

It is likely that changes will be needed in the home environment to enable the family to appropriately care for a child with CLN2 disease. These may include installing ramps, widening doorways and providing suitable floor surfaces. A purpose-built wet room with a specialist bath or shower is commonly needed and there are various other aspects that will require consideration. There are grants and funds available to ensure that the work involved is affordable. An occupational therapist will consult on all aspects of any adaptations and assist the family in undertaking this process.

Will there be an impact on the child's education?

Education will continue to be important for the child and family and there will be many aspects that require consideration and significant assistance from those around them.

The Children and Families Act 2014 came into force in September 2014. The introduction of the 0-25 Education, Health and Care Plan should help children, young people and families affected by NCL. Education, Health and Care (EHC) Plans will gradually replace Statements of Special Educational Needs. Children who do not yet have a Statement will have a statutory Education, Health and Care Needs assessment. An EHC Plan will be drawn up that is personalised to meet the education, health and care needs of the child.

It remains probable that many parents will continue to need guidance, understanding and support when trying to navigate the process of statutory assessment and the drawing up of the EHC Plan. The BDF A has expertise in this field and can be approached by any parties seeking information or help.

The **BDF A Educational Advisor** may be able to provide specific support and can be contacted via **0800 046 9832** email: support@bdfa-uk.org.uk

In what other ways can families be supported?

The realities of caring for a child who has CLN2 disease can place enormous strain on a family, both physical and emotional. It will impact upon all members in numerous ways and so being made aware that support is available to

groups and individuals to help with the challenges that will be faced is important. This support extends to wider family members. There are several options to consider should families wish to explore ways of maximising the limited time available to share with their children. Contacting a charitable wish-granting organisation may lead to them being able to create some valuable and significant memories.

Where can I get additional information and support?

The BDF A offers support to any family member, friend, professional or organisation involved in caring for a child with CLN2 disease or any other form of NCL throughout the UK. We provide informed guidance and assistance as well as seeking to actively increase awareness of the disease and facilitate future research to identify potential therapies and ultimately a cure.

We organise conferences, workshops and are able to arrange connections with other affected families. The BDF A also coordinate a Small Grants Scheme that can provide assistance for a range of needs.

The BDF A has a Support and Advocacy team who are able to assist with many of the issues highlighted in this document and can discuss each of them in greater detail and on a more personal basis. The BDF A family folder can also provide further specific information on CLN2 disease. The folder is free for all families and available to professionals at a cost of £25.

Please contact the **BDF A Family Support and Advocacy team** via our **Freephone Helpline: 0800 046 9832** or email: support@bdfa-uk.org.uk for further information and to order a copy of the family folder.

There are a number of local and national organisations that are also able to offer various forms of support and information that will be relevant to families. The BDF A can provide details and information about them.

It may also be appropriate for a referral to be made to a local children's hospice service, as this can offer an additional experienced and skilled source of holistic support.

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Some of the information contained in this leaflet is based upon chapters in "The Neuronal Ceroid Lipofuscinoses (Batten Disease) 2nd Edition" by Mole, Williams & Goebel (Eds), Oxford University Press 2011 and is used with permission.

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CLN2 Disease, Late-Infantile

Are there any alternative names?

CLN2 disease, late-infantile may also be referred to as late-infantile CLN2 disease. It has previously been called Jansky-Bielschowsky Disease and Late-Infantile Neuronal Ceroid Lipofuscinosis (LINCL), though was more commonly known as Late-Infantile Batten Disease.

What are Neuronal Ceroid Lipofuscinoses (NCLs)?

These refer to several different genetic life-limiting neurodegenerative diseases that share similar features. Although the different forms of NCL are sometimes described according to the age of the child at the onset of the disease, they are now better classified according to the gene identified as the cause e.g. CLN2 (gene) disease, variant late-infantile (age of onset), CLN3 (gene) disease, juvenile (age of onset).

What causes NCL?

Since the first genes causing NCL were identified in 1995, over 400 mutations in 14 different genes have been described that cause the various forms of NCL disease. Our cells contain thousands of genes that are lined up along chromosomes. Human cells contain 23 pairs of chromosomes (46 in total). Most genes control the manufacture of at least one protein. These proteins have different functions and include enzymes that act to speed up molecular chemical reactions. The NCLs are caused by abnormal genes, which are unable to produce the required proteins. As a result, the cells do not work properly and this leads to the development of symptoms associated with these diseases.

What specifically causes CLN2 disease?

The gene called CLN2 was discovered in 1998 and lies on chromosome 11. The CLN2 gene normally directs production of a lysosomal enzyme, which breaks down cellular waste materials and is called tripeptidyl peptidase 1 or TPP1.

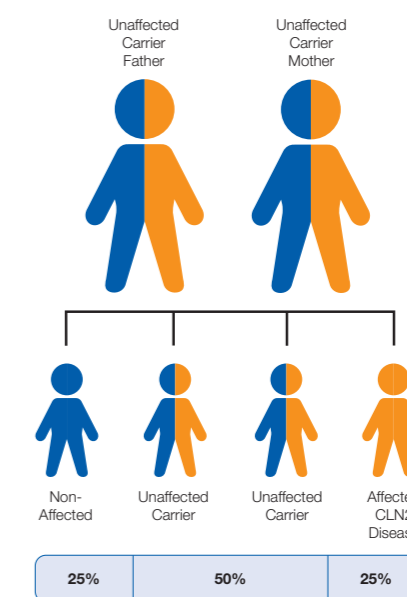
A deficiency in TPP1 results in abnormal storage of proteins and lipids (fats) in neurons (nerve cells) and other cells. The cells cannot function properly, causing the symptoms associated with CLN2 disease.

How are NCLs inherited?

Most forms of NCL are inherited as "autosomal recessive" disorders. This is one of several ways that a trait, disorder, or disease can be passed down through families. An autosomal recessive disorder means that both copies of the gene are abnormal (one inherited from each parent) with neither working properly. The disease does not depend on the sex of an individual.

What are the chances of inheriting CLN2 disease?

CLN2 disease is inherited as an autosomal recessive disorder, which means that both chromosomes carry mutations in the CLN2 gene. Therefore both biological parents of a child with this diagnosis will be carriers of the disease but physically unaffected by it.



A child born to parents who both carry the autosomal recessive mutation in the CLN2 gene has a 25% (1 in 4) chance of inheriting the abnormal malfunctioning genes from both parents and developing CLN2 disease.

They will have a 50% (1 in 2) chance of inheriting one abnormal gene, which would make them a carrier who is unaffected by the disease. There is a

25% (1 in 4) chance of the child being born with two normal genes and therefore being non-affected (not a carrier).

When it is known that both parents are carriers of the abnormal gene, we refer to there being a 2 in 3 chance of a child being a carrier, once it is established that they are unaffected by the disease.

With any pregnancy, the probability of a child inheriting one or both genes from their parents is the same each time, irrespective of any sibling's status.

How is it diagnosed?

Children will probably have been seen by a paediatrician and paediatric neurologist because of symptoms such as seizures. A number of investigations will have been done to look for the cause of the seizures. The diagnosis of CLN2 disease is usually confirmed by enzyme (TPP1) and genetic (CLN2) tests on blood samples.

Genetic testing is recommended to look for the exact mutation or mistake in the CLN2 gene. A blood or saliva sample will be taken to extract DNA from the cells for the test.

How common is it?

Approximately 5 - 6 children are diagnosed with CLN2 disease each year in the UK. We estimate there are currently between 30 - 50 affected children in the UK. Children have been diagnosed with this condition in many countries and from a variety of ethnic backgrounds.

What are the symptoms and how does the disease progress?

Children appear to be healthy and develop normally for the first few years of life. Towards the end of the second year, developmental progress may begin to slow down and some children will be delayed in the development of language skills.

The first significant sign of the disease is usually the onset of epilepsy. The seizures may be varying in nature and include drops, vacant spells (absences) or motor seizures with violent jerking of the limbs and loss of consciousness. Initially, seizures may be successfully managed with medication for several months, yet they will always recur and often become difficult to control.

Children become unsteady on their feet and may frequently fall. Gradually, skills related to walking, playing and speech are lost with children becoming less able and increasingly dependent.

By 4 - 5 years of age, children with CLN2 disease usually have myoclonic (rapid involuntary muscle spasm) jerks of their limbs and are prone to erratic movements of their head (nods). They may have difficulty sleeping and often become distressed around this time, usually without obvious reason. Their vision gradually deteriorates, with its loss being ultimately inevitable.

By the age of 6 years, most children will be completely dependent on families and carers for all of their daily needs. In order to ensure they receive adequate nutrition, they will require a specialist feeding tube (gastrostomy). There may be noticeable stiffening of their arms and legs, whilst some

children become prone to frequent chest infections.

Although there is a general progression of symptoms associated with CLN2 disease, it is impossible to state the exact rate or pattern of this as each child and situation is unique. Sadly most children who have CLN2 disease die between the ages of 6 and 12 years, though there are exceptions.

Are there any treatments?

Currently there is no cure for CLN2 disease. Therefore, appropriate and effective symptom management is essential to assist in maintaining a good quality of life for children and their families. Holistic support for parents, siblings and wider family members is vital throughout the journey.

Epilepsy can be difficult to treat and therefore attaining complete control of seizures is not always possible. Anticonvulsant medications (e.g. sodium valproate) will be necessary from the early stages of the disease process. It is recommended that drugs such as carbamazepine, phenytoin and vigabatrin are avoided.

Myoclonic jerks (involuntary muscle spasms) are common, though should not be confused with epileptic seizures. They can interfere with rest and sleep as well as being distressing for children and their families. Levetiracetam has demonstrated positive effects in a combined action against myoclonic jerks and seizures. Spasticity (unusually tight or stiff muscles) can be managed with baclofen and/or trihexyphenidyl. In order for medication to be sufficient the responsible doctor may need to prescribe higher dosages than are usual for those who do not have CLN2 disease.

A multidisciplinary team of professionals including doctors, nurses, physiotherapists, occupational therapists, sensory specialists and speech and language therapists should be involved in the care of children and young people with CLN2 disease at all stages of the disease. Although their required levels of input may vary at periods, they should work collaboratively and in conjunction with the family to appropriately meet the needs of the child and those caring for them.

Support will be needed for a range of issues including progressive difficulties with chewing and swallowing, constipation, hydration, respiratory function, oral secretions, motor disorder, sleep disturbance and visual impairment. Attention to posture, seating, skin and mouth care is essential and children will require additional nutritional support that will include consideration of a gastrostomy.

Referral for support from local Continuing Care Nursing Teams, Children's Hospice and Community Palliative Care teams are recommended. These teams can provide a variety of services supporting the child and other family members.

What research is being done?

Research into possible methods for slowing the progression of the disease and potential treatments are ongoing, both in the UK and worldwide. These mainly focus on methods that may replenish the activity of the PPT1 enzyme. Several promising therapeutic approaches are being investigated for CLN2 disease, which include gene therapy and enzyme replacement.

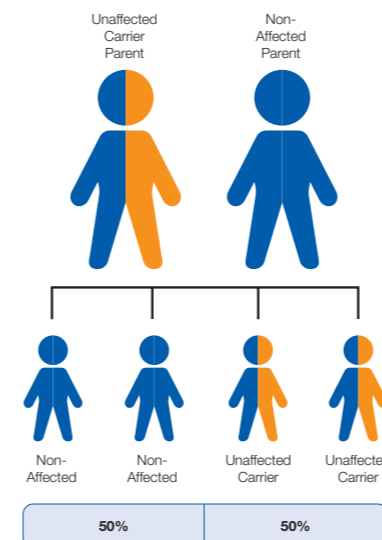
In disorders, such as CLN2 disease, gene therapy aims to introduce a functioning copy of the gene affected into the cell. This "new" gene will then direct the production of a correctly functioning enzyme, PPT1. Research is in the very early stages for CLN2 disease looking to treat the deficiency of the enzyme (PPT1) in the brain and the eye.

BioMarin (a US pharmaceutical company) have delivered a Phase I/II enzyme replacement study in the UK and worldwide. Based on this study Brineura™ (cerliponase alfa) is currently the first enzyme replacement therapy to be directly administered into the fluid of the brain, to treat the underlying cause of CLN2 disease by helping to replace the deficient TPP1 enzyme missing in affected children. The BDFA is working with BioMarin and the UK regulatory authorities on the next steps for Brineura™ as a potential treatment for CLN2 disease.

For updates and information regarding developments in research please visit the BDFA website: www.bdfa-uk.org.uk or contact the **BDFA Family Support and Advocacy team** via **0800 046 9832** email: support@bdfa-uk.org.uk

What are the genetic considerations?

The age that CLN2 disease is usually diagnosed in a child means that some families will have younger siblings who may be affected but have not displayed any symptoms.



It may also be possible that older unaffected siblings are carriers of the disease and may want to understand how CLN2 disease may affect their family choices when they are older.

When only one parent is a carrier of the abnormal gene, and the other is non-affected, there is a 50% (1 in 2) chance that any child will be an unaffected carrier.

If parents are considering having additional children, they can access specialist advice and support from their local clinical genetics service following a referral from their GP. Prenatal testing may be possible in the early stages of any future pregnancy.

Is support available to families?

As soon as possible following a diagnosis of CLN2 disease, families should be offered support from various professionals attached to their local health, social, educational services and the BDFA Support and Advocacy Partner. Ideally a "Team Around the Child" will be formed, with one of the professionals appointed as a Keyworker for the family.

The child's needs should be discussed with the parents and assessed by the team. The team will work together to ensure that the child and family receive the on-going care and support they need and that their choices are taken into account.

A child and family's needs will inevitably change as the disease progresses. As such, it is often helpful if a clear process for regular planned reviews is identified and that a system is established for enabling additional reviews as and when they are deemed necessary. As the rate or pattern of the progression of the disease for each child remains uncertain, an individualised plan of care and support is essential.

The BDFA is able to provide various forms of holistic support and can be contacted via **0800 046 9832** email: support@bdfa-uk.org.uk

How can families manage the financial challenges?

Caring for a child with CLN2 disease will bring additional financial challenges. It is vital that families are well informed about the full level of economic assistance available and the support that they are entitled to. They may well need help and guidance in accessing benefits and other sources of assistance. The professionals and services supporting the family should provide advice and guidance. The BDFA can also support families with these issues in various ways, the Small Grants Scheme being one example.

What are the practical implications for the family?

As the disease progresses, specialist equipment and aids will become necessary and this is another area where the family will need help. Items are likely to include specialist seating, buggies/wheelchairs, bathing and toileting aids, hoisting equipment and a specialist bed/mattress. Professionals will play a key role in ensuring that these and other items are provided in a timely manner following proper assessment of the individual child's needs.