Genetic Fact Sheets for Parents

Other Disorders

Screening, Technology, and Research in Genetics is a multi-state project to improve information about the financial, ethical, legal, and social issues surrounding expanded newborn screening and genetic testing – http:// www.newbornscreening.info

Disorder name: Sickle Cell Disease
Acronym: SCD

This fact sheet has general information about sickle cell disease (SCD). Every child is different and some of this information may not apply to your child specifically. Certain treatments may be recommended for some children but not others. If you have specific questions about SCD and available treatments, you should contact your doctor.

The majority of the management recommendations pertain to hemoglobin SS, which is the most common type of SCD. If your child has hemoglobin SC or hemoglobin beta-thalassemia, ask your doctor for more specific information about that condition.

What is SCD?

SCD is an inherited blood disorder that results in chronic health problems. People with SCD have abnormal hemoglobin. Hemoglobin is the protein in red blood cells that carries oxygen from the lungs to the rest of the body. Abnormal, or sickle-shaped, hemoglobin cannot deliver enough oxygen to the rest of the body. This causes individuals with SCD to experience episodes of pain. Over time, the lack of oxygen damages the organs, especially the spleen, brain, lungs and kidneys. SCD also causes anemia, or a low number of red blood cells.

There are several types of SCD, including hemoglobin SS, hemoglobin SC and hemoglobin S-beta thalassemia. The most common type of SCD is hemoglobin SS. The different types of SCD have some unique symptoms and some in common. It is important to find out which type of SCD your child has and talk with your doctor about signs, symptoms and treatment specific to that condition.

What causes SCD?

SCD is an inherited condition that occurs when the body makes abnormally shaped hemoglobin. Normal hemoglobin is shaped like a disk or doughnut so that it can move through the blood vessels easily. In people with SCD, hemoglobin is long and narrow, or "sickle-shaped". Sickle cells are stiff and can get caught up with each other to form clumps within the blood vessels, so oxygen is not delivered effectively. Therefore, the body tissues and organs lack oxygen. When there is not enough oxygen in the body tissues, anemia, pain and organ damage can occur.

Sickle cells also die more quickly than normal red blood cells. The bone marrow cannot make enough new cells to replenish the blood supply. Having too few red blood cells causes anemia.

SCD is not contagious. You cannot get SCD from living with, touching, or spending time with a person with SCD.

What are the symptoms of SCD?

SCD causes minimal effects in some people and more serious problems in others. Most people with SCD do not develop all of the symptoms. Symptoms can be chronic (on-going or long-term) or acute (immediate or short-term). It is important to be educated about the symptoms so that they can be properly managed.

The symptoms of SCD are related to anemia, pain or the effects of SCD on specific body parts.

Most infants do not show signs of SCD until they are a few months old. Often, the first sign of SCD is pain or swelling in the child's hands or feet when small blood vessels become blocked. This causes some children to develop a fever.

Signs of anemia include:

- Fatigue (feeling tired or weak)
- Shortness of breath
- Dizziness
- Headaches
- Cold hands or feet
- Pale skin
- Chest pain

Most people with SCD experience pain at some point in their life. An episode of pain that occurs because tissues do not have enough oxygen is called a sickle cell crisis. Some people with SCD have one or fewer pain episodes each year, while others can have more than fifteen episodes. Sickle cell crises can affect any part of the body, but most often affect the bones, lungs, abdomen and joints. Crises can be acute, lasting hours or days, or chronic, lasting weeks to months. They can be mild or severe. Many times, the exact cause of a sickle cell crisis is unknown, but it is likely that many factors contribute. Dehydration and infection are known to increase the chance of having a crisis. In children with SCD, sickle cell crises are the leading cause of hospitalizations and missed days of school.

Infants and young children with SCD are at an increased risk to develop infections, including those that are life-threatening. Taking penicillin daily and receiving immunizations can prevent infection.

A stroke can occur if sickle cells block blood vessels to the brain. Strokes can cause permanent brain damage. While strokes are very serious, only about 5% of children with SCD may have a stroke.

The spleen is an organ that removes damaged red blood cells and fights infection. Sickle cells can clog the spleen. This not only weakens the spleen's ability to fight infections, but can cause pain on the left side of the abdomen.

Blocked blood vessels in the lungs cause symptoms such as wheezing, difficulty breathing, chest pain and fever. Children with these symptoms often require hospitalization.

Blocked blood vessels in the eye can lead to blindness over time. Therefore, it is important to have regular eye exams.

When blood vessels leading out of the penis are blocked, some boys with SCD experience painful erections.

Around 30% of children with SCD develop gallstones by age 7. If you notice any signs of gallstones (yellow eyes, pain in right side of abdomen), contact your doctor.

Children with SCD tend to grow more slowly and begin puberty later than their peers.

Ulcers may develop on your child's lower leg.

SCD does ***not*** affect intelligence or the ability to learn. People with SCD are able attend regular school when they are healthy. Many people with SCD have finished college and have full-time jobs.

While there are many complications in SCD, the effects can be lessened when parents know what to do when complications arise.

What is the treatment for SCD?

Children with SCD are cared for by a team of specialists, including a hematologist, a doctor who specializes in treating blood disorders. The main goal of treatment is to prevent complications, and lessen them when they do occur. Your child's individual treatment plan may depend on the symptoms that s/he is experiencing. ***Parents' awareness of signs of complications is crucial to providing rapid treatment.***

Prevent infection

Infection is the leading cause of death in children with SCD. It is very important that children with SCD take penicillin daily to prevent infection.

Have your child receive all of the usual childhood vaccinations according to the regular schedule. In addition, children with SCD should receive:

- Meningococcal vaccine to prevent meningitis (infection of the lining of the brain)
- Pneumococcal vaccine to protect against other serious bacterial infections
- Yearly flu shot

Teach your child good hand washing techniques.

Pain Management

Mild sickle cell crises can be treated with over-the-counter pain medications (such as acetaminophen and ibuprofen) or heating pads. More severe pain may be managed with prescription drugs or hospitalization.

Some adults with severe SCD take a drug called hydroxyurea to prevent crises. The long-term effects of using this drug during childhood are unknown.

Blood transfusion

A blood transfusion may be used to treat a sickle cell crisis or prevent stroke. Some children with SCD receive blood transfusions on a regular basis. However, frequent blood transfusions can cause the body to have a dangerously high level of iron. Talk with your doctor about the risks and benefits of blood transfusions.

Testing

Frequent testing of blood and urine samples can determine how a person's red blood cells are working and check for infection and organ damage.

Some doctors recommend brain imaging studies to check for blood clots in the brain and X-rays to check for lung infection and bone damage.

Eye Check-ups

Routine eye check-ups are important to prevent vision problems or blindness from damaged blood vessels in the eye. Children who have difficulty seeing may have trouble in school.

Activities

Children with SCD should avoid activities which expose them to extreme temperatures (swimming in cold water) or high altitudes (backpacking, hiking and skiing). If participating in these activities, children should plan for temperature differences (i.e., use of gloves, warm clothes) and approach activities with caution and prevention of symptoms in mind. Children with SCD can participate in other normal activities, but should make sure to stay hydrated and rest when tired.

Nutrition

To prevent pain crises, children with SCD need to drink plenty of water, especially when the child is sick, active or in hot weather. Most children with SCD have bedwetting episodes, for which there are strategies such as limiting drinks before bedtime and waking the child during sleep to urinate.

Children older than one year of age may take folic acid daily to stimulate red blood cell production.

Since some children with SCD, especially those receiving blood transfusions, accumulate iron in their blood, they should not be given iron supplements.

Call your doctor at the start of any illness

Sometimes, minor illnesses can be signs of more severe complications of SCD. In order to prevent problems, call your doctor right away if your child has any of the following:

- Fever of 101 degrees or higher
- Signs of infection (chills, lethargy, irritability, poor feeding, vomiting)

- Severe headache or dizziness
- Chest pain or trouble breathing
- Severe stomach pain or swelling
- Sudden pale coloring or jaundice
- Painful erection
- Sudden change in behavior – seizures, paralysis, can't wake up
- Painful swelling of hands and feet

Parents' awareness of warning signs of complications is crucial to treatment.

A small number of children with SCD receive bone marrow transplants. Bone marrow transplants are able to cure SCD for some patients. In order to have a bone marrow transplant, a genetic match must be found. There are risks associated with the transplant, including death.

You may read information about the potential for gene therapy to treat or cure SCD in the future. Researchers are currently trying to find a way to insert a normal hemoglobin gene into the cells that need it. Although they have not yet found a way to do this safely and effectively, researchers across the country continue to work on gene therapy treatments for SCD.

What happens when SCD is treated?

The goal of treatment is to lessen the health problems that occur with SCD. However, even when a child receives proper medical care and prevention, symptoms can still occur.

You may be advised to see a hematologist, a doctor who specializes in caring for children with blood disorders. These doctors can work with your regular pediatrician to ensure up-to-date treatment for your child. Some centers have multidisciplinary sickle cell clinics that provide all of the child's needs in one place. A list of these centers can be found at http://scinfo.org/sickle-cell-clinics-contacts-and-resources.

What causes the red blood cells to be sickle-shaped?

Genes tell the body how to make proteins. An error in the DNA spelling of the gene for hemoglobin causes the hemoglobin protein to be shaped abnormally. People with SCD have spelling errors in both copies of the hemoglobin gene. Everyone with SCD has a specific spelling error that causes the sickle shape in at least one copy.

Different spelling errors in the second copy of the hemoglobin gene cause the different forms of SCD. People with SS have the sickle cell gene change in both copies. People with hemoglobin SC have a gene change that makes another

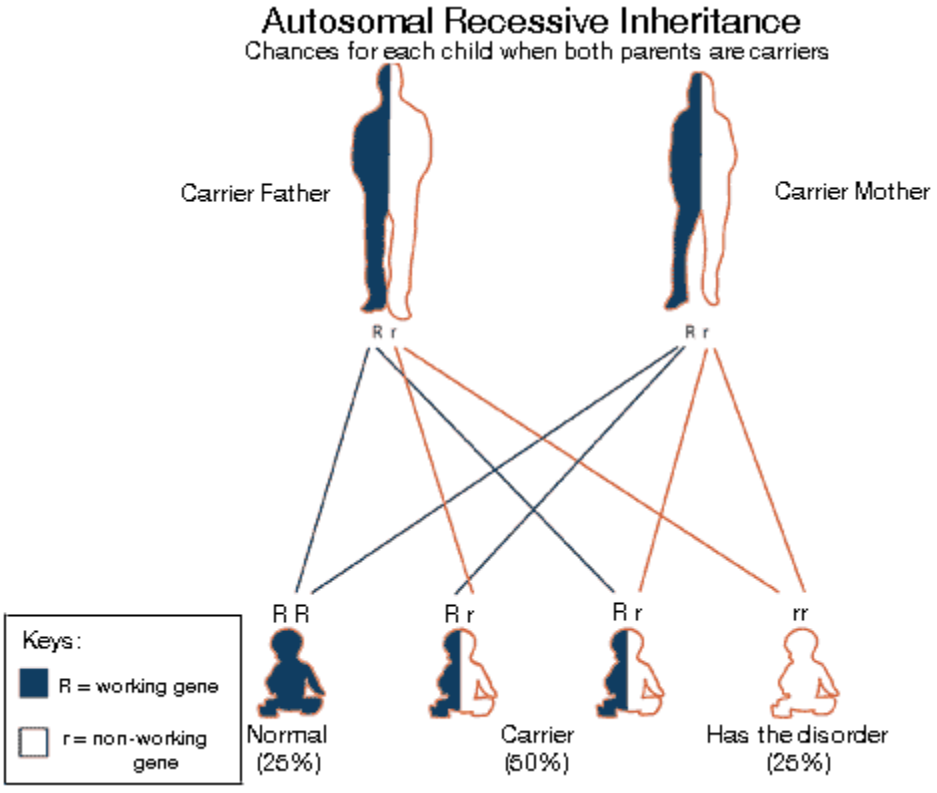
form of abnormal hemoglobin (type C). People with hemoglobin S-beta thalassemia have a different gene error that causes abnormal hemoglobin.

How is SCD inherited?

SCD is inherited in an autosomal recessive manner, meaning that a child must have changes in both copies of their hemoglobin gene to have SCD. Since each parent gave their child one copy of the gene, we know that both parents of a child with SCD have a change in one of their hemoglobin genes.

Parents of children with SCD do not necessarily have SCD. A parent can have a single gene for abnormal hemoglobin, but the other gene in the pair is working correctly. In this case, a parent is called a carrier or said to have sickle cell trait. Carriers do not have SCD because the other gene of this pair is working correctly.

When both parents are carriers, there is a 25% chance in each pregnancy for the child to have SCD. There is a 50% chance for the child to be a carrier, just like the parents. Finally, there is a 25% chance for the child to have two working genes.



Parents may have different changes in the hemoglobin genes that could cause the different types of SCD.

Genetic counseling is available to families who have children with SCD. Genetic counselors can answer your questions about how SCD is inherited, choices during future pregnancies, and how to test other family members. Ask your doctor about a referral to a genetic counselor.

Is genetic testing available?

Genetic testing for SCD can be done on a blood sample. Genetic testing, also called DNA testing, looks for changes in genes that cause SCD. If you have questions about genetic testing, talk with your genetic counselor or hematologist. For most children, genetic testing is not necessary for diagnosis. However, it can be helpful for carrier testing or prenatal diagnosis, discussed below.

What other testing is available?

Newborn Screening

Newborn screening for SCD is now done in all states. A blood spot from a prick on a baby's heel is used to screen for a number of different genetic conditions. The initial newborn screening test determines the amount of normal hemoglobin in the blood spot. If too little normal hemoglobin is found on the initial newborn screening, another test is performed. If the second test is also abnormal, the parents are notified and the child referred to a specialist for an evaluation.

Confirmatory Testing

When your child is around six weeks old, s/he will need to have a confirmatory test performed on a second blood sample. If test results are still unclear, genetic testing may need to be performed on another blood sample.

It is important to complete blood tests at the different points in time recommended by your doctor because the body produces different types of hemoglobin in infancy and adulthood. In the first few months of life, all babies still have some fetal hemoglobin. Therefore, the levels of the different types of hemoglobin need to be compared at different time points in order to establish a definitive diagnosis.

Can you test during pregnancy?

If both gene changes have been found in your child with SCD, DNA testing can be done in future pregnancies. The sample needed for this test is obtained by either CVS or amniocentesis. Parents may either choose to have testing during pregnancy or wait until birth to have the baby tested. A genetic counselor can talk to you about your choices and answer questions about prenatal testing or testing your baby after birth.

Can other members of the family have SCD or be carriers?

Having SCD

The brothers and sisters of a baby with SCD also have a chance of being affected, even if a parent has not noticed any symptoms. Finding out whether other children in the family have SCD is important because early treatment may prevent health problems. Talk to your doctor or genetic counselor about testing your other children for SCD.

SCD Carriers

SCD carriers are not anemic and will generally not have symptoms of SCD. This is because carriers have a working hemoglobin gene to make up for the abnormal one.

Brothers and sisters who do not have SCD still have a chance to be carriers. Except in special cases, carrier testing should only be done on people over 18 years of age.

Each of the carrier parents' brothers and sisters has a 50% chance to also be a SCD carrier. It is important to talk to other family members about their risk of being carriers. There is a small chance they are also at risk to have children with SCD.

When both parents are known to be carriers, newborn screening results are not sufficient to rule out SCD in a newborn baby. In this case, further testing should be done in addition to newborn screening.

Can other family members be tested?

Diagnostic testing

If both gene changes have been found in your child with SCD, brothers and sisters can be tested for SCD using DNA testing on a blood sample or a cheek swab. Other special tests may also be suggested.

Carrier Testing

If both gene changes have been found in your child with SCD, other family members can have DNA testing on a blood sample or cheek swab to see if they are carriers.

How many people have SCD?

Each year, around 2,000 babies are born with SCD in the United States. About one in every 250-600 African-American babies in the United States is born with SCD. SCD is less common in children of other ethnic backgrounds.

Does SCD happen more often in a certain ethnic group?

SCD occurs most often in people with African ancestry. About 1 in every 12 African Americans is a carrier for SCD. People of Mediterranean, Middle Eastern, Indian, Caribbean, South American and Central American descent are also at an increased risk of being a carrier. However, SCD can affect people of any ethnic background.

Does SCD go by any other names?

Hemoglobin SS, the most common form of SCD, may also be called:

- Sickle cell anemia
- Hemoglobin S Disease

Where can I find more information?

Sickle Cell Disease Association of America
http://www.sicklecelldisease.org

Sickle Cell Information Center
http://www.scinfo.org

Document Info	**Created by:**	www.newbornscreening.info
	Reviewed by:	HI, CA, OR, and WA metabolic specialists
	Review date:	November 30, 2012
	Update on:	November 30, 2012

DISCLAIMER:

THIS INFORMATION DOES NOT PROVIDE MEDICAL ADVICE. All content ("Content"), including text, graphics, images and information are for general informational purposes only. You are encouraged to confer with your doctor or other health care professional with regard to information contained on this information sheet. After reading this information sheet, you are encouraged to review the information carefully with your doctor or other healthcare provider. The Content is not intended to be a substitute for professional medical advice, diagnosis or treatment. NEVER DISREGARD PROFESSIONAL MEDICAL ADVICE, OR DELAY IN SEEKING IT, BECAUSE OF SOMETHING YOU HAVE READ ON THIS INFORMATION SHEET.

U.S. Department of Health and Human Services
HRSA
Health Resources and Services Administration
Maternal and Child Health Bureau

This project is supported by a grant from the Maternal and Child Health Bureau, Health Resources and Service Administration, Genetic Services Branch, MCH Project #: H46MC24091 http://mchb.hrsa.gov