MICHIGAN DEPARTMENT OF COMMUNITY HEALTH

Pulse Oximetry Screening for Critical Congenital Heart Disease in the HOME BIRTH COMMUNITY

Michigan Department of Community Health
MDCH
Rick Snyder, Governor
Nick Lyon, Director

Children's National Medical Center

2014

Critical Congenital Heart Disease

Home Birth Toolkit for Implementing Pulse Oximetry Screening

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CCHD **Home Birth** Toolkit is available for download on our website www.michigan.gov/cchd

Program Overview and CCHD Screening

MICHIGAN CCHD SCREENING
INTRODUCTION

Critical Congenital Heart Disease (CCHD) detected by pulse oximetry	
Most likely to be detected:	*Less likely to be detected:*
○ **Hypoplastic left heart syndrome**	○ Coarctation of the aorta
○ **Pulmonary atresia (with intact septum)**	○ Double-outlet right ventricle
○ **Tetralogy of Fallot**	○ Ebstein anomaly
○ **Total anomalous pulmonary venous return**	○ Interrupted aortic arch
○ **D-Transposition of the great arteries**	○ Single ventricle
○ **Tricuspid atresia**	
○ **Truncus arteriosus**	

Congenital heart defects are the most common group of birth defects, affecting 9 in 1,000 newborns. *Critical* Congenital Heart Disease (CCHD) include those requiring surgery or catheter intervention in the first month of life. CCHD remains one of the most significant causes of infant death in the United States.

In 2011, pulse oximetry was recommended by the U.S. Department of Health and Human Services Secretary's Advisory Committee on Heritable Disorders in Newborns and Children as an important screening tool for detection of CCHD in asymptomatic newborns. This recommendation was subsequently endorsed by the American Academy of Pediatrics as a standard of care. As of April 1, 2014, Michigan requires screening for CCHD using pulse oximetry is required for all newborns.

This toolkit serves as a guide to help midwives and home birth attendants establish their own policies and procedures for implementing a CCHD Screening Program.

MICHIGAN CCHD SCREENING
PROGRAM CONTACTS

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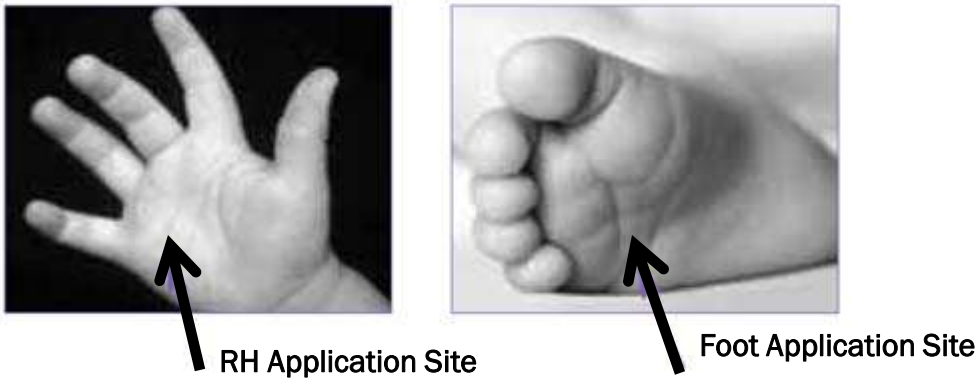
MICHIGAN CCHD SCREENING

PULSE OX PROBE PLACEMENT

PULSE OX PROBE PLACEMENT EDUCATION

1. Select application site on the outside, fleshy area of the infant's right hand and one foot.



2. Place the photo detector portion of the probe on the fleshy portion of the outside of the infant's right hand or foot.
3. Place the light emitter of the probe on the top of the right hand or foot.
4. Remember the photo detector and light emitter must be directly opposite each other in order to obtain an accurate reading.
5. Secure the probe to the infant's right hand or foot using the adhesive or foam tape recommended by the vendor. It is not recommended to use tape to secure probe placement.

CCHD Screening should be done:

- On an infant without respiratory or cardiovascular distress
- As close to 24 hours of life as possible
- When infant is awake, comfortable, and quiet (ok for parent to hold)

MICHIGAN CCHD SCREENING

PULSE OX EQUIPMENT

Use only appropriate infant probes for CCHD Screening. Use a pulse oximeter that is FDA approved for use in neonates.

Pulse oximetry equipment used for CCHD Screening:

- Must be approved by the FDA for use in newborns.
- Must be validated in low-perfusion conditions.
- Must have 2% root, mean-square accuracy.
- Must be calibrated regularly, based on manufacturer guidelines.

FDA CLEARANCE FOR PULSE OXIMETER USE IN NEONATES

http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpmn/pmn.cfm

MICHIGAN CCHD SCREENING

PERFORMING PULSE OX- DOs & DON'Ts

PULSE OX DO's

1. If you are using disposable pulse ox probes, use a new, clean probe for each infant. If you are using reusable pulse ox probes, clean the probe with recommended disinfectant solution between each infant. Dirty probes can decrease the accuracy of your reading and can transmit infection. A disposable wrap can be used to secure the probe to the site.
2. The best sites for performing pulse ox on infants are around the palm and the foot. An infant pulse ox probe (not an adult pulse ox clip) should always be used for infants.
3. When placing the sensor on the infant's skin, there should not be gaps between the sensor and the skin. The sides of the probe should be directly opposite each other.
4. Nail polish dyes and substances with dark pigmentation (such as dried blood) can affect the pulse ox reading. Assure that the skin is clean and dry before placing the probe on the infant. Skin color and jaundice do not affect the pulse ox reading.
5. Movement, shivering and crying can affect the accuracy of the pulse ox reading. Ensure that the infant is calm and warm during the reading. Swaddle the infant and encourage family involvement to promote comfort while obtaining the reading. If possible, conduct screening while the infant is awake.
6. Pulse oximeters have different confidence indicators to ensure that the pulse ox reading is accurate. Determine the confidence indicators for the pulse oximeter you are using.

MICHIGAN CCHD SCREENING

PERFORMING PULSE OX- DOs & DON'Ts

PULSE OX DON'Ts

1. Never use an adult pulse ox clip to obtain a reading for an infant. Using an adult clip on an infant will produce inaccurate results.
2. Blood flow is needed to obtain an accurate pulse ox reading. Never attempt to obtain a pulse ox reading on the same extremity where an automatic blood pressure cuff is located.
3. Bright or infrared light, including bilirubin lamps and surgical lights, can affect the accuracy of the reading. Ensure that the infant is not placed in bright or infrared light while pulse ox is being performed. You may cover the pulse ox probe with a blanket to ensure that extraneous light does not affect the accuracy of your reading.
4. Do not use tape to apply the pulse ox probe to the infant's skin.

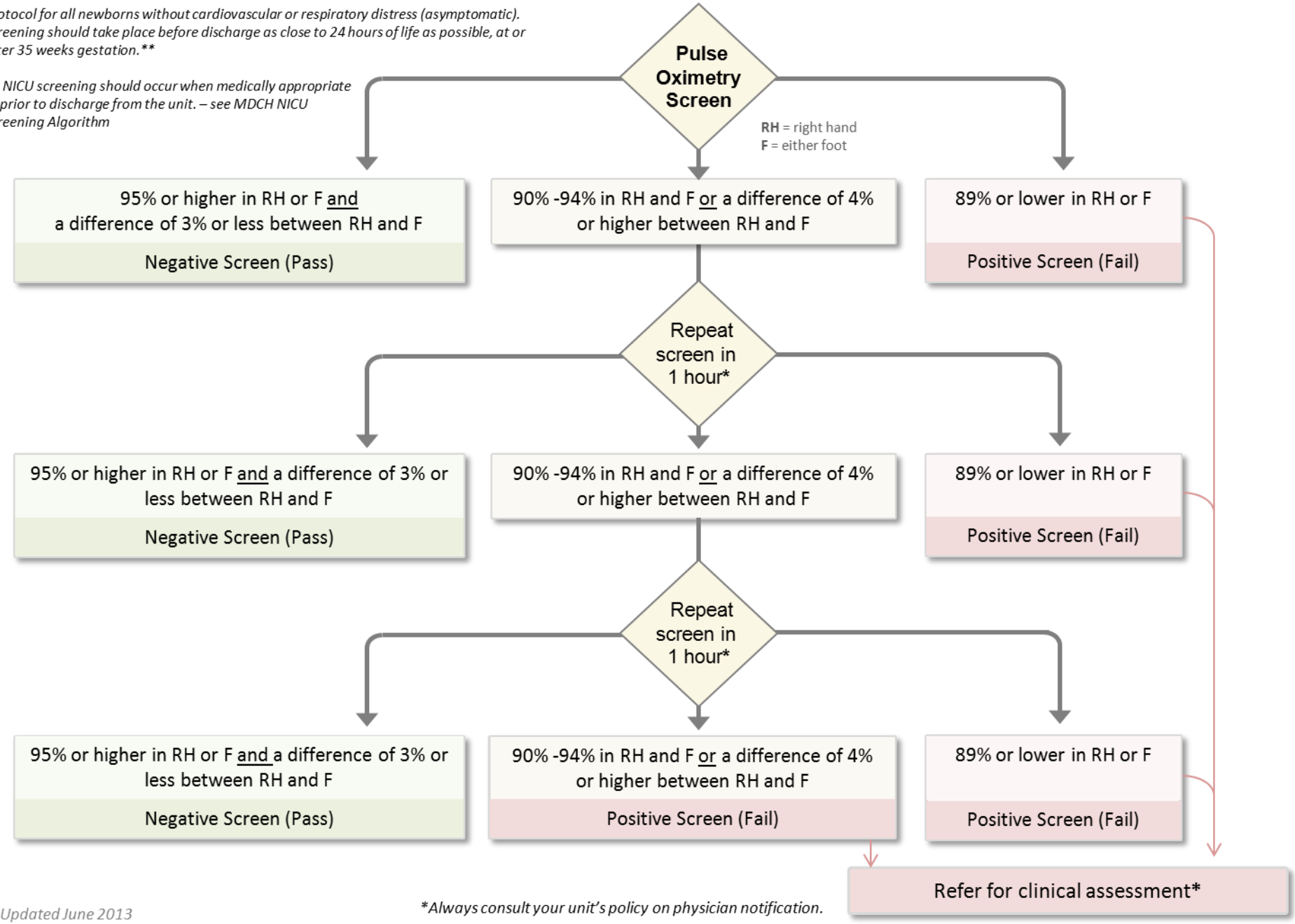
PULSE OX CAUTION

1. A pulse is needed to determine the oximetry reading. Pulse ox is not accurate if the patient is coding or has a cardiac arrhythmia. Remember: No pulse, no oximetry!
2. Pulse ox readings are not instantaneous. The oximetry reading that is displayed on the monitor is an average of readings over the past few seconds.

Michigan Algorithm for Pulse Oximetry Screening

*Protocol for all newborns without cardiovascular or respiratory distress (asymptomatic). Screening should take place before discharge as close to 24 hours of life as possible, at or after 35 weeks gestation.***

*** NICU screening should occur when medically appropriate or prior to discharge from the unit. – see MDCH NICU Screening Algorithm*



**Always consult your unit's policy on physician notification.*

Updated June 2013

MICHIGAN CCHD SCREENING
SCREENER TIP SHEET

Michigan Newborn Screening Tip Sheet

Pulse Oximetry Screening

For Critical Congenital Heart Defects (CCHD)

Newborns without Cardiovascular or Respiratory Distress (Asymptomatic)

Pulse ox on right hand (RH) and one foot (F).

95% or higher in RH or F
and
3% or less difference between RH and F
(for any screen)
Pass*

90-94% in RH and F or 4% or more difference between RH and F
Rescreen in 1 hr*

Screen up to 3 times.
If 3rd screen at 90-94% in RH and F or 4% or more difference between RH and F

89% or lower in RH or F
(for any screen)
Fail*

Baby is:
- ✓ At least 35 weeks gestation
- ✓ Awake and alert
- ✓ Comfortable/quiet

Timing is:
- ✓ Before discharge
- ✓ As close to 24 hours of age as possible

Follow your policy on physician notification.

Evaluation:
Assess for cardiac, respiratory, and/or infectious causes.

RIGHT HAND

Pre-Ductal Screen

Place the sensor on the back of the RIGHT HAND below the 4th or 5th finger. Wrap the tape around the hand. Align the emitter and the detector.

EITHER FOOT

Post-Ductal Screen

Place the sensor on the back of EITHER FOOT below the 4th or 5th toe. Wrap the tape around the foot. Align the emitter and the detector.

You might say:

Screen/Rescreen: "Pulse oximetry (pulse ox) is a way to check the oxygen level in the blood. It is painless and will only take a few minutes. If blood oxygen is a little low, we will recheck it later."

Fail: "Pulse ox showed that the blood oxygen level is low. The medical team needs to follow-up right away to find out why. Sometimes a low pulse ox result is a sign of health problems. If there is a problem, it's good to find before your baby goes ho

Michigan Department of Community Health

MDCH

Michigan Department of Community Health Newborn S
201 Townsend St., Lansing, MI 4891
1.866.673.9939
www.michigan.gov/cchd

Available for download on our website www.michigan.gov/cchd

MICHIGAN DEPARTMENT OF COMMUNITY HEALTH

CCHD Screening for Newborn without Cardiovascular or Respiratory Distress
Interpretation of Pulse Oximetry Results

Oxygen Saturation

(O2 Sats; %)

Right Hand (RH)	Either Foot (F)											
100	100	99	98	97	96	95	94	93	92	91	90	89% or lower
99	100	99	98	97	96	95	94	93	92	91	90	89% or lower
98	100	99	98	97	96	95	94	93	92	91	90	89% or lower
97	100	99	98	97	96	95	94	93	92	91	90	89% or lower
96	100	99	98	97	96	95	94	93	92	91	90	89% or lower
95	100	99	98	97	96	95	94	93	92	91	90	89% or lower
94	100	99	98	97	96	95	94	93	92	91	90	89% or lower
93	100	99	98	97	96	95	94	93	92	91	90	89% or lower
92	100	99	98	97	96	95	94	93	92	91	90	89% or lower
91	100	99	98	97	96	95	94	93	92	91	90	89% or lower
90	100	99	98	97	96	95	94	93	92	91	90	89% or lower
89% or lower	100	99	98	97	96	95	94	93	92	91	90	89% or lower

Pass	95% or higher in right hand (RH) or either foot (F) AND difference of 3% or less between RH and F.	
screen	90-94% in RH and F or difference of 4% or more between RH and F.	Screen up to 3 times.
il	89% or lower in RH or F (at any time) OR 3rd screen: 90-94% in RH and F or difference of 4% or more between RH and F.	

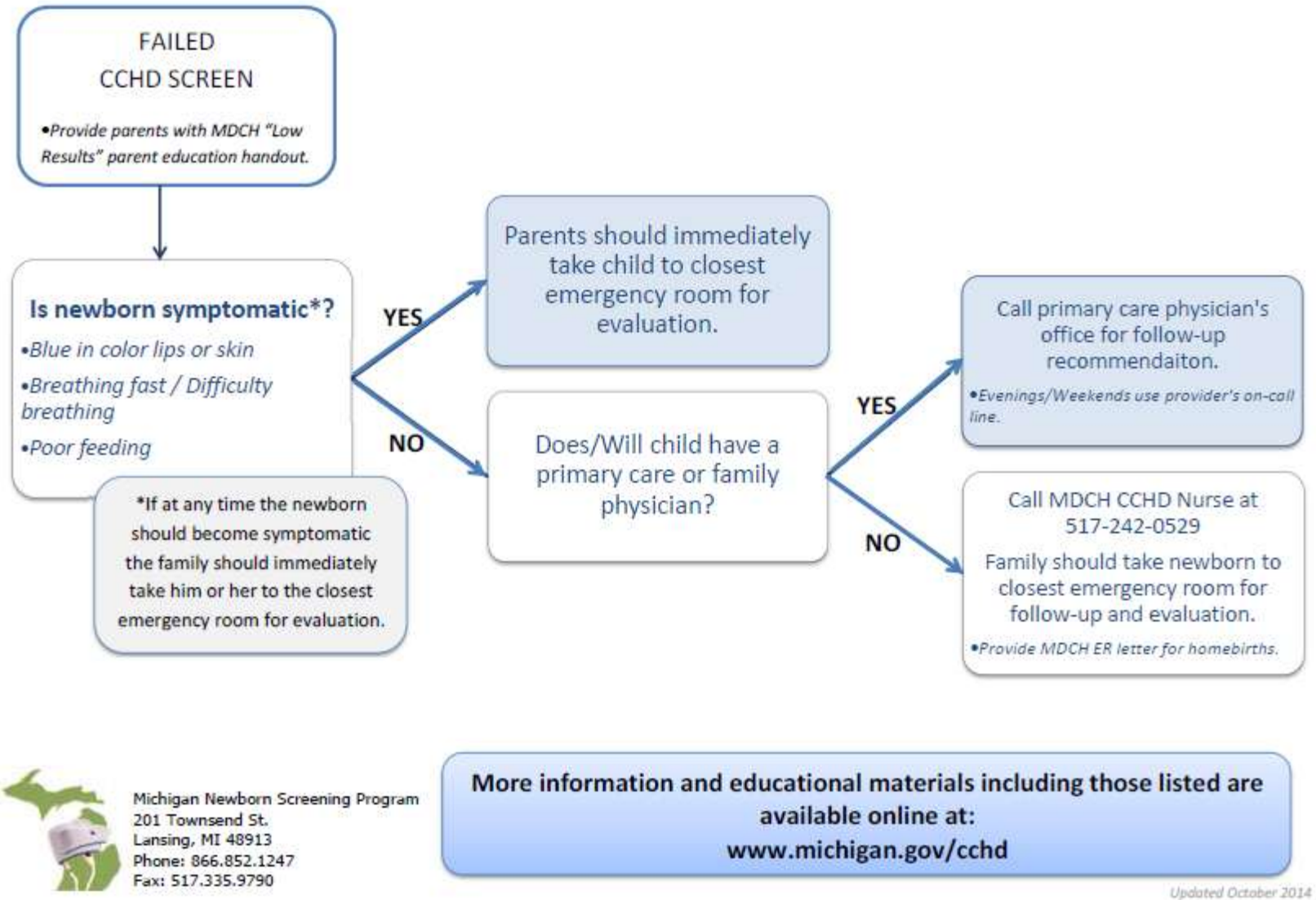
Adapted from *nital Heart Disease Screening with Pulse Oximetry in the Neonatal Intensive Care Unit*
Lakshmins e-Journal of Neonatology Research 2012(2)2: 96-101.

1-May-13
MDCH

Available for download on our website www.michigan.gov/cchd

MICHIGAN CCHD SCREENING
INTERPRETATION OF PULSE OXIMETRY RESULTS

Failed CCHD Screen Follow-Up Procedure for HOME BIRTHS



Michigan Newborn Screening Program
201 Townsend St.
Lansing, MI 48913
Phone: 866.852.1247
Fax: 517.335.9790

More information and educational materials including those listed are available online at:
www.michigan.gov/cchd

Updated October 2014

MICHIGAN CCHD SCREENING-*HOME BIRTHS*
FAILED CCHD SCREEN- FOLLOW-UP

MICHIGAN CCHD SCREENING-*HOME BIRTHS*
FAILED CCHD SCREEN- FOLLOW-UP LETTER FOR EMERGENCY ROOM PHYSICIANS

This letter should be sent with a parent of newborn that failed the CCHD Screen and is being taken to an Emergency Room for follow-up

STATE OF MICHIGAN

RICK SNYDER
GOVERNOR

DEPARTMENT OF COMMUNITY HEALTH
LANSING

NICK LYON
DIRECTOR

Newborn Screening Program for Critical Congenital Heart Disease

Michigan Hospital Emergency Room Provider:

This infant was born at home on ____/____/_____

The newborn is presenting in your Emergency Department for follow-up because at approximately twenty-four hours of life he/she was screened for Critical Congenital Heart Disease (CCHD) using pulse oximetry and **did not pass the screening**.

The screening results were:

Date/Time of Screen	Right Hand (RH)	Foot	Difference	Result *(Pass, Fail, Rescreen)*

As part of your initial triage on the infant we are asking that you re-check the pulse ox on the infant's ***Right Hand*** and ***One Foot***. Using the limits defined by the algorithm (see attached), determine if the infant needs further follow-up (pulse ox of 94% or below, or a difference of 4% or greater between the readings).

The Michigan public health code mandates that all newborns be screened for CCHD using pulse oximetry as close to twenty-four hours of life as possible. Infants should be screened using the Michigan recommended screening algorithm.

Infants who fail the screen in the hospital are immedialty referred for an evaluation, often including follow up with a pediatric cardiologist/neonatologist and a possible echocardiogram for diagnosing CCHD.

If follow up is needed, upon admitance to the emergency room please consider consulting a pediatric cardiologist or neonatologist.

During the hours of 7 am-7 pm you can contact a representative from the MDCH Newborn Screening program with questions @ 517-242-0529.

More information about the screening is available at our website www.michigan.gov/cchd

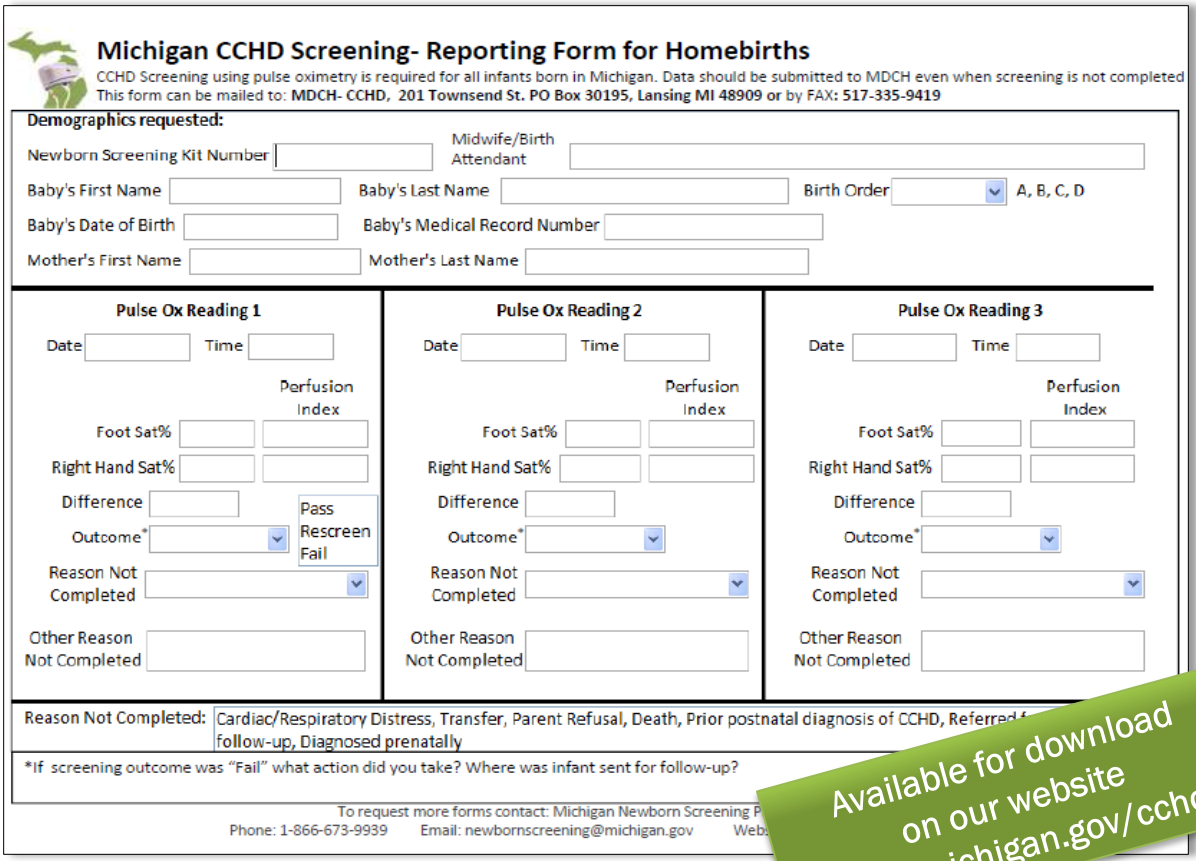
Keri Urquhart, RN, BSN
CCHD Nurse Educator

Available for download on our website www.michigan.gov/cchd

MICHIGAN CCHD SCREENING
DATA REPORTING-HOME BIRTHS

CCHD Screening data reporting can be done in the homebirth community using one of the following methods:

1. **CCHD Data Reporting Form for Homebirths**
This paper form (available on our website) can be submitted by mail or fax to MDCH. To request blank forms be sent to you by mail, please call 1.866.673.9939.



Michigan CCHD Screening- Reporting Form for Homebirths

CCHD Screening using pulse oximetry is required for all infants born in Michigan. Data should be submitted to MDCH even when screening is not completed
This form can be mailed to: **MDCH- CCHD, 201 Townsend St. PO Box 30195, Lansing MI 48909 or** by FAX**: 517-335-9419**

Demographics requested:

Newborn Screening Kit Number | Midwife/Birth Attendant
Baby's First Name | Baby's Last Name | Birth Order A, B, C, D
Baby's Date of Birth | Baby's Medical Record Number
Mother's First Name | Mother's Last Name

	Pulse Ox Reading 1	Pulse Ox Reading 2	Pulse Ox Reading 3
Date / Time			
Foot Sat%			
Perfusion Index			
Right Hand Sat%			
Difference			
Outcome*	Pass / Rescreen / Fail		
Reason Not Completed			
Other Reason Not Completed			

Reason Not Completed: Cardiac/Respiratory Distress, Transfer, Parent Refusal, Death, Prior postnatal diagnosis of CCHD, Referred f… follow-up, Diagnosed prenatally

*If screening outcome was "Fail" what action did you take? Where was infant sent for follow-up?

To request more forms contact: Michigan Newborn Screening P…
Phone: 1-866-673-9939 Email: newbornscreening@michigan.gov Web…

Available for download on our website www.michigan.gov/cchd

2. **Online eReports Module**
This online reporting system requires a secure log-in from the State of Michigan. Birth attendants will be able to sign into the module and enter individual screening results. User manual and more information are available on the website, or for more information and to request access please call 1.866.673.9939.

Information For Parents

"As a mother of a child born with a CCHD I am thankful there is a screening tool for newborns. Just knowing that children just like my daughter can be given a chance at life by catching their defects soon after birth shows the importance of screening. It gives these children their chance to fight and early diagnosis is key."

Jenny Lincoln
Mom to Aly Jean and Parent Advocate for CCHD screening
www.alyjeansspecialheart.com

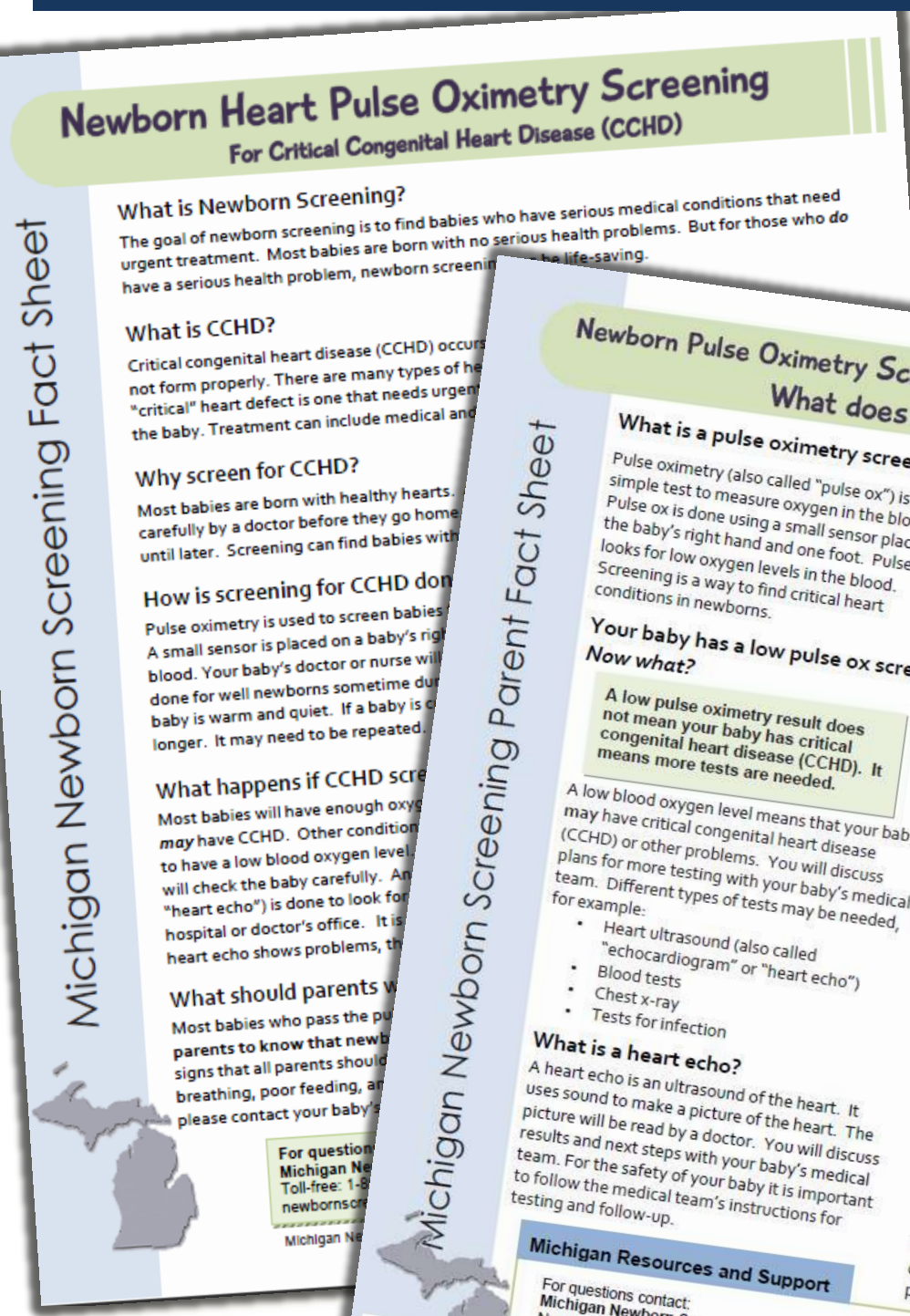
MICHIGAN CCHD SCREENING

CHECKLIST FOR INFORMING PARENTS

INFORM THE PARENT:

- The purpose of screening is to detect serious heart defects in babies.
- The baby will be screened after 24 hours of life (or as close to as possible).
- The pulse ox test will be done on the baby's right hand and one foot, if possible.
- The pulse ox test is not painful and only takes a few minutes when the baby is quiet, warm, and not moving.
- It is possible that a baby with a heart problem may have a normal pulse ox reading.
- They have the right to decline screening.
- They may ask questions at the time of screening or anytime before or following the screening.

MICHIGAN CCHD SCREENING
PARENT FACT SHEETS



Educational Materials are available in bulk supply from MDCH by request.

Available for download on our website www.michigan.gov/cchd

MICHIGAN CCHD SCREENING

SUGGESTED RESOURCES FOR FAMILIES

Support Groups and Online Resources

American Heart Association	www.amhrt.org
Children's Heart Association	www.heartchild.info
Children's Heart Foundation	www.childrensheartfoundation.org
Congenital Heart Information Network	www.tchin.org
Congenital Heart Defects.com	www.congenitalheartdefects.com
Kids with Heart	www.kidswithheart.org
PediHeart	www.pediheart.net
1 in 100	www.1in100.org
Mended Little Hearts	www.mendedlittlehearts./org
Hearts of Hope	www.heartsofhopemi.org

Books for Parents

"Heart Defects in Children: What Every Parent Should Know" by Cheryl J. Wild
"Heart of a Child" by Catherine A. Neill, Edward B. Clark and Carleen Clark
"It's My Heart" by Children's Heart Foundation
"The Heart of a Mother" by Anna Marie Jaworski and Judy Norwood

Books for Children with Heart Defects

"Blue Lewis and Sasha the Great" by Carol Donsky Newell
"Matty's Heart" by C.J. Hribal
"Nathan's Special Heart" by Jessica Ennis (available as a virtual book)
"Pump the Bear" by Gisella Olivo Whittington

Books for Siblings

"Cardiac Kids" by Vicci Elder
"My Brother Needs an Operation" by Anna Marie Jaworski & Sarah Lualdi Moran
"When Molly was in the Hospital" by Debbie Duncan

Resources

CRITICAL CONGENITAL HEART DEFECTS:

*Pulse oximetry screening is **most likely** to detect seven of the CCHDs. These seven main screening targets are:*

D-transposition of the Great Arteries

A heart in which the two main arteries carrying blood away from the heart are reversed. In a normal heart the blood flows in a cycle: body-heart-lungs-heart-body. When a d-transposition occurs, the blood pathway is impaired because the two arteries are connecting to the wrong chambers in the heart.

Tetralogy of Fallot

A heart defect that features four problems. They are: a hole between the lower chambers of the heart; an obstruction from the heart to the lungs; the aorta (blood vessel) lies over the hole in the lower chambers; and the muscle surrounding the lower right chamber becomes overly thickened.

Total anomalous pulmonary venous return (TAPV)

A defect in the veins leading from the lungs to the heart. In TAPV, the blood does not take the normal route from the lungs to the heart and out to the body. Instead, the veins from the lungs attach to the heart in abnormal positions and this problem means that oxygenated blood enters or leaks into the wrong chamber.

Truncus Arteriosus

When a person has one large artery instead of two separate ones to carry blood to the lungs and body. In a normal heart, the blood follows in a cycle: body-heart-lungs-heart-body. When a person has a truncus arteriosus, the blood leaving the heart does not follow this path. It has only one vessel, instead of two separate ones for the lungs and body. With only one artery, there is no specific path to the lungs for oxygen before returning to the heart to deliver oxygen to the body.

Hypoplastic Left Heart Syndrome (HLHS)

An underdeveloped left side of the heart. The aorta and left ventricle are too small and the holes in the artery and septum did not properly mature and close.

Pulmonary Atresia

A non-existent pulmonary valve, so that the only blood receiving oxygen is the blood that is diverted to the lungs through openings that normally close during development.

Tricuspid Atresia

A missing tricuspid valve in the heart so blood cannot flow from the body into the heart in the normal way. The blood is not being properly refilled with oxygen and it does not complete the normal cycle of body -heart–lungs-heart-body.

*These defects are **less likely** to be detected through pulse oximetry screening:*

Coarctation of the Aorta

A narrowing of the major artery (the aorta) that carries blood to the body.
This narrowing affects blood flow where the arteries branch out to carry blood along separate vessels to the upper and lower parts of the body. CoA can cause high blood pressure or heart damage.

Ebstein Anomaly

A malformed heart valve that does not properly close to keep the blood flow moving in the right direction. Blood may leak back from the lower to upper chambers on the right side of the heart. As a result, the right atrium becomes enlarged. If the tricuspid regurgitation (leak) is severe enough, congestive heart failure can result. This syndrome also is commonly seen with an atrial septal defect, or ASD (a hole in the wall dividing the two upper chambers of the heart).

Double-outlet right Ventricle

In double outlet right ventricle, something goes wrong during the formation of the heart and both great arteries are attached to the right ventricle. No arteries, or only a part of the aorta, are attached to the left ventricle. In some cases, because more blood than normal is flowing into the right ventricle, this heart defect means that too much blood is pumped to the lungs. Over time this uncontrolled flow can damage the lungs and heart, and heart failure can result.

Interrupted aortic arch

An absence or discontinuation of a portion of the aortic arch. IAA is classified by the site of the interruption, and is thought to be a result of faulty development of the aortic arch system during the fifth to seventh week of fetal development. This defect is almost always associated with a large ventricular septal defect (VSD).

Single ventricle

The term "single ventricle anomaly" is purposely non-specific. It is used to describe a group of cardiac defects that may differ quite dramatically from each other but share the common feature that only one of the two ventricles is of adequate functional size. Because of this feature, the ultimate plan for reconstruction is actually quite similar for most of these anomalies. All will generally undergo staged reconstructive procedures.

References:
American Heart Association. (2013). About Congenital Heart Defects. Available from http://www.heart.org/HEARTORG/Conditions/CongenitalHeartDefects/AboutCongenitalHeartDefects
Cincinnati Children's Hospital. (2013). Heart Institute Encyclopedia: Congenital Heart Defects. Available from http://www.cincinnatichildrens.org/patients/child/encyclopedia/defects/default/

***Images and Video of Defects available online from above resources. ***

MICHIGAN CCHD SCREENING
SUGGESTED RESOURCES FOR PROVIDERS

Michigan Department of Community Health
www.michigan.gov/cchd

American Academy of Pediatrics
www.aap.org
AAP Strategies for Implementing Screening
http://pediatrics.aappublications.org/content/128/5/e1259.full.html

American Heart Association
www.aha.org

Children's National Medical Center-Washington DC*
(Videos available for parents and providers)
www.childrensnational.org

Children's Hospital of Philadelphia (CHOP)*
www.chop.edu

Atlanta Children's Hospital *
(CCHD Mobile App available)
www.pulseoxtool.com

Cincinnati Children's Hospital *
www.cincinnatichildrens.org

Center for Disease Control and Prevention
www.cdc.gov

Congenital Heart Information Network*
www.tchin.org

Baby's First Test*
(Videos available for parents and providers)
www.babysfirsttest.org

**Inclusion on the list does not necessarily imply endorsement, nor do we guarantee the accuracy of the information contained on these sites. Always consult your institution and its physicians with questions and concerns.*

MICHIGAN Treatment Centers for CCHD:

Children's Hospital of Michigan
3901 Beaubien
Detroit, MI 48201
(313) 745-KIDS
1-888-362-2500
www.childrensdmc.org

Helen DeVos Children's Hospital
Congenital Heart Center
100 Michigan Street NE, Floor 10,
Grand Rapids, Michigan 495031
616-267-9150
866.989.7999
www.helendevoschildrens.org

Congenital Heart Center at C.S. Mott Children's Hospital
1540 East Hospital Drive Floor 11
Ann Arbor MI 48109
1-877-308-9111
www.mottchildren.org