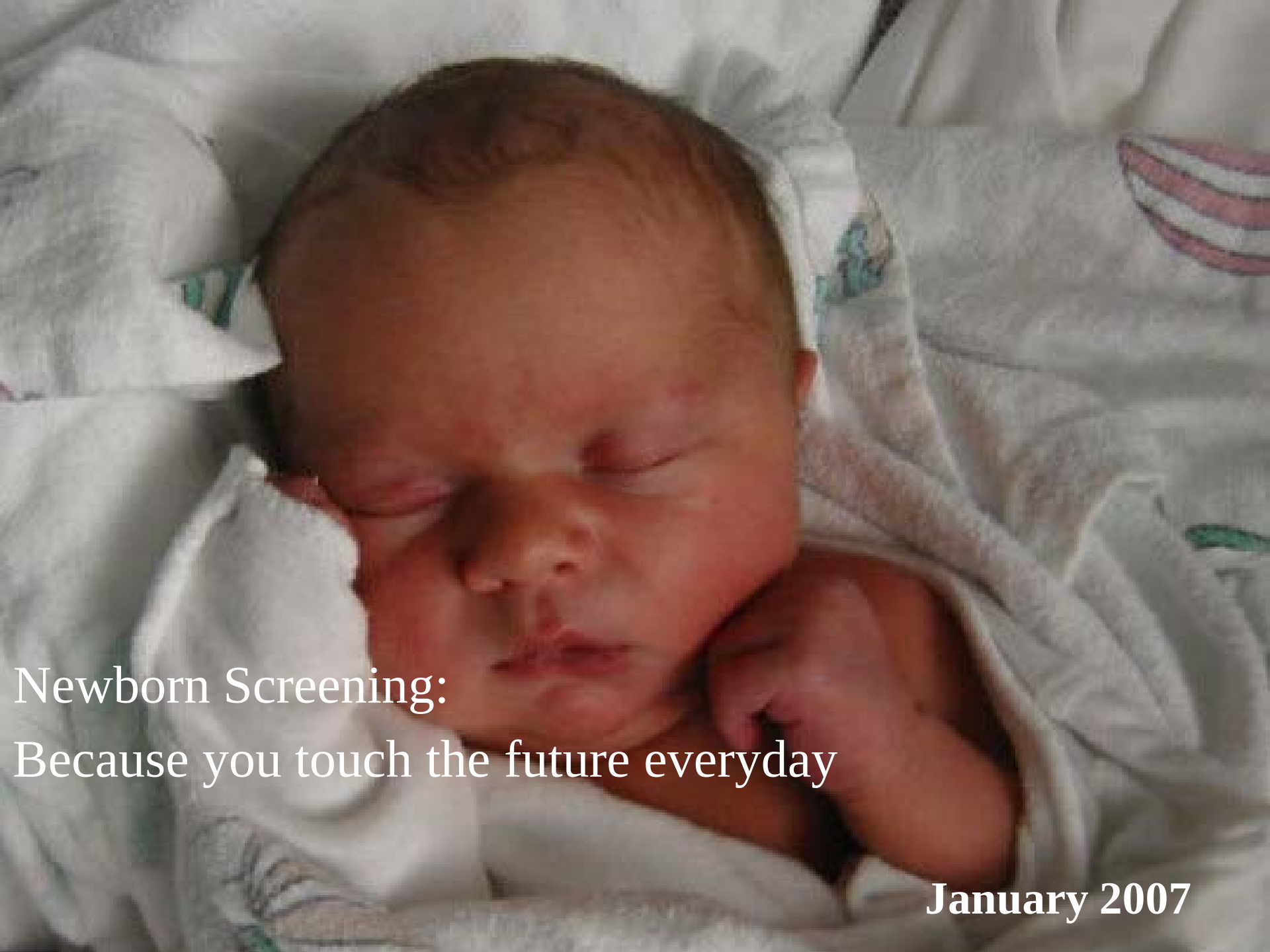
Newborn Screening:
Because you touch the future everyday
January 2007

Purpose of Newborn Screening

- Program to screen for congenital and heritable disorders
- These disorders may cause severe mental retardation, illness, or death if not treated early in life
- If treated, infants may live relatively normal lives
- Results in savings in medical costs over time

If Untreated, Disorders

- Can result in:
  - Growth problems
  - Developmental delays
  - Behavioral/emotional problems
  - Deafness or blindness
  - Retardation
  - Seizures
  - Coma, sometimes leading to death

NBS Screening

- Identification is a multi-step process
  - Blood specimens from infants are analyzed by the laboratory
  - If a result is abnormal, laboratory staff notifies case management staff
  - Case management provides follow-up to assist linking families with appropriate providers to
    - Confirm the test results and
    - Ensure the infant has the disorder prior to treatment
    - Ensure the infant receives appropriate treatment

Results from Lab

- Normal Screen Results
  - Results are sent to submitter when all test are final
- Abnormal results
  - Results are reported to Case Management as soon as available for that disorder

Abnormal Results
for each disorder

- High Panic Codes
  - are reported to RN in NBS Case Management
  - RN will notify MD ASAP. If MD unavailable RN will notify mother
- Low Panic Codes
  - Health Tech will notify MD or facility
  - Mother notified by letter

Texas Department of State Health Services
Laboratory Services Section
CLIA #45D0000044

1100 West 49th Street
Austin, Texas 78756-3194
www.dshs.state.tx.us
1-888-963-7111

CONFIDENTIAL LABORATORY REPORT

(Insert duplicate or revised report header when required)

(ensure that address and bursting /stuffing break lines are in the correct position)

(Insert bursing stuffing break lines)

CHANDRAMA KHUMCHAROEN - ######
ST. VINCENT'S MEDICAL CENTER
10812 SPRINGHILL JUNCTION
AUSTIN, TX 78756

Newborn Screening Report - ####

(ensure that submitter address and Patient Name are far enough apart that the patient name will not show in the envelope address window)

Patient's Name:	First Last	TxDSHS Laboratory Number:	YYYY JJJ ####
Mother's Name:	First Last	Form Serial No.:	YY-#######
Date of Birth:	MM/DD/YYYY	Date Collected:	MM/DD/YYYY
Medical Record:	xxxxxxxxxxxx	Date Received:	MM/DD/YYYY
Birth Weight:	#### grams	Date Reported:	MM/DD/YYYY
Race/Ethnicity:	Am. Indian	Date Revised:	MM/DD/YYYY
Sex:	Female Birth Order: x	Test:	Previous Abnormal
Feed:		Mother's SSN:	
Status:	(May require up to 3 lines or one long line) (May require up to 3 lines or one long line) (May require up to 3 lines or one long line)	Mother's Address:	Street City, State zip
		Mother's Phone:	(xxx) xxx-xxxx
		Physician:	JANET MCINTYRE-JOHNSON, MD
		Physician Phone:	(xxx) xxx-xxxx

NORMAL SCREEN

Disorder	Screening Result
Amino Acidemias:	Normal
Fatty Acid Oxidation Disorders:	Normal
Organic Acidemias:	Normal
Galactosemia:	Normal
Biotinidase Deficiency:	Normal
Endocrine Disorders:	Normal
Hemoglobinopathies:	Normal

(Global Message Text - to be editable by DSHS)
ATTENTION: The Texas Department of State Health Services has completed implementation of the expanded screening panel. This is the new mailer format.

Disorders Screened: AMINO ACIDEMIAS: Argininosuccinic Acidemia (ASA), Citrullinemia (CIT), Homocystinuria (HCY), Maple Syrup Urine Disease (MSUD), Phenylketonuria (PKU), Tyrosinemia type I (TYR1) FATTY ACID OXIDATION DISORDERS: Med.-Chain Acyl-CoA Dehydrogenase Def. (MCAD), Very Long Chain Acyl-CoA Dehydrogenase Def.(VLCAD), Long Chain Acyl-CoA Dehydrogenase (LCHAD), Trifunctional Protein Def. (TFP), Carnitine Uptake Def. (CUD), Carnitine Palmitoyl Transferase Def. I (CPT1); ORGANIC ACIDEMIAS: Glutaric Acidemia I (GA-I), 3-OH 3-Methyl Glutaric Aciduria (HMG) Isovaleric Acidemia (IVA), Multiple Carboxylase Def. (MCD), 3 Methyl Crotonyl-CoA Carboxylase Def. (3-MCC), Methylmalonic Acidemia (MMA), Propionic Acidemia (PA), Beta-Ketothiolase Def. (BKT), GALACTOSEMIA, BIOTINIDASE DEFICIENCY, ENDOCRINE DISORDERS: Congenital Hypothyroidism (CH), Congenital Adrenal Hyperplasia (CAH), HEMOGLOBINOPATHIES.

Abnormal Specimen

- Case Management will send:
  - Lab results for that disorder
  - ACT sheet specific to that disorder
  - FACT sheet for families
  - List of Metabolic Specialists

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(insert bursting stuffing break lines)

CHANDRAMA KHUMCHAROEN - ######
ST. VINCENT'S MEDICAL CENTER
10812 SPRINGHILL JUNCTION
AUSTIN, TX 78756

Newborn Screening Report - ####

(ensure that submitter address and Patient Name are far enough apart that the patient name will not show in the envelope address window)

Patient's Name:	First Last	TxDSHS Laboratory Number:	YYYY JJJ ####
Mother's Name:	First Last	Form Serial No.:	YY-########
Date of Birth:	MM/DD/YYYY	Date Collected:	MM/DD/YYYY
Medical Record:	xxxxxxxxxxxxx	Date Received:	MM/DD/YYYY
Birth Weight:	#### grams	Date Reported:	MM/DD/YYYY
Race/Ethnicity:	Am. Indian	Date Revised:	MM/DD/YYYY
Sex:	Female Birth Order: x	Test:	Previous Abnormal
Feed:		Mother's SSN:	
Status:	(May require up to 3 lines or one long line)	Mother's Address:	Street
	(May require up to 3 lines or one long line)		City, State zip
	(May require up to 3 lines or one long line)	Mother's Phone:	(xxx) xxx-xxxx
		Physician:	JANET MCINTYRE-JOHNSON, MD
		Physician Phone:	(xxx) xxx-xxxx

ABNORMAL SCREEN

Disorder	Screening Result	Analyte	
Amino Acidemias:	Normal		
Fatty Acid Oxidation Disorders:	Normal		
Organic Acidemias:	Abnormal Result: See Note 1	C5DC	Elevated
		C5	Normal
		C14:1	Elevated
		All other analytes	Normal
Galactosemia:	Abnormal Result: See Note 4	GALT	Elevated
Biotinidase Deficiency:	Normal		
Endocrine Disorders:	Unsatisfactory: See Note 1	CAH – 17 OH progesterone	
	Normal	All other analytes	
Hemoglobinopathies:	Normal		

Screening Result Notes:

1. *(DSHS Abnormal Result Mailer Description from library Ex:* This result is suggestive of Glutaric Acidemia Type 2. An immediate recollection is necessary to further evaluate this infant.

(Global Message Text - to be editable by DSHS)
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Disorders Screened: AMINO ACIDEMIAS: Argininosuccinic Acidemia (ASA), Citrullinemia (CIT), Homocystinuria (HCY), Maple Syrup Urine Disease (MSUD), Phenylketonuria (PKU), Tyrosinemia type I (TYR1). FATTY ACID OXIDATION DISORDERS: Med.-Chain Acyl-CoA Dehydrogenase Def. (MCAD), Very Long Chain Acyl-CoA Dehydrogenase Def. (VLCAD), Long Chain Acyl-CoA Dehydrogenase (LCHAD), Trifunctional Protein Def. (TFP), Carnitine Uptake Def. (CUD), Carnitine Palmitoyl Transferase Def. I (CPT 1), ORGANIC ACIDEMIAS: Glutaric Acidemia I (GA-I), 3-OH 3-Methyl Glutaric Acidoria (HMG), Isovaleric Acidemia (IVA), Multiple Carboxylase Def. (MCD), 3 Methyl Crotonyl-CoA Carboxylase Def. (3-MCC), Methylmalonic Acidemia (MMA), Propionic Acidemia (PA), Beta-Ketothiolase Def. (BKT). GALACTOSEMIA. BIOTINIDASE DEFICIENCY. ENDOCRINE DISORDERS: Congenital Hypothyroidism (CH), Congenital Adrenal Hyperplasia (CAH). HEMOGLOBINOPATHIES.

gure 3: Abnormal Mailer with Laboratory Unsat (Page 1)

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10812 SPRINGHILL JUNCTION
AUSTIN, TX 78756

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Mother's Name:	First Last	Form Serial No.:	YY-########
Date of Birth:	MM/DD/YYYY	Date Collected:	MM/DD/YYYY
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Birth Weight:	#### grams	Date Reported:	MM/DD/YYYY
Race/Ethnicity:	Am. Indian	Date Revised:	MM/DD/YYYY
Sex:	Female Birth Order: x	Test:	Previous Abnormal
Feed:		Mother's SSN:	
Status:	(May require up to 3 lines or one long line)	Mother's Address:	Street
	(May require up to 3 lines or one long line)		City, State zip
	(May require up to 3 lines or one long line)	Mother's Phone:	(xxx) xxx-xxxx
		Physician:	JANET MCINTYRE-JOHNSON, MD
		Physician Phone:	(xxx) xxx-xxxx

ABNORMAL SCREEN

2. *(DSHS Unsatisfactory Mailer Description from library Ex:* The specimen received was Unsatisfactory for testing Congenital Adrenal Hyperplasia. An immediate recollection is necessary to further evaluate this infant.

(Global Message Text - to be editable by DSHS)
ATTENTION: The Texas Department of State Health Services has completed implementation of the expanded screening panel. This is the new mailer format.

Disorders Screened: AMINO ACIDEMIAS: Argininosuccinic Acidemia (ASA), Citrullinemia (CIT), Homocystinuria (HCY), Maple Syrup Urine Disease (MSUD), Phenylketonuria (PKU), Tyrosinemia type I (TYR). FATTY ACID OXIDATION DISORDERS: Med.-Chain Acyl-CoA Dehdrogenase Def. (MCAD), Very Long Chain Acyl-CoA Dehydrogenase Def.(VLCAD), Long Chain Acyl-CoA Dehydrogenase (LCHAD), Trifunctional Protein Def. (TFP), Carnitine Uptake Def. (CUD), Carnitine Palmitoyl Transferase Def. I (CPT1). ORGANIC ACIDEMIAS: Glutaric Acidemia I (GA-I), 3-OH 3-Methyl Glutaric Acidura (HMG), Isovaleric Acidemia (IVA), Multiple Carboxylase Def. (MCD), 3 Methyl Crotonyl-CoA Carboxylase Def. (3-MCC), Methylmalonic Acidemia (MMA), Propionic Acidemia (PA), Beta-Ketothiolase Def. (BKT). GALACTOSEMIA. BIOTINIDASE DEFICIENCY. ENDOCRINE DISORDERS: Congenital Hypothyroidism (CH), Congenital Adrenal Hyperplasia (CAH). HEMOGLOBINOPATHIES.

Newborn Screening ACT Sheet
[Absent/Reduced biotinidase activity]
Biotinidase Deficiency

Example

***Differential Diagnosis*:** Biotinidase deficiency; see C5-OH for non-biotinidase associated conditions.
***Metabolic Description*:** Biotinidase deficiency results from defective activity of the biotinidase enzyme. When identified (possibly) through elevated C5-OH, 3-hydroxyisovaleric acid and 3-methylcrotonylglycine are elevated and holocarboxylase synthase deficiency must be considered.

You Should Take the Following IMMEDIATE Actions:

- Contact family to inform them of the newborn screening result and ascertain clinical status (poor feeding, lethargy, hypotonia).
- See and evaluate infant.
- Consultation/referral to a metabolic specialist to determine appropriate follow-up. (See attached list)
- If infant cannot be seen immediately at metabolic specialist, undertake confirmatory testing in consultation with a metabolic specialist.
- Initial testing: enzyme assay for biotinidase
- Repeat newborn screen if second screen has not been done.
- Emergency treatment if symptomatic.
- Report findings to newborn screening program.

***Confirmation of Diagnosis*:** Enzyme assay for biotinidase reveals low activity. Plasma acylcarnitine analysis may show normal or increased 3-hydroxyisovaleric acid and 3-methylcrotonylglycine. C5-OH acylcarnitine may be high but lack of an abnormal acylcarnitine profile does not rule out biotinidase deficiency.

***Clinical Expectations*:** The neonate is usually asymptomatic but episodic hypoglycemia, lethargy, hypotonia, and mild developmental delay can occur at any time from the neonatal period through childhood. Untreated biotinidase deficiency leads to developmental delay, seizures, alopecia, and hearing deficits. Biotin treatment is available and highly effective.

***Reporting*:** Report diagnostic result to family and NBS program.

Additional Information:
Gene Tests
http://www.genetests.org/servlet/access?db=geneclinics&site=gt&id=8888891&key=EJ4Gy2VAan2GT&gry=&fcn=y&fw=xn8V&filename=/profiles/biotin/index.html
OMIM http://www.ncbi.nlm.nih.gov/entrez/dispomim.cgi?id=253260
Genetics Home Reference http://ghr.nlm.nih.gov/condition=biotinidasedeficiency

Medium Chain Acyl-CoA Dehydrogenase Deficiency (MCAD)

What is MCAD?

MCAD is a type of fatty acid oxidation disorder. People with MCAD have problems breaking down fat into energy for the body.

What Causes MCAD?

Enzymes help start chemical reactions in the body. MCAD happens when an enzyme called "medium chain acyl-CoA dehydrogenase" is either missing or not working. This enzyme breaks down certain fats in the food we eat into energy. It also breaks down fat already stored in the body.

What Symptoms or Problems Occur with MCAD?

[Symptoms are something out of the ordinary that a parent notices.]

MCAD can cause bouts of illness called Metabolic Crises. Children with MCAD often show symptoms for the first time between 3 months and 2 years of age. Some of the first signs of a Metabolic Crisis are:

- too much sleepiness
- behavior changes (such as crying for no reason)
- irritable mood
- poor appetite

If a Metabolic Crisis is not treated, a child with MCAD can develop:

- breathing problems
- seizures
- mental retardation
- cerebral palsy
- coma, sometimes leading to death

What is the Treatment for MCAD?

The following treatments are often used for children with MCAD:

1. **Do not go a long time without food** – Babies and young children with MCAD need to eat often to avoid low blood sugar or a Metabolic Crisis. They should not go without food for more than 4 to 6 hours. Some babies need to eat even more often. It is important that babies be fed during the night. They need to be woken to eat if they do not wake up on their own. Young children with MCAD may need to have a starchy snack (such as bread, cereal, rice) before bed and another during the night. They may need another snack first thing in the morning. Your dietitian can give you ideas for good night-time snacks. Dietitians know what are the correct foods to eat. Most teens and adults with MCAD can go without food for up to 12 hours without problems when they are well. They need to continue the other treatments for life.
2. **Diet** – Sometimes a low-fat, high carbohydrate diet (such as vegetables, fruits, grains) is advised. Your dietitian can create a food plan with the right type and amount of fat your child needs. Ask your doctor whether or not your child needs to have any changes in his or her diet.
3. **Learnitine** – L-carnitine (Carnitor) may be prescribed for some children. This is safe and natural and helps body cells make energy. It also helps the body get rid of harmful wastes.

Things to Remember

Always call your doctor when your child has any of the following:

- poor appetite
- low energy or too much sleepiness
- vomiting
- diarrhea
- an infection
- a fever

People with MCAD need to eat extra starchy foods and drink more fluids during any illness – even if they don't feel hungry – or they could develop low blood sugar or a Metabolic Crisis. Children who are sick often don't want to eat. If they won't or can't eat, they may need to be treated in the hospital to prevent problems.

Estimated Expansion Statistics

- Approximately 400,000 births a year
- Approximately 800,000 specimens a year collected
- Follow-up on approximately 15,000 abnormal screens a year
- Approximately 600 diagnosed cases per year

Current Legislation & Rules

Requires newborn screening on 27 disorders

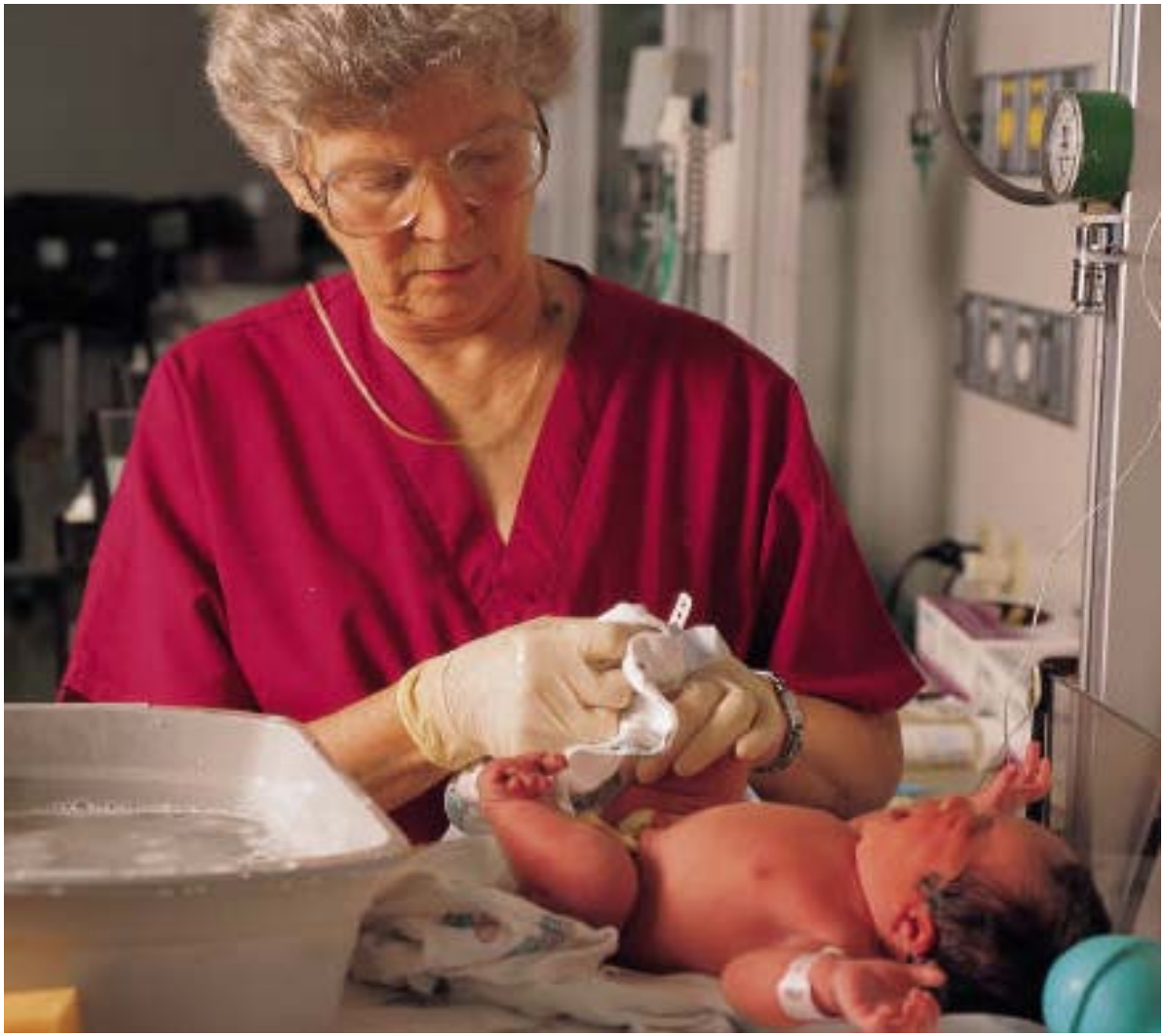
- 6 Amino acid disorders including PKU
- 5 Fatty acid oxidation disorders
- 9 Organic acid disorders
- Galactosemia-1-phosphate uridyltransferase deficiency
- Biotinidase deficiency
- 3 Sickling hemoglobinopathies, including sickle cell disease
- 2 Endocrine disorders

Texas babies are mandated to have 2 newborn screens

- The first screen at 24-48 hours or before leaving hospital, whichever is first
- The second screen at 1-2 weeks of age

NICU Babies

First screen must be taken 24-48 hours of life regardless of feeding status or weight



Tandem Mass Spectrometer (MS/MS)

- Molecules are sorted & weighed by mass
- Compounds analyzed are amino acids & acylcarnitines
  - Amino acids: building blocks for proteins
  - Acylcarnitine= Carnitine (vehicle) +fatty acid
    - Identified by size of fatty acid: short, medium, long and designated by initials & numbers

Expanded Newborn Screening

In 2005 HB790 was passed requiring expansion of the newborn screening program using the ACMG (American College of Medical Genetics) recommended panel as funds allowed

Criteria for screened disorders

- Disorder occurs with significant frequency
- Test are inexpensive and reliable
- Effective treatment/intervention exists
- If untreated, baby may die or develop severe retardation
- Affected baby may appear normal at birth

Organic Acid Metabolism Disorders

- IVA - Isovaleric acidemia
- GA I – Glutaric acidemia type I
- HMG – 3-OH 3-CH3 glutaric aciduria
- MCD – Multiple carboxylase deficiency
- MUT – Methylmalonic acidemia (mutase def)
- 3MCC – 3-Methylcrotonyl-CoA carboxylase deficiency
- Cbl A,B – Methylmalonic acidemia
- PROP – Propionic acidemia
- BKT – Beta-ketothiolase deficiency

Fatty Acid Oxidation Disorders

- MCAD – Medium-chain acyl-CoA dehydrogenase deficiency
- VLCAD – Very long-chain acyl-CoA dehydrogenase deficiency
- LCHAD – Long-chain L-3-OH acyl-CoA dehydrogenase deficiency
- TFP – Trifunctional protein deficiency
- CUD – Carnitine uptake defect

Amino Acid Metabolism Disorders

- PKU – Phenylketonuria
- MSUD – Maple syrup urine disease
- HCY – Homocystinuria
- CIT – Citrullinemia
- ASA – Argininosuccinic acidemia
- TYR I – Tyrosinemia type I

Hemoglobinopathies

- SCA – Sickle cell anemia
- Hb S/Th – Hb S/ Beta-thalassemia
- Hb S/C – Hb S/C disease

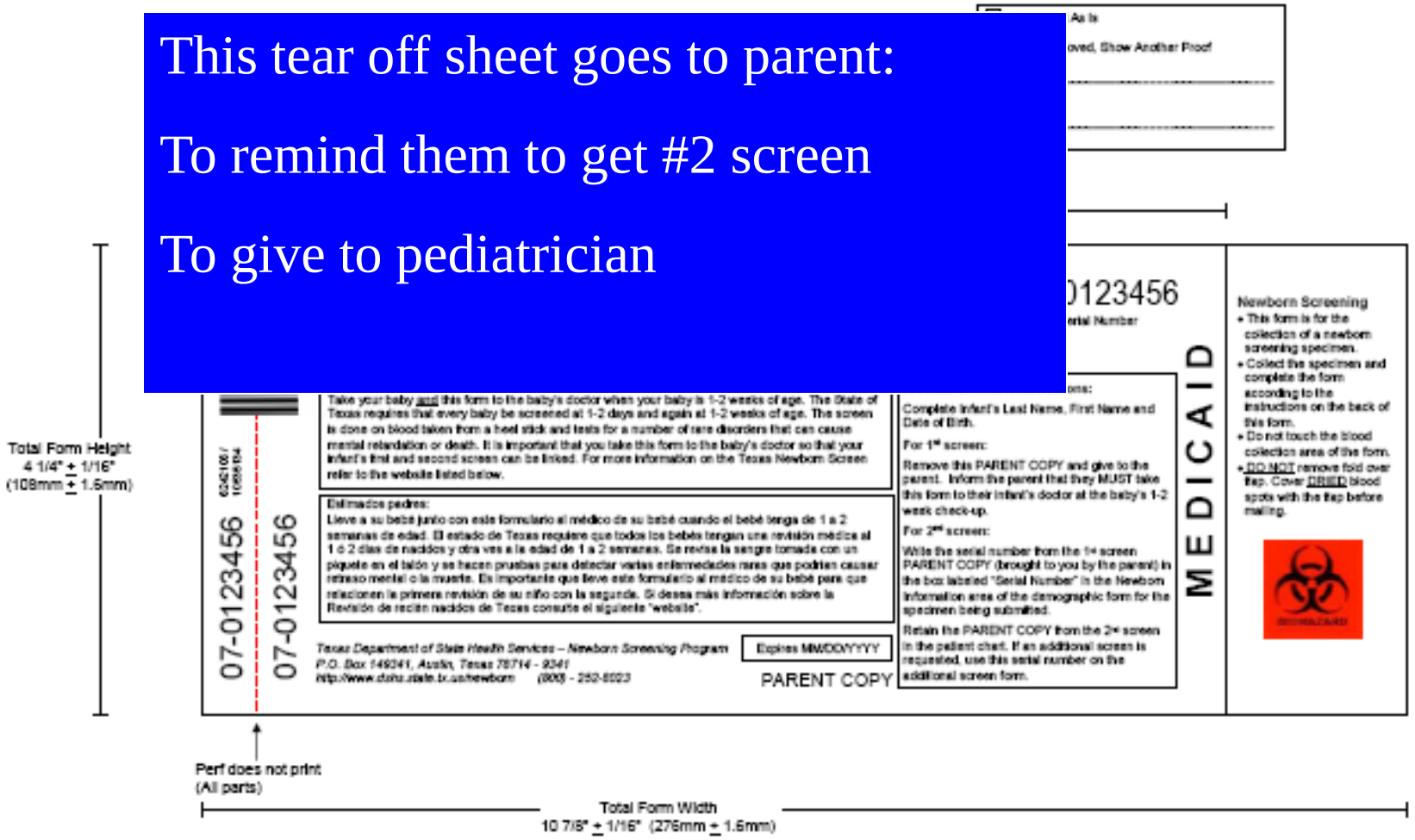
Others

- HYPOTH – Congenital hypothyroidism
- BIOT – Biotinidase deficiency
- CAH – Congenital adrenal hyperplasia
- GALT – Galactosemia
- HEAR – Hearing deficiency

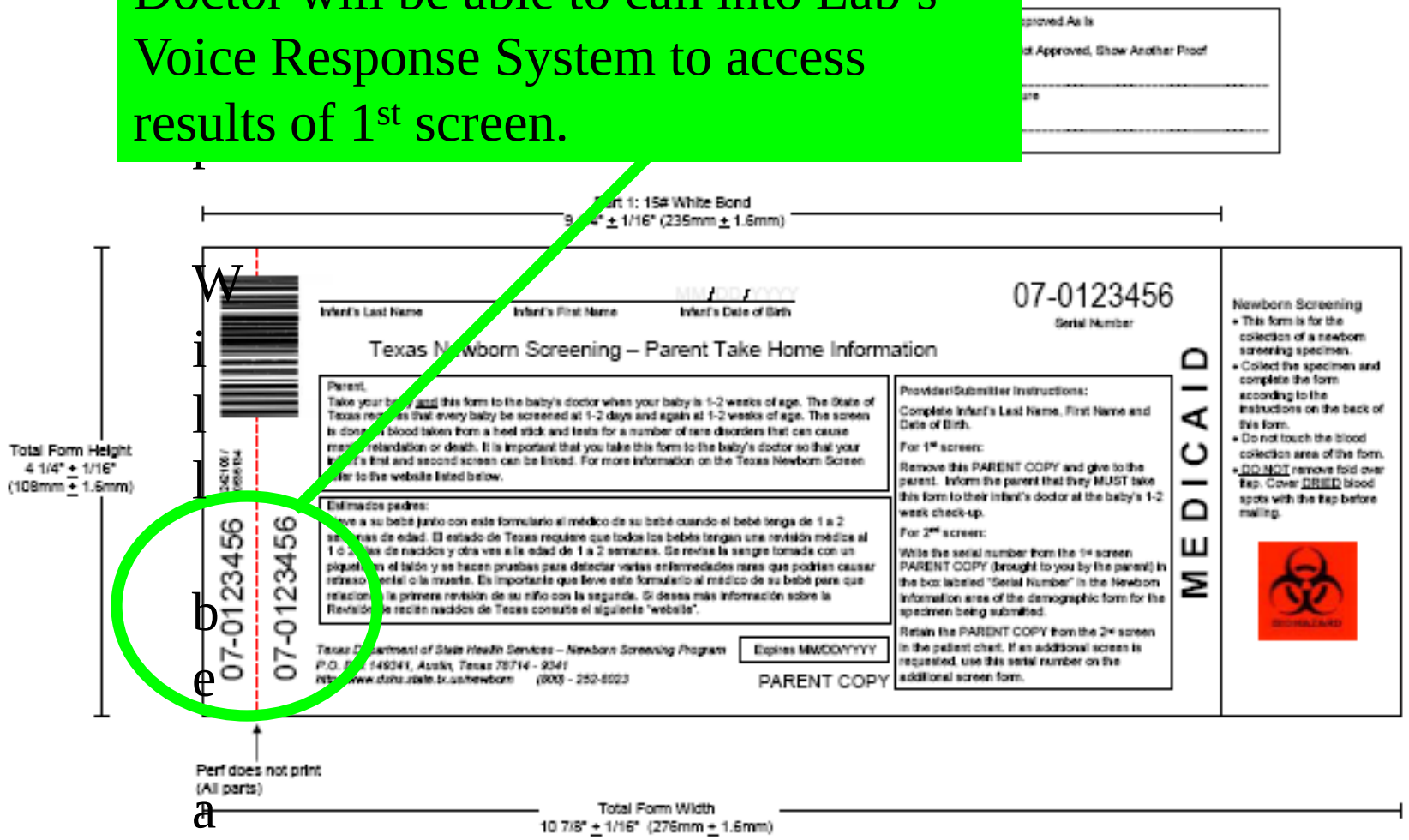
This tear off sheet goes to parent:

To remind them to get #2 screen

To give to pediatrician



Doctor will be able to call into Lab's Voice Response System to access results of 1st screen.



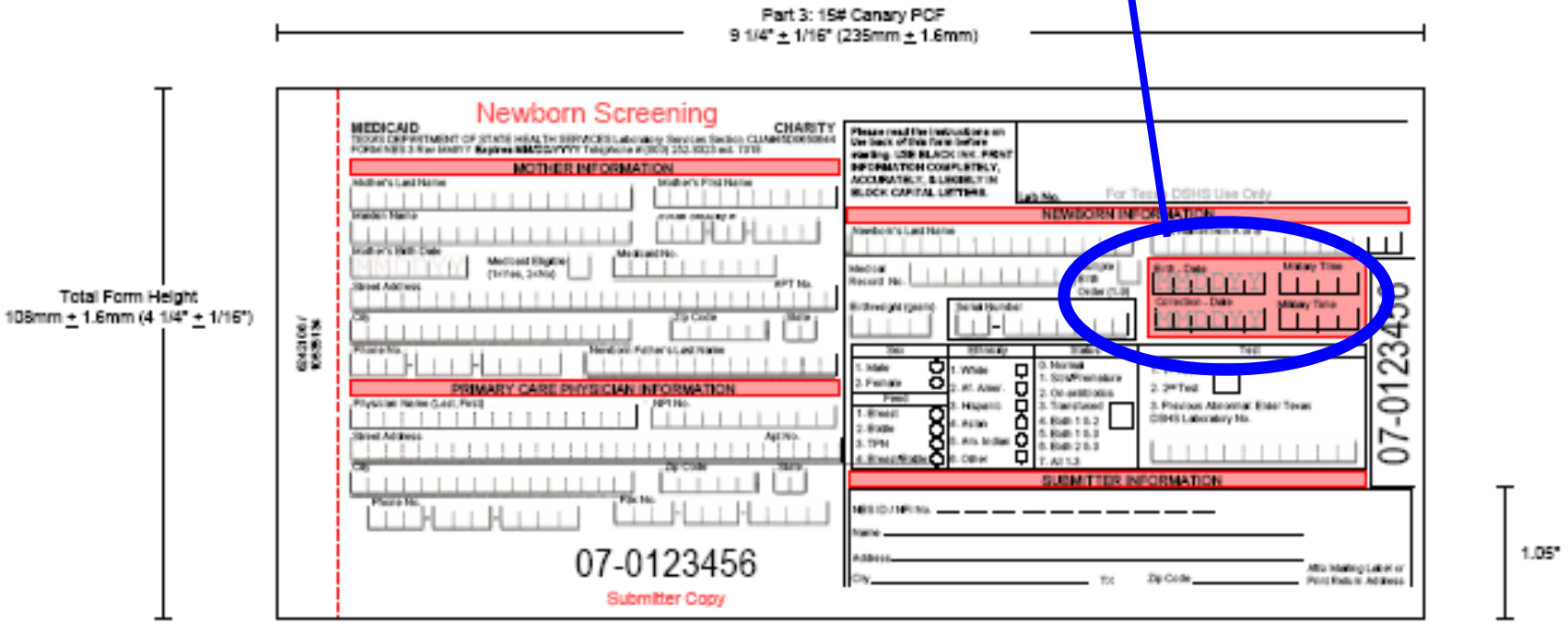
Will be available

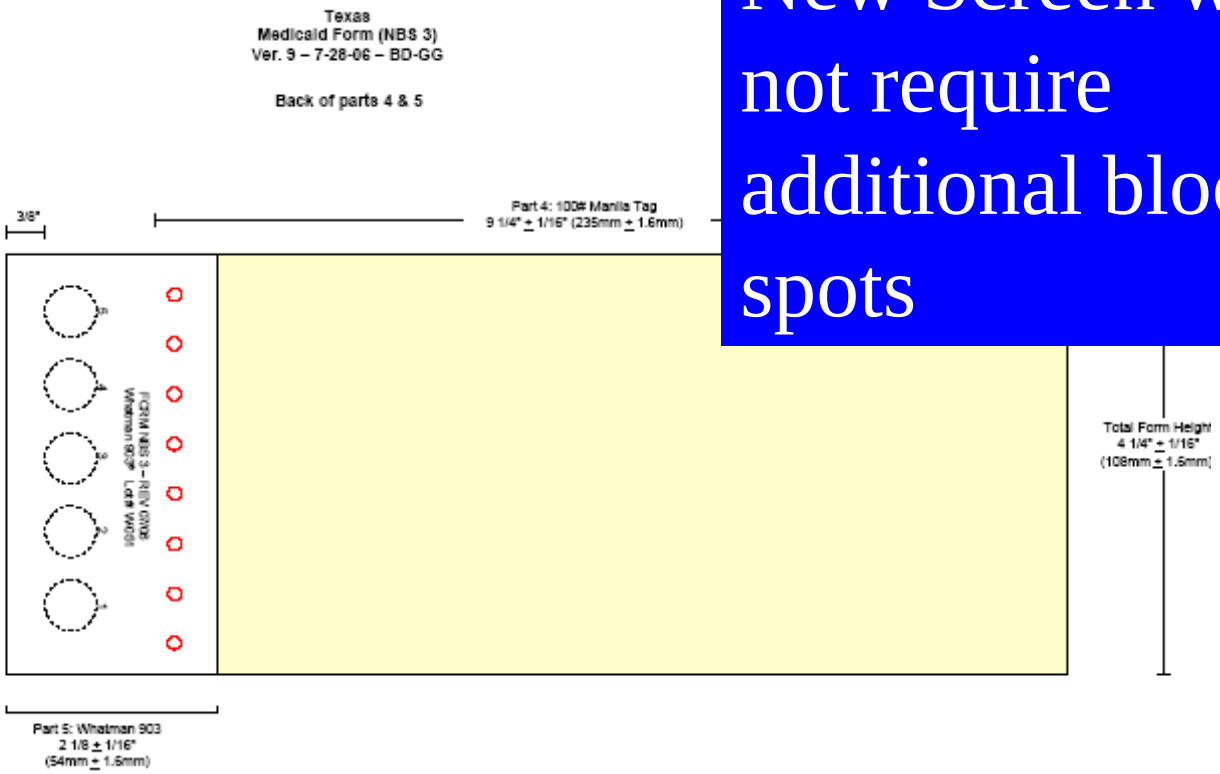
New forms will ask for (in military time):

- Time of birth
- Time of collection

Texas
Medicaid Form (NBS 3)
Ver. 3 – 7-28-06 – BD-GG

Part 3





New Screen will not require additional blood spots

Texas
Medicaid Form (NBS 3)
Ver. 9 – 7-28-06 – BD-GG

Back of Form: Part 6

Part 6: 28# White Ledger
12 1/2" ± 1/16" (317.5mm ± 1.5mm)

TEXAS NEWBORN SCREENING INSTRUCTIONS

A first specimen is required for all newborns at 24-48 hours of age, or just prior to discharge. A second specimen is also required at 1-2 weeks of age.

Invalid results may occur with:

- Infants having received a transfusion.
- Specimens accompanied by improper or incomplete paper work.
- Infants on TPN

Completion of Form:

1. Legibly and accurately print ALL information in spaces provided. USE ONLY BLACK INK AND BLOCK CAPITAL LETTERS. Press hard for good copies.
2. Enter complete and accurate information.
3. Complete information on top "PARENT COPY" form, remove and give copy to parent explaining that the form must be taken to the baby's doctor for the baby's 1-2 week checkup.
4. For 2nd screens write serial number from baby's 1st screen "PARENT COPY" (given to parent at baby's birth) on demographic information sheet in the designated location.
5. Color in appropriate *bubble* circle as indicated for sex, feed, and ethnicity.
6. Fill in correct number to indicate infant's 'Status' and 'Test'.
7. If the specimen is a repeat for a previous abnormal, enter Texas DSHS laboratory number in appropriate spaces.
8. Enter complete submitter's address for location where results are to be sent. Labels for this purpose may be ordered from Texas DSHS, Laboratory Service Section.
9. Remove and keep the submitter 'yellow' copy of the demographic information.

Collection Procedure: Cord blood is not acceptable

1. Place infant/child's limb in dependent position.
2. Cleanse skin with alcohol, DRY, and puncture with disposable lancet.
3. Wipe off first drop of blood.
4. Allow a drop of blood to form and apply DIRECTLY to filter paper. Apply to one side only while viewing from the other side to ensure COMPLETE SATURATION OF THE ENTIRE CIRCLE (see below).
5. Complete one circle at a time and FILL ALL FIVE (5) CIRCLES.
6. Allow card to dry thoroughly in a horizontal position (min 3-4 hours). Do NOT allow specimen to touch any surface.
7. Cover dried specimen with attached flap.
8. Must ship dried specimen WITHIN 24 HOURS in provided envelope to:
   Texas Department of State Health Services
   Laboratory Services Section
   P.O. Box 149341
   Austin, TX 78714 - 9341

DO NOT use expired form.
DO NOT use devices that contain EDTA or citrate anticoagulant.
DO NOT use capillary tubes.
DO NOT expose card to heat, moisture, or direct sunlight.
DO NOT stack or mail wet specimens.
DO NOT hold specimens for bulk mailing. Send within 24 hours of collection.

Collect sample from shaded area

Acceptable
Circle filled and completely saturated

Unacceptable
Caked, clotted, or layered

Insufficient, multiple applications

Serum rings present

To order more Newborn Screening Forms, contact
Texas Department of State Health Services
Laboratory Services Section
1100 West 49th Street
Austin, TX 78756
1-888-963-7111 ext. 7661

MEDICAID

Newborn Screening

- This form is for the collection of a newborn screening specimen.
- Collect the specimen and complete the form according to the instructions on the back of this form.
- Do not touch the blood collection area of the form.
- DO NOT remove fold over flap. Cover DRIED blood spots with the flap before mailing.

BIOHAZARD

Total Form Height
4 1/4" ± 1/16"
108mm ± 1.5mm

"UNSAT": *THE TOP 5*

#4

- Avoid Contaminants
- Do not touch filter paper
  - EDTA
    - Do not use purple capped tubes
    - Be careful of hand lotion
- Dry flat 3-4 hours
- Do not put in plastic bag

#3

- Mail specimen within 24 hours
  - Do Not Batch
  - Eliminate unnecessary Stops
  - If someone is on vacation- assign to someone else

#2

- Date of Collection
  - Specimen cannot be processed without date of collection
- Date of Birth
  - New forms will also ask for time of birth
- Other Demographic are Important

  Get mother's name, address

  Get a good phone # for someone to call if abnormal

  Get MD's name if possible

#1

- Get a good Blood Spot!
  - Must soak through to other side of filter paper
  - Do not scratch or abrade paper


THE END