



Universal Pulse Oximetry Screening for Critical Congenital Heart Disease in Newborns Frequently Asked Questions

1. How much will this cost? What's less expensive, re-usable or disposable probes?

At this time, there is no way to bill for this screening. Costs of a screening program are variable; however, estimates are from \$5 or less per infant up to \$10 per infant, depending on the protocol. Re-usable probes are less expensive than disposable probes. Staff time is estimated to be 5 minutes, including talking with parents.

2. Can we do the test outside the 24-48 hour window? Some babies stay for 72 hours or maybe longer for various reasons. On the other hand, some parents are discharged with their newborn before 24 hours.

It is best to do the test in the 24-48 hour window, even if it is planned that the baby will be staying longer, as the earlier critical congenital heart disease is detected, the earlier definitive care can be provided. A newborn can pass the screen prior to the preferred window of 24-48 hours of age; however, the chances of a positive (failed) screen increase when done prior to 24 hours of age. If discharge is planned before 24 hours of life, it is recommended that screening be performed as close as possible to discharge.

The best available data relevant to this question comes from a meta-analysis of studies of pulse oximetry screening published in 2012 by Thangarantinam et al. The authors divided numerous studies into whether the pulse oximetry screening was conducted before 24 hours or after 24 hours of age. Here are the summary statistics:

Screening at less than 24 hours of age: the best estimate of the false positive rate is 1/200 babies (95% confidence interval 1/116 to 1/345).

Screening at more than 24 hours of age: the best estimate of the false positive rate is 1/2000 babies (95% confidence interval 1/833 to 1/5000).

Examining the table and the appendix of this paper, the median age or the age set by protocol for screening for the studies that were categorized as "<24 hours" were:

- Meberg 2008: Median 6 hours (range 1-21 hours)
- Artlettaz 2006: Median 8 hours
- Sendelbach 2008: 4 hours, if <96% repeat at discharge
- Richmond 2002: 2 hours, then repeat at 12 hours
- Hoke 2002: ≥6 hours, then repeat at 24 hours or at discharge

The two biggest studies, in terms of subject numbers, are by Meberg and Sendelbach. These studies will most highly influence the results of the meta-analysis. These studies tested babies at a median of 6 hours or by protocol at 4 hours (the latter with option for repeat at discharge).

What does it all mean? Performing the pulse oximetry screen on newborns in the first 12 hours of life, probably increases the false positive rate by 10 fold. However, there is little data currently available that would shed light on what the false positive rate would be of screening, for example, at 22 hours of age. This will be an important piece of information to gather as we implement pulse oximetry screening.

Reference: Thangaratinam S, Brown K, Zamora J, Khan KS, Ewer AK. Pulse oximetry screening for critical congenital heart defects in asymptomatic newborn babies: a systematic review and meta-analysis. *Lancet* 2012; published online May 2. DOI:10.1016/S0140-6736(12)60107-X.
Also see the supplementary appendix to this article posted May 2, 2012 DOI:10.1016/S0140-6736(12)60107-X.

3. I know the newborn is supposed to be awake and calm during the screen, but if the baby passes while he's asleep, is that still a pass (negative screen)?

If the baby passes while asleep, that is still a pass. However, screening sleeping babies will increase the frequency of failed screens, so it is best to set up your protocol so that it is done the same way every time, with a newborn who is awake and calm.

4. How long does the oxygen saturation on the pulse oximeter need to be at least 95% to interpret it as a passing (negative) screen? If it just hits the 95% mark but cannot stay that high for more than a second or two, is that still a pass? How long is the pulse oximeter left in place?

Borderline or failing oxygen saturation readings mean the baby doesn't pass. So, repeat the test in one hour and re-assess. Leave the pulse oximeter in place until there is a steady signal steady with numbers that aren't vacillating wildly. For a calm newborn with warm (not cool) extremities, the screen should take only a few minutes.

5. Does it matter if the baby is on his stomach or back during the screen? When we have babies in supplemental oxygen, we can sometimes improve their sat by placing them prone, so do we stand a better chance of getting a pass for this test if baby is prone?

You are correct that saturations will improve when the newborn is prone. But we are assessing oxygen saturation at rest in the supine position, not trying to maximize the saturation based on positioning. If the saturations are borderline but improve when prone, that indicates a possible problem—be it cardiac or pulmonary related. Therefore, do the test as recommended, not to maximize the saturations based on positioning. In addition, positioning the baby prone is bad modeling for parents who should be taught that the safest sleep position for newborns is supine.

6. Can the baby be nursing or bottle feeding during the screen, to help keep the baby calm? Can the baby have a pacifier?

It would be best not to have the infant nursing or feeding at the time of the test. Feeding may decrease oxygen saturations due to the increased work of breathing associated with feeding (which is normal in the term newborn). If your hospital policy and the baby's parent allow a pacifier for self-calming, it can be permitted during pulse oximetry screening if necessary.

7. What if the baby's hands and feet are cold but his axillary temperature is normal? Is the screening accurate?

Pulse oximetry assesses the oxygen saturation of pulsatile arterial blood, so it should theoretically not be altered by acrocyanosis or cool hands and feet in an otherwise healthy infant. However, if you are having difficulty obtaining a good pulsatile signal, you can try wrapping a warm towel or blanket around the right hand and either foot for a few minutes before applying the pulse oximeter probe. There is no reason to warm the entire baby if the axillary temperature is normal. If this intervention is not successful, consider the possibility that the inability to obtain a signal is related to serious cardiovascular issues that warrant more than pulse oximeter screening.

8. Does it matter if the pulse oximeter probe is placed on the right wrist or the right hand?

The appropriate place to attach the pulse oximeter probe is the right upper extremity. The pulse oximetry screening guideline states usage of the right hand, but there is precedent for use of the right wrist in neonates, consistent with the *Textbook of Neonatal Resuscitation*, 6th edition. Therefore, place the pulse oximeter probe on the right hand or wrist and either foot.

9. Should universal pulse oximetry screening for critical congenital heart disease include infants in the Neonatal Intensive Care Unit (NICU)?

The screening protocol recommended in Kemper AR et al, "Strategies for Implementing Screening for Critical Congenital Heart Disease," *Pediatrics* 2011 is intended for use in the well baby or intermediate nurseries, not the NICU population. Intermediate nurseries in this document were equated to units where discharge is common in the first week of life.

The reason that universal screening is not recommended for the NICU population is that the probability that low oxygen saturation is due to heart disease is much lower in the NICU population,

given the high incidence of lung disease. The consequence of a failed screen is an echocardiogram, so screening the entire NICU population would result in many unneeded echos. Essentially all neonates in an NICU are monitored with pulse oximetry and closely evaluated by neonatologists, nurse practitioners, and neonatal nurses, who will consider the possibility of congenital heart disease as clinically indicated. Many newborns with neonatal lung disease (for example, RDS and meconium aspiration) and late preterm infants may have intermittent oxygen saturations < 95% for days to weeks, due to resolving lung disease or mild hypoventilation (usually during sleep). They should be able to maintain baseline oxygen saturations > 90% in room air. Monitoring pre-ductal (right hand or wrist) and post-ductal (either foot) oxygen saturations in newborns with lung disease is definitely indicated if they remain tachypneic in room air (respiratory rate > 70/minute) when they are otherwise ready for discharge, or if they continue to have intermittent desaturations requiring oxygen supplementation. This evaluation would be specific to the infant in question and interpreted within the context of the clinical situation. Synthesizing the information above, we believe that it is reasonable to screen all infants who have no apparent lung disease and are likely going home in the first week of life, regardless of where they are admitted in your hospital. For example, screening should be performed on term newborns admitted to the NICU due to a maternal diagnosis of chorioamnionitis.