

Pulse-oximetry During Neonatal Resuscitation

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Disclosure

- I do not intend to discuss an unapproved/investigative use of a commercial product/device in my presentation.
- I have no relevant financial relationships with the manufacturers(s) of any commercial products(s) and/or provider of commercial services discussed in this activity.

Learning Outcomes

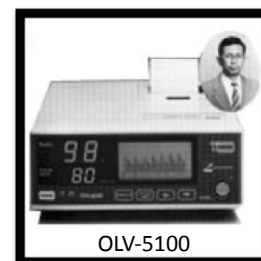
- Participants will be able to recall the recommendations for the use of pulse-oximetry during neonatal resuscitation.
- Participants will be able to describe appropriate location for pulse-ox probe attachment during neonatal resuscitation.
- Participants will be able to recite appropriate target pre-ductal saturations for full term gestational infants during neonatal resuscitation.

Outline

- The birth of pulse oximetry
- Pulse oximeter potpourri
- Oxygen levels around birth
- Pulse oximetry during neonatal resuscitation
 - Recommendations from the Neonatal Resuscitation Program
- Feasibility of pulse oximetry for home births

The Birth of Pulse oximetry

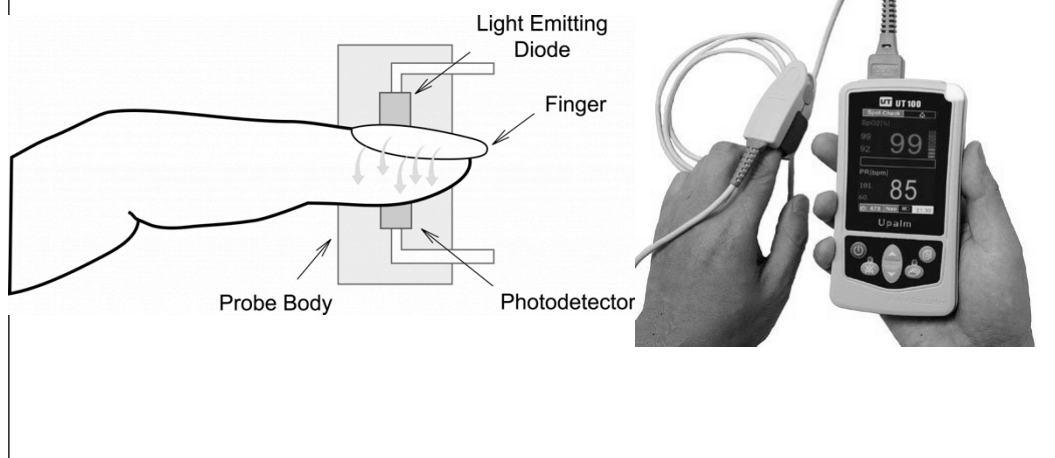
- In 1974, Takuo Aoyagi developed the principle of pulse oximetry
- 1975, Nihon Kohden introduced the world's first ear oximeter
- All pulse oximeters today are based on Dr. Aoyagi's original principle of pulse oximetry



Pulse oximetry, the basics

- Two basic types of pulse oximeter probes:
 - **Transmission probes** - light emitter and sensor are placed opposite each other on pulsatile tissue such as a digit or ear
 - **Reflectance probes** - light emitter and sensor are placed side by side on a flat body surface such as forehead
- Two diodes emit alternating light in the red range (660 nm) and in the infrared range (940 nm).
 - **Red light** is absorbed primarily by **deoxygenated blood** and **infrared light** is absorbed primarily by **oxygenated blood**, the ratio (%) of absorption can be measured.*
- These numbers are compared against baseline values, and through a derived formula, both the pulse oximetry oxygen saturation (SpO₂) and the pulse rate are shown

*Beer-Lambert law-the concentration of an absorbing substance in a solution is related to the intensity of light transmitted through that solution



Pulse ox probes



Pulse oximeters



Which pulse oximeter is the best?



Masimo Radical

Masimo had higher SpO2 sensitivity and specificity during conditions of motion and induced low perfusion in volunteer study



Datex - Ohmeda TruSat



Nellcor N-600

Shah N, et al. Performance of Three New-Generation Pulse Oximeters during Motion and Low Perfusion in Volunteers. *J Clin Anesth.* 2012 Aug;24(5):385-91

Which oximeter is the best?



Masimo



Novamatrix MARS



Nellcor N-200



Nellcor N-395



Philips Viridia 24

Masimo recorded fewer false SpO₂ and pulse alarms and identified more true hypoxic and bradycardic events in neonates

Hay WW Jr. et al. Reliability of conventional and new pulse oximetry in neonatal patients. *J Perinatol.* 2002 Jul-Aug;22(5):360-6.

There's an app for that!



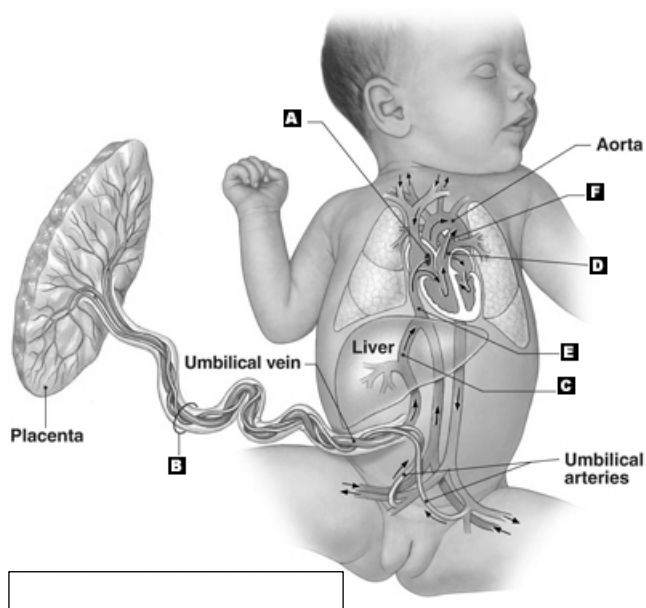
<http://www.voanews.com/content/researchers-develop-life-saving-app-for-smartphones-and-tablets/1757967.html>

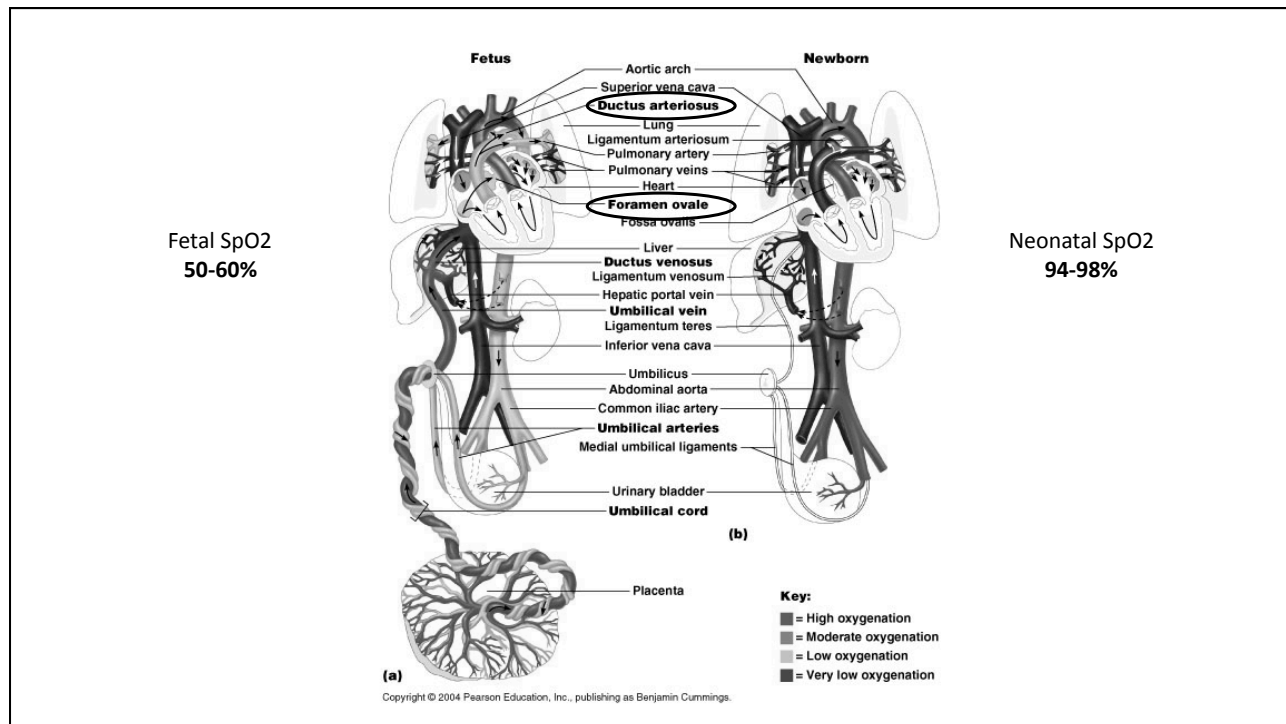


TRACK AND TREND YOUR BLOOD OXYGEN & PULSE RATE FOR SPORTS AND AVIATION USE*

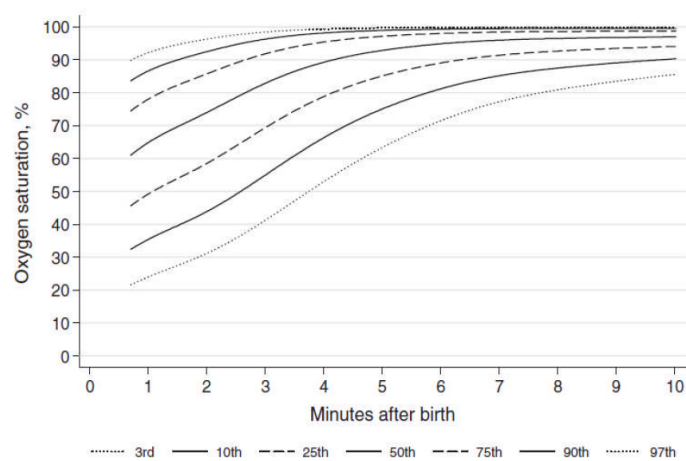


Oxygen levels around birth





Oxygen saturations after birth



Dawson JA, et al. Defining the reference range for oxygen saturation for infants after birth. *Pediatrics*. 2010 Jun;125(6):e1340-7.

Pulse oximetry during neonatal resuscitation



Room air vs. oxygen at delivery

- **Resuscitation should be initiated with air or a blended oxygen** and titrating the oxygen concentration to achieve an SpO₂ in the target range using pulse oximetry
- If the baby is bradycardic (HR 60 per minute) after 90 seconds of resuscitation with a lower concentration of oxygen, oxygen concentration should be increased to 100% until recovery of a normal heart rate

Why room air?



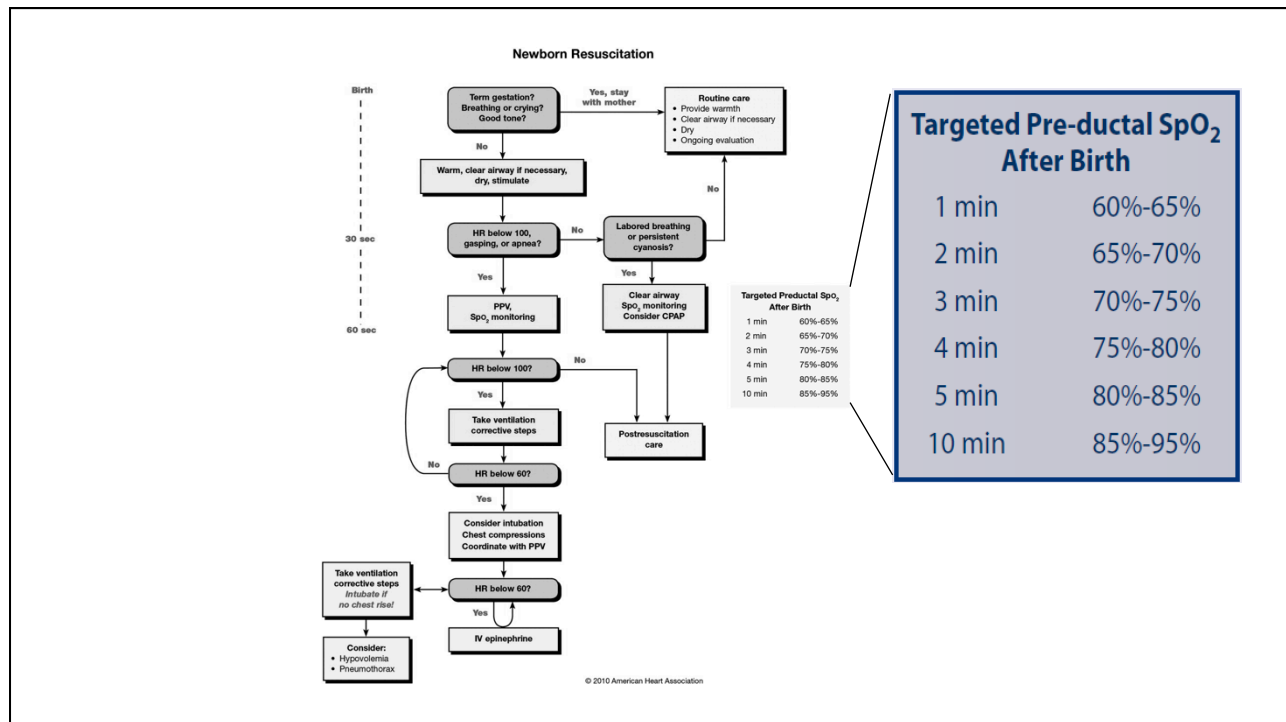
100% oxygen exposure is unnecessary and potentially harmful in neonates

Pulse oximetry during neonatal resuscitation

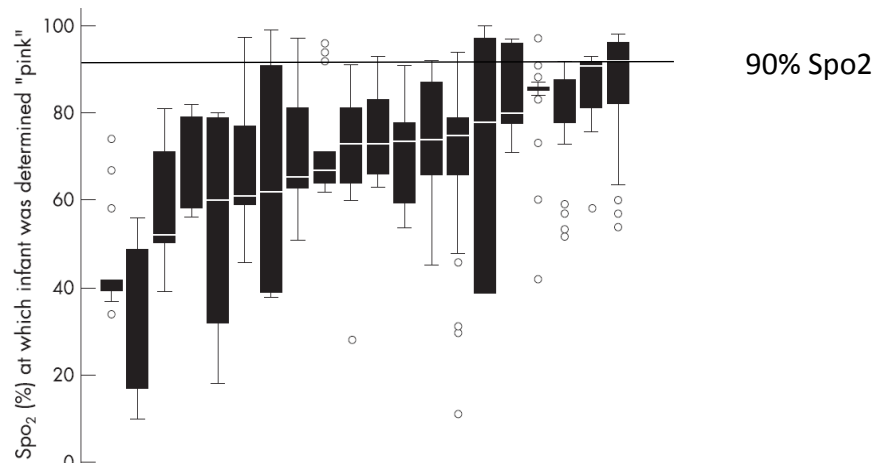
- **Pulse oximetry should be *immediately available*** in all birth settings
- Use an oximeter:
 - Whenever resuscitation is anticipated
 - When positive pressure ventilation is administered for more than a few breaths
 - When cyanosis is *persistent*
 - When supplemental oxygen is administered
 - All infants < 32 wks gestation
- The percentage of oxygen given should be guided by saturations that have been demonstrated by healthy babies during the 10 minutes following their birth (*NRP algorithm*)



Neonatal
Resuscitation
Program™



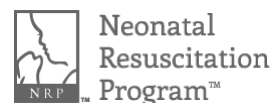
Why not just go by color?



O'Donnell, et al. Clinical assessment of infant colour at delivery
Arch Dis Child Fetal Neonatal Ed. 2007 November; 92(6): F465-F467

Pulse oximetry during neonatal resuscitation

- Many healthy newborns appear slightly cyanotic in the first minutes after birth
- Healthy newborns may take up to 10 minutes after birth to reach their normal oxygen saturation of more than 90%
- If the newborn remains cyanotic, you should attach a pulse oximeter and assess the need for supplemental oxygen based on the preductal measurement of oxygen saturation and the newborn's age in minutes.

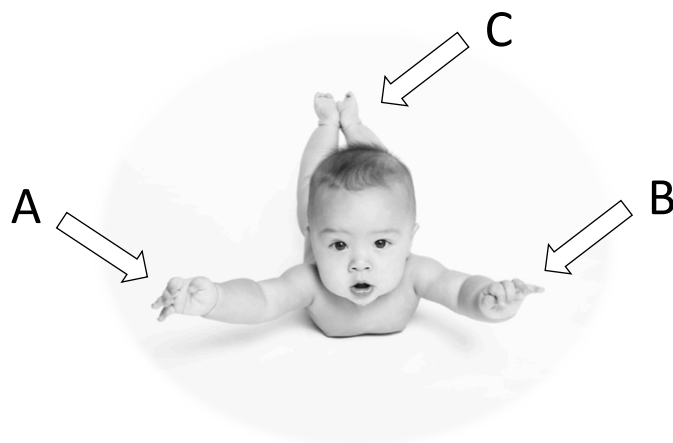


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www.marktoon.co.uk

Targeted Pre-ductal SpO ₂ After Birth	
1 min	60%-65%
2 min	65%-70%
3 min	70%-75%
4 min	75%-80%
5 min	80%-85%
10 min	85%-95%

Location, location, location...

- Where do you place the pulse-ox?



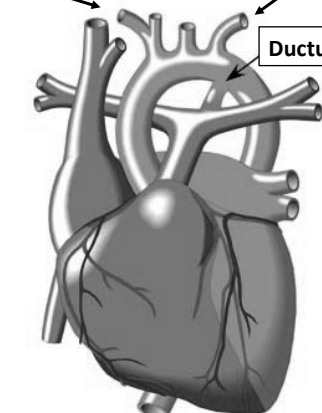
Right subclavian artery

"Pre-ductal"

Left subclavian artery

"Post-ductal" (?)

Ductus Arteriosus



"Post-ductal"

Right hand = right place



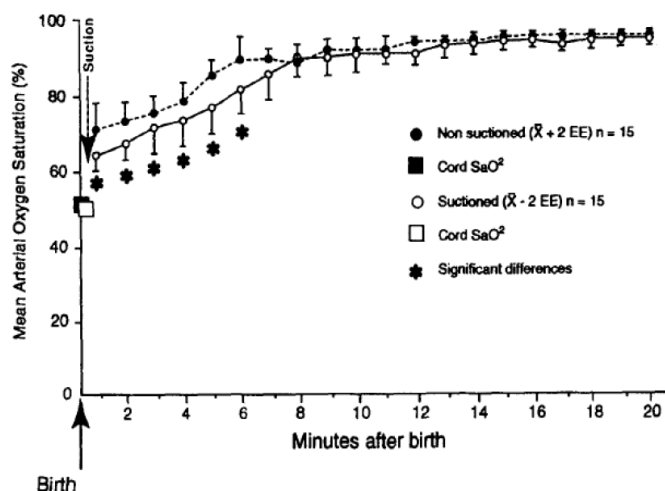
Tips and Tricks – how to apply pulse ox

1. Turn on pulse ox → 2. Put probe on baby → 3. Plug probe into pulse ox

Best case - reliable readings within 1 to 2 minutes following birth

Saraswat A, et al. Determining the best method of Nellcor pulse oximeter sensor application in neonates. *Acta Paediatr.* 2012 May;101(5):484-7.

Tips and Tricks – avoid routine suctioning



Carrasco M et al. Oronasopharyngeal suction at birth: effects on arterial oxygen saturation. J Pediatr. 1997 May;130(5):832-4

Feasibility of pulse oximetry in community-based midwifery care

- Prospective, observational study of infants born after midwifery supervised home births
 - 27 midwives from 7 practices over a ten-month period
 - 153 infants
- Results:
 - Pulse ox was successfully used in 90% of infants
 - 88% of midwives found it easy to use
 - In 97% of infants pulse ox did not influence midwives' clinical judgment and referral policy
 - In case of suboptimal neonatal condition or resuscitation, 100% of midwives declared they would use pulse ox again

Smit M et al. Feasibility of pulse oximetry for assessment of infants born in community based midwifery care. Midwifery. 2013 Jul 15

Case examples

- 38 week infant male born through clear fluids
- Cyanotic at birth and remains cyanotic at **5 minutes**, but appears less blue than at birth
- Should you apply pulse ox?



Case examples

- 38 week infant male born through clear fluids
- Cyanotic at birth and remains cyanotic at **10 minutes**, but appears less blue than at birth
- Should you apply pulse ox?



Case examples

- 38 week infant male born through clear fluids
- Cyanotic at birth and remains cyanotic at **15 minutes**, but appears less blue than at birth
- Should you apply pulse ox?



Case examples

- 38 week infant male born through meconium
- Cyanotic and apneic at birth, received PPV x 30 seconds
- At 5 minutes of life infant remains cyanotic and has audible grunting and subcostal retractions
- Should you apply pulse ox?
- What is your target saturation?



Questions?

