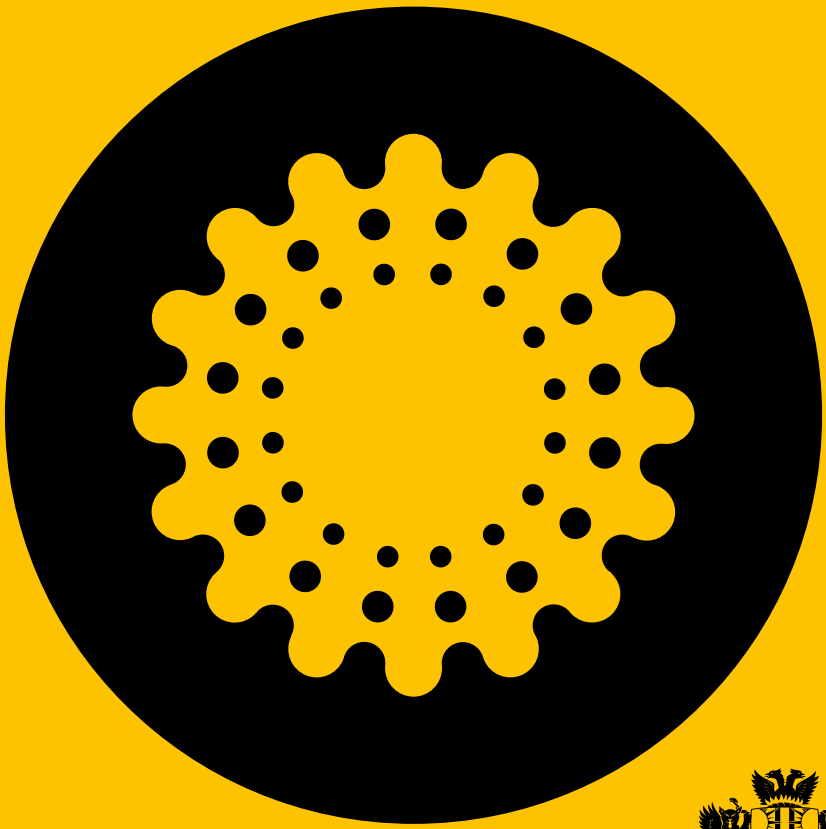
Understanding

Inherited Retinal Dystrophies

including Retinitis Pigmentosa

RNIB

See differently



The ROYAL COLLEGE of OPHTHALMOLOGISTS

The Sight Advice FAQ

The Sight Advice FAQ answers questions about living with sight loss, eye health or being newly diagnosed with a sight condition. It is produced by RNIB in partnership with many other sight loss organisations. **sightadvicefaq.org.uk**

Contact us

We're here to answer any questions you have about your eye condition or treatment. If you need further information about inherited retinal dystrophy or on coping with changes in your vision, then our Helpline is there for you.

Just give us a call on **0303 123 9999** or email us at **helpline@rnib.org.uk** and we'll be happy to speak with you.

RNIB's Understanding series

The Understanding series is designed to help you, your friends and family understand a little bit more about your eye condition.

The series covers a range of eye conditions, and is available in audio, print and braille formats.

Contents

What is an inherited retinal dystrophy (IRD)?

An inherited retinal dystrophy (IRD) is a genetic eye condition which affects the light sensitive cells in the retina at the back of your eyes, which over time, stops them from working. Retinitis pigmentosa (RP) is the most common group of IRD, but there are others that have different names, and which may lead to different patterns of sight loss. Most IRDs cause progressive and permanent changes that reduce your vision, but these changes usually happen slowly, taking years to develop. There are some IRDs that do not get worse with time, but these non-progressive conditions aren't covered within this information.

The way in which your sight is affected depends on the type of IRD you have. Most forms of IRD affect night vision and peripheral vision first, but there are some which affect central vision first. Our peripheral vision lets us see what's around us when we look straight ahead, helping us detect movement and avoid obstacles. Our central vision lets us see in detail and in colour when we look directly at something. The type of IRD you have determines what area of your vision is affected

and by how much. It can also dictate how quickly this happens and at what age it starts to affect your sight. Some IRDs begin to affect a person in their early childhood while others may not start to affect a person's sight until they are an adult.

How your eye works

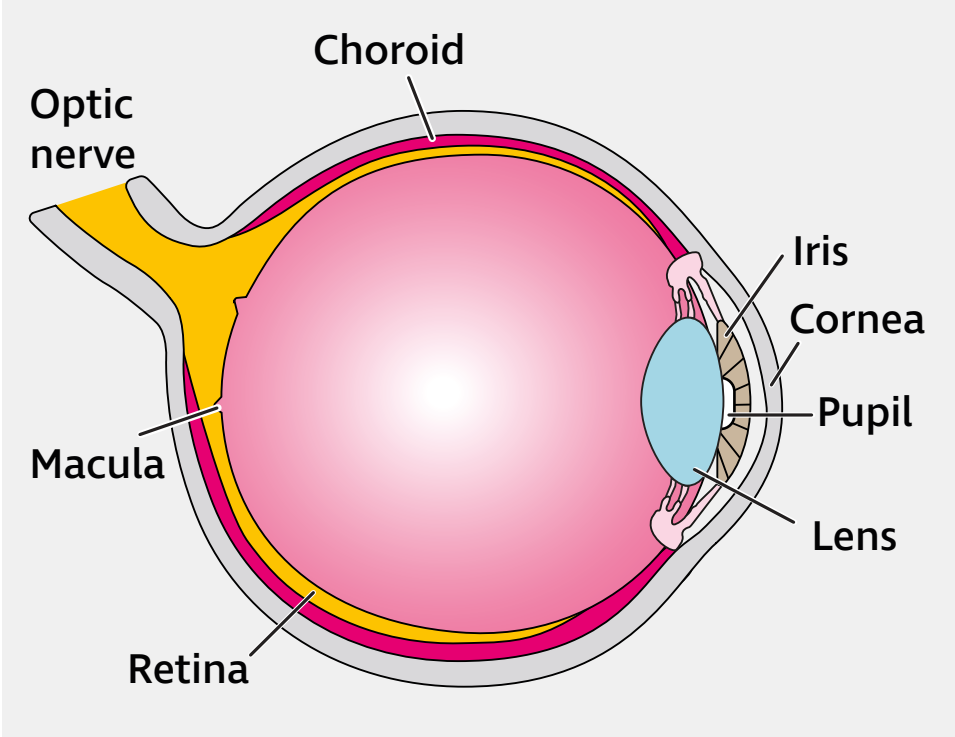
When light enters your eye, it is focused onto your retina at the back of your eye. The retina has layers that must work together to enable you to see. One of these layers is made up of light sensitive photoreceptor cells known as rods and cones. When light reaches the retina, it is converted into electrical signals, a process that is started by the photoreceptor cells. These electrical impulses then pass along the optic nerve of the eye to reach the brain, where they are interpreted as vision.

The macula is the central part of the retina. The central part of the macula contains thousands of specialised photoreceptor cells called cone cells. These cone cells work best in bright light and allow you to see fine detail for activities like reading and writing and recognising colours.

The peripheral retina is further away from the central macula. The photoreceptor cells of the peripheral retina are responsible for our awareness of what is around us when we're looking straight ahead (our peripheral vision). Unlike the central macula, the peripheral retina is mostly made up of rod cells which allow us to see when light is dim,

such as at night. The cone cells that are present in the peripheral retina provide our peripheral vision in normal daylight conditions.

Below is a diagram of the eye showing the iris, cornea, pupil, lens, optic nerve, macula, retina and choroid.



What causes an IRD?

IRDs are hereditary conditions caused by a fault (mutation) in one of the genes involved in maintaining the health of the retina. Your genes give the cells in your body the instructions they need to work well and stay healthy. If a gene has a mutation, there is a fault in their instructions and the cells using those instructions don't work as they should. Having an IRD means that the faulty gene involved stops your retinal cells from working correctly and results in the cells eventually failing over time. Researchers have identified many genes that are associated with different IRDs, but there are still other genes to discover.

How are IRDs inherited?

About half of people with an IRD have a relative who also has the condition. “Inherited” and “genetic” mean the same thing and both relate to the genes that are passed on from one generation to another. The way in which these genes are passed on can tell you who in your family has had the condition, how severely your vision could be affected, and the chances of your children being affected.

Genes are made of deoxyribonucleic acid (DNA) and they mostly come in pairs, giving us two copies of each gene in the cells of our body. You inherit one copy from each of your parents to make each gene pair and when you have children, you only pass on one copy of the gene to them. Most of your genes are found in cell structures called chromosomes and you have 23 pairs of chromosomes within each cell. Chromosome pairs 1-22 are called autosomes and both males and females have these. Chromosome pair 23 is made up of the sex chromosomes and they are different in males and females. These sex chromosomes are named either X or Y, with males having one X and one Y chromosome, while females have two X chromosomes.

You can inherit IRDs in different inheritance patterns. These relate to how the faulty gene has led to the condition. Inheritance patterns involving the genes in our chromosomes can be autosomal dominant (AD), autosomal recessive (AR) and X-linked (XL). An IRD that is autosomal (AD or AR) involves faulty genes on chromosomes 1-22, which means that both males and females are usually equally affected by these conditions. XL inheritance relates to a faulty gene on the X chromosome and these conditions affect males and females differently.

Some of our genes are not located within the 23 pairs of chromosomes, but within separate structures inside our cells called mitochondria, which provide energy for our cells to work. We inherit all our mitochondrial genes from our mothers and none from our fathers. Genetic conditions that are passed on with mitochondrial inheritance are rarer and are not covered within this information. The following sections describe the more common autosomal and X-linked forms of inheritance.

The names given to genes are often long, so they are usually identified using letters (and sometimes numbers). Some examples of genes relating to different IRDs include RPGR, RPE65 and CHM.

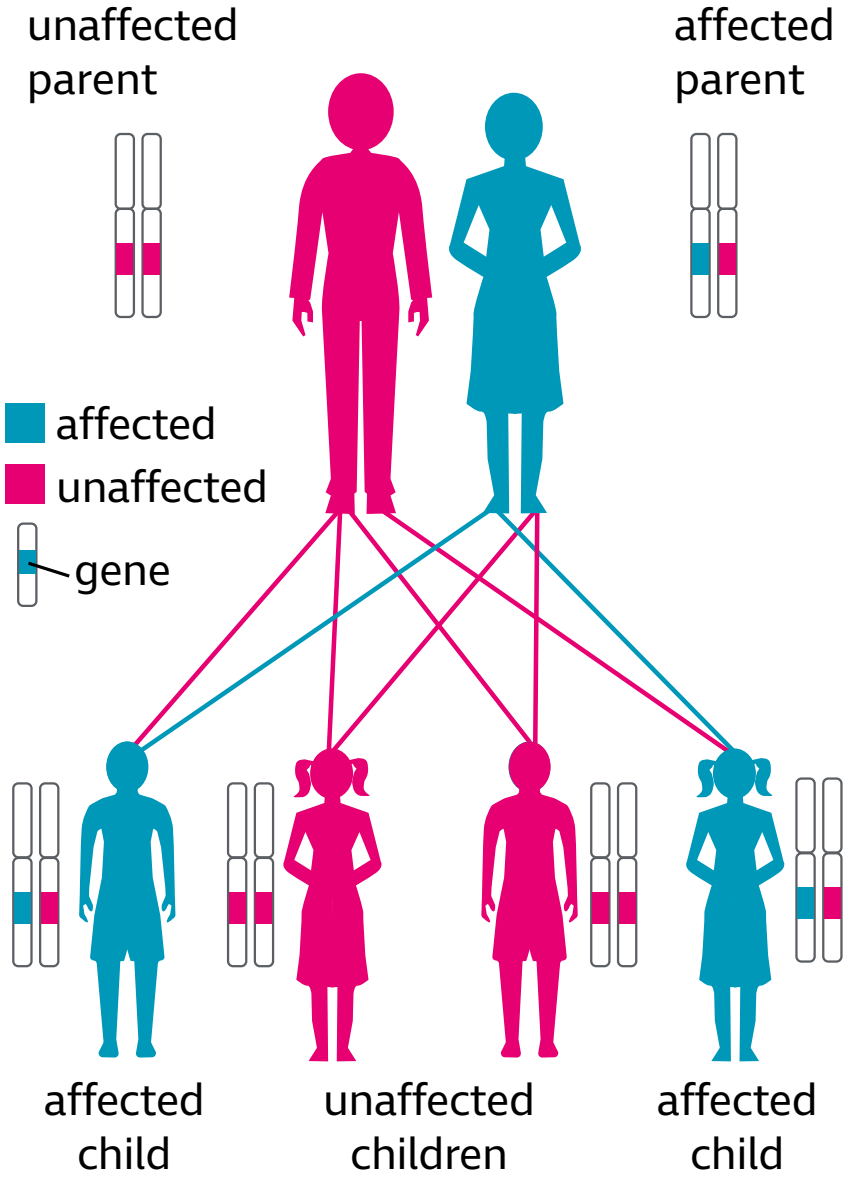
Autosomal dominant (AD) inheritance of an IRD

An IRD that is passed on with AD inheritance is a condition where only one of the genes in the relevant gene pair needs to have a fault to cause the condition. This gene fault can be inherited from either your mother or your father. Usually, this parent will also have the condition.

There tends to be a known family history of an IRD that is AD. However, some family members may be affected more than others. If you have IRD that is AD, there is a 50% chance of passing on the faulty gene every time you have a child and for that child to have the condition.

The diagram overleaf shows the four possible ways in which a child can inherit the genes that relate to an autosomal dominant (AD) IRD when either one of their parents has the condition. (It doesn't represent a family with four children in it.) For each child these parents have, there is a 50% (two out of four) chance that they will inherit the condition, regardless of whether they are a boy or a girl. Equally, there is a 50% chance that each child will be unaffected.

Autosomal Dominant Inheritance



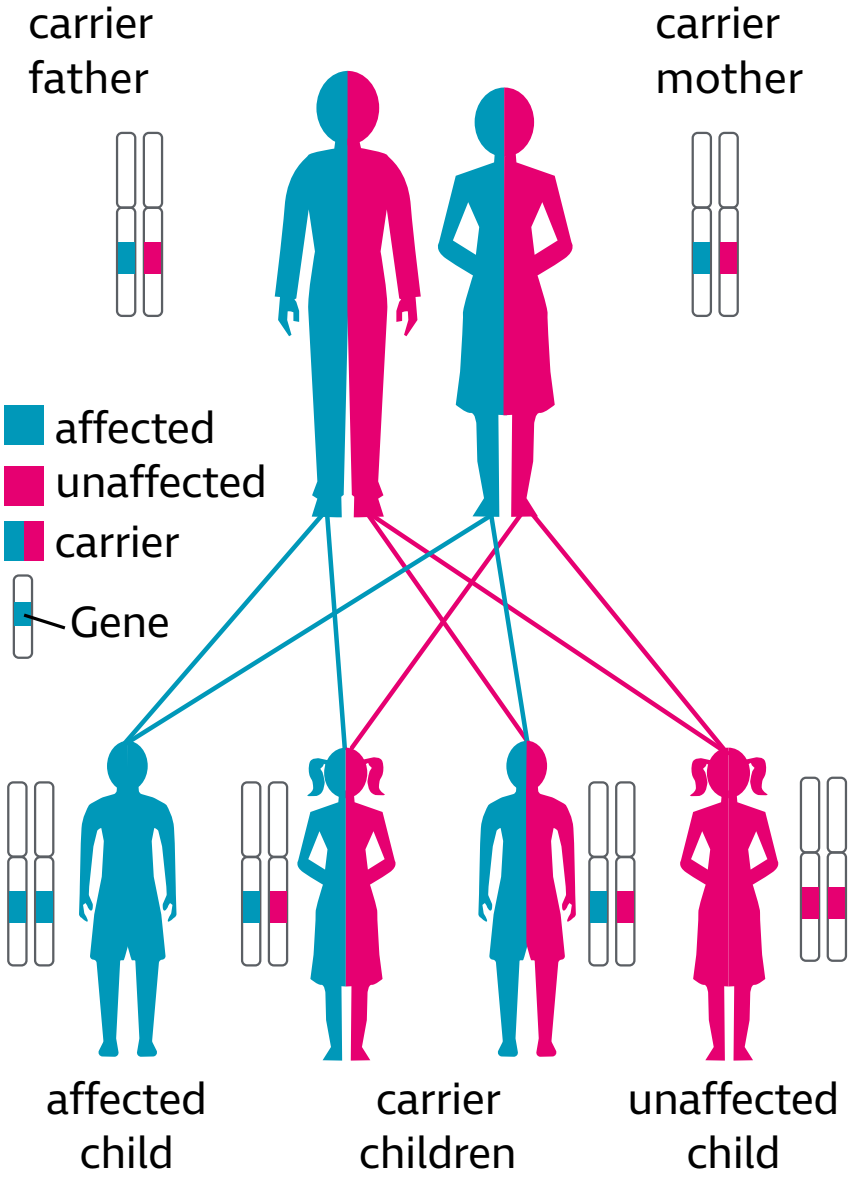
Autosomal recessive (AR) inheritance of an IRD

IRDs that are passed on with AR inheritance require both genes in the relevant pair to be faulty. This means you need to inherit one faulty gene from your mother and the other faulty gene from your father to have the condition. If your parents have one faulty gene and one normal gene, they will only be carriers of the condition and their vision will be unaffected by it. In an AR condition, having one normal gene is enough to provide the retinal cells with the right instructions to stay healthy and work normally. If both parents pass on the gene fault to you, you will inherit the condition and your sight will be affected. Someone who has an IRD that is AR will pass on a faulty gene to all their children. However, if these children also inherit a normal copy of the gene from their other parent, they will only be carriers of the condition. Because you need both copies of the gene to be faulty in this type of IRD, it usually appears in families without any history of the condition in other generations. An IRD that is AR tends to have a more severe effect on sight than AD types and symptoms can start at an earlier age.

The diagram overleaf shows the four possible ways in which a child can inherit the genes that relate to an autosomal recessive (AR) IRD when their parents are both carriers of the condition. (It doesn't represent a family with four children in it.) For each child these parents have:

- there is a 25% (one in four) chance that the child will inherit the condition, regardless of whether they are a boy or a girl
- there is a 50% (two out of four) chance that each child will be a carrier of the condition
- there is a 25% (one in four) chance that each child will inherit two completely normal genes.

Autosomal Recessive Inheritance



X-linked (XL) inheritance of an IRD

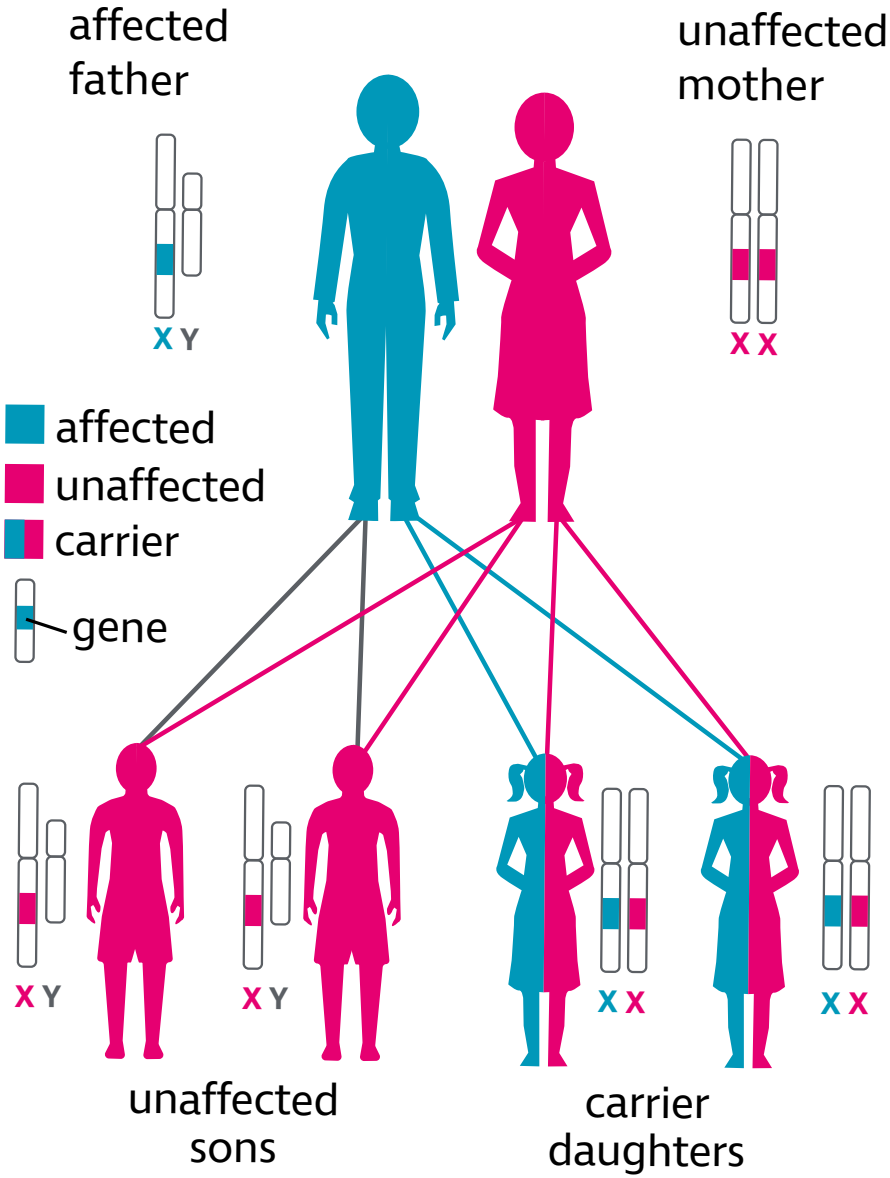
This is a type of IRD that affects predominantly males although some females can be affected to different extents. Vision tends to be significantly affected in males with an XL condition and can result in very poor sight by the age of 30 to 40.

To have an X-linked IRD, the faulty gene is located on the X chromosome. For a male, who has only one X chromosome in each of his cells, if there is an XL gene fault on this X chromosome, he will have the condition.

A female, who has two X chromosomes in each of her cells, may have a faulty gene on one X chromosome but a normal copy of the gene on the other. If the normal copy is enough for her to have no symptoms at all or to be only mildly affected, she is a carrier of the condition and the inheritance pattern is X-linked and recessive in nature (X-linked recessive or XLR). X-linked IRDs can affect some women more severely but this is very rare. This may be because the inheritance pattern is X-linked and dominant in nature (X-linked dominant or XLD) so that a faulty gene is only needed on one of her X chromosomes for her to have the condition.

The following diagram shows the four possible ways in which a child can inherit the genes that relate to an X-linked recessive (XLR) condition when their father is affected, and their mother is unaffected. (It doesn't represent a family with four children in it.) For each child these parents have, there is a 50% chance it will be a son and a 50% chance it will be a daughter. This father will pass on the faulty gene to all his daughters via the X chromosome they inherit from him but he will not pass the faulty gene on to his sons, because they only inherit the Y chromosome from him. As this mother does not carry the same faulty gene, all their daughters are likely to be carriers of the condition and all their sons will be unaffected.

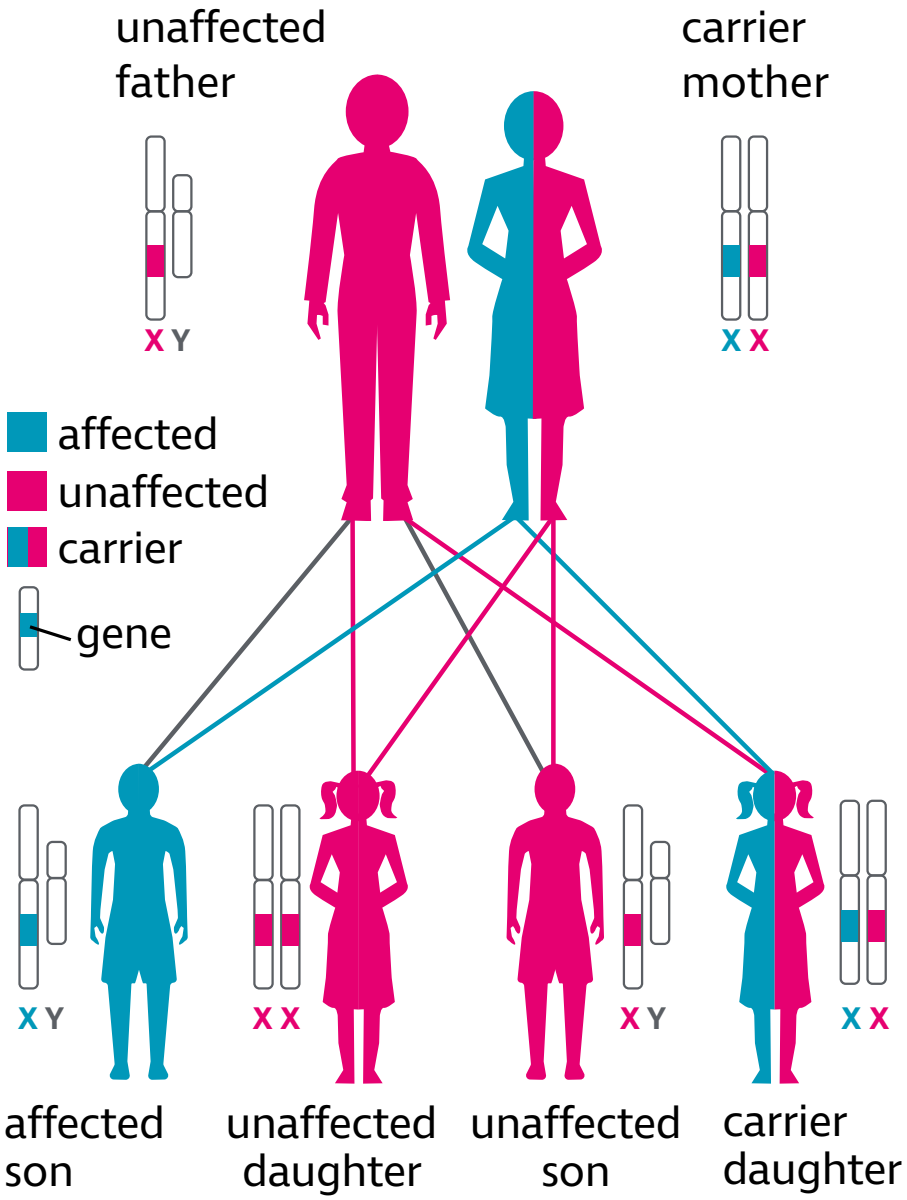
X-Linked Recessive Inheritance (1)



The following diagram shows the four possible ways in which a child can inherit the genes that relate to an X-linked recessive (XLR) condition when their father is unaffected, and their mother is a carrier of the condition. (It doesn't represent a family with four children in it.) For each child these parents have, there is a 50% chance it will be a son and a 50% chance it will be a daughter. Each son they have has a 50% (one out of two) chance of inheriting the condition, unlike their daughters who are either unaffected or carriers of the condition.

The diagram shows that every time they have a child, there is a 25% (one in four) chance it will be a son who is affected, a 50% (two out of four) chance it will be either a son or daughter who is unaffected and a 25% (one in four) chance it is a daughter who is a carrier of the condition.

X-Linked Recessive Inheritance (2)



No known relative

About half of people with an IRD don't know of any other members in their family with the condition. This may be because their relatives were carriers of the condition and haven't shown signs of it themselves. Sometimes, a person can have an IRD because the fault in the relevant gene has happened spontaneously by itself after conception, without being directly inherited from their parents. A spontaneous gene fault like this is known as a de novo mutation. If there is no known relative with the condition in your family, it may not be possible to find out how your IRD has been inherited without the help of genetic testing to find out which genes are faulty.

Can other members of my family be affected?

Genetic testing

Genetic testing can be carried out to identify the specific faulty gene that is causing your IRD. As your test results can indicate the inheritance pattern, it can help to show how likely it is for other members of your family to have the condition as well as indicating whether you could pass on a faulty gene to your children. It may also be useful in predicting how your vision will change over time and with what speed.

Research into various gene therapies is ongoing and it is also hoped that in the future, new treatments may be developed. As many of these therapies are specific to particular gene faults, it will be important to know which faulty genes have been identified from genetic testing.

There are several genetic centres around the country that carry out genetic tests and the service is provided free on the NHS if your ophthalmologist or your GP refers you to one.

Genetic testing uses a blood test to look at your genes to see if any faults are present. Testing for an IRD is complicated and it doesn't always identify all forms of these conditions as new gene faults are still being discovered. A test may not be offered to you routinely so you may wish to ask your ophthalmologist or GP to discuss this with you further.

"I was diagnosed at around ten years old. I had a genetic test in the last 14 years and my daughter won't be affected. The gene that is affected is the RDH12 gene and this was blood test. Through the last 40 years I have been to Moorfields and their equipment has got more advanced and better, for example, scanning and digital photographing."
Seema Flower

Genetic counselling

This is not talking therapy or an emotional support service. Genetic counselling does not relate to a talking therapy service. Instead, it aims to provide you with the information you need to understand your condition and to enable you to make informed decisions relating to it. Genetic counselling can be invaluable before genetic testing is carried out, to give you an understanding of the implications the results might have. It is also very useful when you want to explore the impacts of a condition that is already known within your family and talking to a genetic counsellor may help you and your relatives to discuss this.

Genetic counsellors have specific qualifications and training in genetics and counselling, and they work in genetic centres to offer you support around your test results. They also help you understand how a condition is passed on within your family by considering your family tree in detail, as well as offering you guidance and support in making any future decisions relating to your condition; for example, knowing the chances of passing on any condition you have can help if you are thinking about starting a family. Genetic counselling is a free service within the NHS and to access this service, you can ask your GP or ophthalmologist to refer you.

What is retinitis pigmentosa (RP)?

Retinitis pigmentosa, often called RP, is the name given to the most common group of IRDs. The genes that cause RP affect the rod photoreceptor cells in the retina first so that they gradually stop working over time. The cone photoreceptors are affected later on. Depending on the genes involved and inheritance pattern, you may notice your first symptoms in early childhood or later, between adolescence and early adulthood. Some people don't have symptoms until later in life.

What are the symptoms of RP?

Early symptoms

As RP affects the rod cells first, the first symptom you'll notice is that you don't see as well as people without a sight condition in dim light, such as outside at dusk, or at night. Medically, this is known as nyctalopia, which is often called "night blindness". People without a sight condition can usually fully adapt to dim light in 15 to 30 minutes, but if you have RP, it will either take you much longer or it won't happen at all.

As well as difficulty in dim light, you'll start having problems seeing things in your peripheral vision. You may miss things to either side of you and you might trip over or bump into things that you would have seen in the past.

"I started noticing symptoms a couple of years before my diagnosis. I could not see very well in the dark. I would also trip over things if it was dark. This was the only early symptom I had, and it made it difficult for me to drive in low light and to go out in the dark." Rupa Ray

Difficulty seeing in dim light and loss of peripheral vision are signs that the rod cells in your retina are being affected by your RP. As the cone cells in the peripheral retina depend on the rod cells to survive, they are also affected by your RP. In the more common forms of RP, your cone cells in the central retina are not affected in the early stages so your central vision should still be good enough to recognise faces, see colour and to continue activities such as reading and watching television.

Later symptoms

RP is a progressive condition, which means that your sight will continue to get worse over the years. Often, after your vision has been stable for a while, it can get worse suddenly over a short period of time. This new level of vision may then remain stable for quite some time. However, there may be further changes to your vision in the future. This may mean that you have to keep re-adapting to lower levels of sight. The type of RP that you have can affect how quickly these changes develop.

As your RP progresses, you'll gradually lose more of your peripheral sight, leaving a central narrow field of vision, often referred to as having "tunnel vision". How long your central vision is preserved will depend on the type of RP that you have. This may be into your 50s or beyond. However, advanced RP will often affect your central vision, so that reading or recognising faces becomes difficult.

You may find that bright lights and sunlight give you glare and moving between a light and a dark room can cause you problems. This is because, as your RP progresses, your retinal cells become less able to adapt to changing light levels.

Some people who have already lost a lot of their sight report seeing flashes of light or a continuous coloured light in their vision. It is always worth discussing any new symptoms you have with your ophthalmologist (hospital eye doctor).

"I was unaware of any problems with my eyesight, until age 30, when RP was first identified at a routine eye examination. At that time my visual fields were normal, and my only symptom was some difficulty with dark adaptation. The consultant told me that the disease would be very slowly progressive and for many years it did not present me with any significant problems.

However, it was my experience that years of stable vision were followed by periods of quite rapid disease progression when I reached about 50 years of age. I then started having significant problems and was finally registered as partially sighted about five years ago."
Bill Majrowski

Are the symptoms of other IRDs the same as RP?

There are many IRDs, some with similar symptoms to RP and some that are very different. Some IRDs affect the whole retina while others only affect the macula in the central retina. There have always been different types of RP too, but in the past, they've all been given the same name – retinitis pigmentosa. This happened because many of the conditions looked the same when ophthalmologists looked inside someone's eyes. However, as research developed, giving a better understanding of how our genes cause eye conditions, it became possible to tell the difference between conditions which would all have been called RP in the past.

IRDs can be grouped into different types, such as rod-cone dystrophies, cone-rod dystrophies, cone dystrophies and choroidal dystrophies, depending on which cells are affected. Some people may therefore have their originally diagnosed RP more accurately renamed as a specific rod-cone dystrophy or cone-rod dystrophy, distinguished because of the genes involved. Other IRDs have more specific names and some form part of a syndrome where, in addition to sight loss, other

aspects of general health are also affected. Some of these are described in more detail in the next two sections of this information booklet.

IRDs such as RP are called rod-cone dystrophies because the rods are affected more than the cones but the whole retina is ultimately affected.

Cone-rod dystrophies affect the cones earlier and more severely than the rods so that central vision is affected more than peripheral vision.

Macular dystrophies primarily affect your central vision, usually leaving peripheral vision intact. Stargardt disease and Best disease are examples of macular dystrophies. They are not discussed in detail here, but you can find out more about both conditions by looking at our website **rnib.org.uk/eyehealth** or by calling our helpline on **0303 123 9999** and requesting our factsheets on Stargardt disease and Best disease.

Choroidal dystrophies (also known as RPE dystrophies) mainly affect how the rod and cone cells work, but they also affect the choroid and the retinal pigment epithelium (RPE) which both lie underneath the retina. The RPE is the layer that's affected initially by the

faulty gene involved. Peripheral vision can be affected first with central vision affected later on. Choroideremia is an example of this type of dystrophy and it is described in more detail within the next section of this information.

What other IRDs are there?

There are many IRDs that are caused by many different genes and we've only described a few of them in this section. If you have been diagnosed with an IRD we haven't mentioned here, you can call our Helpline on **0303 123 9999** to speak to one of our eye health advisors who would be happy to give you more information on your condition.

Leber congenital amaurosis (LCA)

Leber congenital amaurosis (LCA) is the name given to a group of more severe rod-cone dystrophies that lead to greater sight loss in very early childhood. It usually has an AR inheritance. There are several types, some more common than others. These different types are caused by faults in several different genes which are important for the health of the rods and cones. Depending on which type of LCA a child has will determine how quickly and by how much their sight gets worse. LCA is the most common cause of inherited sight loss in children.

LCA is often detected at birth when it is noticed that a child's eyes wander around in different directions or have a wobble-like movement called nystagmus. They may dislike lights in some forms of LCA and rub their eyes with their fingers

repeatedly, known as oculodigital syndrome. This constant eye rubbing can lead to a condition called keratoconus where the cornea on the front of the eye becomes more cone shaped.

Some of the genes that cause LCA can also form part of a syndrome where other aspects of general health are affected.

Clinical trials of specific gene therapy to treat LCA are ongoing and this is discussed in more detail in the treatment and research section of this information.

Choroideremia

Choroideremia is caused by a fault in the CHM gene. This gene affects not only the retinal rods and cones but also the layers underneath them, called the retinal pigment epithelium (the RPE) and the choroid. Choroideremia is therefore referred to as either a choroidal or RPE dystrophy. The RPE enables the photoreceptors to work properly and the choroid contains a network of blood vessels that supply the retina with nutrients and oxygen to remain healthy.

Choroideremia has an X-linked inheritance so it mainly affects males with females being carriers

of the condition. Night blindness begins in adolescence (ages 10-19), with a loss of peripheral vision followed by loss of central vision over time. The symptoms and rate at which vision deteriorates vary from person to person but usually by your 40s to 50s, your sight loss will be more severe, with possibly some useful central vision remaining into your 60s.

Clinical trials of specific gene therapy are ongoing in the hope of finding a future treatment for choroideremia.

Gyrate atrophy

Gyrate atrophy is a genetic condition caused by faults in the OAT gene which is involved in the breakdown of a chemical in the body's cells called ornithine. Ornithine is important for the body's cells to remove waste products. If there is too much ornithine in the body, the cells of the retina and choroid are affected, although it is still unclear as to why these changes happen. In adolescence, a child might become more short-sighted (myopic) and experience night blindness which progresses to loss of peripheral vision leading to tunnel vision. Central vision is the last to be affected but sight loss is usually severe by the age of 50.

Some people have a form of gyrate atrophy that responds to a treatment using vitamin B6, also known as pyridoxine. In this type of gyrate atrophy, vitamin B6 works by reducing the ornithine levels in the body, so that the condition is less severe, and sight loss might develop more slowly. A specialist in metabolic medicine (the chemical processes that take place in your body) can tell you if this is the type of gyrate atrophy you have, as vitamin B6 is not an appropriate treatment for everyone with the condition. Some people may also benefit from a diet that is low in arginine as this can also affect ornithine levels in the body. Arginine can be found in meat, nuts, seeds and dairy foods. Your specialist in metabolic medicine can be best placed to advise you about any diet you should follow, and your ophthalmologist or GP may be able to refer you to one.

Will I have other health problems? (Syndromes involving IRDs)

In most cases, the inherited faulty gene only affects the eyes. Sometimes, within syndromes, other parts of the body are also affected. One example of this is Usher syndrome, where people develop both hearing loss and sight loss due to RP. Other syndromes include Bardet-Biedl (BBS) syndrome, Refsum disease and Alström syndrome, all of which cause sight loss due to retinal dystrophy along with other health issues.

Usher syndrome

Usher syndrome is inherited with an AR inheritance pattern and there are three different forms; types 1, 2 and 3. Faults in several different genes can cause the condition, all of which lead to sight loss due to RP as well as hearing loss and, in some cases, balance problems. Type 1 is the most severe form with profound hearing loss and sight loss due to RP in childhood. Sight loss due to RP in Type 2 develops in adolescence or your early 20s, whereas in Type 3, sight loss begins later on in adulthood.

Bardet-Biedl syndrome (BBS)

Bardet-Biedl syndrome is a condition that affects many parts of the body, including kidney abnormalities, having extra fingers or toes, obesity and learning difficulties and it is inherited as an AR inheritance pattern. Several different faulty genes have been identified as a cause for BBS. Sight loss is related to RP-like changes as well as cone-rod dystrophy where central vision is also affected. Sight loss is severe by the age of 20 for most people with BBS.

What tests are used to diagnose an IRD?

If you've noticed that you're having problems with any aspect of your vision, including seeing in dim light or at night, you should see your optometrist (also known as an optician). Early symptoms can vary from person to person so your IRD might be diagnosed at an early stage or after many years of having the condition.

An optometrist will examine your retina by looking into your eyes. If you have the signs of classic RP, there will be tiny but distinctive clumps of dark pigment around your retina.

Any changes to your peripheral vision can be detected by a field of vision test, which your optometrist can also carry out. This test may not be offered to you routinely so if you're worried about your peripheral vision, you should ask your optometrist to check your field of vision for you.

If you've got a family history of an IRD or you have problems with your vision in dim light or problems when moving from light to dark, you should tell the person examining your eyes. This will help them to carry out the most appropriate

tests. If your optometrist is concerned after your eye examination, they can refer you to an ophthalmologist for more tests.

What tests will the hospital do?

There are various tests that can diagnose an IRD but it's unlikely that they'll do all of them at your first visit. These tests can also monitor how your condition changes over time. Your ophthalmologist may be able to say that you have an IRD when they've got the results of these tests, but it may not be possible to know the specific IRD you have and what the long term effects on your vision will be without genetic testing.

It's important to ask your ophthalmologist about these tests and about what the results mean for you. None of the tests are painful or cause you any harm but they may take a long time and be repetitive. Here are some of the tests you may need to undergo:

Examining the retina at the back of your eye

Your retina will be examined each time you visit the hospital. You'll be given drops to dilate (widen) your pupils to allow the ophthalmologist to see your retina clearly. These drops take about 30 minutes to work. They'll make you sensitive to light

and make your vision blurry. The effects of the drops usually wear off in about six hours, though sometimes it can take overnight. It isn't safe to drive until the effects have worn off.

Retinal photographs, optical coherence tomography and autofluorescence imaging

Your retina may be photographed using a special camera. By comparing the photographs taken on different visits, your ophthalmologist might be able to monitor how your condition is changing over time.

Optical coherence tomography (OCT) imaging uses infrared light to give a cross-sectional image of the retina, so the different retinal layers can be seen. Your ophthalmologist can use this test to assess the health of the photoreceptors and other retinal layers.

Autofluorescence imaging involves taking more pictures of the back of your eye, usually with a blue or green light, that show the health of the outermost layer of your retina. This layer, called the retinal pigment epithelium (RPE), helps the retinal photoreceptors to work and if it's not working properly itself, the health of the retina will be affected.

Visual field test

A visual field test uses a machine which checks how much of your peripheral vision has been affected by an eye condition. One of your eyes is covered with a patch and your chin rests on the machine, which is in a darkened room. You'll be given a button to hold in your hand and asked to look straight ahead at a central point on the machine's bowl-shaped screen. It's important to keep looking at this central point and not to move while the test is being carried out. You'll notice spots of light flash on the screen and each time you see one, you press the button you're holding. The test takes about 10 minutes for each eye and shows how much vision you have above, below and to the sides of looking straight ahead.

"I went to get tested – there was a bowl that was lit up, the lights came on in certain places, I had a clicker in my hand and had to click when I saw light. They took a lot of photographs and put stuff in my eyes to dilate the pupils."
John Chapman

Colour vision
To test your colour vision, you'll be asked to pick out numbers or patterns that you can see on a background of coloured dots. This test takes less than five minutes to do and shows what colours you're able to see.

Electro-diagnostic tests
Electro-diagnostic tests can tell your ophthalmologist how well your retina is working. They check how your retina responds electrically to patterns and different lighting conditions. Different tests can be carried out to show the results of your retina's electrical activity. These test results will indicate which layers of your retina have been affected.

The tests you may be offered include the electroretinogram (ERG), the pattern electroretinogram (PERG) and the electro-oculogram (EOG). The ERG shows how your retinal cells are working and you'll usually have to sit in a darkened room or wear dark goggles for about 20 to 30 minutes to start with. Then you might be given anaesthetic eye drops before having recording electrodes placed around the eye. These could be a thread placed under the lower eyelid or a gold foil or a contact lens as well as skin

surface electrodes (similar to those used during an ECG recording from the heart). During this test, you'll be shown flashing lights and the response of your retina will be recorded on an electrical trace or plot.

The ERG tests the whole of your retina but the PERG uses a checkerboard pattern to check how your macula, at the centre of your retina, is working.

The EOG shows how the rods and cones and the RPE layer behind them are working.

These tests are usually carried out by the electro-diagnostics department of the eye clinic and you should ask the staff to explain exactly what will happen for each test before they're carried out. The tests are painless and straightforward but will usually involve having your pupils dilated and/or numbed.

What other eye conditions might I get?

Some people with an IRD also develop cataracts. A cataract is a clouding of the lens in your eye. Your lens sits just behind your iris, the coloured part of your eye. When you have an IRD, you may develop a cataract as young as your 20s, but it's more often picked up in your 40s or later. Your ophthalmologist may recommend that you have your cataract removed, particularly if it's making your remaining useful vision misty. Your cataract can be removed and replaced with a clear artificial lens.

Many people find that, although they still have sight loss due to their IRD, their useful remaining vision is of a better quality after their cataract has been removed.

You can find more information about cataracts on our website **rnib.org.uk/eyehealth** or by calling our Helpline **0303 123 9999** and requesting our information about cataracts.

Some people with an IRD develop macular swelling, known as macular oedema. The macula is at the centre of your retina and you use it to see fine detail and colour. If blood vessels near your macula leak, this can lead to macular swelling, which can make your central vision more blurred and distorted. Macular oedema can also happen occasionally after cataract surgery. It can be diagnosed with a scan of the macula using optical coherence tomography (OCT) which looks at the thickness of the macular tissue. There is treatment for macular oedema and your ophthalmologist will be able to discuss with you what options are appropriate in your case.

Can I drive when I have an IRD?

If you have an IRD, your sight in both eyes will be affected so you are required by law to tell the Driver and Vehicle Licensing Authority (DVLA) that you have the condition. They will assess your vision regularly to find out if your sight meets their standards in order to keep you and others safe. If your vision meets the DVLA driving standards, then you would be able to continue driving. However, if your vision has started to change, it may mean it is no longer safe for you to drive. Your ophthalmologist and optometrist will be able to advise you further about this.

How will my IRD be monitored over time?

Your ophthalmologist might offer to continue to monitor your IRD and assess your vision over time. They will be able to advise you how often this should be in your case, for example every year or two. They will be able to advise you if your condition has worsened, tell you about any other eye condition you may have and what these outcomes may indicate for you, including whether or not you would be eligible to be registered as visually impaired. You will be able to ask any questions you may have as to how your vision is expected to change over time and whether a low vision assessment would be helpful to you.

You should continue to visit your optometrist at least every two years, or as often as you're advised, as they can also monitor your overall eye health, update any spectacle prescription that may be beneficial to you and refer you back to the ophthalmologist if you develop another eye condition that requires treatment. They can also advise you about low vision aids that may be helpful.

Are there any treatments or technology for IRDs and what research is being carried out?

While much progress has been made in the past few years in the understanding of the genes involved in RP and other IRDs, there is currently no cure for these conditions. However, ongoing research funded by sight loss charities is taking place all the time and the types of treatment currently being investigated include:

Gene therapy

The aim of gene therapy is to introduce normal genetic material to the affected retina which will override the fault in the gene which has caused the IRD. For this to have any chance of success, there must be some retinal cells that are still working. Gene therapy relies on knowing which specific gene is faulty as a different therapy is required for faults in different genes. Gene therapy is ongoing for many IRDs in the hope of finding future treatments. There are different approaches within gene therapy which include:

Gene replacement

Normal genes created by genetic scientists are injected into the retina at the back of the eye and

the genetic material is carried into the retinal tissue using a harmless virus, known as a vector. This virus does not cause any illness and is unlikely to come under attack from the body's immune system. The aim is that the instructions from the normal genes will lead to vision that improves or stops getting worse.

The first gene replacement therapy, Luxturna (voretigene neparvovec), has been approved as a treatment for IRDs caused by faults on the RPE65 gene. This treatment is available on the NHS and was given to a patient for the first time in the UK in early 2020. Faults in the RPE65 gene lead to Leber Congenital Amaurosis Type 2 (LCA2) as well as a severe, early onset form of RP. By delivering a healthy copy of the RPE65 gene to working retinal photoreceptor cells, it is hoped that a pigment essential for sight can be made correctly, so that vision does not worsen but stabilises or even improves.

As the IRDs resulting from faults in the RPE65 gene are of early onset, it is likely that the recipients of this therapy will be children or young adults. At this early stage, there is no clinical evidence yet to indicate how the treatment will preserve vision in the long term, and clinical trials are ongoing, but

scientists believe there are good indications that the effects of treatment could last for many years.

Research is ongoing to develop gene replacement therapy for other gene faults in the hope that the IRDs they cause can be successfully treated in the same way. There are still some IRDs where the faulty gene has not yet been identified. Geneticists must continue their research so that gene therapy can be developed as a treatment for other IRDs in the future.

Gene editing

A virus vector is able to deliver normal genetic material to the retina when the gene to be replaced is single and small in size. However, a virus vector is not able to carry a large gene into cells effectively. Instead, scientists "cut out" the faulty section of genetic material within the larger gene and replace it with a normal section instead. This is known as gene editing. Scientists have developed a means of gene editing using a technology known as CRISPR-Cas9 (or just CRISPR). Although CRISPR is an accurate means of gene editing and clinical trials are currently ongoing, this approach to treatment needs further development as it is not yet precise enough to ensure that normal genes are not damaged in the process.

Optogenetics

Gene replacement and editing need some of the retinal photoreceptor cells to be still working. For advanced IRDs, where none of the retinal photoreceptor cells work anymore, there needs to be a different approach. Optogenetics is a branch of gene therapy that is in the early stages of investigation as a potential future treatment when all the retinal photoreceptors have stopped working and the IRD is more advanced. Optogenetics involves making retinal cells that are not photoreceptors able to respond to light, making them behave as if they are photoreceptors. This is done by introducing genes into the retina that can instruct these cells to alter their behaviour this way. Currently, optogenetics is still in the early stages of research.

Stem cell therapy

The body contains many different types of cells, and some are more specialised than others. The retinal photoreceptors are an example of specialised cells that the body cannot repair or replace when they stop working. Stem cells are cells that have not yet specialised to form a specific tissue in the body. If stem cells could be turned into retinal photoreceptors, it may be possible to replace the cells that have stopped working as a

result of an IRD, particularly in the more advanced stages of the condition where more cells have been affected and gene therapy would not be an option. Currently, early phase clinical trials are taking place for stem cell treatments but at the time of writing this information, there are no approved stem cell treatments available for any IRDs.

Growth factors

Growth factors are chemicals in the body that support cells to grow and repair. Research into the use of growth factors to treat retinal disease has been investigated to see if they may be able to preserve retinal cells for longer. At the moment, there is insufficient evidence that growth factors would have any long-term benefit in preserving sight. However, this research is continuing and there may be further developments in this field in the future.

Other biochemical approaches

Clinical trials are also taking place using other aspects of the body's chemistry, such as substances called antisense oligonucleotides (AONs), as these can "silence" the effects of the faulty gene in some IRDs.

Electrical stimulation therapy

There have been some early investigations into whether electrical stimulation can slow down the degeneration of retinal cells in an IRD. There is still much to learn about this approach and further research is still needed to find out if this has any potential as a treatment for the future.

Nutrition

For most IRDs, there's no evidence that suggests taking vitamin supplements or having a particular diet will help you avoid sight loss. There are exceptions to this, such as in some forms of gyrate atrophy and Refsum's syndrome for example.
In the past there has been some debate about vitamin A and whether people with RP should take vitamin A supplements. However, research has found that vitamin A supplements do not protect sight for people with RP. Taking large doses of vitamin A can be bad for your health and should be discussed with your GP and ophthalmologist.

People with a condition called Refsum's syndrome have sight loss due to RP as well as other health concerns. Refsum's syndrome is caused by gene faults that stop the body from breaking down a type of fat called phytanic acid which is found in certain foods such as dairy, beef, lamb and fatty

fish. If you have been diagnosed with Refsum's syndrome, your GP or ophthalmologist can refer you to a specialist doctor or dietician to help manage your diet so that it is low in phytanic acid. This might help reduce the rate of sight loss.

Technology known as artificial vision

An IRD causes degeneration of the retinal photoreceptor cells but it does not stop the other retinal cells or the optic nerve from working. The optic nerve carries electrical impulses to the brain to be processed, giving us sight. There are electronic microchips that have been successfully implanted within the human retina that are able to bypass the damaged retinal photoreceptor cells, stimulating the remaining retinal nerve fibres. These nerve fibres form the optic nerve and as long as it is also healthy, the optic nerve can conduct a signal to the brain, allowing the person to see patterns of light or outlines of objects. These implants don't bring your vision back or stop your vision from getting worse and you'd still need the other aids you have, such as your cane or your guide dog. Artificial vision systems are still being investigated, both within the retina and brain and there isn't a system which is able to be easily implanted which returns high levels of vision. No artificial systems are currently available on the NHS.

Coping

It's completely understandable to be upset when you or a family member are diagnosed with an IRD and it's normal to find yourself worrying about the future and how you or your relative will cope. You may find yourself wondering how this will affect your employment and how you will be able to provide for yourself and your family. It may be your child who has been diagnosed with an IRD and you may be worrying about their education at school, college or university and what opportunities are now possible for them in the future.

Support from RNIB

It can sometimes be helpful to talk about these feelings with someone outside your circle of friends or family. By calling our RNIB Helpline, you are no longer alone. We can support you at every step, putting you in touch with the advisors you need from any of our supportive teams. From support with your education to advice on your employment, from using assistive technology to understanding more about your eye condition, we are here to help. Our Counselling and Well-being team is also available to provide the emotional support you may need. Your GP or social worker may also find a counsellor for you if you feel this might help.

"After my diagnosis, we discovered RNIB. I signed up for RNIB's Living with Sight Loss course and it really changed my perspective. I feel that I have come a long way since my diagnosis. It was so helpful to meet other people in the same situation and get information." John Chapman

The Eye Clinic Liaison Officer (ECLO)

You may think of further questions about your IRD on your way home from hospital or in the days and weeks following your diagnosis. There is someone to turn to with these questions. Your eye clinic may have a sight loss advisor working alongside the doctors and nursing staff. This advisor may be known as either the Eye Clinic Liaison Officer (ECLO), the Vision Support Officer or the Early Intervention Support Officer and they are on hand within your hospital to provide you with further practical and emotional support about your eye health. To find out if your hospital eye clinic has an ECLO, you can search within the RNIB Sightline Directory by visiting **sightlinedirectory.org.uk**. Alternatively, you can call our Helpline to speak to our advisors within our Eye Health Information Service as they would be happy to discuss any questions you may have.

"I would want someone diagnosed with RP to know that they can have an ECLO with them for support who is at the eye hospital, also there is a huge amount of support from RNIB; cane training, benefits and employment advice."
Rupa Ray

Retina UK

Retina UK is a UK charity set up specifically to support people with inherited sight loss. They offer information and support to people living with the conditions as well as family members, friends and the sight loss professionals who support them. They provide up-to-date information, including the latest research being carried out as well as stimulating and funding medical research into inherited sight loss conditions. Retina UK are also able to put you in touch with other people living with retinal dystrophies via their National Helpline and Talk and Support services. Talking with other people who have experience of the same daily ups and downs that you do can be very helpful.

The helpline number is **0300 111 4000**.

Further help and support

Making the most of your sight

Having a progressive IRD means that you'll eventually lose sight, but there are things that you can do to make the most of your remaining vision. This may mean making things bigger if your central vision is affected. However, if your peripheral vision is very restricted leaving only a limited area of reasonably good central vision, you may prefer to make things smaller so that the detail of your near task is more accessible. In addition, using brighter lighting or using contrasting colours can make things easier to see.

We have a series of leaflets with helpful information on living with sight loss, including how to make the most of your sight. You can find out more about our range of titles by calling our Helpline.

The low vision assessment

Ask your ophthalmologist, optometrist or GP about low vision aids and having a low vision assessment. During this assessment with an optometrist, you'll be able to discuss the use of magnifiers and aids to help you to see things more clearly.

Assistive technology

There is also technology available that can help with low vision. Many smart phones and tablets are already equipped with in-built software that can enable people with low vision to access information. There are also specific apps and low vision devices that may help too, as well as computer software programmes that can be installed. If you would like to find out more about the assistive technology that is available and how it can help you, our Technology for Life team advisors would be happy to chat to you. You can get in touch with this team by calling our Helpline on **0303 123 9999.**

"RNIB's Technology Help has also been a huge support. Not being able to read was pretty harrowing initially. I feared that it would mark a decrease in my independence. But thank goodness for technology! Try not to panic, although you may think it's the end of the world, it certainly isn't. Socially we have evolved so much and there is a lot more access to technology and phones"
Seema Flower

Registration

You should also ask your ophthalmologist whether you're eligible to register as sight impaired (partially sighted) or severely sight impaired (blind). Registration can act as your passport to expert help and sometimes to financial concessions. Even if you aren't registered, a lot of this support is still available to you.

Social services support

Local social services should be able to give you information on staying safe in your home and getting out and about safely. They should also be able to offer you some practical mobility training to give you more confidence when you are out.

Family and friends

Your family or the people you live with can help you as your vision deteriorates by keeping your home environment free of obstacles and by putting things away in the same place, so they are easy to find.

"I'm lucky that I have a good family around me, but there's people out there that don't have anyone. So, it's really important to have RNIB, to meet other people, it makes you feel like you're not a lost cause or on your own."
John Chapman

If you have questions about anything you've read in this information, please get in touch with us.

RNIB Helpline

Our Helpline is your direct line to the support, advice and services you need. Whether you want to know more about your eye condition, buy a product from our shop, join our library, find out about possible benefit entitlements, or be put in touch with a trained counsellor, we're only a call away. Give us a call today to find out how we can help you.

RNIB Helpline

Call: **0303 123 9999**
email: **helpline@rnib.org.uk**
or say, **"Alexa, call RNIB Helpline"** to an Alexa enabled device.

We're ready to answer your call Monday to Friday 8am to 8pm and Saturday 9.30am to 1pm.

You can also get in touch by post or by visiting our website:

RNIB
105 Judd Street
London WC1H 9NE
rnib.org.uk

Connect with others

Meet or connect with others who are blind or partially sighted online, by phone or in your community to share interests, experiences and support for each other. From book clubs and social groups to sport and volunteering, our friendly, helpful and knowledgeable team can link you up with opportunities to suit you.

Visit rnib.org.uk/connect or call 0303 123 9999.

Other useful contacts

Retina UK
Wharf House, Stratford Road, Buckingham
MK18 1TD

Helpline **0300 111 4000**
Email: **helpline@RetinaUK.org.uk**
retinauk.org.uk

Gene Vision
A resource on rare genetic eye disorders
for everyone. **https://gene.vision**

ROAM (Research Opportunities At Moorfields)
Get involved in research
Email: **research.moorfields.nhs.uk/**

Sense
101 Pentonville Road, London N1 9LG
Telephone **0300 330 9256**
Text relay (not SMS) **18001 0300 330 9256**
Email: **info@sense.org.uk**
sense.org.uk

Driver and Vehicle Licensing Authority (DVLA)
Drivers' Medical Enquiries, Swansea SA99 1TU
Telephone: **0300 790 6806**
gov.uk/government/organisations/driver-and-vehicle-licensing-agency

RNIB Booklet Series

About the Starting Out series

The Starting Out series aims to give people who are losing or have recently lost their sight essential information about living with sight loss. Titles include:

- Benefits, Concessions and Registration
- Emotional Support
- Help from Social Services
- Making the Most of Your Sight

About the Confident Living Series

The Confident Living series is for people who are losing or have recently lost their sight and are trying to build their confidence to continue to lead full and independent lives. Titles include:

- Reading
- Shopping
- Technology
- Travel

About the Understanding Series

The Understanding series is designed to help you, your friends and family understand a little bit more about your eye condition. Titles include:

- Age Related Macular Degeneration
- Cataracts
- Charles Bonnet Syndrome
- Dry Eye
- Eye Conditions Related to Diabetes
- Glaucoma
- Nystagmus
- Retinal Detachment
- Inherited Retinal Dystrophies including Retinitis Pigmentosa
- Posterior Vitreous Detachment

All these leaflets are available in audio, print and braille formats. To order please contact our Helpline on **0303 123 9999** (all calls charged at local rate), email **helpline@rnib.org.uk** or visit **shop.rnib.org.uk**

For a full list of the information sources used in any of these titles please contact **ckit@rnib.org.uk**

We value your feedback

You can help us improve our information by letting us know what you think. Is this booklet useful, easy to read and understand? Is it detailed enough or is there anything missing? How clear, relevant and helpful did you find the images and diagrams? How could we improve it?

Send your comments to us by emailing us at **eyehealth@rnib.org.uk** or by writing to the Eye Health Information Service, RNIB, 105 Judd Street, London, WC1H 9NE.

Information sources

RNIB and The Royal College of Ophthalmologists do all we can to ensure that the information we supply is accurate, up to date and in line with the latest research and expertise. This publication uses information from:

- The Royal College of Ophthalmologists' guidelines for treatment
- clinical research and studies obtained through literature reviews
- specific support groups for individual conditions
- medical textbooks
- RNIB publications and research.

For a full list of references and information sources used in the compilation of this publication, email **eyehealth@rnib.org.uk**.

About The Royal College of Ophthalmologists

The Royal College of Ophthalmologists champions excellence in the practice of ophthalmology and is the only professional membership body for medically qualified ophthalmologists.

The College is unable to offer direct advice to patients. If you're concerned about the health of your eyes, you should seek medical advice from your GP or ophthalmologist.

rcophth.ac.uk

Special thanks

A special thank you to Retina UK for their support in the developing this booklet.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RNIB Helpline

Call: **0303 123 9999**

Email: **helpline@rnib.org.uk**

Or say, **"Alexa, call RNIB Helpline"** to an Alexa enabled device.

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