



From Children's National Medical Center. Congenital Heart Disease Screening Program Toolkit: A Toolkit for Implementing Screening. Washington, DC: Children's National Medical Center; 2009.



Children's National
Medical Center®

VDH VIRGINIA
DEPARTMENT
OF HEALTH
Protecting You and Your Environment
www.vdh.virginia.gov

 **UNIVERSITY
of VIRGINIA**
SCHOOL OF MEDICINE

Critical Congenital Heart Disease Screening Program

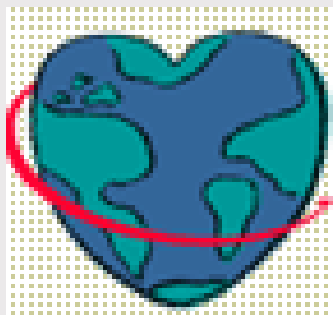
November, 2012



A Parent's Perspective

“Over the eleven years since I started C.H.I.N., hardly a day goes by when I do not hear from a distraught parent whose child was not diagnosed at birth, leading to tragic or serious life-long consequences”

Mona Barmash, President of Congenital Heart Information Network
JCCHD Meeting, Fall 2007



Congenital Heart Disease

- ♥ Congenital heart disease (CHD) is the most common birth defect and occurs in 8 per 1,000 live births
- ♥ Critical CHD – Forms of CHD that are usually associated with hypoxia in the newborn period and require intervention during the first months of life
- ♥ Critical CHD accounts for approximately 1/3 of all CHD¹

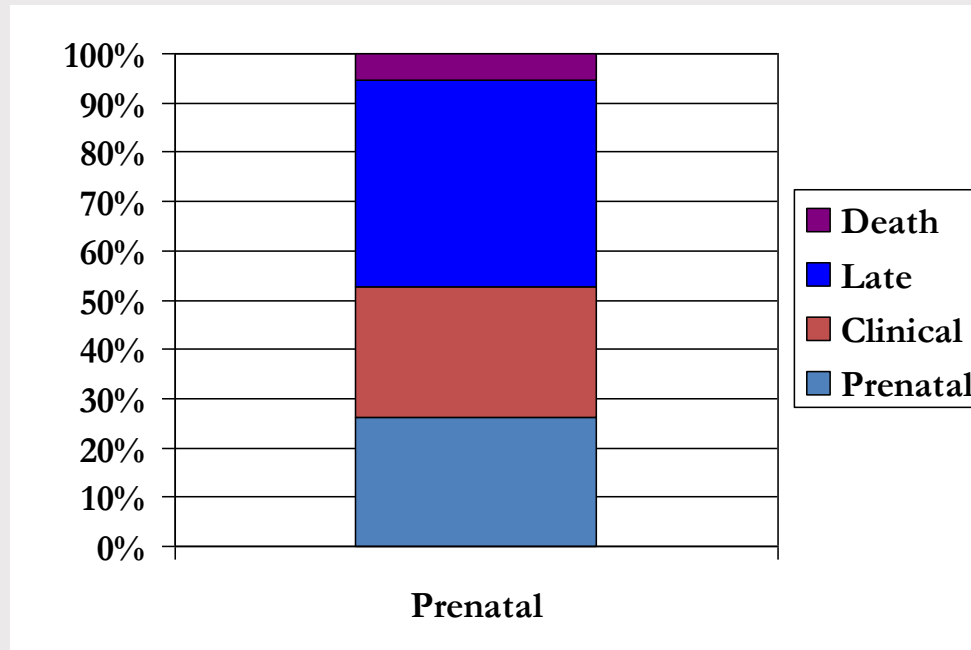
Congenital Heart Disease

CHD is important cause of morbidity & mortality in infants:

- ♥ Accounts for approximately 40% of deaths from congenital anomalies²
- ♥ Majority of deaths occur among infants during the first year of life²
- ♥ 10% of infants who died with CHD before one year of age were first diagnosed with CHD at the time of autopsy³

Congenital Heart Disease

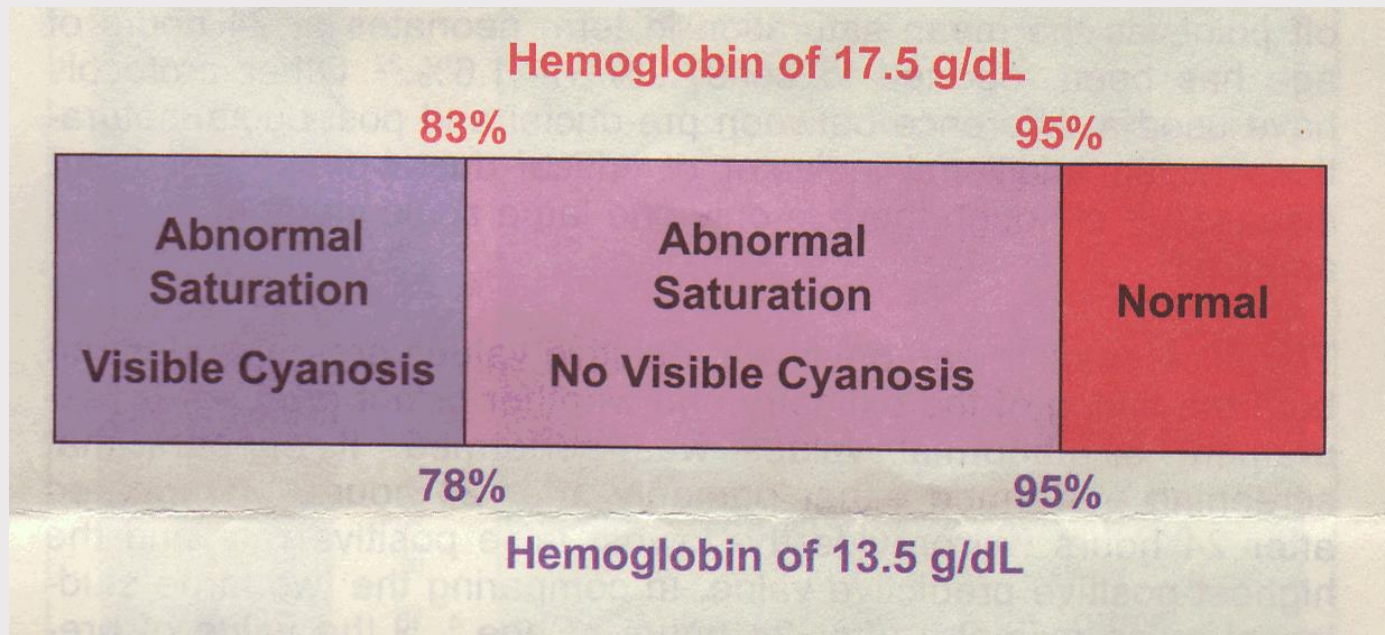
- ♥ Over the past 40 years there have been improvements in survival due to improved surgical outcomes
- ♥ There is still room for improvements in the detection of critical CHD



Why is CCHD Missed?

Visual recognition of cyanosis is difficult

Mean threshold for detection 69% ⁴



Pulse Oximetry

- ♥ A painless and non-invasive way of measuring the oxygen saturation of hemoglobin in the arterial blood.
- ♥ Routine to clinical care, often thought of as the 5th vital sign.



© Masimo Corporation 2011

Pulse Oximetry

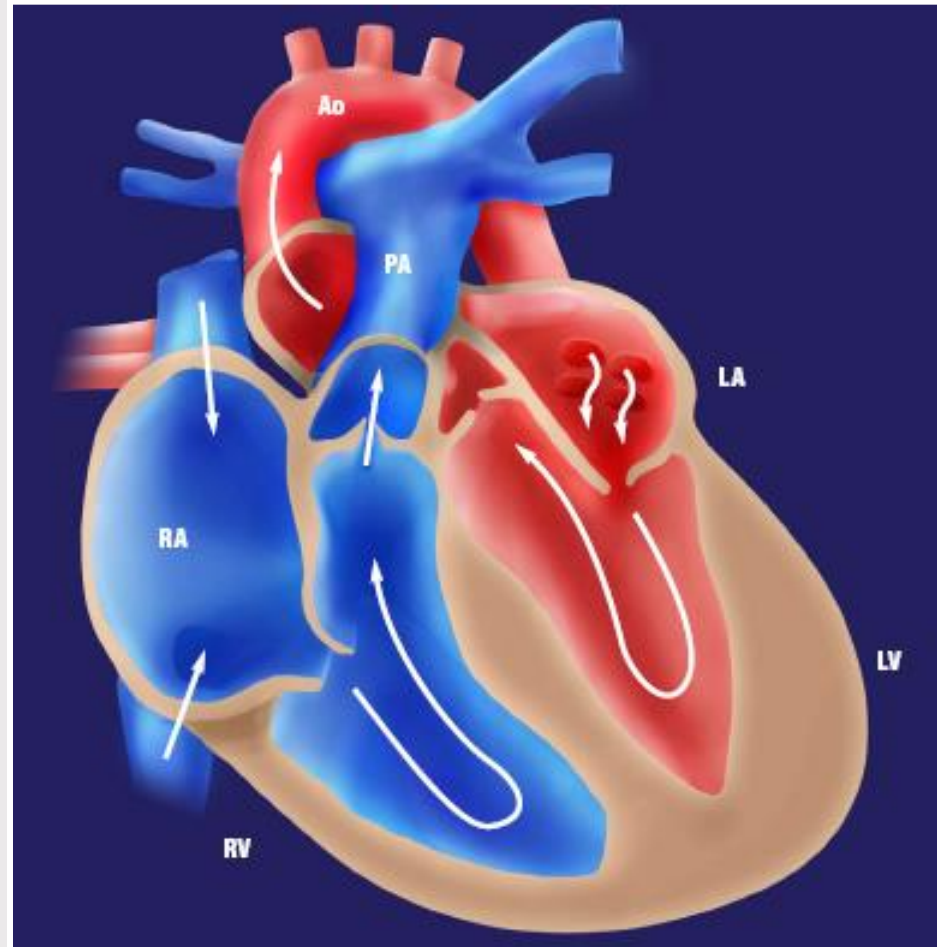
How Does Pulse Oximetry Work?

- ♥ Dependent on Heart Beat as arterial blood vessels contract/expand with each HB
- ♥ Red (R) and Infrared (IR) Light are transmitted via Light Emitters to a Photodetector
- ♥ Oxygenated and Deoxygenated Hb absorb different amounts of both R and IR light
- ♥ A ratio of the light absorbed by the photodetector correlates for oxygen saturation of hemoglobin in the arterial blood

Pulse Oximetry as a Screening Method

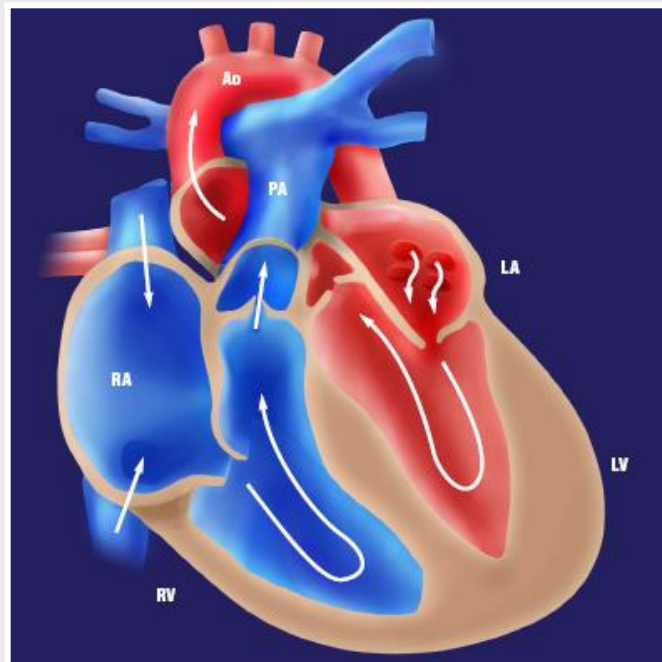
Normal Heart

No Mixing of
Systemic and
Pulmonary
Venous Blood
Flow

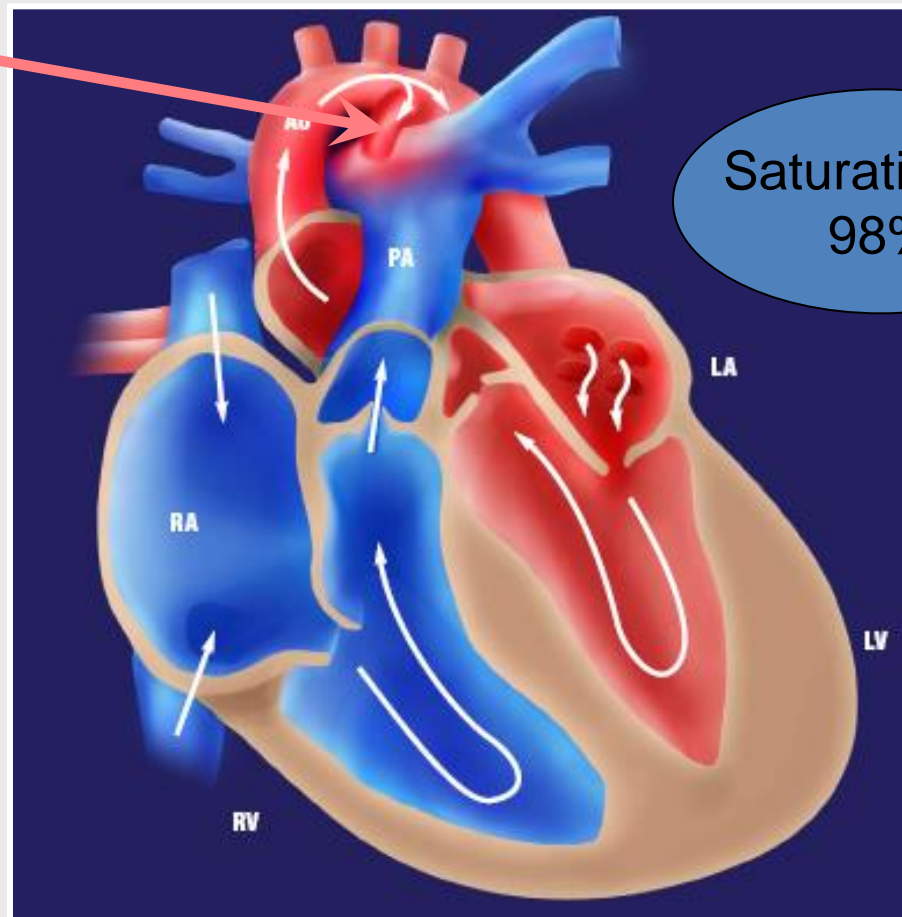


Saturation of
100 %

Fetal Circulation



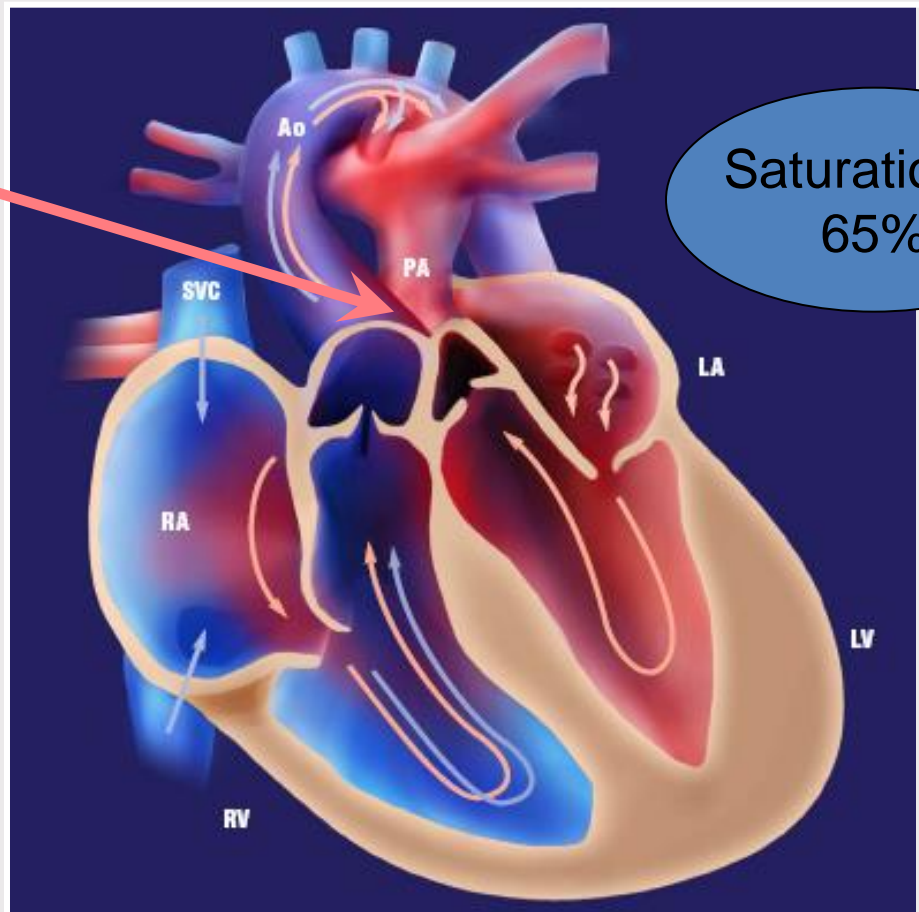
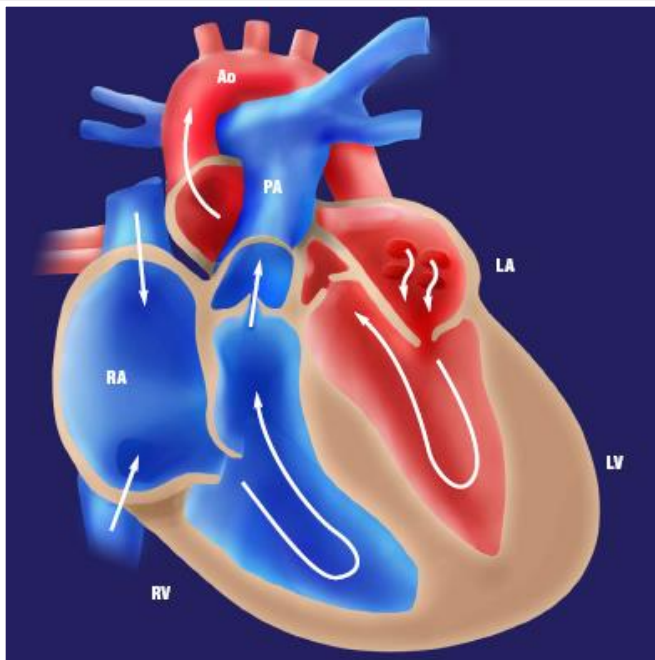
PDA



Saturation of
98%

Transposition of the Great Arteries

TGA



Pulse Oximetry as Screening Method

- ♥ Highest sensitivity (true positives) and highest specificity (true negatives) associated with screening the right hand and one foot, using a cut-off of less than 95% or a greater than 3% difference between the two ⁵
- ♥ Best outcomes may be found when physical examination is paired with pulse oximetry screening.
- ♥ September 21, 2011- Health and Human Services Secretary Kathleen Sebelius **endorsed adding screening for CCHD to the recommended universal screening panel** ⁶

Congenital Heart Disease Screening Program

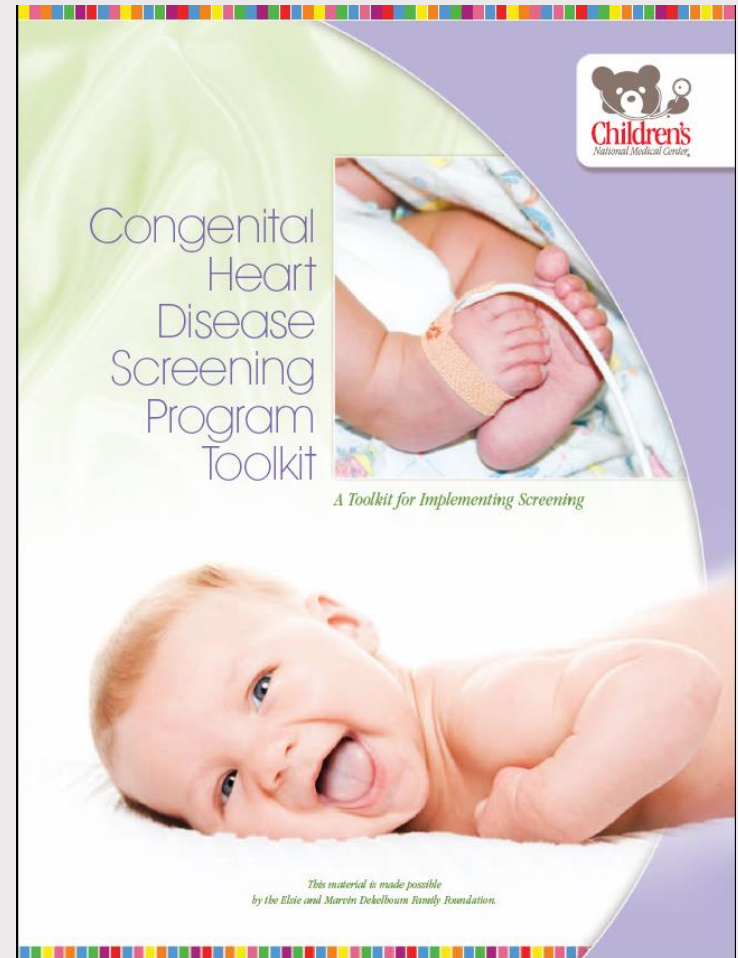
Vision

All infants with critical congenital heart disease are detected before leaving the newborn nursery.

Congenital Heart Disease Screening Program

Program Aims:

- ♥ Implement pulse oximetry screening programs for the detection of critical CHD in newborn nurseries
- ♥ Minimize obstacles encountered while performing pulse oximetry screening methods
- ♥ Screen 100% of infants eligible for screening
- ♥ Detect critical CHD before clinical deterioration of infant



Congenital Heart Disease Screening Program

- ♥ Who is eligible to be screened?
 - All infants that are at least 24 hours of age

- ♥ How will mothers be educated about screening?
 - Prenatal
 - Tours and Prenatal Classes
 - OB/GYN Clinics
 - Newsletters and Hospital Websites
 - Postnatal
 - Prior to screening

Placement of Pulse Oximetry Sensor

Application with
Disposable Probe



“Star to the Sky”

Application with
Reusable Probe

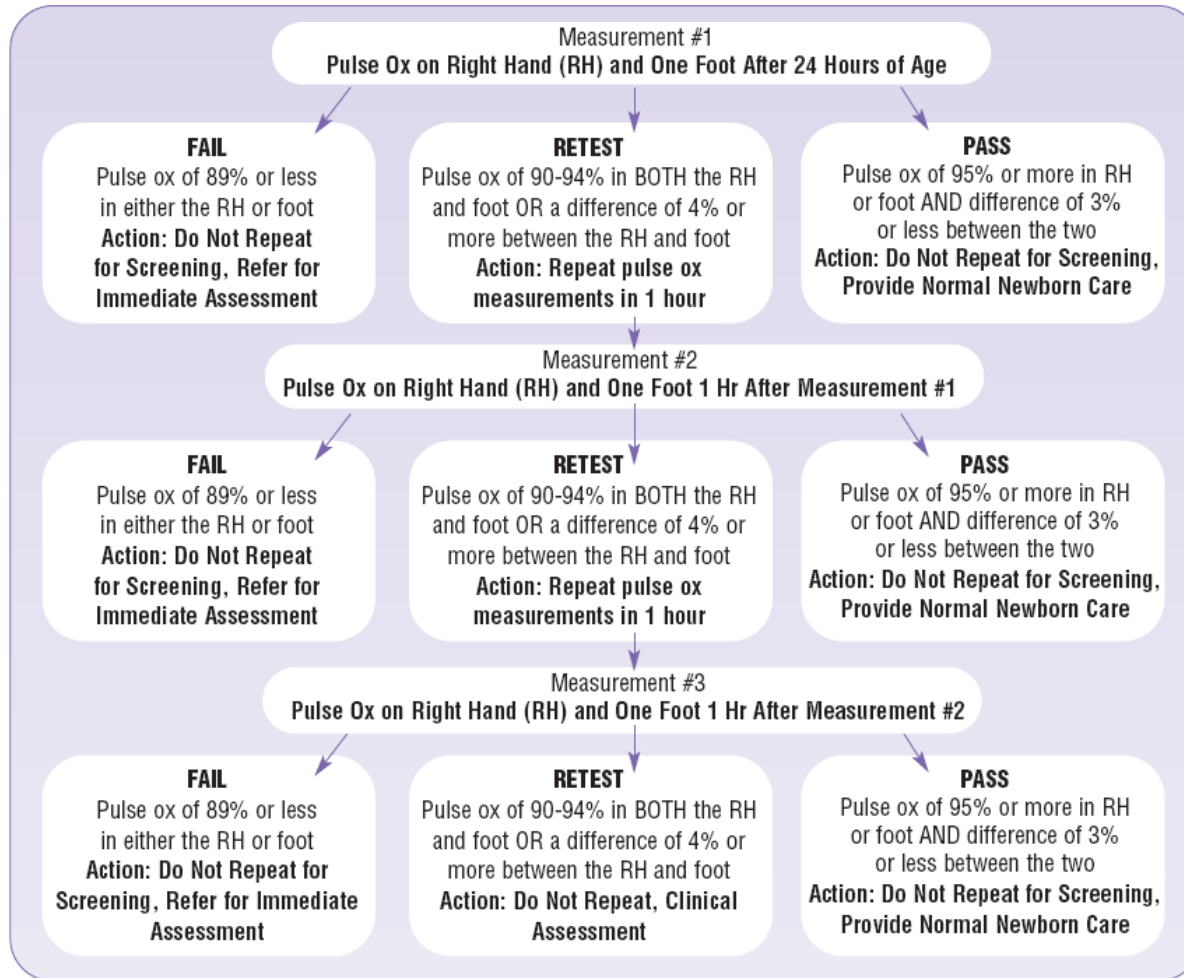


© Masimo Corporation 2011

“Raise the (Red) Bar”

Congenital Heart Disease Screening Program

Screening Protocol ^{7, 8}



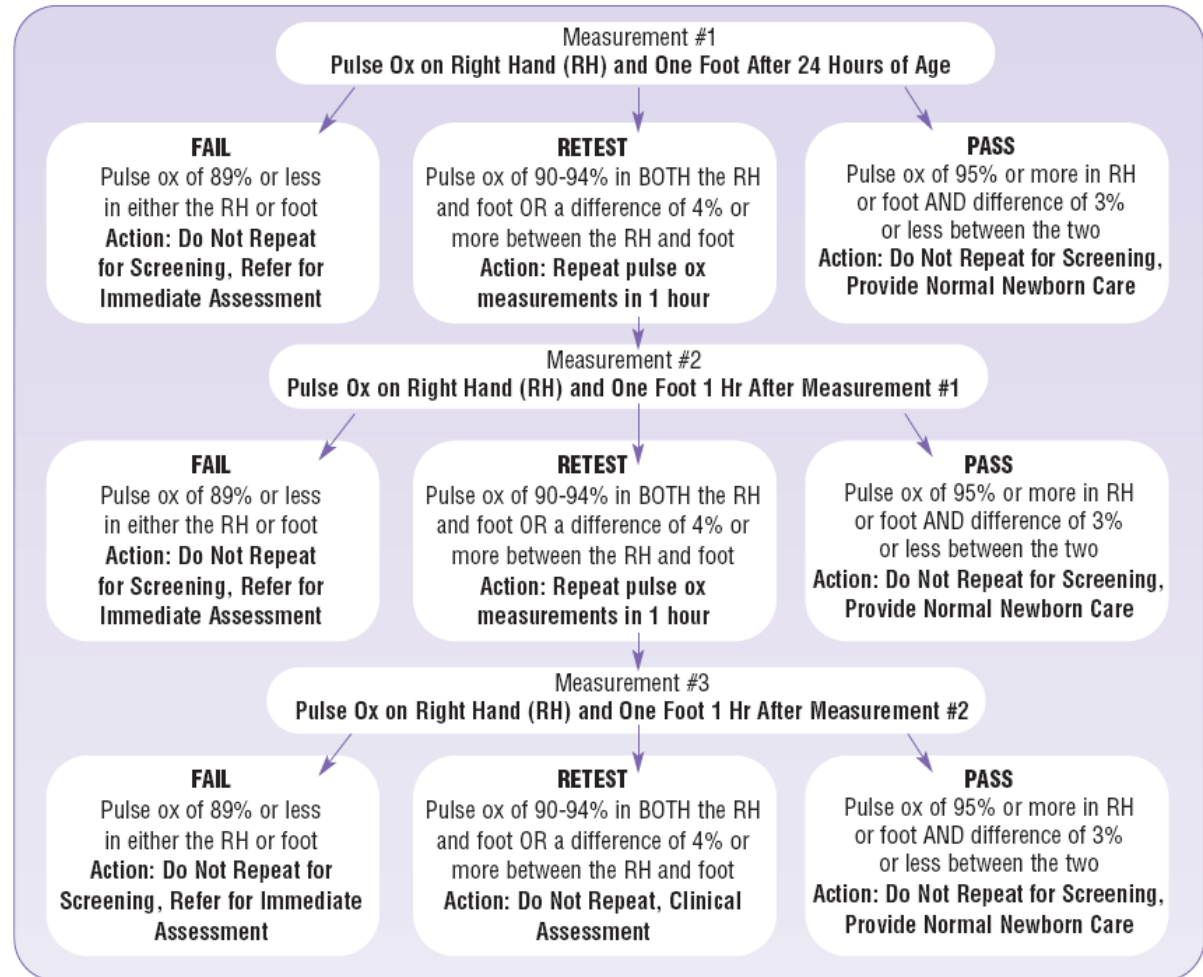
Example 1

UE Sat - 100%

LE Sat - 96%

a. PASS

b. FAIL



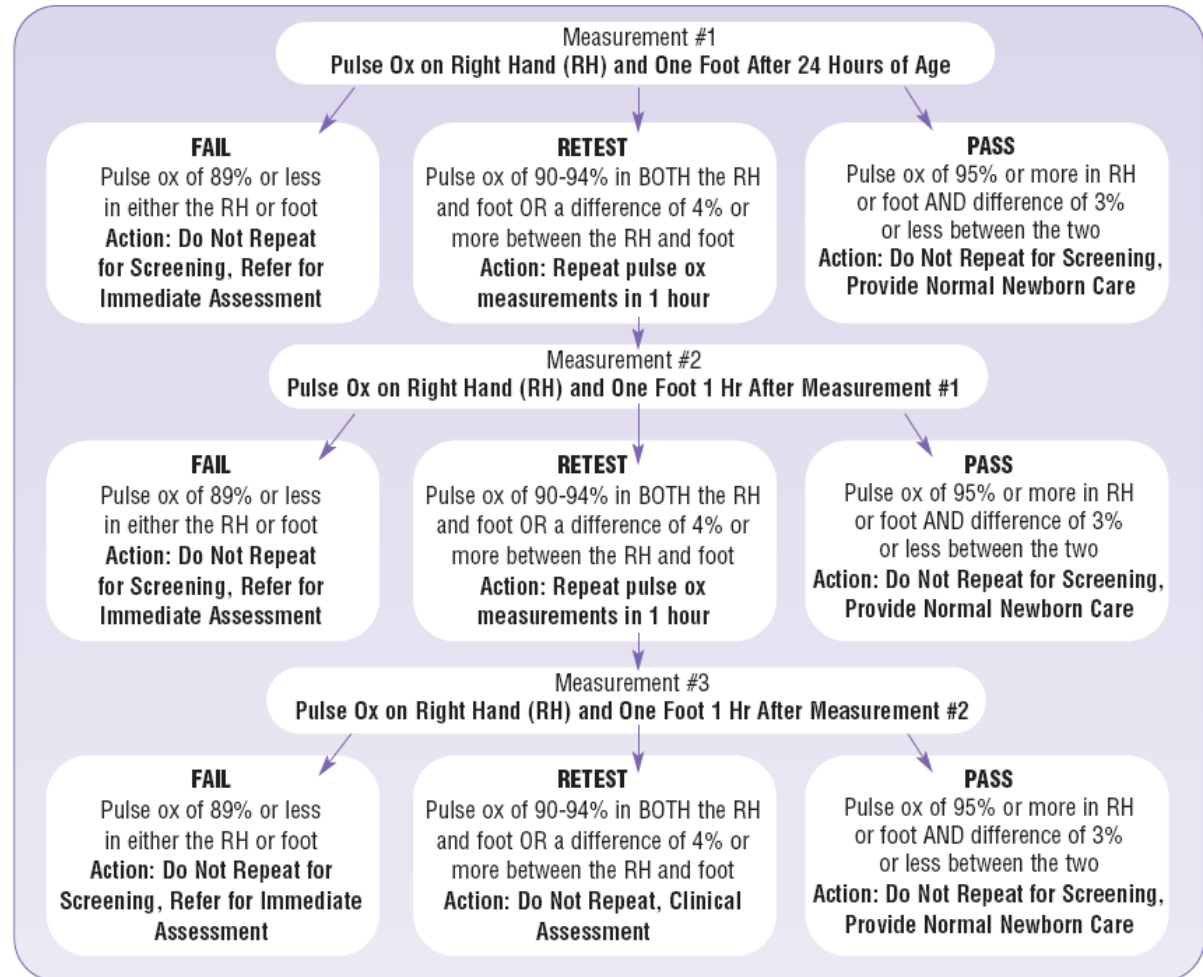
Example 1

UE Sat - 100%

LE Sat - 96%

a. PASS

b. FAIL



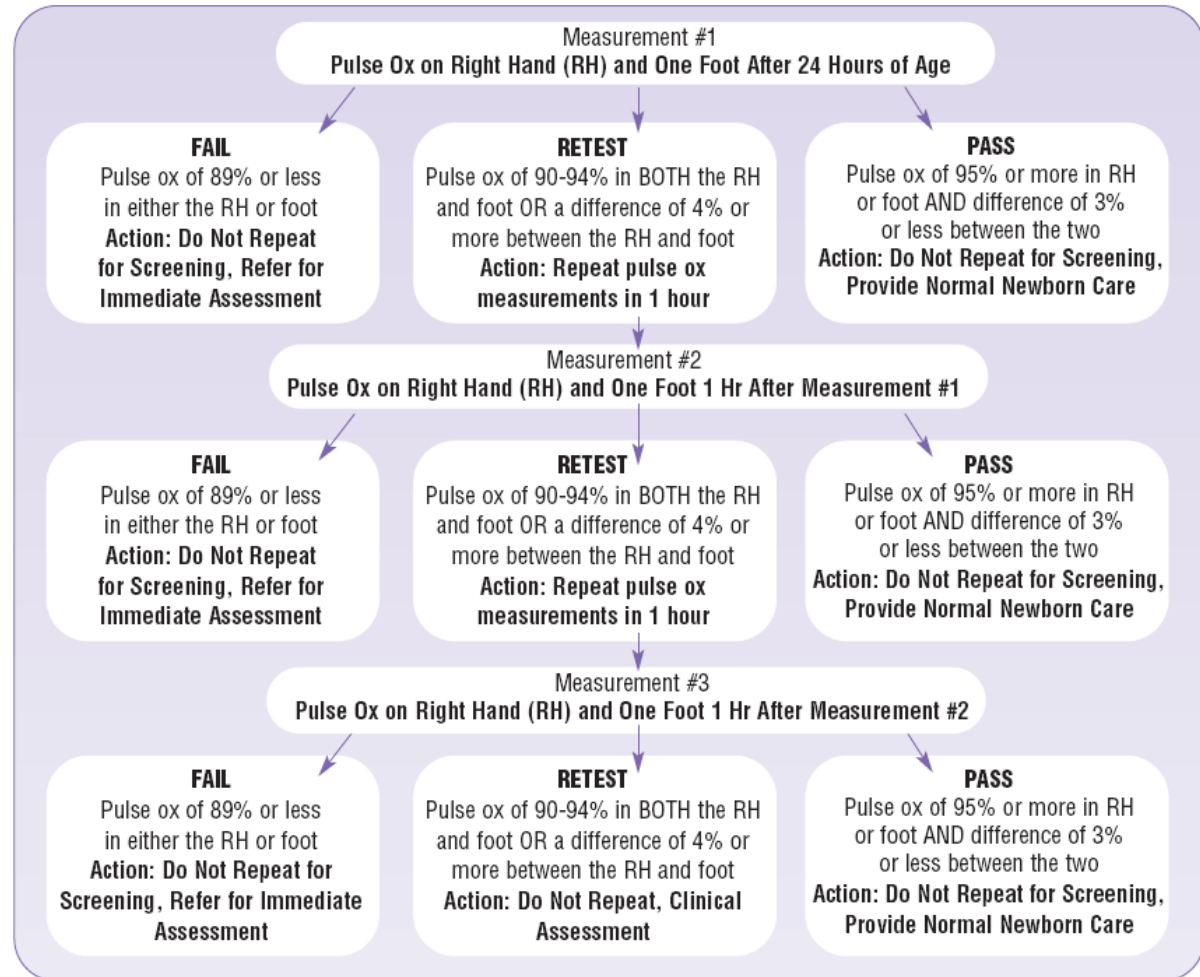
Example 1

2nd Screen:

UE Sat – 99%

LE Sat – 98%

- PASS
- FAIL



Example 1

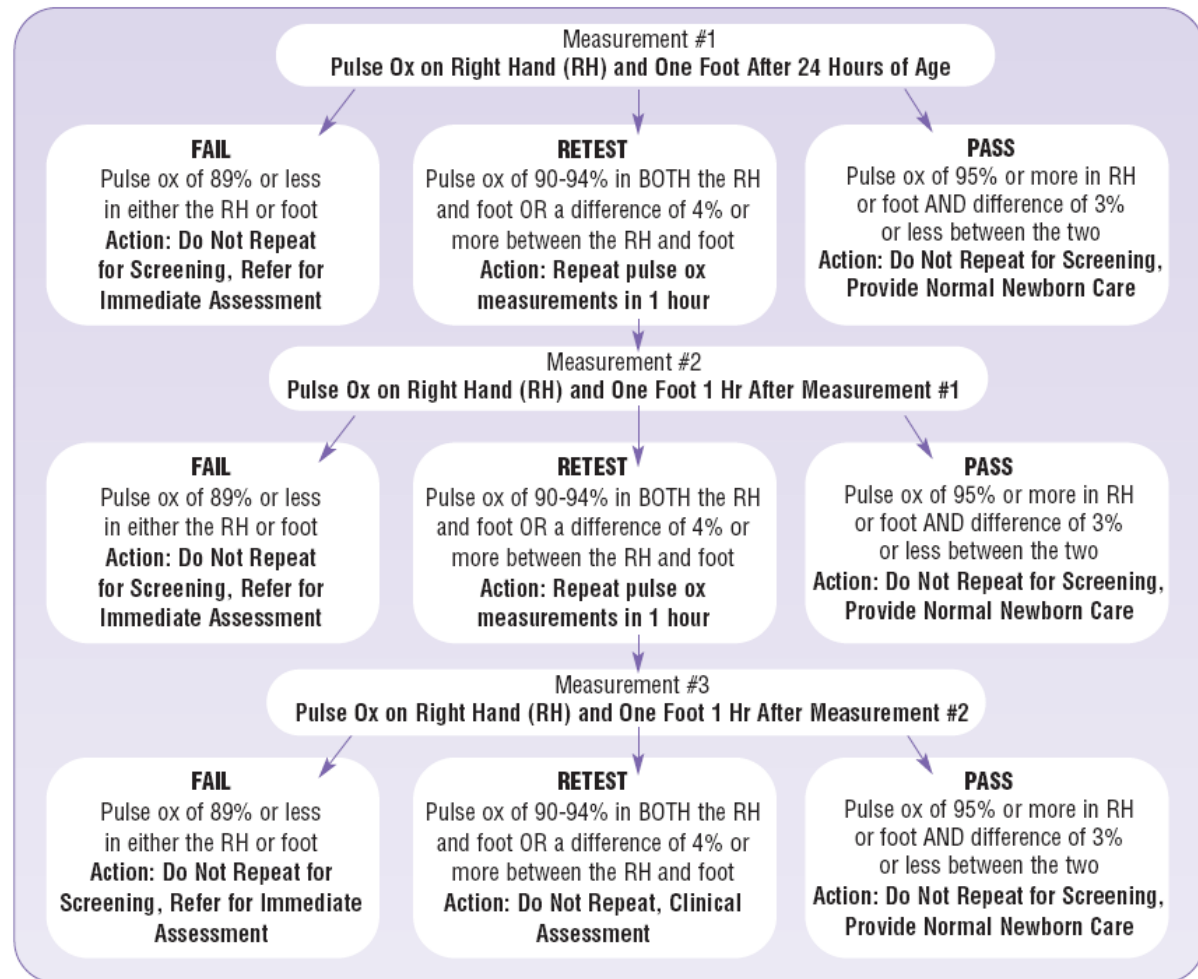
2nd Screen:

UE Sat – 99%

LE Sat – 98%

- **PASS**

- **FAIL**



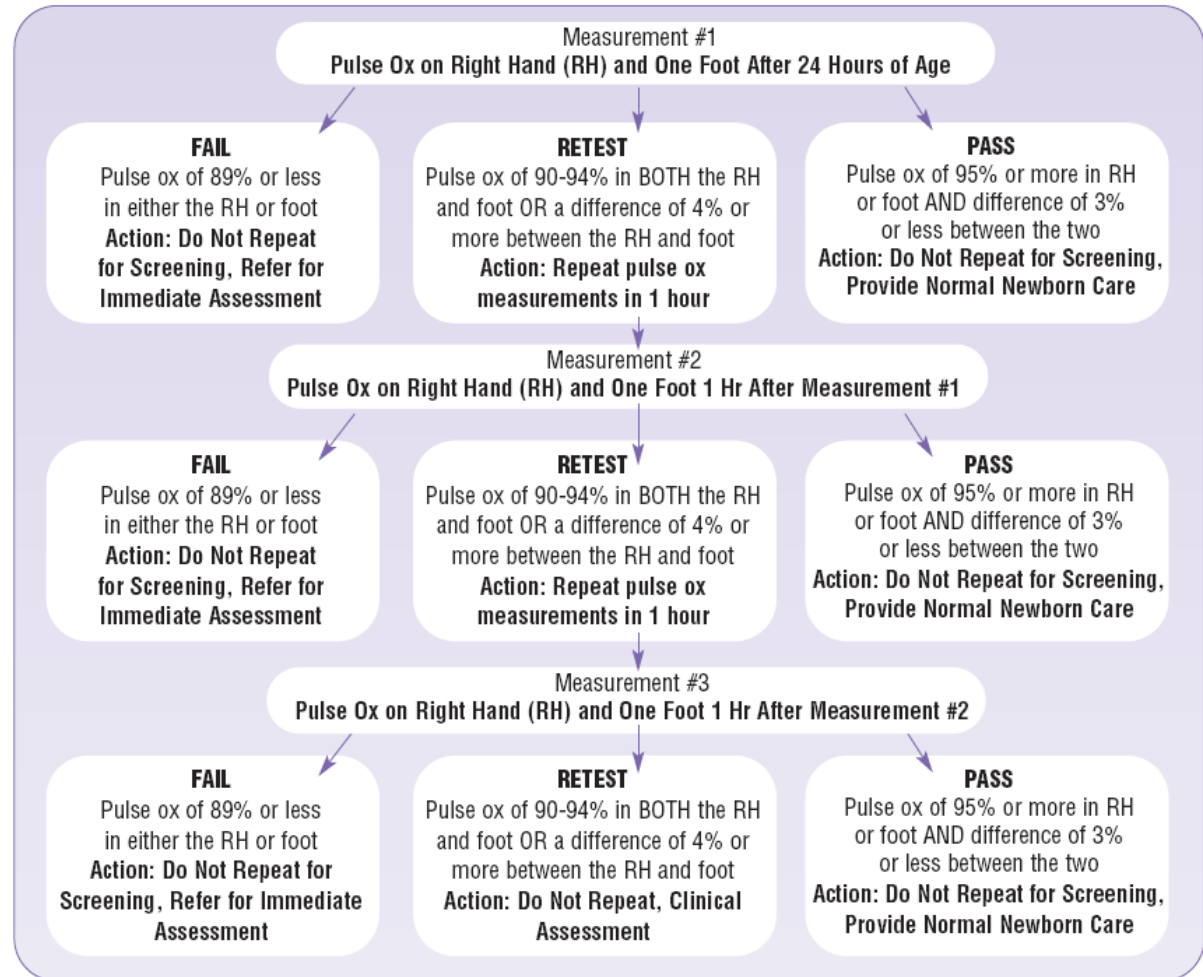
Example 2

UE Sat - 96%

LE Sat - 94%

a. PASS

b. FAIL



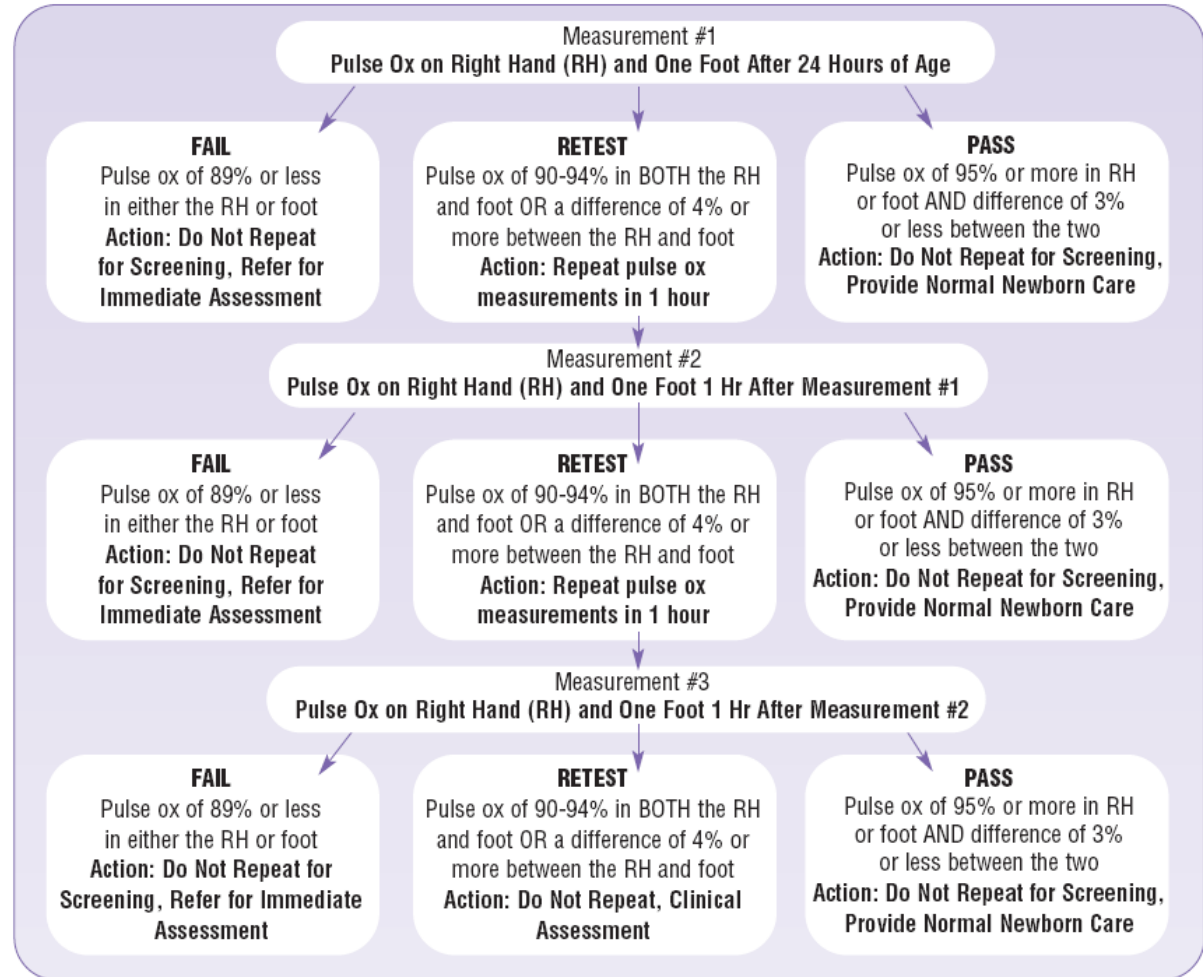
Example 2

UE Sat - 96%

LE Sat - 94%

a. **PASS**

b. **FAIL**



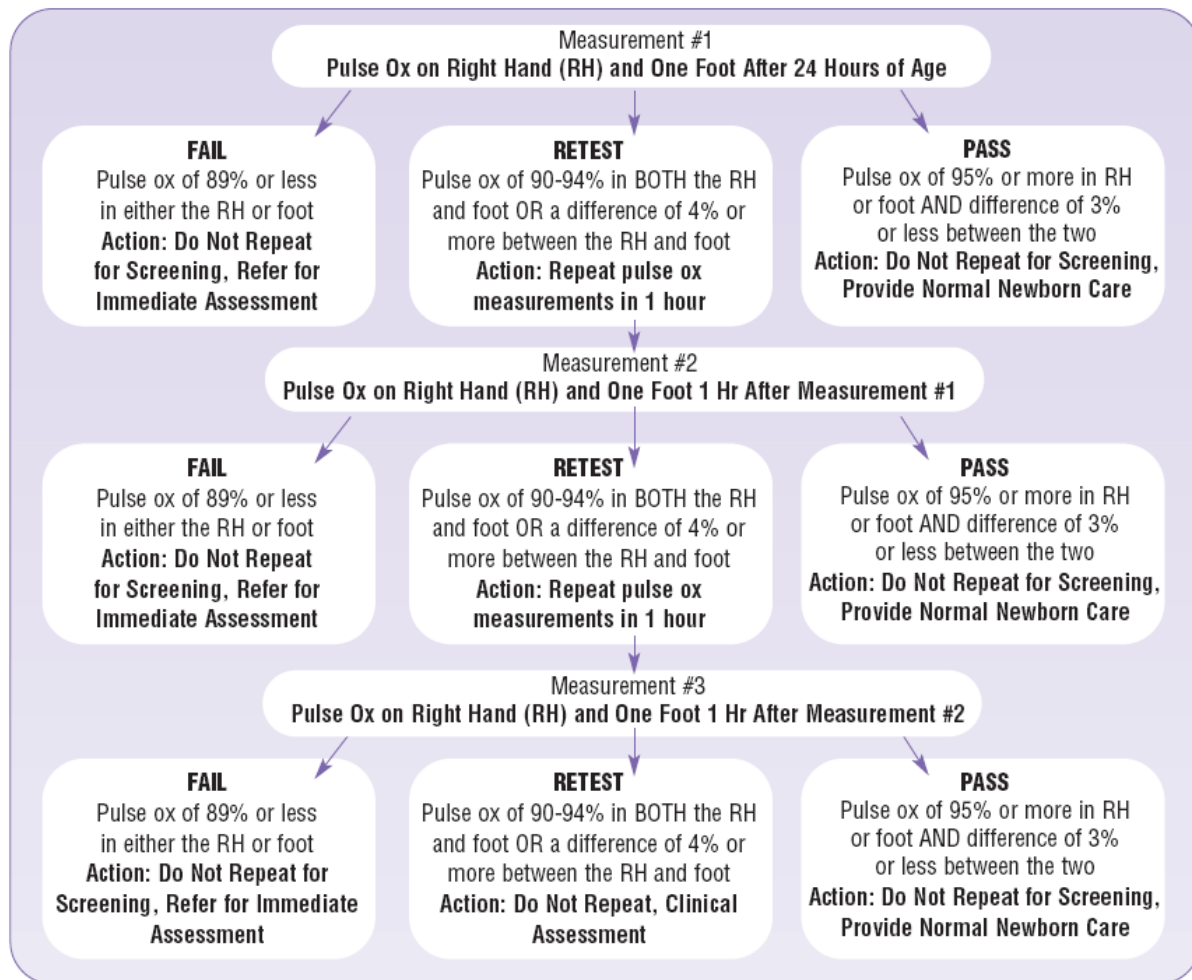
Example 3

UE Sat - 89%

LE Sat - 87%

a. PASS

b. FAIL



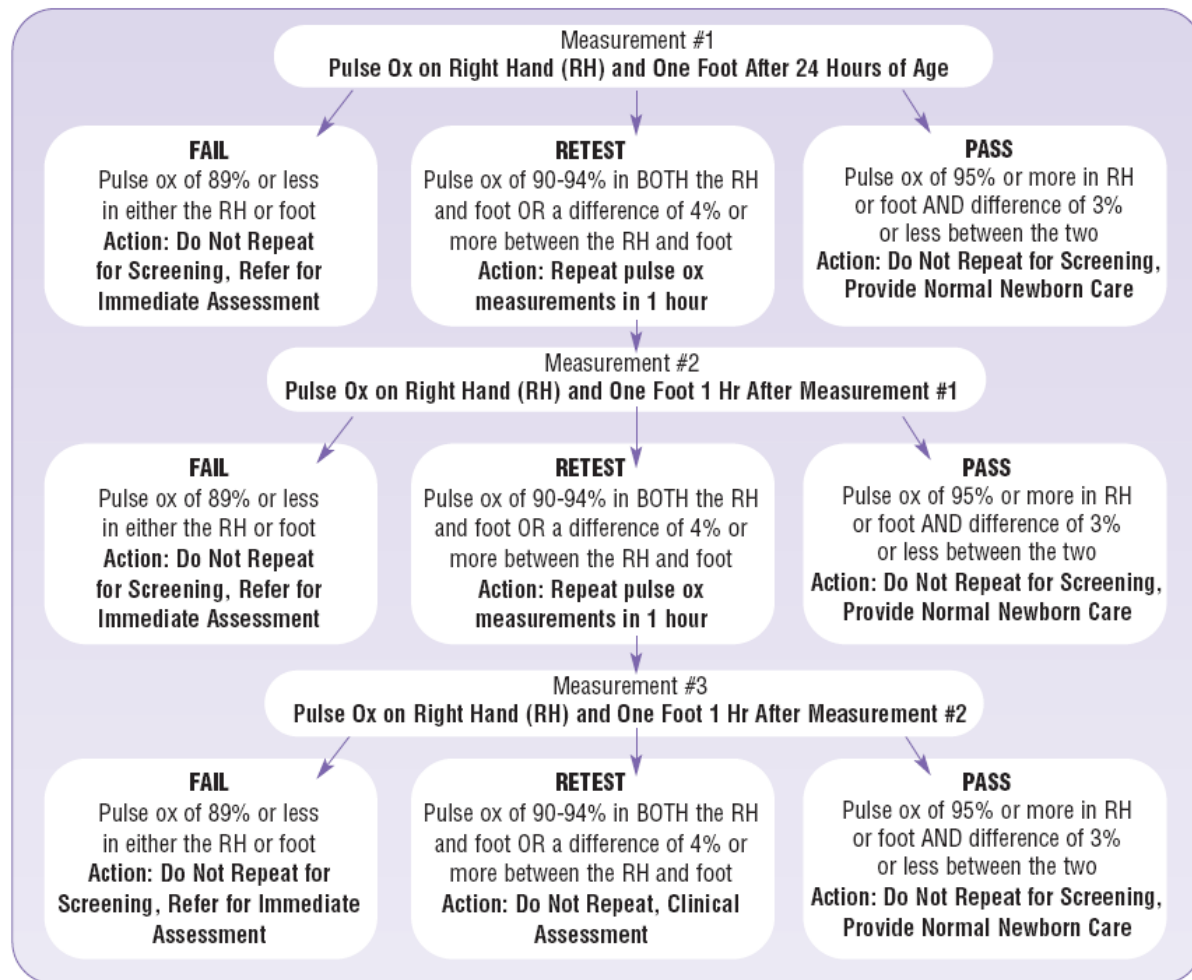
Example 3

UE Sat - 89%

LE Sat - 87%

a. PASS

b. **FAIL**



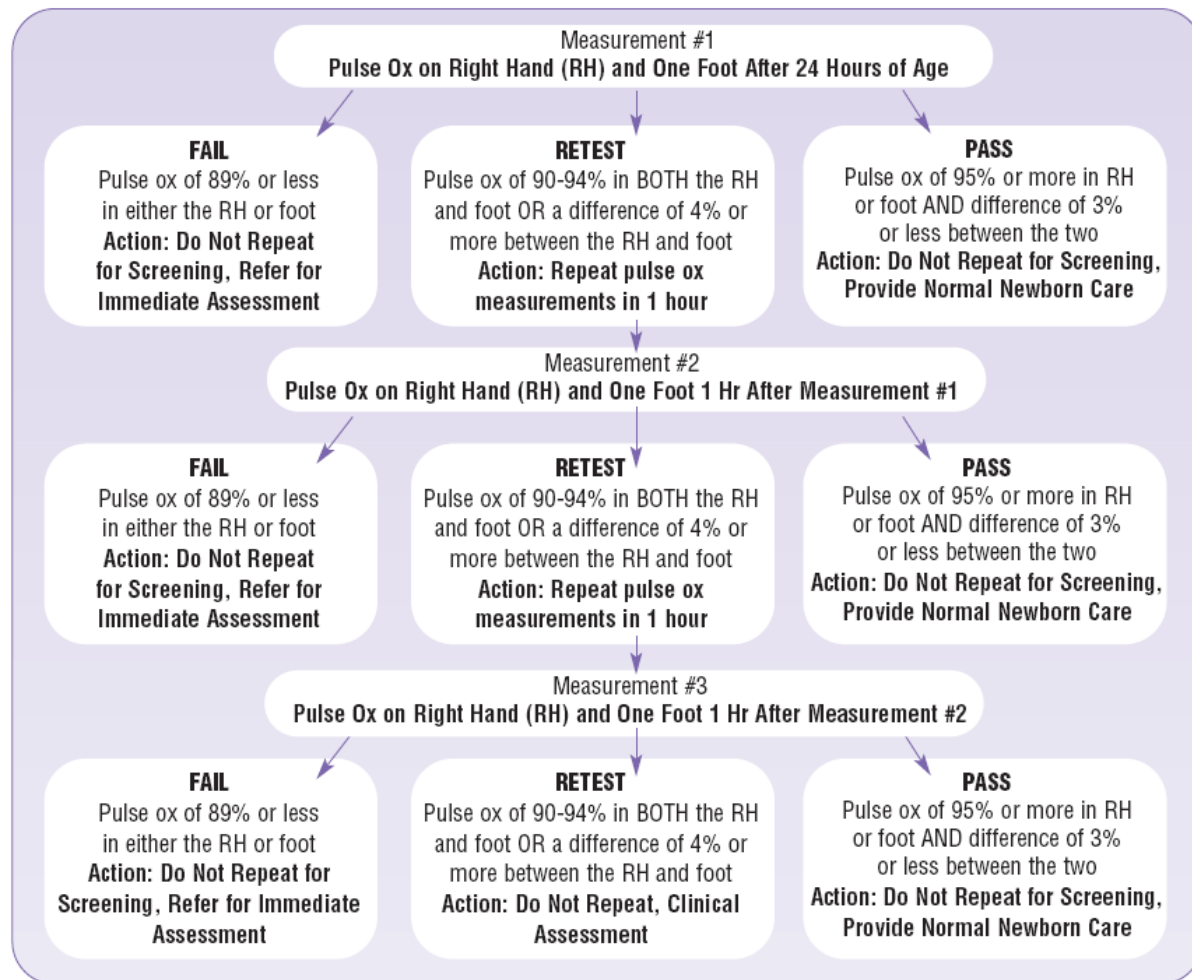
Example 4

UE Sat - 92%

LE Sat - 96%

a. PASS

b. FAIL



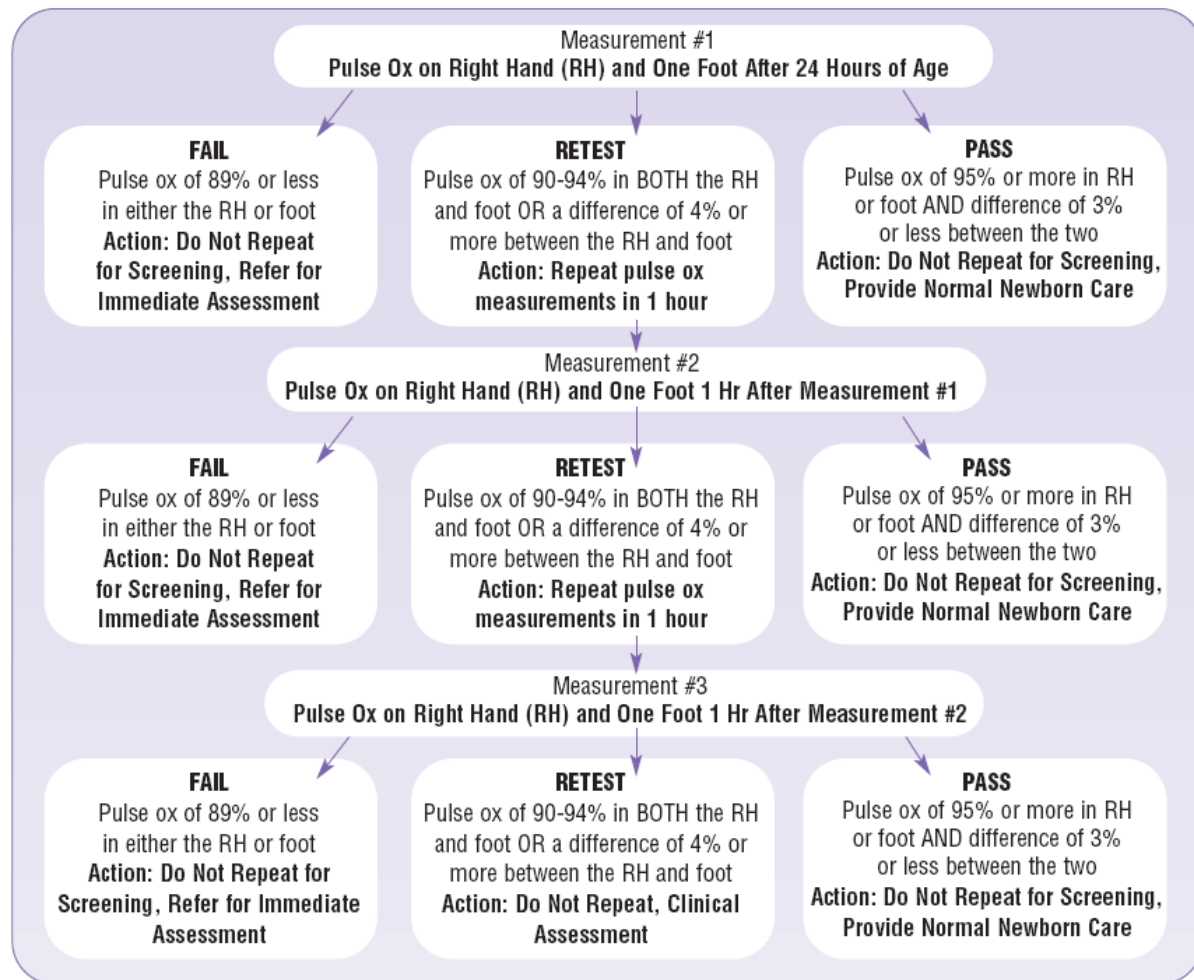
Example 4

UE Sat - 92%

LE Sat - 96%

a. PASS

b. **FAIL**



Example 4

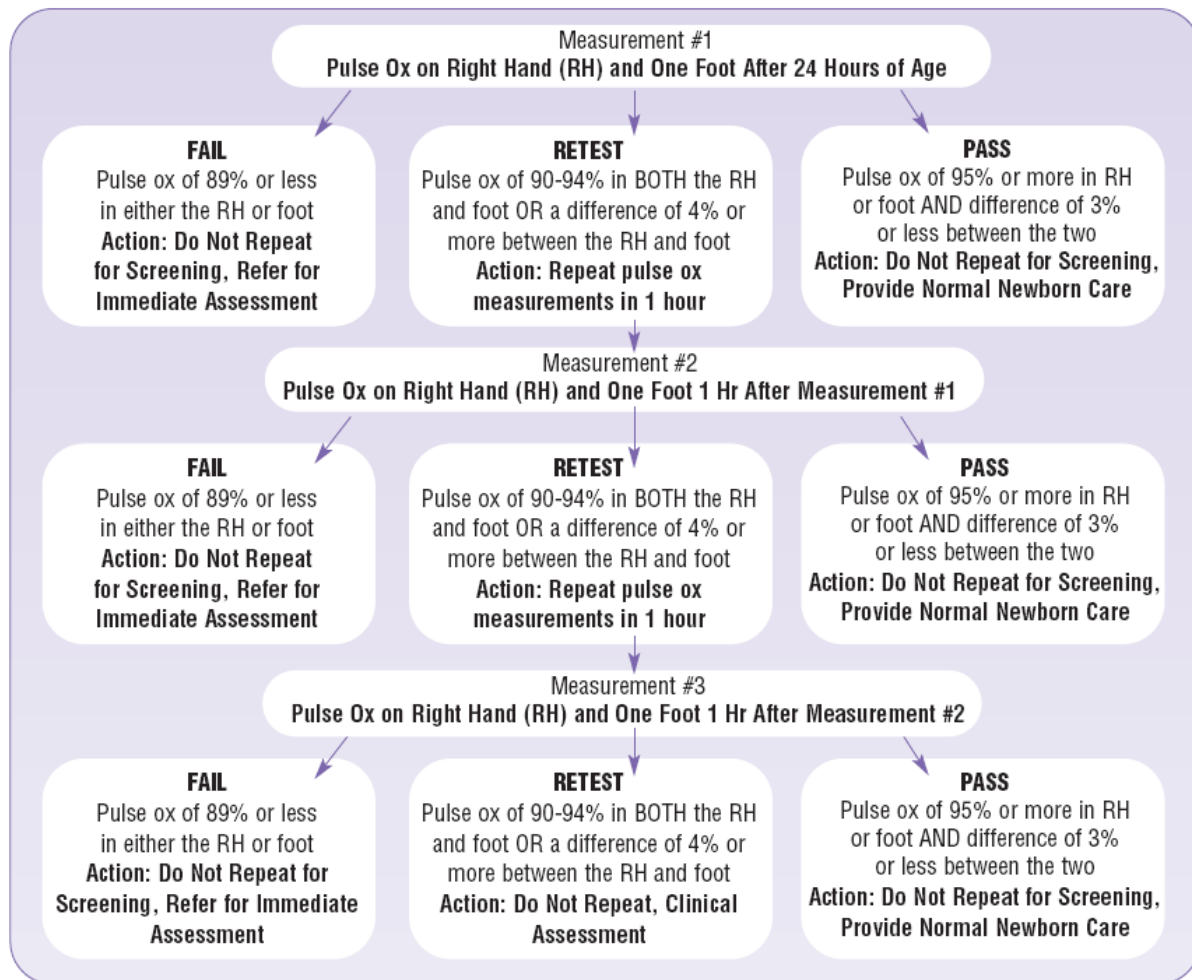
2nd Screen

UE Sat - 92%

LE Sat - 94%

a. PASS

b. FAIL



Example 4

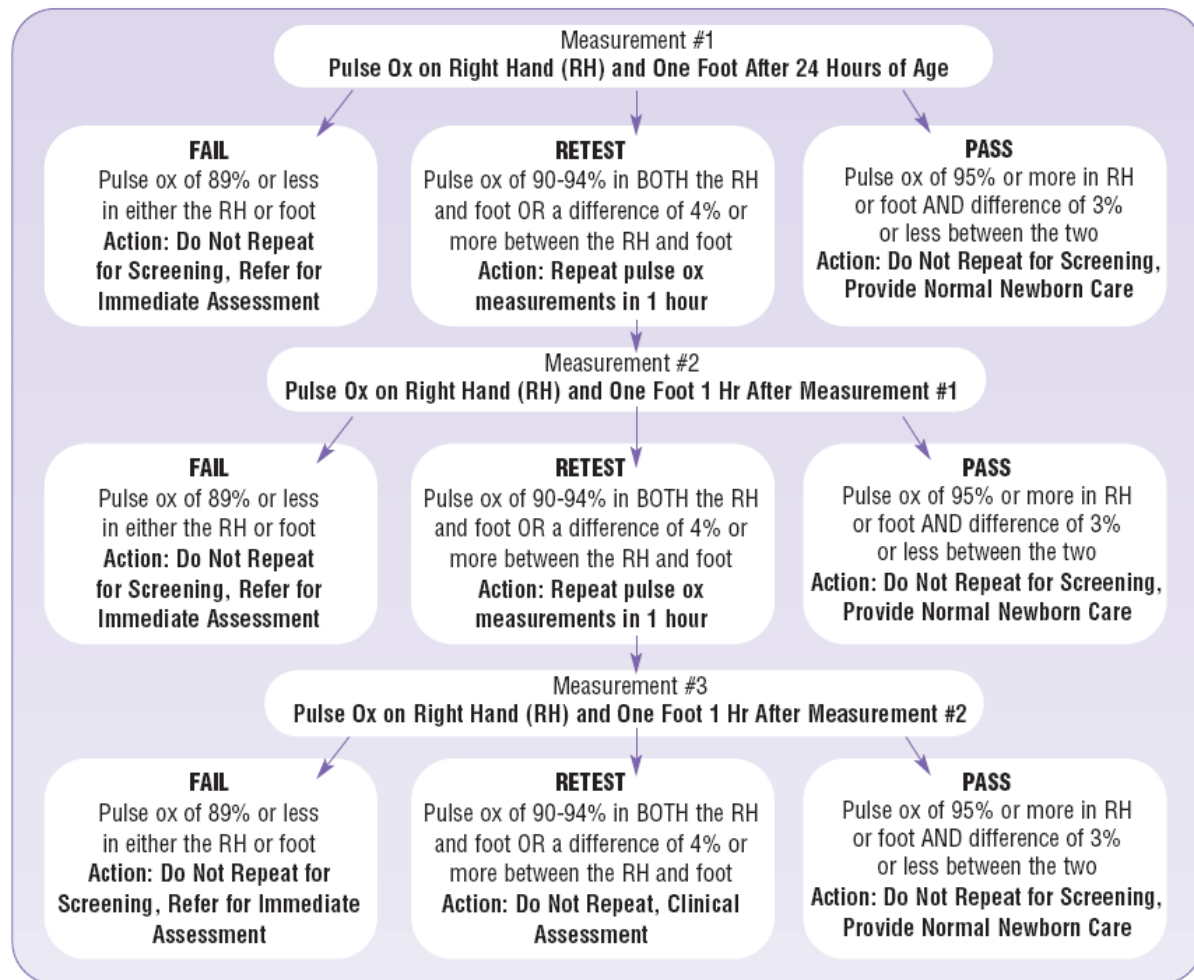
2nd Screen

UE Sat - 92%

LE Sat - 94%

a. PASS

b. FAIL



Example 4

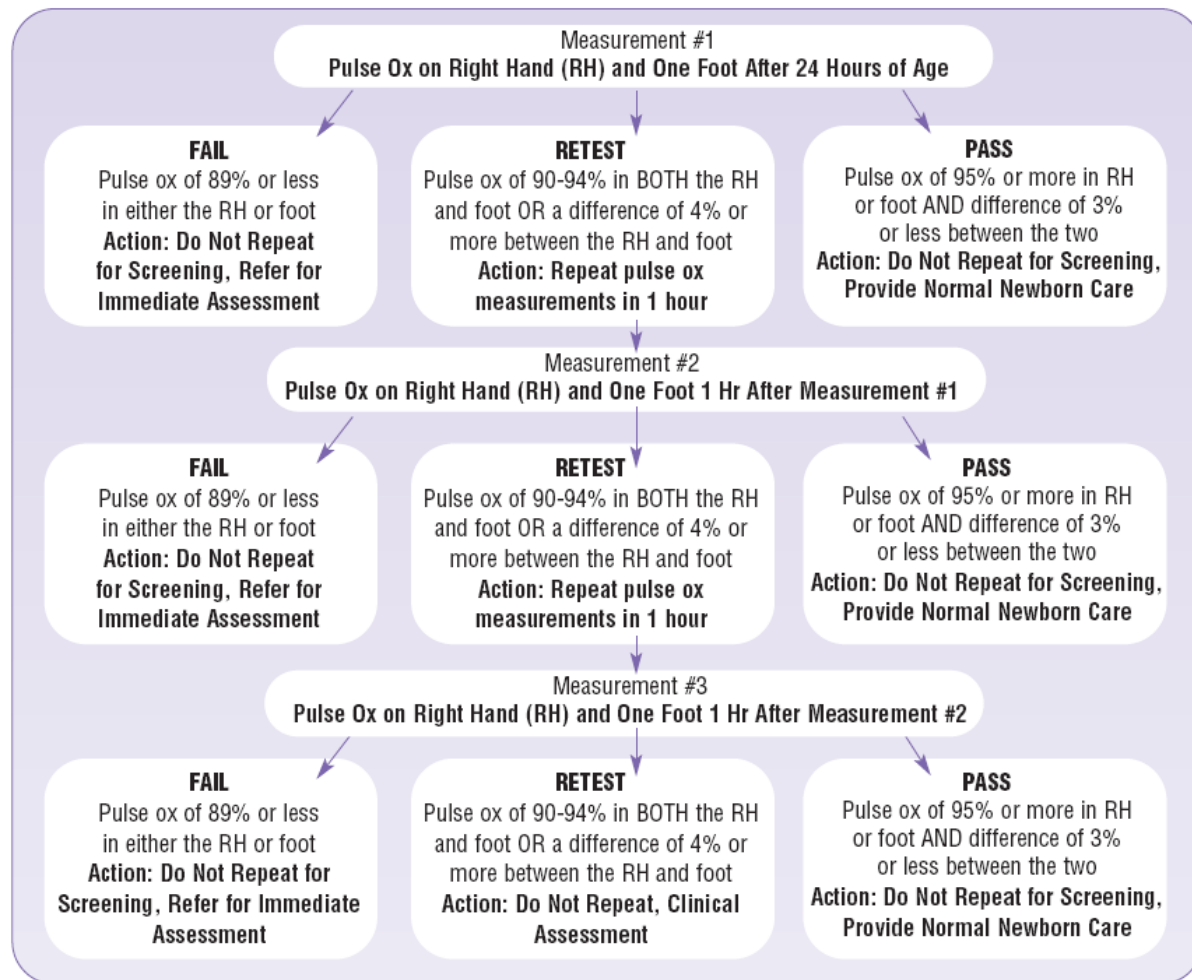
3rd Screen

UE Sat - 92%

LE Sat - 92%

a. PASS

b. FAIL



Example 4

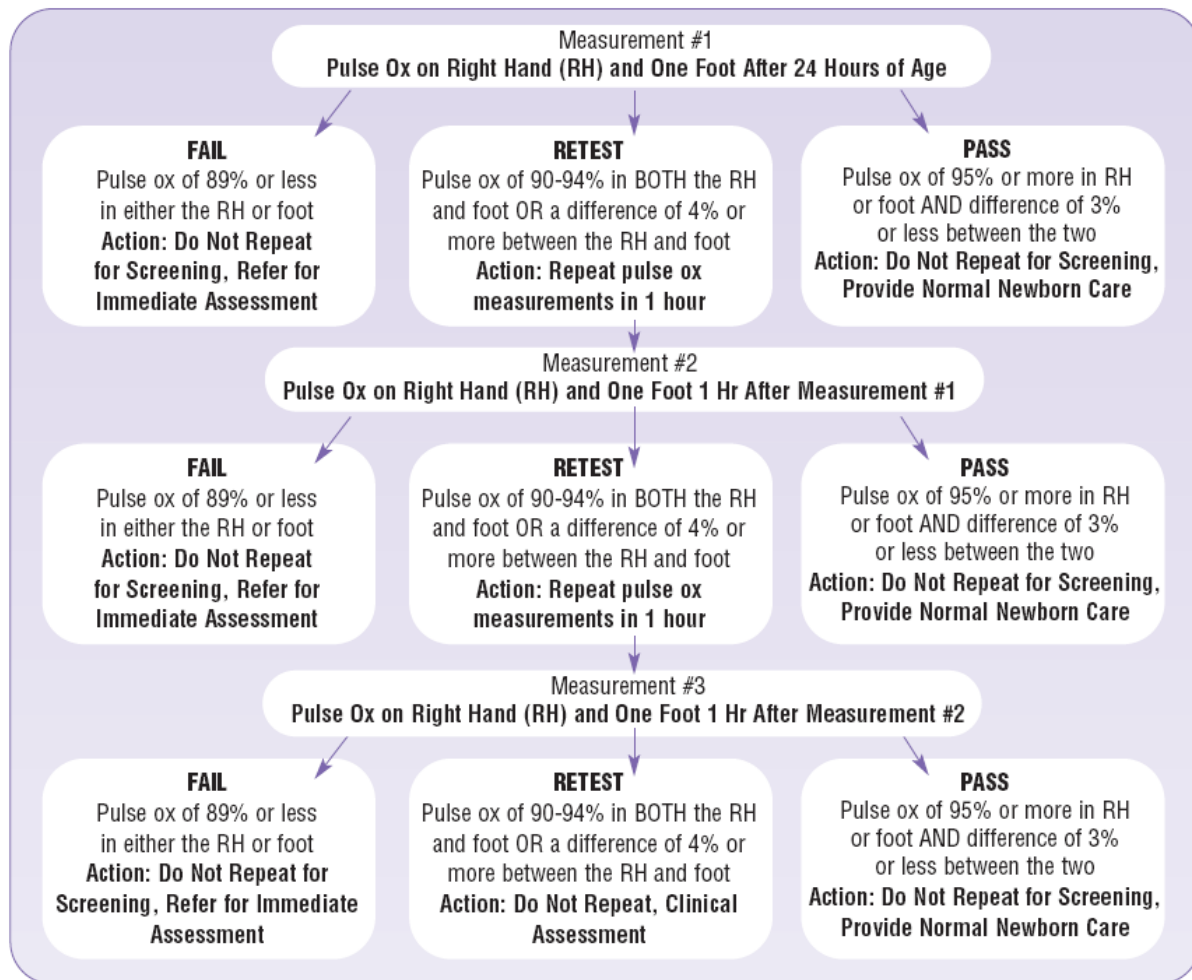
3rd Screen

UE Sat - 92%

LE Sat - 92%

a. PASS

b. FAIL



Congenital Heart Disease Screening Program

References

1. Hoffman, J.I.E., Kaplan, S. (2002). The incidence of congenital heart disease. *Journal of the American College of Cardiology*, 39, 1890-1900.
2. Boneva, R.S., Botto, L.D., Moore, C.A. Yang, Q., Correa, A., Erickson, J.D. (2001). Mortality associated with congenital heart defects in the United States: Trends and racial disparities, 1979-1997. *Circulation*, 103, 2376-2381.
3. Kuehl, K.S., Loffredo, C.A., Ferencz, C. (1999). Failure to diagnose congenital heart disease in infancy. *Pediatrics*, 103(4), 743-747.
4. Hokanson, J.S. Pulse Oximetry Screening for Unrecognized Congenital Heart Disease in Neonates. *Congenital Cardiology Today*. 2011; 9(1).
5. Granelli, A.D., Wennergren, M., Sandberg, K., Mellander, M., Bejlum, C., Inganas, L., Eriksson, M., Segerdahl, N., Agren, A., Ekman-Joelsson, B.M., Sunnegardh, J., Verdicchio, M. & Ostman-Smith, O. (2008). Impact of Pulse Oximetry Screening on the Detection of Duct Dependent Congenital Heart Disease: A Swedish Prospective Screening Study in 39,821 newborns. *BMJ*, 337:a3037
6. Sebelius, K. Letter to R. Rodney Howell, M.D [Internet]. 2011 [updated 2011 Sept 21; cited 2011 Sept 23]. Available from: <http://www.hrsa.gov/advisorycommittees/mchbadvisory/heritabledisorders>
7. Kemper, A.R, Mahle, W.T., Martin, G.R., Cooley, W.C., Kumar, P., Morrow, R.W. et al. Strategies for Implementing Screening for Critical Congenital Heart Disease: Recommendations of the United States Health and Human Services Secretary's Advisory Committee on Heritable Disorders in Newborns and Children.
8. Children's National Medical Center. *Congenital Heart Disease Screening Program Toolkit: A Toolkit for Implementing Screening*. Washington, DC: Children's National Medical Center; 2009.