Washington State Newborn Screening

Screening Tests, Result Classifications and Corresponding Follow-Up Actions

This document briefly explains the tests for the disorders screened for by the Washington State Newborn Screening Program. It also contains cutoff tables for the disorders, results classifications and corresponding follow-up actions. Follow-up actions described in this document are general guidelines and are sometimes modified based on individual test results, consultation with specialists, and the child's clinical status. The table below serves as a key relating the classification of results in this document to the comments found in Newborn Screening Reports.

Classification of results within this document	Corresponding comments found on NBS mailer report
Normal	NORMAL FINDINGS
Borderline, Presumptive, Partial, Profound or Elevated	Abnormal
Interfering Substances	Unsuitable

Disorders

Amino acid disorders

argininosuccinic acidemia (ASA)
citrullinemia
homocystinuria
maple syrup urine disease (MSUD)
phenylketonuria (PKU)
tyrosinemia type 1

CPT-II deficiency, not in the list.
Even in the list, there are false-positive cases. Thus, doctors should still get values to interpret.

Fatty acid disorders

carnitine uptake deficiency (CUD)
long-chain L-3-hydroxy acyl-CoA dehydrogenase (LCHAD) deficiency
medium-chain acyl-CoA dehydrogenase MCAD) deficiency
trifunctional protein (TFP) deficiency
very-long chain acyl-CoA dehydrogenase (VLCAD) deficiency

Organic acid disorders

3-hydroxy-3-methylglutaric aciduria (HMG)
beta-ketothiolase deficiency (BKT)
glutaric acidemia type 1 (GA-I)
isovaleric acidemia (IVA)
methylmalonic acidemias (CblA,B and MUT)
multiple carboxylase deficiency (MCD)
propionic acidemia (PROP)

Other disorders

biotinidase deficiency
congenital adrenal hyperplasia (CAH)
congenital hypothyroidism (CH)
cystic fibrosis (CF)
galactosemia
hemoglobinopathies

Argininosuccinic acidemia (ASA) / Citrullinemia (CIT) - 2/11/2010

Screening Test

Screening for these disorders is performed by tandem mass spectrometry (MS/MS) measuring *citrulline (cit), argininosuccinic acid (asa)* and *arginine (arg)*. If CIT is elevated, secondary markers are considered. Results are classified in the tables below.

Screening Result Classifications and Corresponding Follow-up Actions for ASA

Citrulline µmol/L serum	Age at collection ≤ 6 days	Age at collection > 6 days
< 35	Normal	Normal
35-99	Borderline or Presumptive†	Normal
≥ 100	Borderline or Presumptive†	Borderline or Presumptive†
Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to submitter. No follow-up is required.	Health care provider is contacted to recommend repeat newborn screening specimen or *diagnostic testing*. Newborn screening results are also mailed to submitter.	Health care provider is contacted by phone to recommend immediate follow-up specimen or *diagnostic testing*. Newborn screening results are also mailed to submitter.

†Final results depend on secondary markers (normal ranges: cit/arg < 5.56, asa < 0.77 and asa/arg < 0.15)

Screening Result Classifications and Corresponding Follow-up Actions for CIT

Citrulline µmol/L serum	Age at collection ≤ 6 days		Age at collection > 6 days	
	cit/arg < 5.56	cit/arg ≥ 5.56	cit/arg < 5.56	cit/arg ≥ 5.56
< 40	Normal	Normal	Normal	Normal
40 - 99	Borderline	Presumptive	Normal	Normal
≥ 100	Borderline	Presumptive	Borderline	Presumptive
Typical Follow-up Actions				
Normal Results	**Borderline Results**		**Presumptive Results**	
Results are mailed to submitter. No follow-up is required.	Health care provider is contacted to recommend repeat newborn screening specimen or *diagnostic testing*. Newborn screening results are also mailed to submitter.		Health care provider is contacted by phone to recommend immediate follow-up specimen or *diagnostic testing*. Newborn screening results are also mailed to submitter.	

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Homocystinuria (HCYS) – 1/21/2012

Screening Test

Homocystinuria screening is done using tandem mass spectrometry (MS/MS) to measure the level of *methionine(met)* and *phenylalanine (phe)* in the blood. Results are classified as in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for HCYS

Methionine µmol/L serum	Classification	
	met/phe <1.0	met/phe ≥1.0
< 72	Normal	Normal
72 – 89	Borderline	Borderline
≥ 90	Borderline	Presumptive
Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to specimen submitter. No follow-up is required	If first specimen on non-NICU baby, health care provider is contacted to request second specimen. If first specimen on LBW baby or collected early (1-6 hours) NBS waits for the routine second specimen. If second screen and previous normal, health care provider is contacted to request third specimen. If second screen and previous abnormal, health care provider is contacted to recommend *diagnostic testing*. Results are also mailed to submitter.	If first screen, health care provider is contacted by phone to recommend immediate second screen. If second screen, immediate *diagnostic testing* is recommended if non-NICU baby and third screen if NICU baby. Results are also mailed to submitter.

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Maple Syrup Urine Disease (MSUD) – 1/21/2012

Screening Test

The MSUD screening is done using a tandem mass spectrometry (MS/MS) to measure the levels of *leucine/isoleucine (leu)*, *valine (val)*, *phenylalanine (phe)* and *alanine (ala)* in the blood. Results are classified as in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for MSUD

Leucine µmol/L serum	Age at collection ≤ 6 days		Age at collection > 6 days	
	not all secondary markers† elevated	all secondary markers† elevated	not all secondary markers† elevated	all secondary markers† elevated
< 236	Normal	Normal	Normal	Normal
236-321	Borderline	Borderline	Normal	Normal
322-465	Borderline	Presumptive	Borderline	Presumptive
≥ 466	Presumptive	Presumptive	Borderline	Presumptive
Typical Follow-up Actions				
Normal Results	**Borderline Results**		**Presumptive Results**	
Results are mailed to submitter. No follow-up is required.	If first screen on non-NICU baby, health care provider is contacted by phone to request a repeat newborn screening specimen. If first specimen on LBW baby or collected early (1-6 hours) NBS waits for routine second specimen. If second screen and previous abnormal, health care provider is contacted to recommend *diagnostic testing*. Results are also mailed to submitter.		Health care provider is contacted and immediate *diagnostic testing* is recommended. Results are also mailed to submitter.	

†Final results depend on secondary markers (normal ranges: val < 220, leu/ala < 1.5, leu/phe < 3.65 and val/phe < 3.0)

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Phenylketonuria (PKU) – 11/16/2010

Screening Test

The PKU screening is no longer performed by the bacterial inhibition assay developed by Dr. Robert Guthrie, commonly known as the "Guthrie test." Screening is now done using a technology called tandem mass spectrometry (MS/MS). The levels of *phenylalanine (phe)* and *tyrosine (tyr)* in the blood spot are measured by a tandem mass spectrometer. Results are classified as in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for PKU

Phenylalanine (uM)	Age ≤ 24 hrs		Age > 24 hrs	
	phe/tyr ratio < 2	phe/tyr ratio ≥ 2	phe/tyr ratio < 2	phe/tyr ratio ≥ 2
< 152	Normal	Normal	Normal	Normal
152 – 179	Normal	Borderline	Normal	Borderline
180 – 239	Borderline	Presumptive	Borderline	Borderline
≥ 240	Presumptive	Presumptive	Presumptive	Presumptive

Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to submitter. No follow-up is required.	Health care provider is contacted by phone to recommend a repeat newborn screening specimen. Results are also mailed to submitter.	Health care provider is contacted by phone to recommend an immediate repeat newborn screening specimen or *diagnostic testing* per PKU Clinic staff recommendations. Results are also mailed to submitter.

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Tyrosinemia type I (TYR-I) – 9/22/2008

Screening Test

Screening for these disorders is performed by tandem mass spectrometry (MS/MS). The most sensitive (and specific) primary marker for TYR-I is *succinylacetone* (SUAC). If this is elevated, *tyrosine (tyr)* is considered. Results are classified as in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for TYR-I

SUAC µmol/L serum	Classification	
	tyr < 209	tyr ≥ 209
< 3.25	Normal	Normal
≥ 3.25	Borderline	Presumptive
Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to submitter. No follow-up is required.	If first specimen, health care provider is contacted to recommend an immediate second newborn screen. If second specimen, health care provider is contacted to recommend immediate *diagnostic testing*. Newborn screening results are also mailed to submitter.	Health care provider is contacted by phone to recommend immediate *diagnostic testing*. Newborn screening results are also mailed to submitter.

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Carnitine Uptake Deficiency (CUD) – 10/25/2012

Screening Test

Screening for CUD is performed by tandem mass spectrometry (MS/MS). The primary marker is *free carnitine* (*C0*). If *C0* is low, secondary markers are considered. Results are classified in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for CUD

C0 µmol/L serum	Classification	
	not all secondary markers† low	all secondary markers† low
> 10.9	Normal	Normal
7.5-10.9	Normal	Borderline
< 7.5	Presumptive	Presumptive
Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to submitter. No follow-up is required.	If first specimen, NBS waits for routine second specimen. If second specimen with a normal first, the health care provider is contacted to request a third screen. If second specimen with a borderline first, contact health care provider to recommend *diagnostic testing*. Newborn screening results are also mailed to submitter.	If first specimen or second specimen with previous normal, health care provider is contacted by phone to recommend an immediate repeat newborn screening specimen. If second specimen with previous abnormal, health care provider is contacted to recommend immediate *diagnostic testing*. Newborn screening results are also mailed to submitter.

† Final results depend on secondary markers (normal ranges: C3+C16 ≥ 2.0 and (C0+C2+C3+C16+C18+C18:1)/CIT ≥3.0)

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LCHAD deficiency/Trifunctional Protein (TFP) deficiency - 7/12/2012

Screening Test

Screening for these disorders is performed by tandem mass spectrometry (MS/MS). The primary marker for LCHAD and TFP deficiencies is *3 hydroxy-hexadecanoylcarnitine (C16OH)*. If *C16OH* is elevated, secondary markers are considered. Results are classified as in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for LCHAD/TFP

C16OH µmol/L serum	Classification	
	not all secondary markers† elevated	all secondary markers† elevated
< 0.15	Normal	Normal
≥ 0.15	Borderline	Presumptive
Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to submitter. No follow-up is required.	Health care provider is contacted by phone to recommend immediate *diagnostic testing*. Newborn screening results are also mailed to submitter.	

†Final results depend on secondary markers (normal ranges: C14 < 0.60, C14:1< 0.6, C16 < 5.69, C16OH/C16 < 0.062, C18 < 1.73 and C18:1 < 2.48)

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Medium-chain acyl-CoA dehydrogenase (MCAD) deficiency – 2/11/2010

Screening Test

The MCAD deficiency screening is done using tandem mass spectrometry (MS/MS) to measure the levels of *octanoyl carnitine (C8)* in the blood. If *C8* is elevated, secondary markers are considered. Results are classified as in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for MCAD

C8 µmol/L serum	Classification	
	not all secondary markers† elevated	all secondary markers† elevated
< 0.5	Normal	Normal
0.5 – 0.99	Borderline	Borderline
≥ 1.0	Borderline	Presumptive
Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to submitter. No follow-up is required.	If C8/C10 < 0.5, probable carrier, no further testing needed. Health care provider is contacted by phone to recommend *diagnostic testing*. Newborn screening results are also mailed to submitter.	Health care provider is contacted by phone to recommend immediate *diagnostic testing*. Results are also mailed to submitter.

†Final results depend on secondary markers (normal ranges: C8/C2 < 0.02, C8/C10 <0.92 and C10:1 < 0.18 µmol/L).

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Very long-chain acyl-CoA dehydrogenase (VLCAD) deficiency – 7/12/2012

Screening Test

Screening for VLCAD deficiency is performed by tandem mass spectrometry (MS/MS). The primary marker for VLCAD deficiency is *tetradecenoylcarnitine (C14:1)*. If *C14:1* is elevated, secondary markers are considered. Results are classified as in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for VLCAD

C14:1 µmol/L serum	Age at collection ≤ 6 days	Age at collection > 6 days
< 0.45	Normal	Normal
0.45-0.64	Normal	Borderline or Presumptive†
0.65-0.74	Normal or Borderline†	Presumptive
≥ 0.75	Presumptive	Presumptive
Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to submitter. No follow-up is required.	Health care provider is contacted by phone to recommend immediate *diagnostic testing*. Newborn screening results are also mailed to submitter.	

† Final results depend on secondary markers (normal ranges: C14 < 0.60, C14:1/C16 < 0.11, C16 < 5.69, C18 < 1.73 and C18:1 < 2.48)

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HMG deficiency and Multiple Carboxylase deficiency (MCD) – 3/30/2010

Screening Test

Screening for HMG deficiency is performed by tandem mass spectrometry (MS/MS). The primary marker for HMG deficiency is *3-hydroxy-isovaleryl carnitine (C5-OH)*. If *C5OH* is elevated, a secondary marker is considered. Results are classified as in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for HMG and MCD

C5OH µmol/L serum	Classification	
	C5OH/C8 < 10	C5OH/C8 ≥ 10
< 1.0	Normal	Normal
1.0 – 4.9	Borderline	Presumptive
≥ 5.0	Borderline	Borderline

Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to submitter. No follow-up is required.	If first specimen, NBS waits for routine second specimen. If second specimen, health care provider is contacted by phone to recommend immediate *diagnostic testing*. Newborn screening results are also mailed to submitter. **Special Circumstance:** If C5OH is greater than 5.0 µmol/L, the likelihood of HMG is very low. The probable reason for the elevation in C5OH is 3-methylcrotonyl carboxylase (3MCC) deficiency in the newborn or the mother.	

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Beta-ketothiolase deficiency (BKT) – 2/11/2010

Screening Test

Screening for BKT deficiency is performed by tandem mass spectrometry (MS/MS). The primary marker for BKT deficiency is *3-methylcrotonyl carnitine (C5:1),* also known as *tiglyl carnitine*. If *C5:1* is elevated, secondary markers are considered. Results are classified as in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for BKT

C5:1 µmol/L serum	Classification	
	not all secondary markers† elevated	all secondary markers† elevated
< 0.15	Normal	Normal
≥ 0.15	Borderline	Presumptive

Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to submitter. No follow-up is required.	If first specimen, health care provider is contacted by phone to recommend an immediate repeat newborn screening specimen. If second specimen, health care provider is contacted by phone to recommend immediate *diagnostic testing*. Newborn screening results are also mailed to submitter.	Health care provider is contacted by phone to recommend immediate *diagnostic testing*. Newborn screening results are also mailed to submitter.

† Final results depend on secondary markers (normal ranges: C5OH < 0.73 and C5OH/C8 < 8.0)

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Glutaric acidemia type I (GA-I) - 2/11/2010

Screening Test

Screening for GA-I is performed by tandem mass spectrometry to measure the levels of *glutarylcarnitine (C5DC)* in the blood. If *C5DC* is elevated, secondary markers are considered. Results are classified as in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for GA-I

C5DC µmol/L serum	Classification	
	not all secondary markers† elevated	all secondary markers† elevated
< 0.18	Normal	Normal
≥ 0.18	Borderline	Presumptive
Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to submitter. No follow-up is required.	If first specimen, health care provider is contacted by phone to recommend immediate second newborn screening specimen. If second specimen, health care provider is contacted by phone to recommend immediate *diagnostic testing*. Newborn screening results are also mailed to submitter.	Health care provider is contacted by phone to recommend immediate *diagnostic testing*. Newborn screening results are also mailed to submitter.

† Final results depend on secondary markers (normal ranges: C5DC/C5OH < 1.0, C5DC/C8 < 1.0 and C5DC/C16 < 0.055

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Isovaleric acidemia (IVA) - 2/11/2010

Screening Test

Screening for IVA is performed by using tandem mass spectrometry (MS/MS). The primary marker for IVA is *isovalerylcarnitine (C5)*. If *C5* is elevated, secondary markers are considered. Results are classified in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for IVA

	Birth weight ≤ 1500g		Birth weight > 1500g	
C5 µmol/L serum	Age at collection ≤ 6 days	Age at collection > 6 days	Age at collection ≤ 6 days	Age at collection > 6 days
< 0.70	Normal	Normal	Normal	Normal
0.70 – 0.89	Interfering substances	Normal	Borderline	Normal
0.90 – 1.89	Interfering substances	Interfering substances	Borderline or Presumptive†	Borderline
≥ 1.90	Presumptive	Presumptive	Presumptive	Presumptive

Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to submitter. No follow-up is required.	Health care provider is contacted to inquire about antibiotic use (antibiotics may interfere with results). If first specimen and no antibiotics, an immediate second newborn screening specimen is recommended. If second specimen, health care provider is contacted by phone to recommend third screen or *diagnostic testing*. Newborn screening results are also mailed to submitter.	Health care provider is contacted by phone to recommend immediate *diagnostic testing*. Newborn screening results are also mailed to submitter.

† Final results depend on secondary markers (normal ranges: C5/C0 < 0.02, C5/C2 < 0.02 and C5/C3 < 0.33)

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Methylmalonic and Propionic acidemias (MMAs and PROP) – 12/13/2011

Screening Test

Screening for these disorders is performed by tandem mass spectrometry (MS/MS). The primary marker for methylmalonic acidemia and propionic acidemia is *propionylcarnitine (C3)*. If *C3* is elevated, secondary markers are considered. Results are classified in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for MMAs/PROP

C3 µmol/L	Age at collection ≤ 6 days		Age at collection > 6 days	
	not all secondary markers† elevated	all secondary markers† elevated	not all secondary markers† elevated	all secondary markers† elevated
< 4.1	Normal	Normal	Normal	Normal
4.1 - 4.89	Normal	Normal	Borderline	Presumptive
4.9 - 6.09	Normal	Borderline	Borderline	Presumptive
6.1 – 8.39	Borderline	Presumptive	Borderline	Presumptive
8.4 – 11.99	Borderline	Presumptive	Borderline	Presumptive
≥ 12.00	Presumptive	Presumptive	Presumptive	Presumptive

Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to submitter. No follow-up is required.	If first screen, wait for routine second screen. If previous abnormal, health care provider is contacted by phone to recommend repeat newborn screen or immediate *diagnostic testing*. Newborn screening results are also mailed to submitter.	Health care provider is contacted by phone to recommend immediate *diagnostic testing*. Newborn screening results are also mailed to submitter.

† Final results depend on secondary markers (normal ranges: C3/C2 < 0.2 and C3/C16 < 2.2)

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Biotinidase deficiency – 10/14/2008

Screening Tests

Biotinidase deficiency screening is done by a colorimetric assay. Activity of the enzyme biotinidase, which is reduced in infants with this disorder, is measured. A diminished color in the processed blood specimen indicates that the infant may have biotinidase deficiency. Results are classified in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for Biotinidase Deficiency

Biotinidase (% activity)	Classification
> 20%	Normal
10% – 20%	Partial
< 10%	Profound

Typical Follow-up Actions		
Normal Results	**Partial Results**	**Profound Results**
Results are mailed to specimen submitter. No follow-up is required.	If first specimen, NBS waits for routine second specimen. If second specimen with a normal first, no further follow-up in needed. If second specimen with an abnormal first, contact health care provider to recommend *diagnostic testing*. Results are also mailed to submitter.	If first screen, health care provider is contacted by phone to recommend immediate second specimen. If second screen, immediate *diagnostic testing* is recommended. Results are mailed to specimen submitter.

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Congenital Adrenal Hyperplasia (CAH) - 11/1/2010

Screening Tests

CAH screening, is done by fluoroimmunoassay. The test measures hormone levels of *17-hydroxyprogesterone (17-OHP)*, which is elevated in infants with classic CAH. Due to variability of the disorder and the age of the infant, the level of 17-OHP may not correlate with the clinical severity of the disease. Results are classified in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for CAH

	Weight <1500 grams		
17-OHP ng/mL serum	**Age < 6 days**	**Age: 6-29 days**	**Age ≥ 30 days**
≤ 49.99	Normal	Normal	Normal
50 to 74.99	Normal	Normal	Borderline
75 to 99.99	Borderline	Borderline	Borderline
100 to 149.99	Borderline	Borderline	Borderline
≥ 150	Presumptive	Presumptive	Presumptive

	Weight: 1500-2499 grams		Weight ≥2500 grams	
17-OHP Ng/mL serum	**Age < 6 days**	**Age ≥ 6 days**	**Age < 6 days**	**Age ≥ 6 days**
≤ 39.99	Normal	Normal	Normal	Normal
40 to 59.99	Normal	Borderline	Normal	Borderline
60 to 74.99	Normal	Borderline	Borderline	Borderline
75 to 99.99	Borderline	Borderline	Borderline	Presumptive
100 to 149.99	Borderline	Borderline	Presumptive	Presumptive
≥ 150	Presumptive	Presumptive	Presumptive	Presumptive

Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to specimen submitter. No follow-up is required.	If first screen, wait for routine second screen. If previous abnormal, health care provider is contacted by phone to recommend repeat newborn screen or immediate *diagnostic testing*. Results are also mailed to submitter.	Health care provider is contacted by phone to check on clinical status and recommend *diagnostic testing*. Results are also mailed to submitter.

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Congenital Hypothyroidism (CH) – 2/15/2012

Screening Tests

The newborn screening test for CH measures the infant's *thyroid stimulating hormone (TSH)* level using a fluoroimmunoassay technique. Results are classified in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for CH

Age at Collection	Borderline Passive TSH (µIU/mL) ≥	Borderline Active TSH (µIU/mL) ≥	Presumptive TSH (µIU/mL) ≥	Urgent Presumptive TSH (µIU/mL) ≥
1 hr	115	175	190	300
2-7 hr	100	150	180	300
8-17 hr	60	100	125	300
18-22 hrs	40	75	80	300
23-25 hrs	35	75	80	300
26-35 hrs	30	50	80	300
36-47 hrs	26	50	60	100
48-72 hrs	20	50	60	100
73-144 hrs	18	40	50	100
145-504hrs	n/a	16	35	100
≥ 505 hrs	n/a	13	30	100

Typical Follow-up Actions		
Normal Results	**Borderline Results**	**Presumptive Results**
Results are mailed to specimen submitter. No follow-up is required.	***Borderline Passive*** – NBS waits for routine second specimen. ***Borderline Active*** - If first screen, health care provider is contacted by phone to recommend an immediate second screen. If second or third screen, health care provider is contacted by phone to recommend a repeat screen or immediate *diagnostic testing*. Results are also mailed to submitter.	Health care provider is contacted by phone to recommend immediate *diagnostic testing*. For ***Urgent Presumptive*** results, treatment should be initiated immediately (after baseline *diagnostic labs* have been drawn). Results are also mailed to submitter.

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Cystic Fibrosis (CF) – 9/7/2011

Screening Tests

The cystic fibrosis screening is performed using a fluoroimmunoassay to measure the level of *immunoreactive trypsinogen (IRT)* which is elevated in infants with this disorder. No referrals will be made on the basis of a single specimen; elevation on two consecutive newborn screening specimens is the criteria for referral. Results are classified in the table below.

Laboratory Result Classifications and Corresponding Follow-up Actions for CF

	Birth weight < 1500g		Birth weight ≥ 1500g	
IRT (ng/mL)	**Age at collection < 6 days**	**Age at collection ≥ 6 days**	**Age at collection < 6 days**	**Age at collection ≥ 6 days**
< 70	Normal	Normal	Normal	Normal
70 - 99	Normal	Elevated	Normal	Elevated
≥ 100	Elevated	Elevated	Elevated	Elevated

Typical Follow-up Actions		
Normal Results	**Elevated Results**	**Persistent Elevated Results**
Results are mailed to specimen submitter. No follow-up is required.	NBS waits for the routine second specimen. If not received within 2 to 4 weeks, health care provider is contacted to recommend newborn screening specimen as soon as possible. Results are also mailed to submitter.	If previous screen was elevated, health care provider is contacted by phone to refer for *diagnostic testing* (sweat chloride test) as soon as possible.

Note: Two specimens with elevated IRT drawn prior to six days of age or within three days of each other do not meet our criteria for persistent elevation. DOH will request a 3rd specimen for newborns when both specimens demonstrating an elevated IRT are drawn prior to six days of age or within three days of each other.
A second-tier protocol, implemented in late 2007 to improve sensitivity, calls for a third newborn screening specimen if the IRT on the first screen is greater than 50 ng/mL AND the IRT on the second screen is greater than 85 ng/mL.

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Galactosemia – 10/30/2012

Screening Tests

Galactosemia screening is done by a fluorometric assay that measures activity of the GALT enzyme. Diminished fluorescence in the processed blood specimen indicates that the infant may have galactosemia. A second-tier test will be performed on screen positive specimens if needed to further clarify the significance of the initial test results. Results are classified in the table below.

Screening Result Classifications and Corresponding Follow-up Actions for Galactosemia

GALT (Units/gHb)	Classification
> 3.37	Normal
2.64 – 3.37	Partial
< 2.64	Profound

Typical Follow-up Actions		
Normal Results	**Partial Results**	**Profound Results**
Results are mailed to specimen submitter. No follow-up is required.	If first screen, health care provider is contacted by phone to request routine second specimen. If second specimen with a normal first, no further follow-up is needed. If second specimen with an abnormal first, health care provider is contacted and *diagnostic testing* is recommended. Results are also mailed to specimen submitter.	Health care provider is immediately contacted by phone to recommend substitution of soy formula for breast milk or commercial based formula and prompt *diagnostic testing*. Results are mailed to specimen submitter.

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Hemoglobin Disorders – 1/14/2011

Laboratory Result Classifications and Follow-up Actions for Common Abnormal Hemoglobins

Hemoglobin Phenotype	Likely Genotype	Classification	NBS Typical Follow-up Action
FA	Normal	Normal	None
AF	Infant >10 days		
AA	Transfusion	Normal	Recommend repeat screening 4-6 weeks after last transfusion.
FSS	Sickle cell disease	Severe Disease	Contact health care provider (HCP) by phone and recommend immediate referral to a pediatric hematologist.
FS- or FS2A	Sickle beta 0/+ thalassemia		
FSC	Sickle C disease		
FSD	Sickle D disease		
F only	Beta thalassemia major	Severe Disease	Contact HCP by phone and recommend immediate referral to a pediatric hematologist.
FE-	E beta 0 thalassemia		
FA + high Bart's	Hemoglobin H disease		
FEE or FEA	Homozygous E or E beta +thalassemia	Mild/Moderate Disease	Report by phone or letter recommending a diagnostic work-up.
FCC, FC- or FC2A	Homozygous C or C beta 0/+thalassemia		
FDD, FD- or FD2A	Homozygous D or D beta 0/+thalassemia		
FAS or FSA	Hemoglobin S carrier	Carrier	Report by letter to HCP recommending family studies and genetic counseling.
FAE	Hemoglobin E carrier		
FAC or FCA	Hemoglobin C carrier		
FAD or FDA	Hemoglobin D carrier		
FA + moderate Bart's	Bart's hemoglobin, marker for alpha thalassemia and Constant Spring	Carrier	Report by letter to HCP recommending follow-up testing to determine clinical significance for child and reproductive implications for family.
FA + Variant	Unidentified variant hemoglobin trait	Carrier	Report by letter to HCP recommending follow-up only if accompanied by clinical signs or *family history* of hemoglobinopathy.

Hemoglobin disorders, with the exception of alpha thalassemia trait and variant trait, are only reported after receipt of two concurring specimens. For traits only, the second specimen eliminates the need for further confirmatory testing.

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