, gender, sexual orientation or religion. |

Guideline Framework for Neonatal Pulse Oximetry Screening

Contents

| Paragraph | | Page |
|-------------------|--|-------------|
| 1 | Aim of Guideline | 3 |
| 2 | Scope of Guideline | 3 |
| 3 | Guideline Framework | 3/4 |
| 4 | Background information | 4 |
| 5 | Guideline Summary | 4 |
| 6 | Details of Guideline | 5/6 |
| Appendices | | |
| Appendix 1 | Pulse Oximetry Screening Pathway for babies born in Hospital | 7 |
| Appendix 2 | Pulse oximetry Screening Pathway for babies born in Midwifery Led Units (MLUs) and at Home | 8 |
| Appendix 3 | Investigations of babies who fail Pulse Oximetry Screening (Test Positive) | 9 |
| Appendix 4 | Parent information leaflet | 10/11/12 |
| Appendix 5 | Information guidance for health care professionals performing Pulse Oximetry Screening | 13/14/15/16 |

1.0 Aim of Guideline

The purpose of this guideline is to ensure that all newborn babies born in hospital, midwifery led units or at home are screened for critical congenital heart defects through the early recording of pre- and post-ductal oxygen saturations with a hand-held pulse-oximeter.

It also outlines the subsequent management of newborns who fail pulse oximetry screening (Test positive).

2.0 Scope of Guideline

The guideline applies to all neonates in neonatal units and maternity units covered by Thames Valley & Wessex Neonatal ODN. This includes the following hospitals:

| Thames Valley | | |
|--|--|-------------|
| TRUST | Hospital | Designation |
| Oxford University Hospitals NHS Foundation Trust | - John Radcliffe Hospital, Oxford | NICU |
| Buckinghamshire Healthcare NHS Trust | - Stoke Mandeville Hospital, Aylesbury | LNU |
| Frimley Health NHS Foundation Trust | - Wexham Park Hospital, Slough | LNU |
| Milton Keynes University Hospital NHS Foundation Trust | - Milton Keynes General Hospital | LNU |
| Royal Berkshire NHS Foundation Trust | - Reading | LNU |

| Wessex | | |
|--|---|--------------------------------|
| TRUST | Hospital | Designation |
| University Hospital Southampton NHS Foundation Trust | - Princess Anne Hospital | NICU |
| Portsmouth Hospitals University NHS Trust | - Queen Alexandra Hospital | NICU |
| University Hospitals Dorset NHS Foundation Trust | - Poole Hospital | LNU |
| Salisbury NHS Foundation Trust | - Salisbury District Hospital | LNU |
| Hampshire Hospitals NHS Foundation Trust | - Basingstoke and North Hampshire Hospital | SCU (Temporary designation) |
| Hampshire Hospitals NHS Foundation Trust | - Royal Hampshire County Hospital, Winchester | SCU (Temporary designation) |
| Dorset County Hospital NHS Foundation Trust | - Dorset County Hospital, Dorchester | SCU |
| Isle of Wight NHS Trust | - St Mary's Hospital | SCU |
| University Hospitals Sussex NHS Foundation Trust | - St Richard's Hospital, Chichester | SCU |

3.0 Guideline Framework

This guideline provides guidance on the routine use of pre-discharge pulse oximetry screening in the delivery suite, the postnatal ward and the community to improve the early detection of critical congenital heart disease (CCHD) in asymptomatic newborn babies; and identify babies with non-cardiac respiratory conditions. It is designed to be used by the following staff group:

Paediatric/Neonatal doctors/ Advanced Neonatal Nurse Practitioner (ANNPs)

Neonatal nurses

Midwives

Nursery nurses

4.0 Background information

Cardiovascular malformations are the leading group of congenital malformations with an incidence of 4 to 10 per 1000 live births. They account for 6-10% of all infant mortality. Cardiovascular malformations also account for 20-40% of deaths attributable to all congenital malformations and most of these deaths occur in the first year of life. The term congenital heart disease (CHD) encompasses a variety of lesions with a wide range of clinical importance, ranging from those with no functional or clinical significance, to potentially life threatening lesions. If critical defects are not detected early, they can result in cardiovascular compromise resulting in death or significant long-term effects on neurodevelopment. Critical CHD refers to heart defects that require intervention or lead to death in the first 28 days after birth. Timely recognition of these conditions allows the possibility of early intervention that may influence the natural history of the condition and subsequent outcome.

What is the current screening programme for heart defects in newborn babies?

All babies are currently screened for heart defect antenatally (antenatal ultrasound) and following birth (postnatal clinical examination).

Antenatal ultrasound – between 2014 and 2017 in the UK, **less than half** (42%) of babies with heart defects that require intervention were identified before birth (*2018 NICOR report, table 12a*). Between different health regions in the UK there is great variability in the rate of identification – between **33% in the lowest performing regions** and 62% in the highest.

Postnatal examination – **fails to identify up to 45%** of babies with critical congenital heart defects and up to **30% are sent home without diagnosis**. Some of these babies will die and many will have a worse outcome as a result of late diagnosis.

What will Pulse Oximetry Screening add?

Routine newborn pulse oximetry screening identifies babies with critical congenital heart defects that would otherwise have been missed by antenatal ultrasound and postnatal examination. Research has consistently shown that when **Pulse Oximetry Screening** is added to the existing programme the identification rate for critical congenital heart defects increases to **between 90 and 95%**.

Pulse oximetry screening reduces mortality from critical congenital heart defects and identifies babies with other important conditions, such as respiratory disorders and sepsis. Many countries now recommend pulse oximetry screening, but the UK National Screening Committee is still undecided. Despite the absence of a national recommendation, many neonatal units in the UK have introduced pulse oximetry screening. In 2017, 78 (40%) of the 193 neonatal units in the UK used pulse oximetry screening (an increase from 15 (7%) of 224 neonatal units in 2010).

5.0 Guideline Summary

All newborn babies across Thames Valley & Wessex will undergo Pulse Oximetry Screening to identify babies with congenital heart disease; as well as identify babies with non-cardiac causes of low oxygen saturations. Undetected illness including potential infection, breathing difficulties, congenital heart disease and slow adaptation to ex-utero life are among the causes of low saturations. All these conditions merit neonatal review to diagnose, and if needed, to treat the underlying condition.

6.0 Details of the guideline

Measurement of oxygen saturation in newborn babies

Pulse Oximetry Screening is performed by measuring the baby's pre and post- ductal saturations. The saturation probe is applied to the **baby's right hand (provides a pre-ductal reading)** and either **foot (provides a post-ductal reading)**. For best readings tape must be applied to the right hand & either foot to hold the probe in place (see Appendix 5 for further details). It is necessary to wait until a stable good quality waveform is seen. A sustained, good signal **both readings of $\geq 95\%$ and difference less than 3%** is accepted as **normal (test negative)** and constitutes no concerns.

Pulse Oximetry Screening for babies born in hospital (Appendix 1 Pulse Oximetry Screening for babies born in Hospital)

- All babies born in hospital should be screened, preferably between 4-12 hours of life before discharge home. Ideally the screening will be conducted prior to the newborn examination and will be performed by a trained professional i.e., Midwifery Support Worker (MSW), midwife, Health Care Assistant (HCA), or SHO/ ANNP who have received the appropriate training.
- Dedicated hand-held saturation monitors with reusable probes should be made available on the postnatal wards, delivery units, and midwife-led birth unit. Each community team should have a monitor available for home births (see separate section for home births).
- Two saturation readings should be taken, a pre-ductal saturation (right arm) and a post- ductal saturation (either foot) – **Test one**.
- The highest consistent reading attainable in both should be recorded in the neonatal notes and should be available for the newborn examination.
- The following outcomes apply:
 - A **Pass** (test negative) – both readings 95% or higher and difference less than 3%.
 - A **Fail** (test positive) – either reading 89% or less, or clinical concerns.
 - A **Borderline** – either reading 90-94% or difference of 3% or greater.
- For a pass, no further action is required, other than recording the saturations in the medical notes.
- Babies who **fail** screening (test positive) will be referred to the neonatal/paediatric team for urgent assessment.
- If the result is borderline, and the baby is clinically well, the test should be repeated in 1 to 2 hours by the midwife/HCA – **Test two**.
- If the result is again borderline, a trained neonatal clinician should examine the baby.
- If this examination is normal, the test should be repeated in 1-2 hours – **Test three**.
- Anything but a clear pass in **Test three** requires urgent senior paediatric assessment and investigation.
- Passing the screening does not rule out a congenital heart defect, and an abnormal cardiac examination should always be investigated.
- Oxygen saturations should be checked in any baby where there is a clinical concern regardless of whether or not they have previously passed the test.

Pulse oximetry Screening Pathway for babies born in midwifery led units (MLUs) or at home (Appendix 2 Pulse Oximetry Screening Pathway for babies born in MLU and at home)

- All babies born in Midwifery Led Units should undergo pulse oximetry screening. This can be performed by the attending midwife or maternity support worker (MSW).
- Pulse oximetry screening for babies born at home would usually be undertaken by the attending midwife **prior to leaving the home** after delivery and not at the Newborn Physical Examination NIPE, that is done at a later stage.
- Each team should have its own portable pulse-oximeter with reusable probes.

- Screening should ideally be performed from **2 hours** after birth or sooner if there is clinical concern
- Two saturation readings should be taken, a pre-ductal saturation (right arm) and a post- ductal saturation (either foot) – **Test one**
- The highest, consistent reading attainable in both will be recorded in the neonatal notes and will be available for the newborn examination.
- The following outcomes apply:
A Pass (test negative) – both readings 95% or higher and difference of less than 3%
A Fail (test positive) – either reading 89% or less, or baby symptomatic
A Borderline – either reading 90-94% or difference 3% or greater
- Babies who **fail screening** (Test positive) should be referred to the neonatal/paediatric team for urgent assessment.
- A **borderline** result should also be discussed with the on-call neonatal/paediatric registrar, and if both midwife and registrar have no clinical concerns, the test can be repeated in 1 to 2 hours – **Test two**
- If the baby does not pass **Test 2**, or the examination is abnormal, or there are other clinical concerns, the baby should be referred to the neonatal registrar for immediate assessment in hospital.
- Oxygen saturations should be checked in any baby where there is a clinical concern regardless of whether or not they have previously passed the test.
- Passing the screening does not rule out a congenital heart defect, and an abnormal cardiac examination should always be investigated.

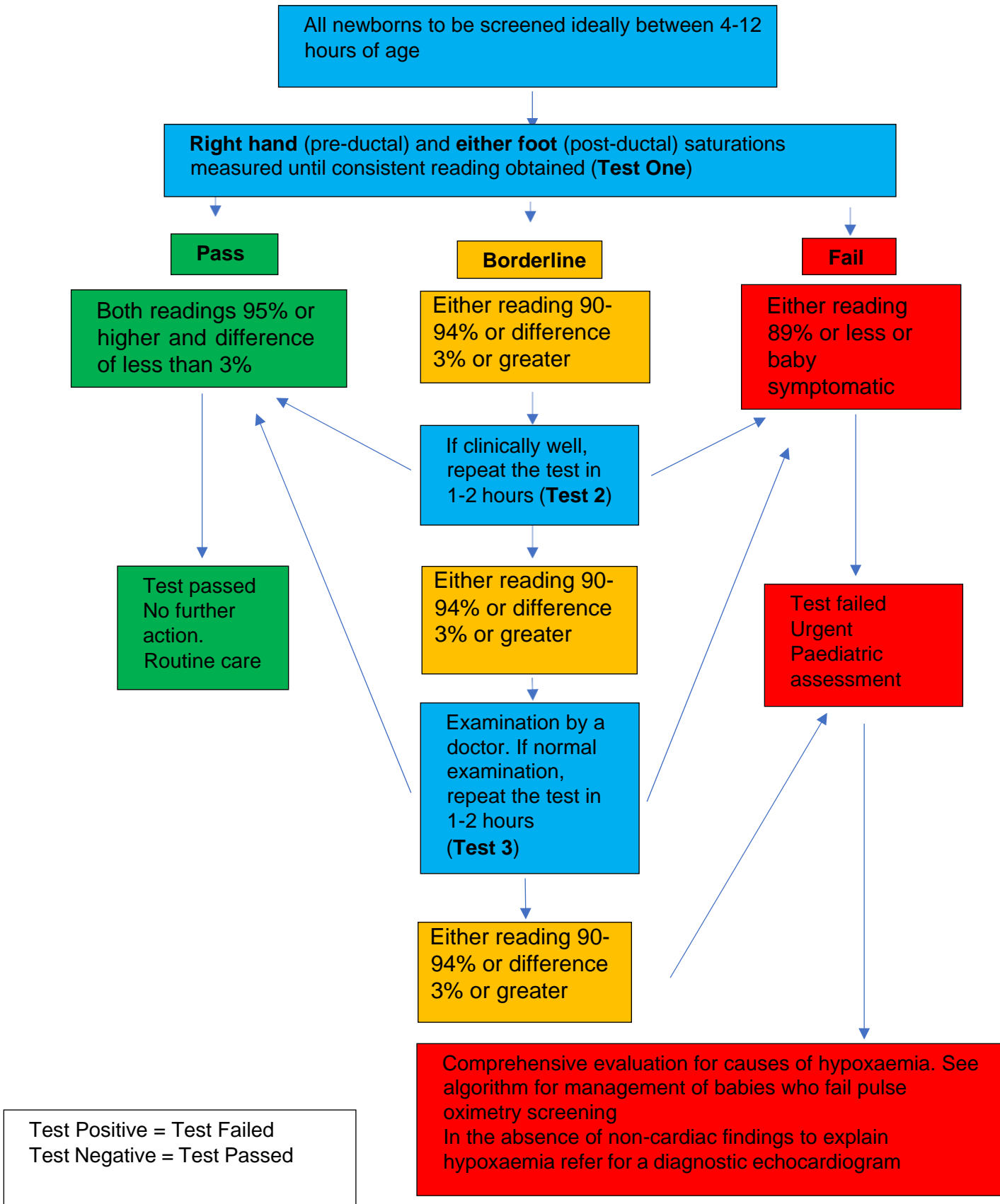
Note:

The NEWTT2 Deterioration of the Newborn framework of practice was published by BAPM in January 2023¹⁰. This framework is designed for use in postnatal care settings including the delivery suite, postnatal ward and transitional care. It describes at risk groups of babies and provides an updated Newborn Early Warning Trigger and Track (NEWTT2). Recommendations for assessment and monitoring are given for all newborns and at risk groups. The pulse oximetry screening guideline should be used in conjunction with the NEWTT2 framework, with the aim of all newborn babies receiving POS as part of their routine postnatal care.

Version Control:

| Version | Date | Details | Author(s) | Comments |
|---------------------|-------------------|---|---|--|
| 1 | December 2020 | New guideline | Dr Lambri Yianni Dr Victoria Puddy Dr Kenny McCormick | Ratified at Governance December 2020 |
| 2 | March 2021 | Amendment to appendix 2 | Dr Lambri Yianni | March 2021 |
| 3 | Feb 2024 | No significant change pending national guidance. Reference to BAPM NEWTT 2 framework of practice added. Table of units updated. | Dr Lambri Yianni | Circulated for Governance in March 2024. No comments received. Ratified March 2024 |
| Review Date: | March 2026 | | | |

Pulse Oximetry Screening for babies born in Hospital



Pulse Oximetry Screening Pathway for babies born in Midwifery Led Units (MLUs) and at Home

- All babies born at home or in Midwifery Led Units should undergo pulse oximetry screening, performed by the attending midwife/maternity support worker (MSW)
- Screening should ideally be performed from **2 hours after birth**, unless there is a **cause for clinical concern**

Right hand (pre-ductal) and either foot (post-ductal) saturations measured until consistent reading obtained (Test One)

Pass
Both readings 95% or higher and difference of less than 3%

Borderline
Either reading 90-94% or difference of 3% or greater

Fail
Either reading 89% or less, or baby symptomatic

No further action required
Document saturations in the notes

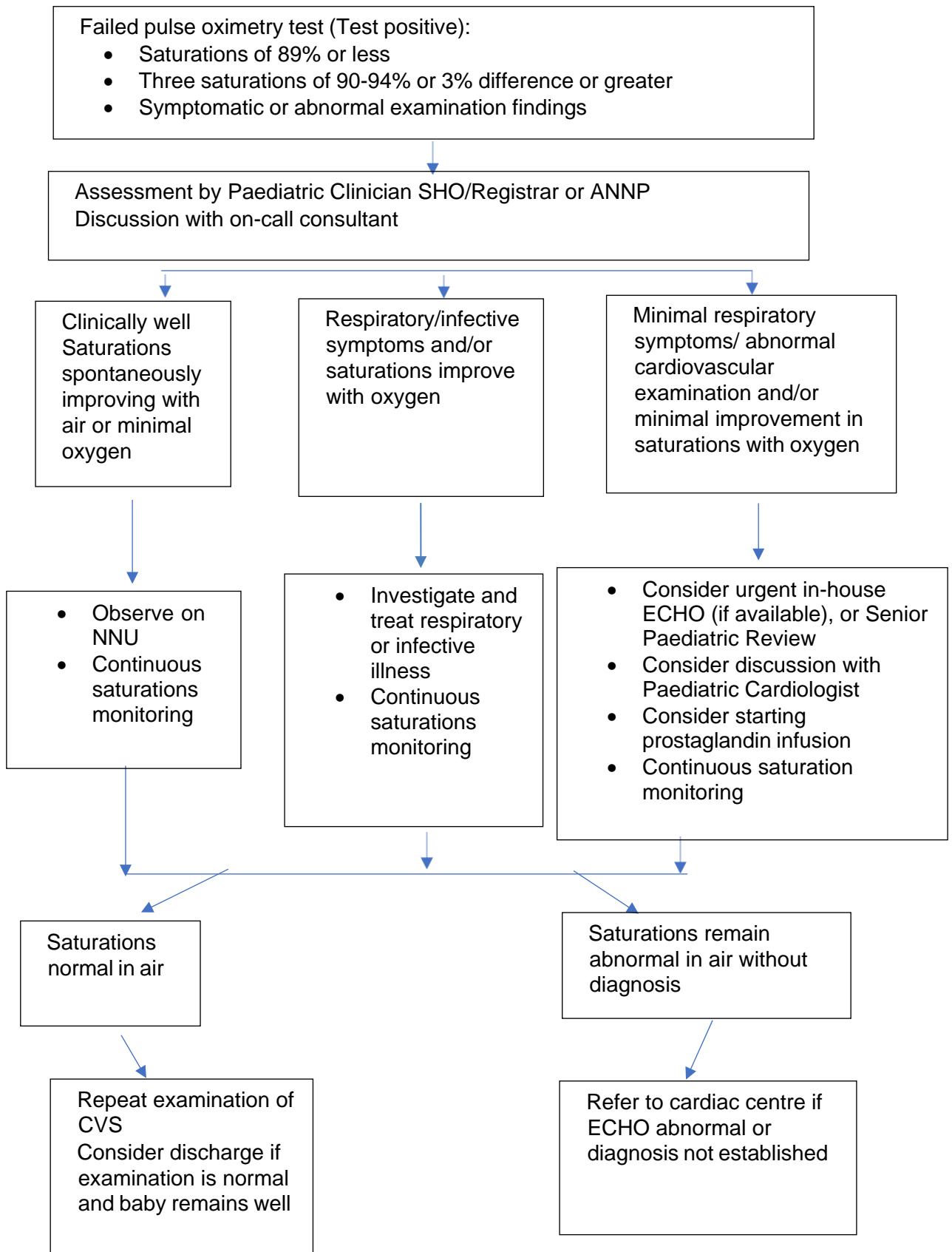
Discuss with on-call neonatal/paediatric registrar.
If both midwife/MSW and doctor have no clinical concerns, repeat the test in 1-2 hours (**Test 2**)

Refer to neonatal/local paediatric team for urgent assessment

Test Positive = Test Failed
Test Negative = Test Passed

Note:
Passing the screening does not rule out a congenital heart defect, and an abnormal cardiac examination should always be investigated (even if the baby has passed the screening)

Investigations for babies who fail Pulse Oximetry Screening (Test positive)



Pulse Oximetry Screening Parent Information Leaflet

What is a Newborn pulse oximetry screening test?

Your newborn baby will undergo a routine pulse oximetry test, usually within the first 12 hours after birth.

A pulse oximeter is a special machine which is used routinely throughout the world to measure the amount of oxygen in the blood. They are very simple to use – a small probe is wrapped around your baby's hand and foot and connected to the machine which then measures the oxygen levels by shining a light through the skin.

It is very quick – the whole test takes less than 5 minutes – and ***completely harmless and painless.***

We are measuring blood oxygen levels in newborn babies to try to identify the small number of babies who have an **unidentified serious heart defect**. We know that these babies usually appear healthy at birth but often have lower oxygen levels. The test identifies babies with lower oxygen levels so we can check these babies very carefully to identify a possible heart defect before the baby becomes unwell.

Babies with other potentially serious conditions such as **breathing problems, infections and circulation problems** often have lower oxygen levels too and the test may also identify these babies.

The midwife looking after you will explain the test beforehand and answer any queries you may have.

A doctor or specialist nurse will check all babies who do not pass the test to see if further tests or treatments are required. They will explain what is happening with your baby at each step.

What if my baby passes the test?

If your baby passes the test (**Test Negative**) this means the baby's oxygen levels are within normal limits and no further pulse oximetry testing is necessary at this time. Your baby will continue with routine care before discharge, including a newborn physical examination (NIPE).

Passing the test is **very reassuring** but does **not always mean that there is no problem**. A small proportion of babies (about 1 in every 8000) who pass the test may still have a serious heart problem, therefore it is still important to observe the baby for any change in condition and carry out the routine physical examination.

What if my baby does not pass the test?

About **3 in every 100 (3%)** babies **will not pass the test first time** but the oxygen levels will only be slightly low. This might cause some worry for you, but we know that the lungs of some babies adapt to being born at a slower rate than others – this is normal, and these babies are healthy.

Because we know this, if the babies oxygen levels are only **slightly reduced** in the first test and the baby **appears healthy** then we will repeat the test a second time about 1 to 2 hours later (**Retest**).

9 out of 10 babies will pass the Retest and these babies will be treated as healthy (Test Negative). It is important that the baby's oxygen levels are normal before going home and so very occasionally this will lead to a slight delay in the baby's discharge (1 to 4 hours).

Those who **do not pass the Retest (Test Positive)** will be seen by a doctor or specialist nurse used to looking after babies. They will examine your baby and may do tests to try to find out why the levels are low (including checking for a heart problem) [see below].

About **3 babies in every 1000 (0.3%)** tested will have very low oxygen levels on the first test which means that they will be seen by a doctor or specialist nurse used to looking after babies straight away (**Test Positive**). They will examine your baby and may do tests to try to find out why the levels are so low (including checking for a heart problem) [see below].

What will happen if my baby is Test Positive?

About 7 in every 1000 babies tested (0.7%) of babies will be **Test Positive** (either after the first or second test).

This might cause you to worry but the doctor or specialist nurse **will check your baby straight away and explain what is happening**.

More than half of the babies (6 out of every 10 or 60%) who test positive are healthy and they just have slow adaptation to birth. **Five out of these 6 babies** will develop normal oxygen levels very quickly and need no investigation or treatment.

Five out of every 10 babies who test positive (3.5 out of every 1000 babies tested) will need further investigations and almost all will be admitted to the Neonatal Unit (NNU) for further assessment.

This may make you worried, but the doctor or nurse will explain what is happening. Most babies will have blood tests, x-rays and other investigations to try to find out the cause of the low oxygen levels.

Of the babies admitted to NNU:

2 in every 10 will be healthy – these babies will have tests that were unnecessary and may have a delayed discharge, but they are usually on NNU for less than 12 hours.

7 in 10 will have a breathing problem or infection and most will benefit from the test by early diagnosis and treatment of a potentially serious illness.

1 in 10 will have a heart problem and they will all benefit from early diagnosis and treatment.

Healthcare information: How to perform pulse oximetry screening

Checking Oxygen Saturation (SpO₂) Measurement in a Baby

- 1) Explain to parents that you are going to check the baby's blood oxygen level and that it will not hurt the baby. Give parents the parent information leaflet on neonatal pulse oximetry screening.
- 2) Place the flat sides of the probe on opposing sides of the baby's **right hand to check the pre-ductal saturations**. To get a good trace the probe 'faces' must be opposite one another with **'red emitter light'** being on top. Now measure the **post ductal saturations** by placing the saturations probe on either foot (**Fig.1**)
- 3) Use Posey wrap to secure the probe - it is much less likely to pick up a safe and reliable trace if held in place by hand (**Fig. 2**). Once connected turn on the power.
- 4) Allow time for a stable reading to appear. This may take up to 30-60 seconds to settle. Always wait for a good trace as shown below (**Fig 3 and 4**).



Figure 1: The probe 'faces' are placed opposite one another with red emitter light being on top

Figure 2: Use a posey to secure the probe



Figure 3: Good trace
Action: Pass, reassure parents

Figure 4: Good trace with low saturations
Action: Inform neonatal team urgently

Test 1:

- If both readings are **equal to or more than 95% and difference of less than 3%** has been present for 20s (steady reading) with the baby breathing air, the baby has **'passed'** the test with a normal result (**Test negative**). No further action is required providing the baby remains well.
- If **either reading shows saturations of 89% or less, or if the baby is symptomatic** then contact the neonatal/paediatric team for an urgent review. The baby has **'failed'** the test (**Test positive**).
- If the saturations are between 90 - 94% or the difference is 3% or more then **providing the baby is clinically well**, the test can be repeated in 1-2 hours (see **Test 2** of the pathway).

Test 2:

- If both readings are **equal to or more than 95% and difference less than 3%**, the baby has passed the test (**Test negative**). No further action is required providing the baby remains well.
- If **either reading shows saturations of 89% or less, or if the baby is symptomatic** then contact the neonatal/paediatric team for an urgent review. The baby has **'failed'** the test (**Test positive**).
- If the saturations remain between 90 - 94% or the difference is 3% or more then contact the neonatal/paediatric team for an urgent review. If the examination by the neonatal/paediatric team is normal, then the test can be repeated in 1-2 hours, **providing the baby remains well** (see **Test 3** of the pathway)

Test 3:

- If both readings are equal to or more than 95% and the difference is less than 3%, the baby has passed the test (**Test negative**). No further action is required **providing the baby remains well**.
- If the saturations remain between 90-94% or the difference is 3% or more, then the **test is positive**. Call for an urgent paediatric/neonatal review.

5) Clean probe with detergent wipes.

6) Document oxygen saturation levels in the baby notes, date, time and sign.

7) Babies should not be discharged home without documented normal oxygen saturation level.

What do I do if the trace is poor?

Chose a time when the baby is settled to do the test. This will optimise the chances of getting a good trace. If the baby is unsettled or crying, wait until the baby is settled to perform the test.

Make sure that the probe is attached to the baby's hand and foot as shown in the picture above. Reposition the probe if required. Ensure that the baby's skin is dry and warm.

What do I do if the test is negative, but the baby appears unwell?

If at any one point, during the test, you think the baby appears unwell (respiratory distress, mottled, blue, unresponsive, floppy) then call for an urgent paediatric/review immediately.

What do I tell the parents if the baby passes the test (Test negative)?

If the baby passes the test, then it means that the baby's oxygen levels are within normal limits and no further pulse oximetry is necessary at this point. Passing the test is very reassuring but it does not always mean that there is no problem. A small proportion of babies who pass the test (about 1 in every 8000) may still have a serious heart condition, therefore it is still important for the parents to know that and inform a health care professional if they are worried about their baby.

What do I tell the parents if the baby does not pass the first test (Test 1)?

About **3 babies in every 1000 (0.3%)** tested will have very low oxygen levels (saturation of <89%) on the first test which means that they will be seen by a doctor or specialist nurse used to looking after babies straight away (**Test Positive**). They will examine the baby and may do tests to try to find out why the levels are so low (including checking for a heart problem).

About **3 in every 100 (3%)** babies **will not pass the test first time** but the oxygen levels will only be slightly low (saturation of 90-94%). We know that the lungs of some babies adapt to being born at a slower rate than others – this is normal, and these babies are healthy. Because we know this, if the baby's saturation levels are only **slightly reduced** in the first test and the baby **appears healthy** then we will repeat the test a second time about 1 to 2 hours later (**Test 2**).

It's important to reassure parents that **9 out of 10 babies will pass Test 2** and **these babies will be treated as healthy (Test Negative)**. The baby's oxygen levels need to be normal before going home and so very occasionally this will lead to a slight delay in the baby's discharge (1 to 4 hours).

What do I tell the parents if a baby does not pass Test 2?

Those who do not pass **Test 2 (Test Positive)** will be seen by a doctor or specialist nurse used to looking after babies. They will examine the baby and may do tests to try to find out why the levels are low (including checking for a heart problem). If clinical examination is normal, and the baby remains well, then the test can be repeated a third time 1-2 hours later (**Test 3**).

What do I tell the parents if a baby does not pass Test 3?

Those babies who do not pass **Test 3** will need a further paediatric/neonatal review and further investigations. This may include admission to the neonatal unit for further investigations. If the baby passes the test, then no further tests are required at that point, providing the baby remains well. The baby can be discharged home.