



Non-Hodgkin lymphoma is a type of cancer of the blood cells. It occurs when certain types of white blood cells (lymphocytes) grow in an uncontrolled way. Lymphocytes are part of the immune system that help our bodies fight infection. They include B cells and T cells.

Non-Hodgkin lymphoma can start anywhere in the lymphatic system (the network of vessels, tissues and organs that make white blood cells and move lymph around the body) and can spread throughout the lymphatic system.

There are 3 main types of non-Hodgkin lymphoma that affect children:

- **Lymphoblastic lymphoma** affects cells called lymphoblasts, which are very early lymphocytes. It can start in the thymus (the organ in the chest that produces T cells), and lymph nodes in the neck and chest, and can spread quickly to other parts of the body.
- **Burkitt lymphoma** develops from B cells and often starts as a tumour in the abdomen. It can spread quickly to other parts of the body.
- **Large cell lymphoma** starts in older B cells or T cells anywhere in the body. It is less likely to spread than other forms of lymphoma.

Non-Hodgkin lymphoma occurs more often in older children than in younger children.

A different type of lymphoma that occurs in children is called [Hodgkin disease](#).

Risk factors

A risk factor is anything that increases a person's chance of developing a certain condition or disease, such as cancer. In adults, lifestyle and environmental factors (such as smoking or exposure to certain chemicals) can be significant risk factors for developing certain types of cancer. In children, very few risk factors have been identified that increase the chance of developing cancer. For most children with cancer, the underlying cause is unknown.

Even if your child has a risk factor, it does not mean they will develop cancer. Many children with a risk factor will never develop cancer, while others with cancer may have had no known risk factors. Even if a child with a risk factor develops cancer, it is usually hard to know how much that risk factor contributed to the development of their disease.

The causes of non-Hodgkin lymphoma are not well understood, but factors associated with a higher chance of developing non-Hodgkin lymphoma include the following:

Genetic conditions

Certain genetic disorders that affect the immune system are associated with a higher chance of developing non-Hodgkin lymphoma. These include:



- Wiskott–Aldrich syndrome
- severe combined immunodeficiency syndrome (SCID)
- ataxia-telangiectasia
- common variable immunodeficiency
- Bloom syndrome
- X-linked lymphoproliferative syndrome.

If your child is diagnosed with one of these genetic conditions, they will need specific follow-up. The health care team will advise which ongoing tests your child will need.

Cancers in children that are linked to genetic conditions may also affect the risk for other family members. Speak to your child's treatment team to see whether genetic counselling is recommended for you or your family.

For more information about genetic conditions, see the [children's cancer glossary](#) or the [Centre for Genetics Education](#).

Exposure to radiation

Children who are exposed to radiation, or who were exposed to X-rays before they were born, have a slightly higher chance of developing non-Hodgkin lymphoma. Children who have previously had radiation therapy (radiotherapy) to treat cancer also have a slightly higher chance of developing non-Hodgkin lymphoma later in life.

Certain virus infections

People who have been infected with Epstein–Barr virus (also called glandular fever, infectious mononucleosis or 'mono') have a higher chance of developing non-Hodgkin lymphoma, especially Burkitt lymphoma. This risk is higher in children who have had an organ transplant and are receiving medicines that weaken their immune system.

People who are HIV-positive also have a higher chance of developing non-Hodgkin lymphoma.

Other factors

Non-Hodgkin lymphoma is more common in boys than in girls.





Symptoms

Symptoms of non-Hodgkin lymphoma may include:

- fever
- night sweats
- unexplained weight loss
- enlarged lymph nodes, usually felt as painless lumps under the skin in the neck, underarm or groin
- swollen belly
- tiredness
- loss of appetite, or feeling full after only a small amount of food
- itchy red or purple lumps under the skin (if the lymphoma has spread to the skin itself)
- coughing or trouble breathing (a swollen thymus or lymph nodes in the chest can press on the windpipe)
- problems going to the toilet (if the lymphoma presses on the bladder or bowel)
- headaches, or problems with vision or speech (if the lymphoma presses on the brain).

Note about symptoms

Many conditions – including common childhood infections – can cause these symptoms, not just non-Hodgkin lymphoma. If your child has any of these symptoms and you are concerned, talk to your child's doctor.

Diagnosis

Your child will have a number of tests to investigate their symptoms and confirm a diagnosis of non-Hodgkin lymphoma, including:

- medical history and physical examination
- blood tests
- medical imaging, which may include:
 - chest X-ray
 - ultrasound
 - computed tomography (CT) scan
 - magnetic resonance imaging (MRI)
 - positron emission tomography (PET) scan
- biopsy – where a small sample of a tumour or lymph node is removed to be examined under a microscope



- mediastinoscopy – where a thin tube is inserted through an incision (cut) in the chest to look for tumours in the space between the lungs (the mediastinum)
- lumbar puncture (spinal tap) – where a sample of cerebrospinal fluid is taken to be examined under a microscope
- paracentesis or thoracentesis – where a thin, hollow needle is used to collect fluid that has built up in the belly cavity (paracentesis) or chest cavity (thoracentesis) to be examined under a microscope
- bone marrow aspiration and biopsy – where a sample of bone marrow is taken with a small piece of bone to be examined under a microscope.

These tests are explained in more detail in [How is cancer diagnosed?](#)

Staging

If your child is diagnosed with non-Hodgkin lymphoma, some of the diagnostic tests will also help to stage the tumour. Staging determines where the tumour is, how big it is, which nearby organs are involved and whether the cancer has spread to other parts of the body. This is important to determine the outlook (prognosis) for your child, and to decide on the best options for treatment.

There are different ways to assess the stage and extent of disease. One of the most common ways to describe stages for non-Hodgkin lymphoma is as follows:

- Stage I – the lymphoma is either a single tumour (not in the lymph nodes), or is in the lymph nodes in a single part of the body. The lymphoma is not in the chest or belly
- Stage II – the lymphoma is not in the chest, and is 1 of the following:
 - a single tumour, and in nearby lymph nodes in 1 part of the body
 - more than 1 tumour and/or involves more than 1 set of lymph nodes on the same side of the body (either both above or both below the diaphragm, which separates the chest and the abdomen)
 - in the digestive tract (e.g. the intestine or stomach) and can be removed during surgery; lymph nodes may or may not also have lymphoma cells
- Stage III – one of the following applies:
 - the lymphoma started in the chest
 - the lymphoma started in the belly but has spread too far to be completely removed with surgery
 - the lymphoma is next to the spine (and may also be in other places)
 - the lymphoma is more than 1 tumour or is found in more than 1 set of lymph nodes on both sides of the diaphragm (both above and below)
- Stage IV – the lymphoma is in the brain, spinal cord or bone marrow when it is first diagnosed. If more than 25% of the bone marrow is made up of cancer cells, Stage IV non-Hodgkin lymphoma may be reclassified as [acute lymphocytic leukaemia](#).





Treatment

Treatment and care of children with cancer is usually provided by a team of health professionals called a multidisciplinary team. Members of this team are specialists in children's cancers – they understand the differences between children's cancer and adult cancer, and each team member brings different skills in managing care to meet the needs of both you and your child.

The team will be led by a childhood cancer specialist (paediatric oncologist). Other members of the team depend on the age of your child and their type of disease, and may change over time as your child's needs change. A list of team members who might make up the multidisciplinary team can be found in [The treatment team](#).

Treatment for non-Hodgkin lymphoma depends on the age of your child, the stage of the disease, the biological features of the cancer and other factors identified during diagnosis. Treatment will be tailored to your child's particular situation, and may involve one or more of the following (see [How is cancer treated](#) for more detail).

Surgery

Surgery has a limited role in the treatment of non-Hodgkin lymphoma, but your child may have surgery to remove all or part of the tumour. If the entire tumour can be removed and it has not spread to other parts of the body, your child may not need any other treatment.

Your child might have surgery to insert a venous access device (also called a central venous catheter, portacath or central venous line) into a large blood vessel, usually in their chest or upper arm. This is a small plastic tube that either sticks out of the body or sits just under the skin. It allows medicines, including chemotherapy, to be given intravenously, and can also be used to take blood samples for testing.

Chemotherapy

Chemotherapy uses anti-cancer medicines to destroy cancer cells. It is often given as a combination of medicines to try to prevent the cancer cells from becoming resistant to just one or two medicines.

Chemotherapy medicines are given together in courses, often over a few days. Once the body has recovered from the side effects, the next course is given. Most children receive multiple courses of chemotherapy.

Non-Hodgkin lymphoma is usually treated with combination chemotherapy . If your child's doctor thinks that the lymphoma may have spread to the brain or spinal cord, chemotherapy can also be given directly into the cerebrospinal fluid through a device called a ventricular access catheter, which is inserted during an operation. This device has a small tube that passes into the area of the brain where the cerebrospinal fluid flows. The treatment team can inject chemotherapy medicines directly into it, and also take samples of fluid out of it to run tests.





Radiation therapy

Radiation therapy (also called radiotherapy) uses high-energy X-rays or other types of radiation to destroy cancer cells or stop them from growing. Radiation therapy may be used:

- to treat lymphomas that have spread to the brain or spinal cord, in combination with chemotherapy
- as urgent therapy to treat large tumours in the chest
- along with high-dose chemotherapy and stem cell transplant
- to relieve symptoms caused by some tumours.

Radiation therapy can have long-term side effects in children. If radiation therapy is included in your child's treatment, special care will be taken to reduce these risks.

Targeted therapy

Some medicines can target the specific changes in cancer cells that make them different from normal cells. This means that they work differently from standard chemotherapy, and they usually have fewer side effects, or the side effects are not as severe.

Medicines called rituximab and brentuximab vedotin are monoclonal antibodies that may be used to treat non-Hodgkin lymphoma. These medicines find the abnormal cells and attach to them. They can then deliver chemotherapy that either directly destroys the cells or stops the cells from dividing.

Targeted therapies are usually given in combination with other types of treatment.

Stem cell transplant

Some children may be treated using a stem cell transplant (also known as a bone marrow transplant), in combination with high-dose chemotherapy or radiation therapy.

Support

Diagnosis of cancer in a child is a very difficult time for the child, their family and their friends. You might feel overwhelmed, scared, anxious or angry. These are all normal feelings. It is very important to seek support from family, friends, health professionals or other services to help you, your child and your family cope with cancer.





Talk to your child's treatment team if you are having difficulties coping.

[Living with children's cancer](#) has information about physical, emotional and practical issues during and after diagnosis and treatment. There is also a page with helpful links on [where to find support](#).

The [Cancer Council](#) in your state or territory can give you general information about cancer, as well as information on resources and support groups in your local area. Call the Cancer Council Helpline from anywhere in Australia for the cost of a local call on **13 11 20**.

For additional specific information about childhood cancer, contact any of the major [children's hospitals and networks](#) in your state or territory.

Chance of cure

Many children with cancer are cured of the disease. Children's bodies have great capacity for healing. Also, huge improvements have been made in the treatment of childhood cancer in the past few decades. In the 1980s, around 65% of children diagnosed with cancer were alive more than 5 years after their diagnosis. Today, around 83% of children are successfully treated and become long-term survivors.

Long-term survival (also called the outlook or prognosis) and treatment options depend on a range of factors, including:

- age of your child at diagnosis
- extent or stage of the cancer
- appearance of the cancer cells under the microscope (the shape, function and structure of the cells)
- how the cancer responds to treatment
- cancer or tumour biology, which includes
 - the patterns of the cancer cells
 - how different the cancer cells are from normal cells
 - how fast the cancer cells are growing.

Talk to your child's doctor about your child's individual disease, treatment options and outlook.

Clinical trials

Researchers are trialling new ways to diagnose and treat different types of cancer. Your child may be





invited to be part of a clinical trial to test new ways of treating non-Hodgkin lymphoma.

New treatments have to go through very strict regulation and approval processes before they can be used in a clinical trial. Your child's doctor will explain everything about the trial and give you detailed written information. You will need to give special permission for your child to be part of the trial.

Participating in a clinical trial may or may not directly benefit your child, but the results of clinical trials today will help children with cancer in the future.

See [Clinical trials and research](#) for more information, including whether there are any clinical trials your child can join.

More information

For more information about non-Hodgkin lymphoma, see:

- [Non-Hodgkin lymphoma in children](#), from the American Cancer Society
- [Childhood non-Hodgkin lymphoma treatment \(PDQ®\)](#), from the National Cancer Institute (United States).

