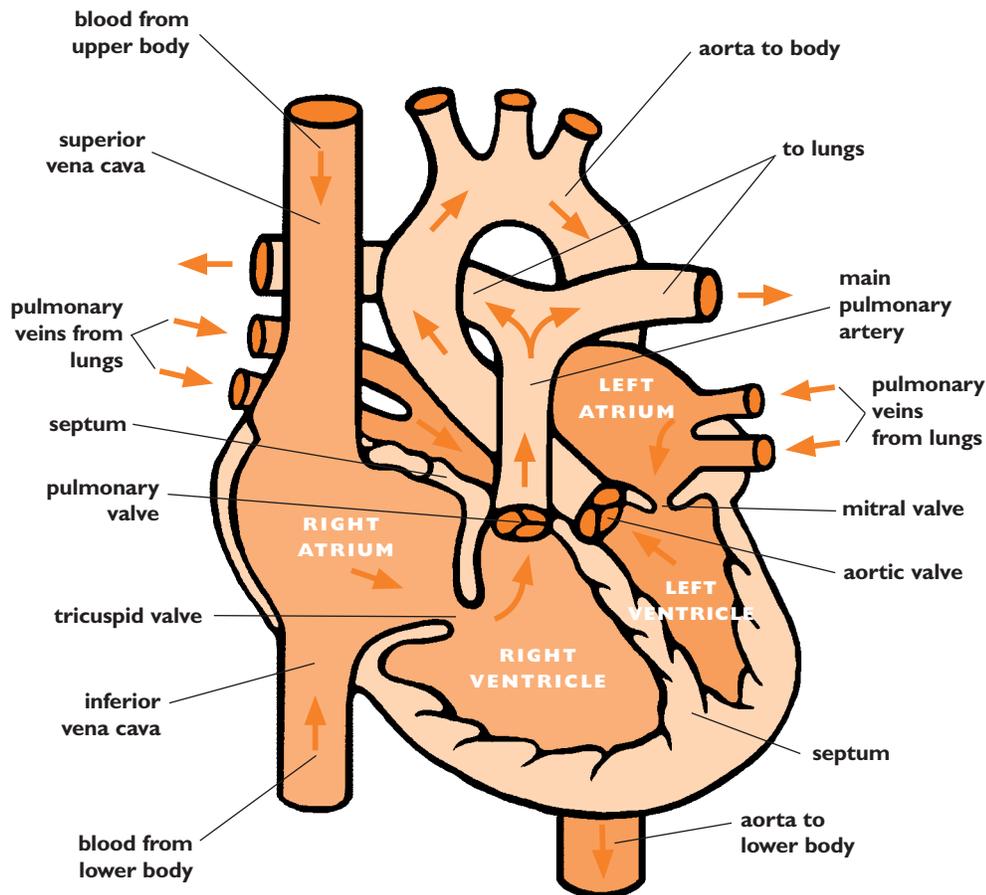


What's here

This section provides some information about the cardiovascular system—the heart, valves, and blood vessels, before and after birth. It also provides general information about **congenital heart defects** (CHDs) and related health concerns.

The topics include: ■ *What is a Congenital Heart Defect?* ■ *How the Heart and Blood Vessels Work* ■ *Before Birth—Mother Provides What Baby Needs* ■ *After Birth* ■ *How To Find Out If Your Baby Has a CHD* ■ *Congestive Heart Failure* ■ *Cyanosis* ■ *Infection Called Bacterial Endocarditis*

Diagram of a Normal Heart



WRITE & ASK

A TIP FROM THE
HEALTH CARE TEAM



WRITE DOWN YOUR
QUESTIONS AS YOU
THINK OF THEM AND
DON'T BE AFRAID TO
ASK QUESTIONS



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COMMON DENOMINATOR

CHDS HAPPEN TO ABOUT ONE IN EVERY ONE HUNDRED BABIES



THEY ARE MORE COMMON THAN ANY OTHER TYPE OF CONGENITAL DEFECT



THEY ARE MORE COMMON IN CHILDREN WITH OTHER CONDITIONS SUCH AS DOWN SYNDROME

WHAT IS A CONGENITAL HEART DEFECT?

“Congenital defect” comes from the words congenital, meaning “existing at birth” and “defect”, meaning a problem. The heart is completely formed by the 8th week of pregnancy. If a problem occurs in the way the heart or the blood vessels close to the heart are formed the baby is born with what is called a congenital heart defect, CHD for short. Congenital heart defects are sometimes called congenital heart disease.

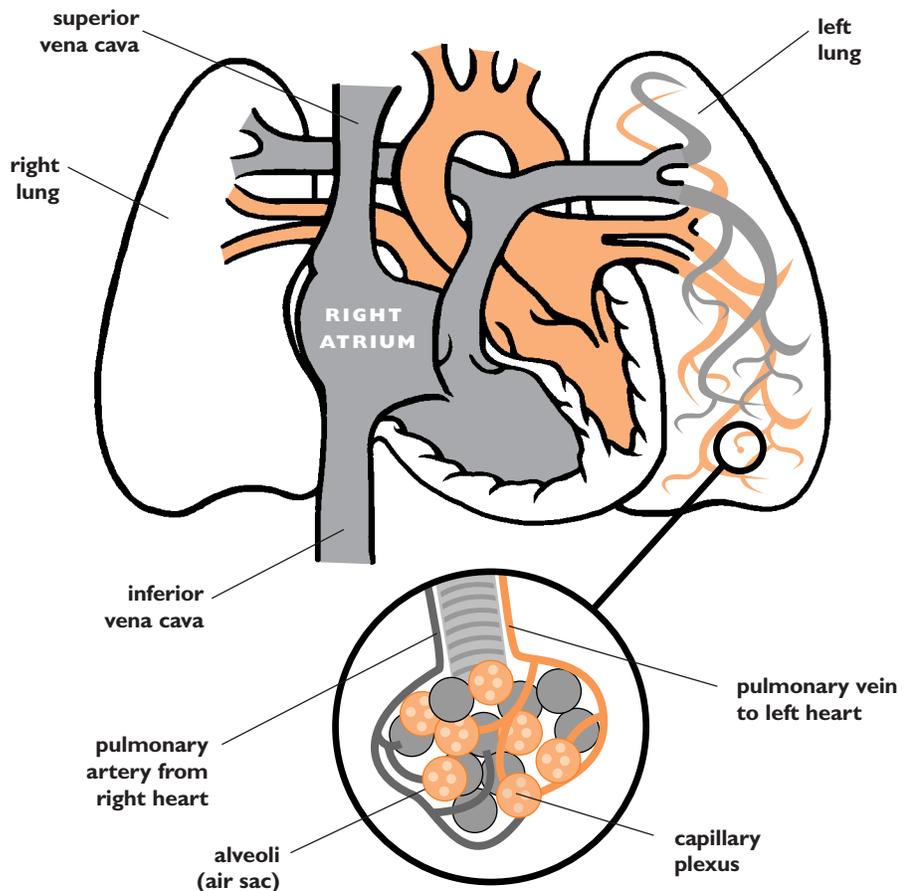
About one of every one hundred babies born has some form of heart defect (i.e., 1%). This ranges from a tiny hole that will never require treatment to a life threatening heart defect.

Sometimes a CHD is associated with other health problems. For example, babies with Down Syndrome often have a particular heart defect.

HOW THE HEART AND BLOOD VESSELS WORK

Every cell in the body needs oxygen and nutrients to work properly. The **cardio-vascular** system (from “cardio”, meaning heart, and “vascular”, meaning blood vessels) refers to the heart and blood vessels by which blood carrying oxygen and nutrients is pumped throughout the body.

Diagram of Heart, Lungs, Alveoli and Capillaries



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The heart is a two-sided pump

Your child's heart is a hollow, muscular organ about the size of a child's fist. It is located between the lungs, slightly to the left of the middle of the chest.

Here are the main parts or the heart:

- a wall made up of membranous and muscular areas called the septum, divides the right and left sides of the heart,
- two chambers on each side of the heart—the upper ones called **atria**, collect blood, and the lower ones called **ventricles**, pump blood out,
- small doors called valves open and close when the heart beats,
- the great vessels—the aorta, which takes blood to the body, and the pulmonary artery, which takes blood to the lungs.

- blood rich in oxygen returns to the heart through the pulmonary veins to the left atrium,
- the left atrium squeezes, which forces the blood through the **mitral valve** into the left ventricle,
- the left ventricle squeezes, which pushes the **aortic valve** open,
- with each beat of the heart, blood rushes through the aortic valve into the **aorta**, which branches into smaller **arteries** that supply the body with oxygen-rich blood,
- blood rushing through the arteries creates a **pulse** you can feel with your fingertips (pulse rate depends on how fast the heart must beat to send blood to all parts of the body).

How does the heart work?

Clench your fist, relax it, and clench it again. This squeezing and relaxing is similar to how the heart beats or contracts.

The heart collects oxygen-poor blood, pumps it to the lungs to get oxygen and then pumps it out to the body through arteries.

Here is the series of actions:

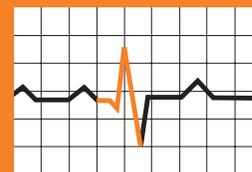
- the right atrium, a collecting chamber, receives oxygen-poor blood (blood that looks bluish),
- the right atrium contracts (squeezes), which pushes open the **tricuspid valve** (the door to the right ventricle) and the blood moves through the valve to the right ventricle,
- the right ventricle, a pumping chamber, contracts, which pushes open the **pulmonary valve** (the door to the pulmonary artery),
- the pulmonary artery carries blood low in oxygen to the lungs, where carbon dioxide is removed and oxygen is added,

The electrical system

(Please refer to the diagram on page 2-4)

The heart's own electrical system makes it beat through a series of actions:

- the **sinoatrial node** (SA node), the heart's natural pacemaker located in the right atrium, causes the atria to contract and pump out blood,
- the signals travel to the **atrioventricular node** (AV node),
- the AV node delays the signal slightly, which allows the blood to pass from the atria to the ventricles,
- the AV node sends the signal to the ventricles, causing them to contract. When the nodes are working well together, the heart pumps blood into the lungs and to the rest of the body. If the electrical system is interrupted, this may cause an irregular heart rhythm.



ELECTROCARDIOGRAM



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DYSRHYTHMIAS

Electrical problems affecting the heart rate or rhythm are called dysrhythmias, and include:

BRADYCARDIA

(A SLOWER THAN NORMAL HEART RATE)



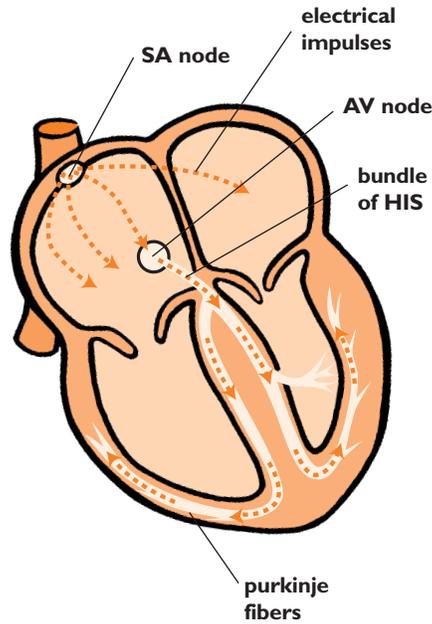
TACHYCARDIA

(A FASTER THAN NORMAL HEART RATE)



FIBRILLATION

(A DISORGANIZED OR IRREGULAR HEARTBEAT)



Healthy blood

The blood has many different parts.

The main parts are:

- red blood cells, which carry oxygen to the body,
- white blood cells, which help fight infection,
- platelets, which help the blood to clot,
- plasma, which contains protein such as albumin.

Oxygen is needed by every part of the body. The red blood cells carry oxygen around the body.

The oxygen attaches itself to **haemoglobin**, a part of a red blood cell. When the haemoglobin is full of oxygen, the blood looks bright red. When the oxygen level is low, the blood looks purple or blue.

The cells use the oxygen, and the waste product is carbon dioxide.

When blood rich in oxygen leaves the lungs to be pumped around the body, it normally looks red. Blood returning to the heart is low in oxygen and high in carbon dioxide and normally looks blue. With some types of

CHDs, the blood leaving the heart does not become filled with oxygen and the child appears blue (see *Cyanosis—Blueness of the Skin*, page 2-11).

Blood delivery through the blood vessels

Blood is delivered by a network of blood vessels, including arteries, veins, and capillaries:

- the arteries carry blood away from the heart,
- the veins carry blood back to the heart,
- the capillaries (tiny blood vessels connecting the arteries and veins) allow oxygen and nutrients to be delivered to the cells and waste products to be picked up.

Blood pressure

Blood pressure is a measure of the pressure against the walls of the arteries. The first number is called the systolic pressure, and the second number is called the diastolic pressure. For example, a blood pressure of 120/80 means 120 systolic, 80 diastolic.

Here’s an explanation. The heart muscle contracts and relaxes in a rhythm:

- contraction (or squeezing), when blood is squeezed out of the heart, is called systole (pronounced “SISS-tow-lee”),
- relaxation, when the heart refills with blood, is called diastole (pronounced “die-AS-tow-lee”),
- when the heart contracts, a wave of blood is pushed out of the heart, putting pressure on the walls of the artery,
- when the heart relaxes, pressure in the arteries lessens.



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Blood pressure can be *too high* (hypertension) or *too low* (hypotension). Possible causes of **hypertension** include: **a)** a structural defect of the aorta, **b)** a change in blood flow to the kidneys or kidney disease or **c)** a change in the flow of blood through the small blood vessels. Possible causes of **hypotension** include: **a)** the heart not pumping blood effectively, **b)** a side effect of certain medications, or **c)** if there is not enough blood going through the body.

BEFORE BIRTH—MOTHER PROVIDES WHAT BABY NEEDS

Before a baby is born, the placenta in the mother's womb does the work of the lungs adding oxygen and removing carbon dioxide. Oxygen in the mother's blood moves across the placenta into the baby's blood. This oxygen rich blood is then carried via the ductus venosus and inferior vena cava (IVC) into the baby's right atrium.

As the baby doesn't use its lungs to breathe until after birth, most of the blood bypasses the lungs through two connectors:

- the **foramen ovale** allows most of the blood to pass from the right atrium to the left atrium,
- a blood vessel called the **ductus arteriosus** carries the blood from the pulmonary artery into the aorta.

Before birth, most babies with CHD do not have any problems because the placenta provides oxygen-rich blood to the baby and because oxygen needs in the womb are lower than after birth. Once the baby is born and the umbilical cord is cut, the mother's and baby's bodies become separate. Newborns have to rely on their own lungs and heart for the blood and oxygen they need.

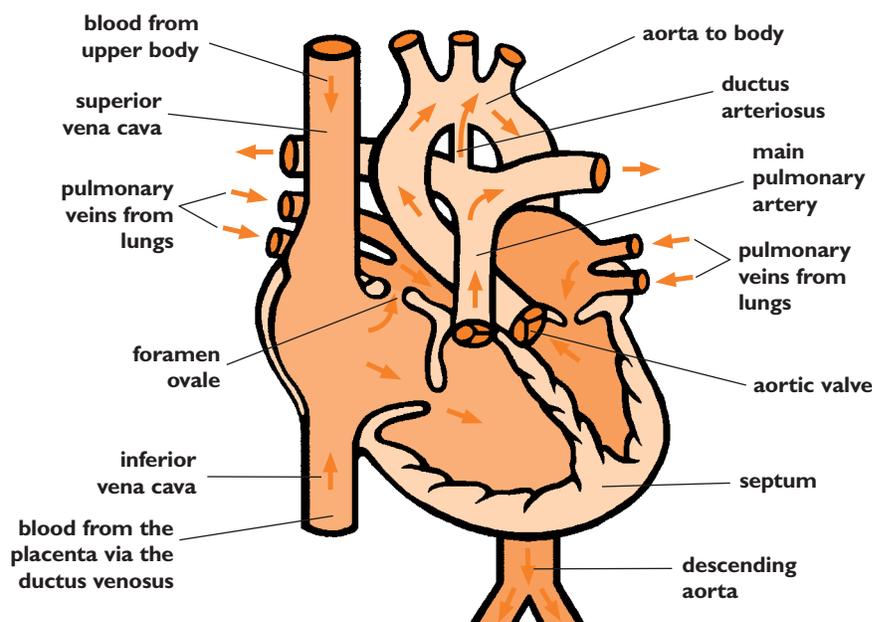
When the baby takes its first breath, the increase of oxygen in the blood and changes in pressure in the heart and lungs encourages the foramen ovale and the ductus arteriosus to close over the first few days of life. In some babies, these openings do not close when they should.

BLOOD PRESSURE

BLOOD PRESSURE CAN BE TOO HIGH IF SOMETHING IS BLOCKING THE BLOOD FLOW

BLOOD PRESSURE CAN BE TOO LOW IF THE HEART IS NOT BEATING WELL

Prenatal Blood Flow



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THE RISKS

Two things that increase the risk of a congenital heart defect are:

MOTHERS CONDITION
WHEN A WOMAN IS PREGNANT, WHAT HAPPENS TO HER BODY CAN AFFECT THE DEVELOPMENT OF HER BABY'S HEART



FAMILY HISTORY
IF SOMEONE IN YOUR FAMILY HAS A CONGENITAL HEART DEFECT, THE CHANCE THAT YOUR BABY WILL ALSO HAVE A DEFECT INCREASES FROM ABOUT 1% TO 3%

AFTER BIRTH

How do CHDs affect the heart after birth?

CHDs can affect the heart in many ways:

- many CHDs slow down or block the blood flow in the heart or in the blood vessels near the heart,
- other CHDs cause blood to flow through the heart in an abnormal way and make the heart work harder.

What causes CHDs?

No one knows what causes most heart defects. You may hear the term “multifactorial causation”. This means that no one thing causes the defect: When certain genetic and environmental factors occur at the same time, a heart defect may result.

Two things that increase the risk of getting a congenital heart defect are the mother’s condition and family history.

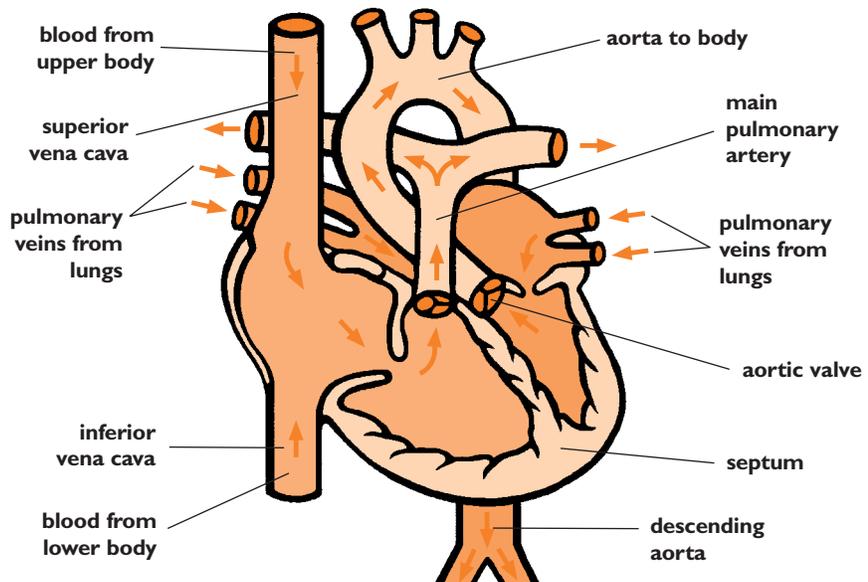
MOTHER’S CONDITION: When a woman is pregnant, what happens to her body can affect the development of her baby’s

heart. For example, illnesses such as diabetes (a disease in which the body doesn’t properly produce or use insulin), rubella (German measles), or viral infections can increase the risk of a heart defect. The risk also increases if the mother takes certain prescription or over-the-counter medications (for example, phenytoin, which prevents seizures, Accutane, which is used to treat acne, and lithium salts, which are used to treat certain mental illnesses) or consumes alcohol or “street” drugs.

FAMILY HISTORY: If you are the parent of a child with a CHD, the chance of having another baby with some form of CHD increases from about 1% (one in every 100 births) to at least 3% (3 in 100 births). More than one child in a family may have a congenital defect, but this is rare.

Medical experts can identify those parents who have a higher risk of having a child born with a CHD, based on the mother’s condition or the parents’ family histories. However, scientists cannot predict which parents will have a child with a CHD because there may be many other reasons besides the mother’s condition and family history.

Postnatal Blood Flow



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Did I do something wrong?

Many parents worry that it is something they did or did not do that caused the heart defect. In most cases, there is nothing the parents could have done to prevent the defect. If you have questions about the cause of your child's heart defect, talk it over with your cardiologist or health care professional.

HOW TO FIND OUT IF YOUR CHILD HAS A CHD

Advancements in technology and medical science have resulted in the ability for many CHDs to be diagnosed antenatally, or prior to birth. Some families are told of their child's diagnosis of CHD shortly after birth because of signs and symptoms noticed on newborn physical assessments in hospital.

Other children are diagnosed with CHD in infancy or childhood through referral to a pediatric cardiologist.

To find out if a child has a CHD, pediatric cardiologists review your child's history and do a physical exam. To get more information, the doctor may order one or more of the tests in Appendix A. Not all of the tests may be needed, depending on your child's condition. Some of the tests may be repeated or ordered later to check on your child's progress.

In Appendix A, you will find information about the purpose of each test, what will happen during the test, how you can prepare your child, and when you will get the results.

History and Physical Exam

How are the history and physical exam done?

The history and physical exam will be done during a visit to the cardiology clinic. You will meet with your cardiologist for a private

interview in an exam room or office. A clinic nurse or medical student may also be there.

Your child's "history"

A history is a review of your child's health concerns up to now, including pregnancy and birth history. Your doctor will ask how severe the problem is, when the symptoms happen and under what conditions, how long the symptoms last, what helps, and what makes them worse (for example, exercise or medications).

A physical exam

The physical exam includes a detailed checkup of your child and your child's heart.

During the exam, the doctor may check:

- Chest sounds, including the sounds the heart makes as it beats, and the sound of air moving into and out of the lungs. To do this, the doctor will listen with a stethoscope at various places on the front and back of the chest.
- The chest wall, for abnormal motion and vibrations of the heart. To do this, the doctor will place or cup a hand on your child's chest (back and front).
- The abdomen (stomach), for organs which are larger than usual or for fluid build-up. To do this, the doctor will gently press on the abdomen.
- Oxygen saturation level (see Appendix A).
- Height and weight.
- The pulses in your child's arms and legs.



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PREPARATION

Let your child know he or she may have to:

GET UNDRESSED, AND WEAR A GOWN FOR THE PHYSICAL ASSESSMENT



EXPLAIN THAT YOU WILL BE THERE DURING THE EXAM



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How can we prepare for this visit?

You can prepare by having the following information ready for the doctor:

- any symptoms your child may have related to his or her heart problem,
- activity level (is your child more or less active than usual?),
- feeding schedule (how often and how much does your child eat/drink/breastfeed, and does your child become tired during feeding time?),
- medications (names and doses of any medications your child is on, including medications for other health problems),
- any other concerns you have about your child's health.

This is your chance to ask questions and have an open and honest talk. Some parents find it helpful to write down their questions in the week before their visit, so they don't forget anything.

How can we prepare our child for this visit?

Let your child know he or she may have to get undressed, and that the doctor will need to touch some areas on your child's body, (such as the chest or groin) and that you will be there during the physical assessment. Gowns are available for older children. Parents may be present for infants and young children. Youth may prefer to go in by themselves and spend some time alone with a doctor. A chaperone will be available if they want.

How long will it take?

The visit with the doctor (pediatric cardiologist) may take from 30 minutes to a few hours, depending on the number of tests needed.

CONGESTIVE HEART FAILURE (CHF)

What is CHF?

Congestive heart failure (CHF) results when the heart is unable to pump an adequate amount of blood to meet the needs of the body. CHF refers to a group of signs and symptoms that include poor feeding, rapid breathing, sweatiness, rapid heart rate, and failure to gain weight.

CHF may be due to:

- abnormal communications or holes within the heart,
- other abnormal structures of the heart or blood vessels that increase the work load on the heart such as
 - > obstructed or leaky (regurgitant) valves,
 - > narrowed blood vessels,
 - > shunts, or
 - > abnormal heart rate or rhythm.

Other causes of CHF are less common in children and relate to poor heart muscle function.

These include:

- **cardiomyopathy**, a disease of the heart muscle, often caused by an infection
- **endocarditis**, an inflammation of the inside of the heart (see *Bacterial endocarditis*, page 2-14),
- **myocarditis**, an inflammation of the heart muscle.

CHF does not mean that the heart will stop or that a heart attack will happen.

CHF can take several days or weeks to develop. It may be mild when it first develops and slowly become worse.

CHF can be controlled. It is usually managed with medications. If needed, surgery may correct or reduce the problem.

How can we tell if our child has CHF?

The health care team will be watching your child for CHF. However, as a parent, you spend more time with your child than the team does, so it is helpful to be aware of the signs or symptoms, which are described on page 2-10.

The signs of CHF are more noticeable in babies when they are feeding, and in children when they are exercising and playing actively.

In babies, slow or inadequate weight gain or weight loss is often seen with CHF.

This is due to:

- increased workload of the heart and lungs,
- need for more calories than the child can take in, and
- lack of appetite due to fatigue.

Many signs, such as crankiness and irritability, are also seen in healthy children. However, when seen in combination with other signs and symptoms of CHF, it may mean that your child requires further assessment and treatment.



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SIGNS OF CHF

Sign	Babies	Children
Faster or more difficult breathing	<ul style="list-style-type: none"> ■ fast breathing even when resting, often with flaring nostrils ■ skin over rib cage drawing in between ribs (indrawing) ■ grunting with breathing 	<ul style="list-style-type: none"> ■ shortness of breath and tiredness on exercising ■ can't keep up to other children's activity levels
Cough	<ul style="list-style-type: none"> ■ also caused by many other conditions 	<ul style="list-style-type: none"> ■ also caused by many other conditions
Not enough weight gain or too rapid weight gain	<ul style="list-style-type: none"> ■ slow or no weight gain or weight loss ■ lack of appetite ■ tires with feeds - often falls asleep part way through feeds 	<ul style="list-style-type: none"> ■ decreased appetite ■ rapid weight gain associated with swelling of face, abdomen and ankles
Sweating	<ul style="list-style-type: none"> ■ seen first when feeding or with crying ■ most visible across forehead and scalp 	<ul style="list-style-type: none"> ■ seen during play/exercise ■ sweaty, pale, clammy skin is a greater concern than sweaty warm skin
Skin colour becomes increasingly pale or blue	<ul style="list-style-type: none"> ■ because the normal skin colour of many babies with CHDs is pale, look for changes in skin colour at rest 	<ul style="list-style-type: none"> ■ because the normal skin colour of many babies with CHDs is pale, look for changes in skin colour at rest
Irritability and restlessness	<ul style="list-style-type: none"> ■ crankiness that seems to happen more often or last longer than usual 	<ul style="list-style-type: none"> ■ increased crankiness ■ mood swings especially when tired ■ increased anxiety and restlessness ■ difficulty sleeping
Listlessness (tiredness)	<ul style="list-style-type: none"> ■ lack of energy to feed, sleeping longer, and not waking as usual for feeding/playing. 	<ul style="list-style-type: none"> ■ tiredness after school days or being unwilling to do normal activities that they used to enjoy ■ expresses feeling tired or weak with normal physical activity

<p>What should we do if we think our child has CHF?</p>	<p>To measure cyanosis, an oxygen saturation monitor is used (see <i>Oxygen Saturation Test</i>, page 15-14).</p>
<p>CHF develops slowly, over days and even weeks. Watch your child and contact your pediatrician or family doctor if:</p> <ul style="list-style-type: none"> ■ there is more than one sign, ■ the signs don't go away with rest, ■ the signs reappear every time your baby feeds or your child is active. <p>If necessary, your cardiologist will need to see your child again to assess and treat the problem.</p> <p><i>Note: Even if your child shows more than one sign, it may not be CHF.</i></p>	<p>What causes cyanosis?</p> <p>Oxygen is carried in the blood by haemoglobin, which is bright red when filled with oxygen, but becomes purple or “blue” when oxygen level is low. Cyanosis occurs when blood going through the body has a lot of “blue” blood in it.</p> <p>Cyanosis can happen in children with CHDs for several reasons:</p> <ul style="list-style-type: none"> ■ there is not enough blood getting to the lungs, ■ blue blood coming back from the body mixes within the heart with bright red blood. <p>Surgery can sometimes reduce or correct the cyanosis, but some children will remain <i>cyanotic</i> for life.</p>
<p>CYANOSIS— BLUENESS OF THE SKIN</p>	
<p>What is cyanosis?</p>	
<p>“Cyan” means blue. Cyanosis is blueness of the skin, lips, gums, nail beds, and the areas around the eyes and mouth. Many children with CHDs have cyanosis. They are sometimes called “blue babies”.</p>	
<p>How can we tell if our child has cyanosis?</p>	
<p>Healthy children, particularly newborns, may have cyanotic hands and feet when they are cold because their bodies do not deliver enough blood to the tiniest blood vessels, the capillaries. This is called <i>peripheral cyanosis</i>, and is normal.</p> <p><i>Central cyanosis</i> means that blood throughout the body is not carrying enough oxygen. Children with CHD who have this type of cyanosis may have a blue tinge to the lips, tongue, and nail beds.</p>	



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HOW MIGHT CYANOSIS AFFECT OUR CHILD?

Cyanosis by itself is not a problem. However, the way in which your child’s body deals with the low oxygen level is important. The more severe the cyanosis and the longer it continues, the more it will affect your child’s health. Here are the most common effects of cyanosis.

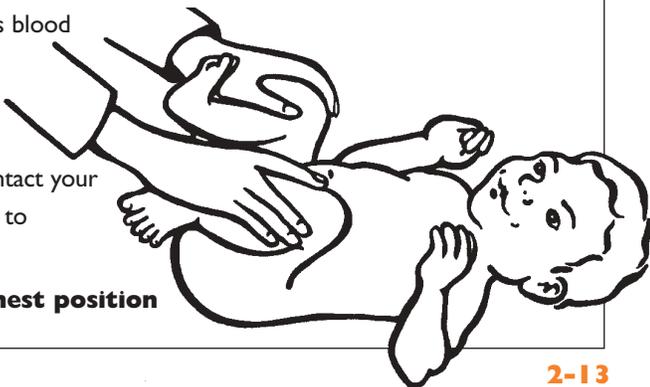
Effects	Description
Growth and Development	<p>Before birth, babies in their mother’s womb have low oxygen levels and grow and develop normally. Babies and children with mild to moderate cyanosis usually have very few effects from cyanosis.</p> <p>Long-term cyanosis interferes with several of the body’s functions. Because the body’s tissues need oxygen to grow and develop normally, very low levels of oxygen can be life threatening. For these reasons, surgery is often done early in the child’s life to reduce or correct the cyanosis.</p>
Size	<p>Children with severe cyanosis are often slightly smaller than other children their age. They may not be able to do as much exercise as other children.</p>
Activity Level	<p>Muscles, including the heart itself, need a certain level of oxygen to work well. Exercise increases the body’s oxygen requirements. Children will generally limit their own activity level, but you may notice more blueness with exercise, and young babies may get tired out with feeding.</p>
Learning	<p>The brain needs enough oxygen to develop and work properly. Some children with cyanosis may take longer to reach their milestones. For example, they may walk and run later than other children the same age. Most children with a CHD do not have significant learning disabilities.</p>
Puberty	<p>Studies show that teens with cyanosis reach puberty later than their peers. Your child’s doctor will be watching for this as your child grows, and you can discuss any concerns as they come up.</p>
Clubbing	<p>Children with severe cyanosis that lasts for many months or years often develop a condition known as “clubbing”. In clubbing, the ends of the fingers become wide and flat. This different appearance can be very upsetting to some children. Clubbing usually improves after surgery to repair the CHD.</p>
Polycythemia	<p>When there is not enough oxygen, the body increases the number of red blood cells for carrying oxygen. This is called polycythemia and may be associated with bleeding and bruising problems.</p>

WHAT SHOULD WE WATCH FOR IF OUR CHILD HAS CYANOSIS?

Children with cyanosis need to have their haemoglobin level in their blood measured regularly to make sure it is not too high or too low.

A low haemoglobin level (**anemia**) may mean your child is anemic and may need an iron supplement (see *Iron Supplement*, page 9-10). A high haemoglobin level can cause the blood to be thicker than normal (**polycythemia**).

In both cases, there may be a slightly greater risk of a stroke or brain abscess. To prevent a problem, make sure your child gets plenty of fluids or breastfeeds well. See your family doctor if your child has prolonged diarrhea and vomiting, which may cause dehydration.

Things to watch for	What you can do
Bleeding	Thick blood (polycythemia) can occasionally cause bleeding problems when too many red blood cells get in the way of proper blood clotting. In such cases, children may bruise more easily than other children, or have nosebleeds or bleeding gums. Check with your child's doctor before giving your child medication such as Aspirin® that may affect clotting.
Dehydration	Ensure adequate intake of breastmilk or other fluids especially in hot weather. Contact your family doctor if your child has prolonged diarrhea and vomiting which may cause dehydration.
Travel	Discuss your travel plans with your child's cardiologist if you plan to fly or travel to high altitude places. Some children may need extra oxygen for short periods when they travel.
Headaches, fever, sudden weakness, confusion, or seizures (signs of stroke or brain abscess)	Call your doctor if you see these signs of stroke or brain abscess.
Severe blueness—short spell (Tet Spells)	<p>A tet spell, or hypercyanotic spell, is a short spell of severe cyanosis. It usually happens in children with a CHD called Tetralogy of Fallot, but may happen to other children as well. A tet spell may happen when a baby cries strongly, especially soon after waking, or feeding or having a bowel movement. A baby or child will breathe deeper and faster than normal, become very blue and sweaty, and may become cranky or "vague". The spell usually lasts a few minutes, but can last longer.</p> <p>To recover, older children learn to squat. You can hold babies in the knee-chest position to help them recover. This helps blood return to the heart and forces more blood to the lungs. If you think your child may have had a "tet spell" you should contact your cardiologist as soon as possible to discuss appropriate therapy.</p> <p style="text-align: center;">Baby in knee-chest position</p> 

WHAT CAUSES BACTERIAL ENDOCARDITIS?

THE BACTERIA CAN USUALLY BE FOUND IN THE MOUTH, DIGESTIVE TRACT, AND URINARY TRACT.

IF THERE IS AN AREA THAT IS INFLAMED, OPEN, BLEEDING, OR THERE IS A DENTAL ABSCESS, THE BACTERIA CAN MOVE INTO THE BLOOD AND TRAVEL THROUGH THE BODY.



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INFECTION CALLED BACTERIAL ENDOCARDITIS

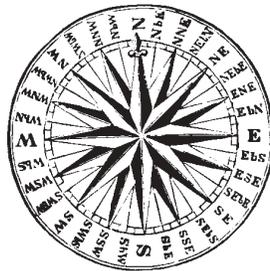
Is our child at risk for bacterial endocarditis?

Children with certain CHDs have a higher risk for endocarditis than others. Ask the cardiologist whether your child is at low, moderate or high risk. Children who are at high risk are sometimes given **prophylactic antibiotics** (medications to prevent the infection).

What is it?

Bacterial endocarditis is an inflammation caused by an infection of the lining of the heart. It starts when bacteria get in the blood and travel through the body. Some of the bacteria attack the lining of the heart in areas where blood flow is not smooth.

Bacterial endocarditis is not common, but it is life threatening. Some types of CHDs increase your child’s risk of getting this infection because they cause turbulent blood flow in the heart.



What causes bacterial endocarditis?

The bacteria that cause endocarditis can usually be found in the mouth, digestive tract, and urinary tract. If there is an area that is inflamed, open, bleeding, or there is a dental abscess, the bacteria can move into the blood and travel through the body.

Sometimes the bacteria travel to the heart from an infection that’s already in the body such as **pneumonia** (a lung infection), **cellulitis** (a skin infection), or a urinary tract infection.

Some medical and dental procedures and surgery increase the chance of endocarditis in children at risk. This is because the procedure may cause bleeding, which lets bacteria get into the blood.

Why is it serious?

Endocarditis can lead to permanent damage of the heart valves or other delicate parts within the heart.

A blood clot can lead to heart attack or stroke. Here’s how it works. The area of infection can be covered by a blood clot. Parts of the blood clot can break off and travel anywhere in the body through the blood. The part can then block the blood vessel, cutting off the oxygen and nutrients. When this happens, the tissue around the blockage dies. If the blocked blood vessel is in the heart, it causes a heart attack; if it is in the brain, it causes a stroke.

Preventing it

To help prevent endocarditis, there are two things to remember:

- clean teeth,
- antibiotic guidelines for doctors and dentists.

Clean teeth

Make sure that your child has good dental hygiene. This includes regular check-ups with a dentist and regular brushing and flossing of teeth. This helps prevent gum disease, which is a common way for bacteria to get into the blood.

Antibiotic guidelines

There are guidelines for doctors and dentists to follow to help prevent this infection. These guidelines include whether or not to give antibiotics before treatment or surgery that put your child at risk. The American Heart Association’s recommendations have become the standard practice across North America. Please see the guidelines on page 2-17.

When you know your child needs antibiotics before medical or dental treatment, discuss this with your family doctor or dentist, who can then order the right medication.

It is difficult to prevent endocarditis altogether, and there are times when the infection has nothing to do with dental or medical treatment. Cases that are related to a treatment happen within two weeks.



How will we know if our child had endocarditis?

Endocarditis can be difficult to diagnose. If not found early, the infection grows damaging the heart and allowing blood clots to form. Once diagnosed, your child will need a long-term hospital treatment along with a close watch on how well your child’s heart is working.

For early detection, many parents worry about what to watch for. Bacterial endocarditis is not easy to identify because so many illnesses have the same symptoms.

If your child experiences any of the following symptoms that cannot be explained or that follow dental or other surgical procedures, consult your family doctor:

- unexplained high fever,
- night chills,
- weakness,
- muscle pain or tenderness—myalgia,
- joint pain—arthralgia,
- no energy, lethargy (sluggishness),
- discomfort, uneasiness, malaise.

WARNING SIGNS

PLEASE CONSULT YOUR DOCTOR IF YOUR CHILD EXPERIENCES ANY OF THE FOLLOWING SYMPTOMS:

- UNEXPLAINED HIGH FEVER, NIGHT CHILLS, WEAKNESS, MUSCLE PAIN, JOINT PAIN, NO ENERGY DISCOMFORT, UNEASINESS OR MALAISE.



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WHEN TO USE ANTIBIOTICS TO PREVENT ENDOCARDITIS

The list below describes when antibiotics should or should not be given. If your family doctor, pediatrician, dentist, or other health care professional orders a procedure for your child, show this list to make sure that antibiotics are given correctly.

For Dental/Oral/Upper Respiratory Tract/Esophageal Procedures

Antibiotics recommended for these conditions	Antibiotics NOT recommended for these conditions
<ul style="list-style-type: none"> ■ All valve replacements, both synthetic and tissue ■ Previous bacterial endocarditis, even without heart disease ■ Surgically constructed systemic-pulmonary shunts or conduits ■ Most congenital heart malformations ■ All valve problems, even after repair ■ Hypertrophic cardiomyopathy ■ Mitral valve prolapse with valvular regurgitation 	<ul style="list-style-type: none"> ■ Isolated secundum atrial septal defect ■ Surgical repair without residua beyond 6 months of secundum atrial defect, ventricular septal defect, or patent ductus arteriosus ■ Previous coronary artery bypass graft surgery ■ Mitral valve prolapse without valvular regurgitation* ■ Physiologic, functional, or innocent heart murmur ■ Previous Kawasaki disease without valvular dysfunction* ■ Previous rheumatic fever without valvular dysfunction ■ Cardiac pacemakers and implanted defibrillators
Antibiotics recommended for these procedures	Antibiotics NOT recommended for these procedures
<ul style="list-style-type: none"> ■ Dental procedures known to cause gum or mouth bleeding ■ Tonsillectomy and/or adenoidectomy (T&A) ■ Operations involving the intestines or airway ■ Bronchoscopy with a rigid bronchoscope ■ Sclerotherapy for esophageal varices ■ Esophageal dilatation ■ Gallbladder surgery ■ Cystoscopy ■ Urethral dilatation ■ Urethral catheterization if urinary tract is present* ■ Urinary tract surgery if urinary tract infection is present* ■ Incision and drainage of infected tissue* 	<ul style="list-style-type: none"> ■ Dental procedures that are not likely to cause bleeding, such as simple adjustment of orthodontic appliances or fillings above the gum line ■ Injection of local intraoral anesthetic (except intraligamentary injections) ■ Loss of baby teeth ■ Tympanostomy tube insertion ■ Endotracheal intubation ■ Bronchoscopy with a flexible bronchoscope, with or without biopsy ■ Cardiac catheterization ■ Endoscopy with or without gastrointestinal biopsy

* For patients who have prosthetic heart valves, a previous history of endocarditis, or surgically constructed systemic-pulmonary shunts or conduits, doctors may choose to use prophylactic antibiotics even for low-risk procedures that involve the lower respiratory, genitourinary, or gastrointestinal tracts.

DOSAGE (HOW MUCH)

Special requirements	Recommended dosage
Standard general prophylaxis for patients at risk	<ul style="list-style-type: none"> ■ <i>Amoxicillin</i>: 50 mg/kg (maximum 2g) orally one hour before procedure.
Amoxicillin/ampicillin/penicillin-allergic patients	<ul style="list-style-type: none"> ■ <i>Clarithromycin</i>: 15 mg/kg (maximum 500 mg orally one hour before a procedure OR ■ <i>Clindamycin</i>: 20 mg/kg (maximum 600 mg) orally one hour before procedure.* OR ■ <i>Erythromycin ethylsuccinate</i> or <i>erythromycin</i>: 20 mg/kg orally 2 hours before a procedure then one-half the dose 6 hours after the initial administration.*
For patients unable to take oral medications	<ul style="list-style-type: none"> ■ <i>Ampicillin</i>: 50 mg/kg IV (or IM) (maximum 2g) 30 minutes before a procedure
For ampicillin/amoxicillin/penicillin-allergic patients unable to take oral medications	<ul style="list-style-type: none"> ■ <i>Clindamycin</i>: 20 mg/kg (maximum 600 mg) IV 30 minutes before a procedure.
The following weight ranges may also be used for the pediatric dose of amoxicillin:	
<p>less than 15 kg (33 lb.) 15-30 kg (33-66 lb.) more than 30 kg (66 lb.)</p>	<p>750 mg 1500 mg 2000 mg (full adult dose)</p>
For genitourinary/gastrointestinal procedures	
High-risk patients	<ul style="list-style-type: none"> ■ <i>Ampicillin</i>: 50 mg/kg IV (or IM) (maximum 2g) plus <i>gentamicin</i>: 1.5 mg/kg IV (or IM) (maximum 120 mg) 30 minutes before starting procedure, followed by <i>amoxicillin</i>: 25 mg/kg orally or <i>ampicillin</i>: 25 mg/kg IV (or IM) (maximum 1g) 6 hours after the initial dose
High-risk amoxicillin/ampicillin/penicillin-allergic patients	<ul style="list-style-type: none"> ■ <i>Vancomycin</i>: 20 mg/kg (maximum 1g) IV administered over 1-2 hours plus <i>gentamicin</i>: 1.5 mg/kg IV (or IM) (maximum 120 mg). Complete infusion within 30 minutes of starting the procedure.**
Moderate risk patients	<ul style="list-style-type: none"> ■ <i>Amoxicillin</i>: 50 mg/kg (maximum 2g) orally one hour before procedure, or <i>ampicillin</i>: 50 mg/kg IV (or IM) (maximum 2g) within 30 minutes of starting the procedure.
For amoxicillin/ampicillin/penicillin-allergic patients	<ul style="list-style-type: none"> ■ <i>Vancomycin</i>: 20 mg/kg IV (maximum 1g) administered over 1-2 hours; complete infusion within 30 minutes of starting procedure.**
<p>* In certain situations, it may be more convenient to give the antibiotic intravenously at the time of the procedure. ** Must be slowly administered intravenously over at least one hour; more rapid infusion can cause hypotension, urticaria or diffuse erythema presumably as a result of histamine release. Such reactions can be prevented or modified by pre-treatment with antihistamines. No second dosage of vancomycin or gentamicin is recommended.</p>	

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