



Neuromyelitis Optica

A guide to the condition



Version I

First published March 2012

Designed and printed by
Artisan Litho, Kingston Bagpuize, Oxfordshire.

Neuromyelitis Optica

If you are reading this booklet you or someone you know has probably been diagnosed with Neuromyelitis Optica (NMO) or a related condition.

Medical names can be confusing, and being given the diagnosis of any long-term condition is daunting. You may be feeling uncertain about the future and may have questions to ask.

This booklet is the first in a series of booklets designed to provide information on the diagnosis and management of NMO and to answer some of your questions.





The Walton Centre in Liverpool and John Radcliffe Hospital in Oxford are recognised as specialist NHS centres in the diagnosis and care of patients with Neuromyelitis Optica (NMO) in the UK.

These two centres aim to provide early diagnosis, treatment and advice for patients, whilst carrying out research into NMO.

Please contact either centre if you have any further concerns regarding your diagnosis or symptoms.

NMO Service
John Radcliffe Hospital
West Wing
Headley Way
Oxford OX3 9DU
nmo.advice@orh.nhs.uk
Contact: 01865-231905

NMO Service
Walton Centre Foundation Trust
Lower Lane
Fazakerley
Liverpool L9 7LJ
nmo.advice@thewaltoncentre.nhs.uk
Contact: 0151-529-8357

This booklet can be provided in other formats including large print or as an audio file, please contact either specialist centre for details, or go to www.nmouk.nhs.uk

Disclaimer

We have made every effort to ensure that information in this publication is correct. We do not accept liability for any errors or omissions, and policy and practice may change. Should you require medical advice as a result of reading the information contained within this site you should seek such advice from a registered medical practitioner.

Contents

1	Introduction	1
2	Areas of the body involved in NMO	5
3	What happens in NMO	11
4	NMO – what to expect	17
5	Diagnosis of NMO	19
6	Recognising a Relapse	25
7	Recovering from a relapse	29
8	Medical management of NMO	35
9	Healthcare Professionals you may meet	41
10	Useful Contacts	49
	Glossary of terms	52



Introduction

What is Neuromyelitis Optica (NMO) and Neuromyelitis Optica Spectrum Disorder (NMOSD)?

Although the name may be slightly different, neuromyelitis optica (NMO) and neuromyelitis optica spectrum disorder (NMOSD) are often treated in the same way. The main differences between the conditions are explained below.

Neuromyelitis Optica (NMO) (also known as Devic's disease)

NMO is an autoimmune neurological condition characterised by attacks (relapses) of inflammation in both the optic nerves (optic neuritis) and spinal cord (transverse myelitis). In some cases, an area which links the brain and spinal cord, called the brainstem may be affected. Most patients with NMO (approximately 60-80%) have proteins called anti-aquaporin 4 antibodies (AQP4) which are the cause of the disease.

Neuromyelitis Optica Spectrum Disorder (NMOSD)

However, if someone experiences one, or several, attacks involving just ONE area (either optic neuritis or transverse myelitis), AND have the AQP4 antibodies in their blood, the diagnosis of NMO spectrum disorder is given. Below is the criteria designed by a group of specialists in NMO to help guide diagnosis.

Diagnostic Criteria of NMO

Definite NMO

Two Absolute criteria:

- 1) Optic Neuritis
- 2) Transverse Myelitis

And at least 2 of 3 supportive criteria

- 1) Presence of continuous spinal cord MRI lesion extending over three or more vertebral segments.
- 2) MRI brain not satisfying diagnostic criteria for Multiple Sclerosis.
- 3) Aquaporin-4 antibody present in serum.

NMO Spectrum Disorder

Optic neuritis **OR** Transverse myelitis

AND presence of aquaporin- 4 antibodies in blood

The symptoms, diagnostic tests and the management of NMO and NMOSD are very similar or often the same. For simplicity, we will use the abbreviation NMO to mean either NMO or NMOSD.

How common is NMO?

NMO is a very rare condition. There are few population-based studies in NMO. In Europe, it is estimated that there is one case of NMO for every 100,000 people potentially affecting approximately 700 people in the UK.

NMO may be more common in people of Asian and African descent.

NMO can affect people at any age, including children.

NMO predominantly affects women, with up to 5 women being affected for every man.

Who is at risk of developing NMO?

NMO is not hereditary. You cannot pass on an increased risk of getting NMO to your children. It is possible that people with other autoimmune diseases, particularly lupus and thyroiditis, may have an increased risk of developing NMO.

It is not possible to 'catch' NMO from another person, i.e. it is not infectious.

The image is a reproduction of the famous drawing 'The Vitruvian Man' by Leonardo da Vinci. It depicts a male figure with long, curly hair and a beard, standing with arms and legs extended. The figure is inscribed within a circle and a square, which are the two primary geometric shapes used in the drawing to represent the human body's proportions. The drawing is executed in a reddish-brown ink on a light-colored background.

[illegible]

Chapter 2:

Areas of the body involved in NMO

This chapter will explain the roles and functions of the areas of the body that are commonly affected by NMO in more detail.

NMO is caused by problems within the immune system, which affect the function of the central nervous system (including the spinal cord and optic nerves). This can cause neurological symptoms and deficits, as well as abnormalities in certain tests.

The Nervous System

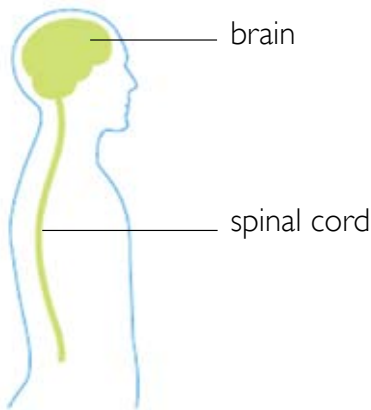
The nervous system contains a network of nerve cells (neurons) and other specialised cells. These specialised cells, called glial cells provide structural and functional support. A particular type of glial cell known as an **astrocyte** plays a role in NMO.

The nervous system coordinates all our actions including: memory, language, vision, mobility and sensation.

The nervous system is made up of two parts: central and peripheral. The central nervous system (CNS) contains the

brain and spinal cord. The peripheral nervous system consists of nerves connecting the central nervous system with the rest of the body including; muscles, joints, skin and internal organs, such as the bladder, helping to control their function.

The main areas of the nervous system affected by NMO are the **spinal cord** and the **optic nerves**. The spinal cord allows information to be exchanged quickly between the brain to the body via nerves. The optic nerves transfer information between the eyes and the brain allowing the visual stimuli to be received and conducted to the back of the brain to be processed and create the images that we see.



The central nervous system comprising of the brain and the spinal cord

Nerve conduction

Neurons send information to other cells in the body using electrochemical signals travelling along thin fibres called axons. **Axons** are usually covered by a kind of a fat membrane, called **myelin sheath**, which protects them and

helps the nerve impulse to travel more quickly (myelin works like an insulator for the electrical impulses similar to plastic insulation around an electrical cable).

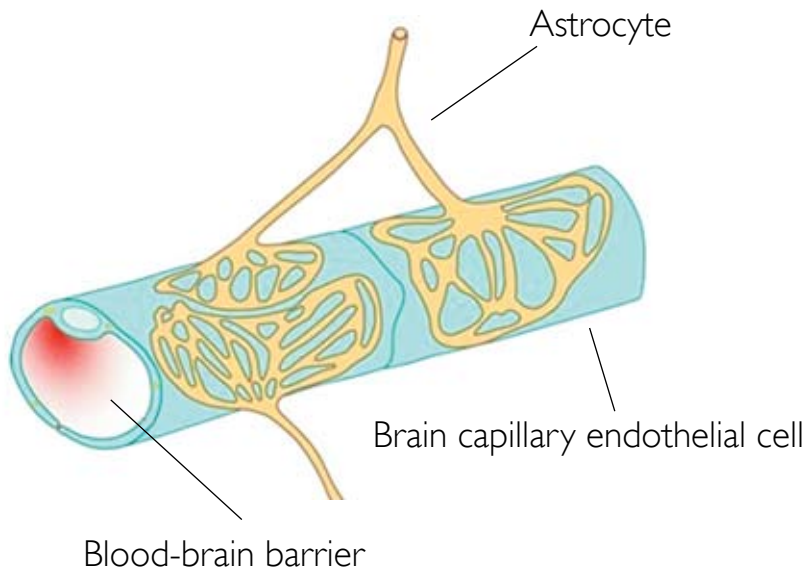
These axons provide the links within the central nervous system and between the spinal cord and muscles or internal organs.

The axons allow the nervous system to pick up signals and information from the surroundings and then transmit this information back to the brain, this is known as a **stimulus**. For example, in the case of a visual (or light) stimulus, the signal goes from the eyes directly to the brain by the optic nerve, also known as the nerve of the eye. In a similar way, in case of tactile (or touch) stimulus, the signal goes from the skin via nerves to the spinal cord and then to the brain.

Blood-brain barrier (BBB)

The BBB separates the blood from the central nervous system. The barrier exists along all the very thin blood vessels (capillaries) within the CNS.

The BBB prevents unwanted substances entering the CNS, only allowing some essential substances, such as oxygen, glucose and water, to cross it. In some rare abnormal circumstances, the BBB may become leaky in some areas and its function may be affected. This allows some substances that would not normally cross it (for example some blood cells) to get into the central nervous system.



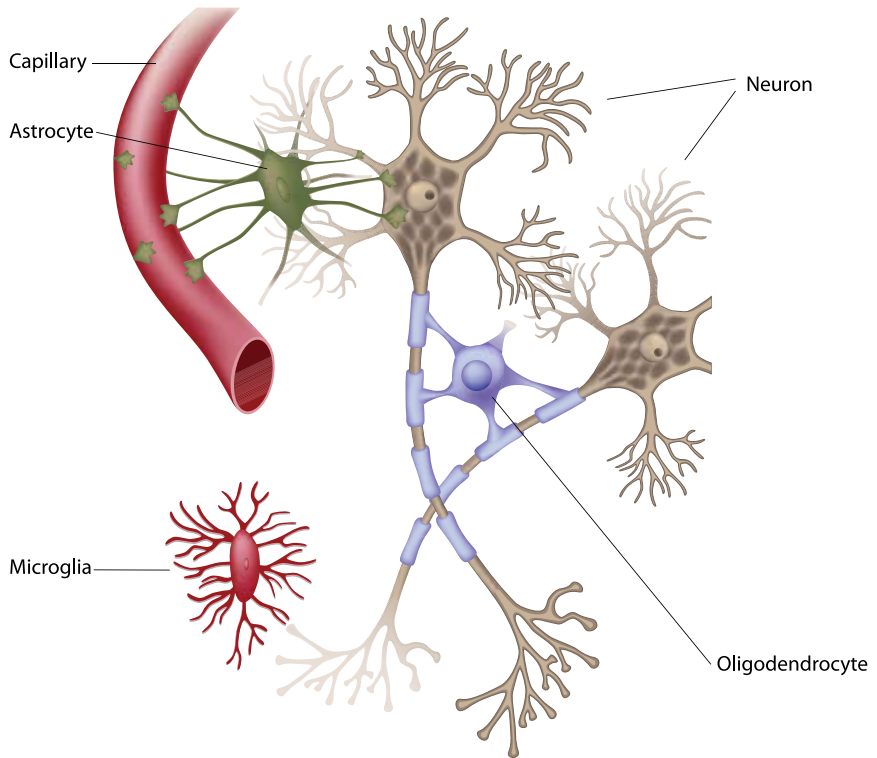
The blood brain barrier – regulating what comes into, and goes out of the CNS

Astrocytes

These cells are found all over the CNS and have a particularly important location and function in the BBB (see above). In addition to help to maintain the BBB, astrocytes seem to have a coordinating role in the brain.

They work with other types of cells to help renew and heal the myelin in the CNS. Astrocytes also contribute to the flow of water in the CNS.

To do this job, astrocytes have many pores (holes) on their surface to provide pathways for water to flow within the cells. This is known as the aquaporin-4 (AQP4) water channel. In NMO, antibodies in the blood attack the AQP4 on the astrocytes and affect their function.



Cells of the central nervous system

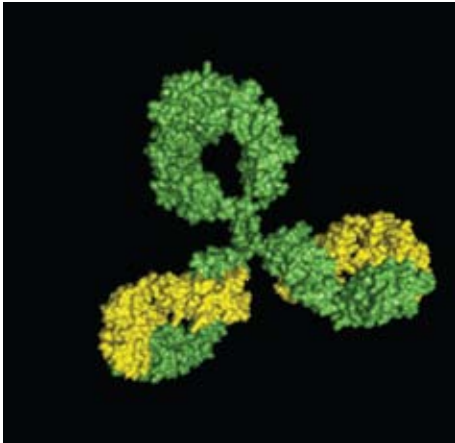
The immune system

NMO develops as the result of a defect in the immune system. The immune system protects the body against infection and is made up of white blood cells, the lymph nodes, the spleen and the bone marrow (where most of our blood cells are created).

The immune system has certain defence methods to prevent infection by bacteria and viruses. In particular, certain types of white blood cells produce **antibodies** which attack and destroy viruses and bacteria. These antibodies also allow us to recognise and defend against infections we have already encountered.

When the immune system is not functioning properly, these white blood cells can produce antibodies that attack healthy parts of our own organs and cells, such as proteins. This is known as an **autoimmune disease**.

This problem – autoimmunity – can affect any organ or system of our body. In NMO, the majority of patients have antibodies against a normal protein, aquaporin-4 in circulation in their blood.



Aquaporin-4 Antibody

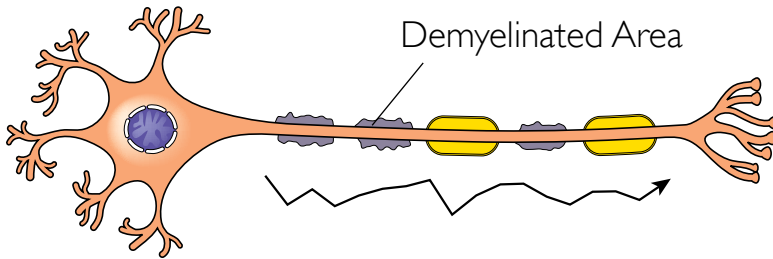
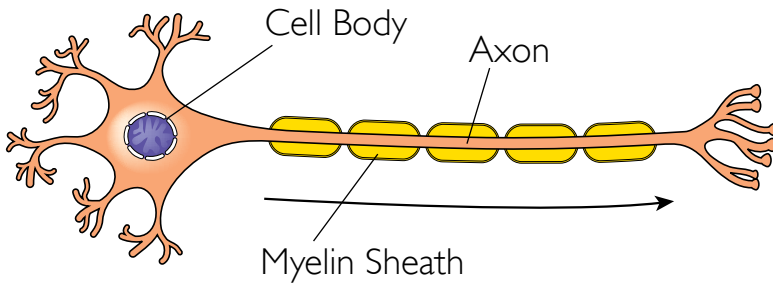
What happens in NMO

Inflammation and demyelination in NMO

Inflammation of the nervous system is similar to inflammation anywhere else in the body. It is the body's response to harmful substance (such as bacteria), and aims to combat the infection and promote healing. In NMO the harmful substance is the AQP4 antibodies produced by the immune system.

If the AQP4 antibodies are able to cross the blood-brain barrier and reach the CNS, they then attach themselves to the AQP4 on the astrocytes which causes white cells within the blood to attack the astrocytes. The white blood cells release chemicals that cause inflammation of the area around the affected astrocyte which damages this cell and potentially also of the surrounding cells and other structures within the CNS.

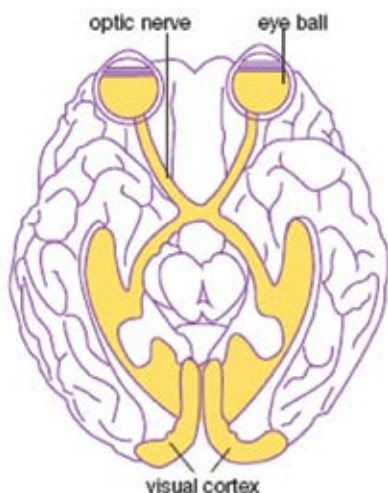
When the AQP4 antibodies attack the nervous tissue, they also damage the myelin sheath protecting the nerve, a process called **demyelination**. The combination of inflammation and demyelination may cause severe damage of the nervous tissue, which is typically seen in NMO. However, the inflammation may go away and myelin may be repaired especially if the right treatment is started rapidly.



A healthy neuron (top) has normal message conduction, where as in a demyelinated neuron (bottom) the message can be interrupted or not complete.

Optic Neuritis (ON)

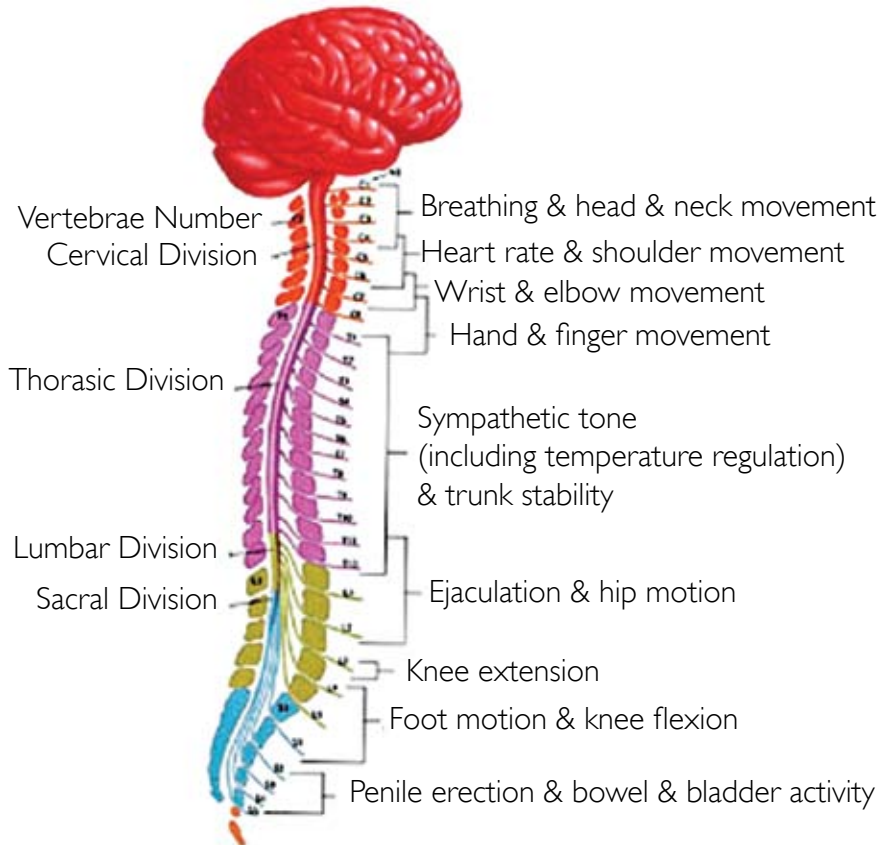
When there is inflammation within a section of the optic nerve (nerves that pass messages between the eyes and brain) it is known as **optic neuritis (ON)**.



The visual pathways of the CNS

In NMO, optic neuritis usually affects one eye, but sometimes it affects both eyes at the same time. ON causes visual disturbances, such as blurred vision, problems seeing colours, visual field defects (where sections of the central or peripheral vision is disturbed) and sometimes complete visual loss. Often it also causes pain on the around the eye and or on back of eye, particularly when moving it.

Transverse Myelitis (TM)



Each area of the spinal cord helps with the control and sensation (motor and sensory) of a certain area of the body.

Inflammation within a section of the spinal cord is known as **transverse myelitis (TM)**. TM in NMO affects 'long areas' (longitudinally extensive), usually the length of 3 or more vertebrae (or sections) of the spinal column.

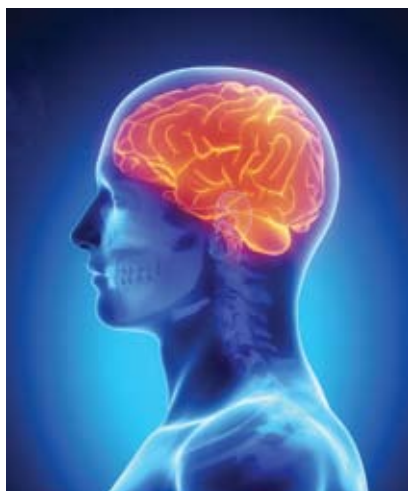
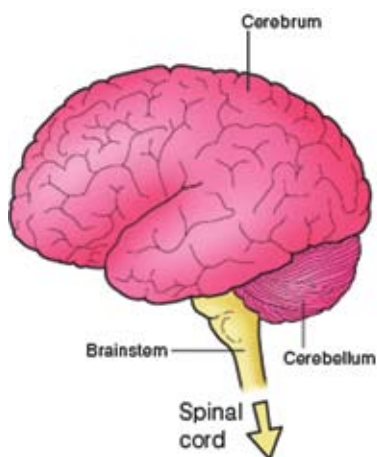
TM can have a different effect on each individual depending on which area of the spinal cord has been affected. The severity of symptoms depends on how extensive the

inflammation is and how much damage has occurred. It is important to note that unlike in a traumatic spinal cord injury (such as after road accidents or falls), function below the level of the attack isn't always completely affected, and symptoms can be "patchy".

The main symptoms of TM are muscle weakness in the legs or arms or both, altered sensations (pins and needles, numbness), bladder and bowel problems, and pain (on the back and or limbs). These symptoms may develop quickly over a few hours or gradually over weeks.

At the very top of the spinal cord there is a structure called the **brainstem** which connects the spinal cord with the brain.

It is thought to be much rarer that this area is affected in NMO. Symptoms that may be associated with an attack in the brainstem are prolonged hiccoughs, nausea and vomiting, and dizziness.



The brain and brainstem – rarely affected in NMO



NMO – what to expect

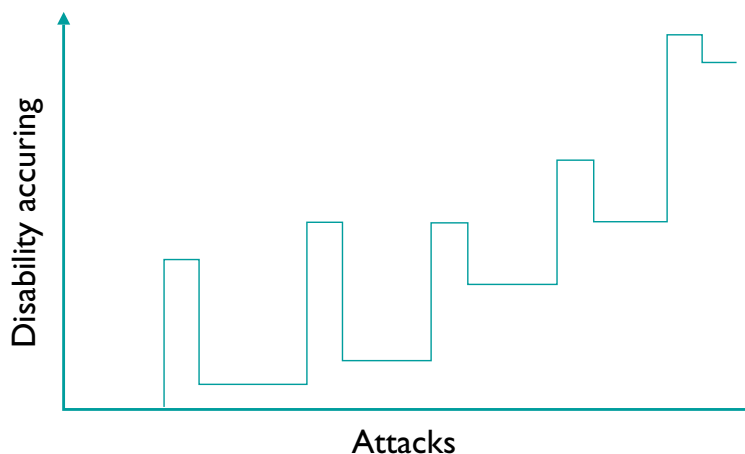
NMO generally starts spontaneously in otherwise healthy people. The disease usually has a rapid onset (it takes hours or days from the onset of the first symptoms to reach their most severe). More rarely the symptoms develop over weeks.

The symptoms people experience correspond to the parts of the nervous system affected. The most common symptoms are those of **optic neuritis** or **transverse myelitis** (as described in the last chapter); in rare cases, both eyes and spinal cord are affected more or less simultaneously. Some people may experience nausea, vomiting and hiccoughs, which may precede the eye problems or leg weakness by several days or weeks, or even months.

However these symptoms are often very treatable and the majority of people improve significantly following treatment. The speed and extent of improvement depends on a number of factors including;

- the severity of the deficits
- the time between the relapse/attack and starting treatment (the quicker the better)
- effectiveness of any additional treatments like physiotherapy.

Following the first attack, some people remain stable and free of additional attacks (relapses) for long periods of time, or even indefinitely, particularly if they are taking medication to prevent attacks.



How disability can accumulate after attacks of NMO

However, other people may find that the disease tends to re-activate and they may experience relapses at variable intervals (months or years). The frequency and severity of these relapses can be managed by adjusting the medication, for example, increasing the dose or switching to an alternative medication.

In general, NMO tends to follow a recurrent course. Around 75% of the NMO patients with AQP4 antibodies have this pattern of recurrent attacks with either new or old symptoms.

People with NMO usually do not experience a clear gradual neurological decline caused by the disease between attacks. The neurological deficits tend to improve over time in patients with long periods without attacks. The cumulative disability people tend to experience seems to be worse if there are repeated NMO attacks.

Diagnosis of NMO

How is NMO Diagnosed?

A diagnosis of NMO is usually made by a neurologist, they will take a detailed medical history and perform a clinical examination. These examinations will take in to account;

- current neurological problems
- any previous neurological symptoms or problems in the past
- signs of old neurological abnormalities

They will also consider manifestations of other autoimmune diseases that may affect other organs.

Following this some special investigations are then requested and analysed to confirm the diagnosis of NMO:

Magnetic Resonance Imaging (MRI) of brain and spinal cord

MRI has become a key tool in the diagnosis of NMO.

Magnetic fields create images of the brain and spinal cord.

The person undergoing the scan lies on a padded bench which slides inside the scanner. The MRI scan usually takes approximately 30 minutes, it is painless but noisy and you have to lie still.

The MRI of the brain often appears normal; the MRI of the spine often shows inflammation extending over 3 vertebrae, usually affecting the neck (cervical) and mid-spine (thoracic) areas, especially during a relapse.



An MRI with green line highlighting the transverse myelitis stretching over numerous vertebral segments

Aquaporin-4 antibody blood test

Blood tests are also requested, particularly to look for AQP4 antibodies and other relevant autoantibodies, related to other autoimmune diseases that patients sometimes have. The presence of aquaporin-4 antibodies is highly specific to a diagnosis of NMO or NMO spectrum disorder. There are between 20-40% of patients clinically diagnosed with NMO or NMOSD who do not have detectable levels of aquaporin-4 Antibodies in their blood.

Lumbar Puncture

Cerebral Spinal Fluid (CSF) is the watery liquid that surrounds and protects the brain and spinal cord. A lumbar puncture (LP) requires a small amount of CSF to be drawn from the spinal cord with a needle. The CSF may show if there is any active inflammation. This procedure only takes a few minutes and is normally done under a local anaesthetic. Some people may experience a headache after the procedure. It can be avoided by lying flat for a few hours after the test and having plenty to drink.

Ophthalmological tests

If someone experiences changes in their vision that are not obvious to diagnose, then special tests may be needed to look for inflammation/damage. These may include:

- Visual Acuity Tests

These are used to check general vision using a “snellen chart” (see image right)

Testing a patients vision can aid diagnosis.



- Visual Field Tests

These show whether there are any areas of vision missing.

- Low Contrast Test

By testing vision against increasingly faded images, it is possible to test how 'washed out' someone's vision has become.

- Ishihara Test

This is a series of 16 images that detect minor changes in colour vision sensitivity.

- Optical Coherence Tomography (OCT)

This is a very fast scan that can measure the thickness of the nerve fibres in the optic nerve. At present this is used more in research.

- Visual Evoked Potential (VEP)

This measures damage to the optic nerve. The person undergoing the test is shown a flashing chessboard pattern on a computer screen. Electrodes are placed on the scalp to measure the speed that messages take to be sent between the eye and brain along the optic nerve. Damage to the optic nerve shows slower response time.

Other conditions that may be considered as a diagnosis rather than NMO

Neuromyelitis optica (NMO) can easily be mistaken for a number of other conditions that have similar symptoms. Therefore the neurologist and the rest of the team will consider other diagnoses, that can be excluded. These include:

- Multiple Sclerosis (MS) – MS is an autoimmune condition of the CNS.
- Transverse Myelitis (TM)- a single episode of myelitis without AQP4 antibodies
- Acute Disseminated Encephalomyelitis (ADEM) – an acute (short term) condition that affects the brain and spinal cord and usually does not recur.
- Systemic Lupus Erythematosus (SLE) – an autoimmune condition that can cause inflammation in several organs and parts of the body such as joint, skin and kidney.
- Virus induced inflammation – inflammation that is caused by viral infection



Recognising a Relapse

Recognising a relapse and what to do

What is a relapse?

A relapse, or an 'attack' of NMO, occurs when there is inflammation within the nervous system. In NMO, this inflammation is usually within the optic nerve and the spinal cord. The inflammation causes people to experience new symptoms, or recurrence of symptoms that they have had previously.

Why do relapses happen?

We don't understand what causes or triggers a relapse. Relapses are usually unpredictable and there is nothing that you may have done to cause them. Occasionally, a relapse may be triggered by infection or by stress.

What symptoms do relapses cause?

In people with NMO, relapses usually affect either the optic nerve or the spinal cord.

Optic neuritis

When relapses affect the optic nerves they cause problems with vision. Symptoms normally come on over a period of hours or days, or people may wake up one morning with visual symptoms. The eye may be painful when looking around, or pain may be felt behind the eye. This may last for a few days. At its mildest, this can cause colours to look faded or 'washed out'. In more severe attacks, vision

may be blurred or be lost completely.

Brief 'stabbing' pain in and around the eye lasting only a few seconds or minutes is unlikely to be caused by a relapse. Many people with NMO find that their vision varies from day to day, for example if tired.



People with NMO may also experience relapses affecting the spinal cord. The spinal cord controls strength and sensation in the arms, legs and trunk and is also involved in bladder and bowel control. Inflammation in the spinal cord may cause many different symptoms including:

- Weakness in the arms and/or legs,
- Tingling, numbness or abnormal sensations in the arms, legs, groin or trunk
- Severe pain in the neck or between the shoulder blades
- A band like sensation around the trunk, like being squeezed or wearing a corset
- Problems with the bladder such as difficulty or inability to pass urine, feeling of incomplete bladder emptying, or incontinence of urine
- Constipation or loss of control of bowel movements.

Each of these symptoms may occur individually, or as a combination of symptoms. Usually symptoms develop over hours or days. They are significant if they last for longer than 24 hours.

What should I do if I think I'm having a relapse?

It is important to remember that **most relapses of NMO need to be assessed and treated promptly.**

Please follow the guidelines below.

If you feel that there is a sustained deterioration in your vision or experience any of the symptoms described above which lasts for longer than 24 hours,

Please contact your NMO Nurse Specialist.

John Radcliffe Hospital, Oxford
01865 231 905

Walton Centre for Neurology,
Liverpool
0151 529 8357

If you have problems out of hours, your GP can contact the on call neurologist at either hospital for advice.

Also contact your local neurologist or GP.

www.nmouk.nhs.uk



- Your NMO nurse will take a history of your current symptoms, considering current treatments, other illness (such as colds, infections) and how the symptoms are currently affecting you.
- Following discussion with the medical team, a plan will be devised on how best to assess and treat your relapse. This may involve asking your local neurologist to see you, or if possible ask you to come to your nearest NMO centre.
- Every patient, and every relapse will have different features and the treatment will depend upon your individual needs.
- It is important that you are assessed quickly during a relapse, as early treatment may prevent long term damage.

Recovering from a relapse

The time taken to recover function after a relapse can vary hugely from person to person.

An important factor to always consider is that any new symptom or sustained worsening of an existing symptom (over 24hrs) should be reported to NMO team, your neurologist or general practitioner or NMO team for further assessment. Early assessment and treatment can improve outcomes on recovery from a relapse.

This is covered in much more detail in the section on Relapses in NMO.

Why do Symptoms persist after the relapse has recovered?

Over time many of the symptoms may improve of their own accord, aided by treatment received. Symptoms may improve over 2-6 months. However, if the nerves have been damaged or destroyed new pathways can not be made, persistent visual changes and symptoms of transverse myelitis may occur.

Some people will have very few residual symptoms from a relapse, others may have more. The severity will also be different between individuals.

The symptoms are treated with either medication or therapy to try and improve daily 'lifestyle.' The medications do NOT prevent further relapses. There is no 'right' drug as individuals respond differently to different treatments. You may have to trial several regimes to find the most suitable drug for you.

- **Neuropathic (nerve) pain** arising directly from damaged nerves in the spine, there are no particular triggers, this pain is described as burning, sharp, electrical shock, shooting or an uncomfortable numbness. Medication suggestions are amitriptyline, gabapentin, pregabalin and carbamazepine.



- **Nociceptive (musculoskeletal) pain** often a more obvious cause, such as banging your knee. In NMO, most common cause is pressure on joints from altered gait (the way you walk), medication suggestions such as paracetamol or ibuprofen may be helpful.
- **Increased muscle tone and spasms** arises from damaged nerves in spinal cord that affects the control of muscles, including when they contract and relax. This can present as prolonged contractions of the muscles, which are called spasms. Medication suggestions are baclofen, tizanidine, gabapentin.
- **Tonic Spasms** which are painful spasms of the muscles that can be frequent and last from seconds

to minutes. Current treatments include Gabapentin and Carbamazepine.

- **Joint Stiffness** is a discomfort after a period of inactivity (such as waking up in the morning or sitting for an extended period of time.) Exercises and stretching are often useful.
- **Muscle weakness** is a reduction in the strength in one or more muscles affecting mobility (legs) or activity (arms), there is no medication to improve weakness. Exercise and stretching can be beneficial.
- **Bladder symptoms** include urgency, hesitancy, frequency and nocturia (passing urine at night) of micturition and retention (unable to pass urine) due to damage on the spinal cord, medicines like oxybutynin or solifenacin may be helpful or learning intermittent self catheterisation, (a very simple technique) which helps manually empty the bladder.
- **Bowel symptoms** mainly constipation, urgency and sometimes faecal incontinence also due to damage on the spinal cord and immobility, laxatives, high fibre diet and fluids, abdominal massage may be useful



- **Sexual dysfunction** – men may experience difficulty getting an erection, or reaching orgasm, and women may also have difficulty reaching orgasm due to lack of sensation and numbness.
- **Osteoporosis (brittle bones)** – this may be the result of long-term use of steroid medication or a lack of weight-bearing activities
- **Depression** – changes in lifestyle associated with the complications of NMO can increase the risk of developing depression
- **Visual symptoms** – at present there are no medications proven to improve visual function after an episode of optic neuritis, however there are many visual aids available.

What about managing permanent disability?

Many of the symptoms experienced in NMO overlap or have knock-on effects on each other. For example; pain interferes with activities such as housework, work, exercise and consequently can have an impact on a person's mood, affecting family relationships. Though problems can be tackled individually, a multi-disciplinary approach is essential to provide holistic care.

Combined efforts by doctors, nurses, occupational therapists, physiotherapists, orthoptists and social services will help the complex requirements of each individual person. Visual aids, walking aids, motorised wheelchairs, and home adaptations can improve quality of life remarkably.

Can symptoms that have been present for many years improve significantly?

It is rare for this to happen. Physical adaptations (modifications in house, wheelchair etc) and lifestyle modifications (change of job, moving to a single floor house) should be planned in advance and money spent wisely rather than waiting for 'miracles to happen' or trying out costly alternative medicines or exotic cures.

Please see the three part series of booklets available - "Living with NMO"

How severe can NMO be?

NMO is a broad spectrum with every person being affected differently. This ranges from people who only experience mild symptoms, such as a mild attack of optic neuritis or myelitis with near complete recovery and no further relapses, to people who experience more severe symptoms and effects of the condition.

Some of the more severe effects may include loss of vision, in one of both eyes, a degree of paralysis in limbs due to damage of the spinal cord in the neck and in rare cases some breathing difficulties.

However, with early diagnosis and effective treatment many of these symptoms can be managed effectively, allowing people to reduce the impact on their daily lives.



Medical Management of NMO

Management of NMO

At present there is no definitive 'cure' for NMO, treatment focuses on the following key areas:

- a) Treating acute attacks/relapses
- b) Preventing relapses
- c) Treating the residual symptoms of the relapse

Managing a relapse

High dose steroids, methylprednisolone (solumedrol) are usually given during a relapse. Steroids (also known as immunotherapies or immunosuppressants) work by dampening the immune system and reducing inflammation around the site of nerve damage. They can be given:

- Intravenously (through a vein) 1g daily for 3-5 days or
- Orally (taken by mouth) 500mg-1g daily for 3-5 days,
- In combination of intravenous and oral, followed by a course of oral steroids over several months.

If steroids don't help, what next?

When attacks progress or do not respond to steroid treatment, there are further treatment options that may be considered. These include, plasma exchange or intravenous immunoglobulins.

Plasma Exchange (PEX)

This treatment aims to remove the harmful APQ4 antibodies from circulation in the blood. Using a specialised technique, the blood is drawn out of the body and part of the blood known as the plasma (which contains the antibodies) is separated. The blood is then returned back into the body with plasma that does not contain the antibodies.

Immunoglobulins (IVIg)

Immunoglobulin aims to work in a similar way to PEX, the immunoglobulin is a part of the blood contained in plasma. It contains proteins taken from the blood donations of thousands of donors and its mode of action is not completely understood. IVIg is also used as a method to suppress inflammation and reduce the antibody levels in the blood.

Preventing relapses

Treatment and management of NMO aims to reduce and prevent the relapses experienced, as these can cause increased symptoms. Immunotherapies (such as the steroid prednisolone) are powerful medicines that dampen down the activity of the body's immune system. Additional treatments such as azathioprine, methotrexate or

mycophenolate are used to allow reduction of steroids. As with all treatments that reduce the activity of the immune system, patients are at a higher risk from infections that the body would normally combat. Therefore, careful monitoring will be given whilst on these therapies including, blood tests for a full blood count, kidney and liver function.

Low dose long term steroids

Steroids are good immunosuppressants. After a diagnosis of NMO, oral steroids are used until other treatments are in place (azathioprine for example can take 3-6 months to get to an effective level). In many patients relapses may occur even on gradual reduction of the steroids and they may need to continue on a low dose of steroids for longer periods. Often a maintenance dose is required.

Long-term treatment side effects including, weight gain, acne, indigestion, cataracts, osteoporosis (thinning of the bones), deterioration of the head of the thigh bone and diabetes. To reduce the side effects of prednisolone other medication is taken such as an antacid (omeprazole, lansoprazole) and tablets for bone protection (alendroic acid and calcium supplements).

Azathioprine (also known as Immuran), Methotrexate and Mycophenolate

These are more powerful treatments to suppress the immune system. They all have side effects that are well understood, but need to be explained to you before you take the medication. Please See the individual information sheet for each medication.

Further treatments available

If this first group of treatments do not manage the condition effectively enough so called 'second line' treatments may be tried. These are more powerful medications that suppress the immune system more than the standard treatments. As with most medications, the more effective they are, the higher the risk of side effects. This is always a consideration when offering medications.

Rituximab

This is an intravenous medication, given in a course of 2 infusions 2 weeks apart, followed by a 6 month break until the next course. As with many of the NMO treatments, it works by reducing the number of cells that produce the harmful AQP4 antibodies in the blood.



Patient receiving an intravenous infusion of Rituximab

Mitoxantrone

This is a treatment that also aims to reduce the activity of the immune system, thereby reducing the number of antibodies in circulation. It is also commonly used in cancer treatment.

Cyclophosphamide

This is another well established chemotherapy that suppresses the immune system. There is very little evidence for its use in NMO.

What about complimentary therapies?

Complementary therapies can be used to target a specific physical, mental, emotional or spiritual problem, or as a preventative measure or purely for relaxation, and may increase your feeling of well-being. Reflexology, Massage, Reiki or Acupuncture may improve relaxation, sleep patterns, relieve pain or reduce stress and tension.

There is little research to show how effective many of these treatments may be. Therefore, they should not replace the pharmacological treatments that your Consultant Neurologist, GP or other health professional prescribe to you, but they may complement their effect.

Potential future treatments for NMO

NMO is a very rare condition, as such a lot of the research and clinical trials in to the condition and future treatments are carried out at specialist centres like the John Radcliffe and Walton Centre.

Your local NMO team will be able to provide you with the most up to date information on the ongoing trials and research.



Health Professionals you may meet

What are their roles in your care?

Most patients have many different people working together to provide healthcare and support. This section helps to section aims to clarify what they all do to help manage your NMO.

General Practitioner (GP)

Everybody who lives within the UK should be registered with a general practitioner (GP). The GP is primarily responsible for providing comprehensive healthcare to every individual seeking medical care. The GP arranges the day-to-day care you may need, such as prescribing medications and monitoring blood results.

Your NMO specialist centre will liaise very closely with your GP to ensure that all aspects of your care are monitored and updated as necessary.

Local Neurologist

A Consultant Neurologist uses their expertise and knowledge to diagnose your symptoms and may refer on to our services for further advice with diagnosis and management.

Your local neurologist will be closely involved in your care alongside the NMO service. You may be seen by your local

neurologist for regular follow up or perhaps if you need to be admitted to your local hospital.

NMO Specialist Neurologist

The NMO Specialist Neurologist ensures that the correct diagnosis is reached and offers most appropriate treatment for anyone with a diagnosis or suspected diagnosis of NMO.

They are responsible for leading and managing your care, working closely with the specialist nurses and other members of the NMO team to ensure you receive the best possible care.

Consultant Paediatrician

For children and adolescents with NMO, all care is managed by a consultant paediatrician who works closely with the NMO clinical team. In a similar way to the NMO Specialist Neurologist, the Consultant Paediatrician will work closely with local doctors and therapists to ensure continuity of care for their patients



NMO Nurse Specialist

The NMO Nurse Specialist is your first point of contact for any concerns you may have about your NMO. Your NMO nurse specialist will take time to discuss your diagnosis, problems that you may encounter and the implications with you, answering questions you may have.

Your NMO Nurse Specialist provides;

- A point of contact when you are worried or concerned about **any** new symptoms or worsening of existing symptoms.
- A source of information on the condition, symptoms, medications and therapies available
- Support with relapse concerns
- Liaison and referral with your local healthcare professionals such as neurologists, continence advisors and therapists.
- Assessment and advice on your symptoms.
- Information regarding NMO and medications to increase your understanding

An important role of the NMO Nurse Specialist is to provide education to other healthcare professionals who come into contact with NMO patients (such as GPs, MS Specialist Nurses and Neurology unit ward staff) about NMO.

The NMO advice line and email service is run by the NMO nurse specialist, who directs queries, or answers them as appropriate.

Immunologist

As mentioned in the first chapter, NMO is associated with an antibody found in the blood. In the UK, this test is done at the John Radcliffe Hospital. This team of scientists work very closely alongside the clinical team to continue developing the services and to share expertise.

The John Radcliffe lab team test hundreds of samples per month from all over the world. They are constantly updating and improving their test to ensure that patients who have the antibody are identified very quickly to aid a prompt diagnosis.

Consultant Ophthalmologist

The consultant ophthalmologist is an expert in the assessment of visual problems such as Optic Neuritis. The consultant ophthalmologist may also arrange scans and other tests to assess your vision.

They discuss their findings with the NMO Neurologist, as well as linking patients with persistent visual problems into the appropriate local support services for visually impaired people.

NMO Clinical Fellow

A clinical fellow is a doctor who is gaining experience in a specific area (in this case, neurology) to become a consultant. They have interests in clinical care as well as actively undertaking research projects.

You may meet a Clinical fellow if you visit the NMO clinic or are admitted to the hospital, and they may invite you to participate in research.

Orthoptist

The role of Orthoptist is to carry out an assessment of your vision and discuss your day-to-day visual needs and

to ensure any visual defects are taken into account when treatment is being planned. The Orthoptist will give advice in the NMO clinic and liaise with your local visual rehabilitation team as required to ensure seamless care.

Physiotherapist (PT)

The role of physiotherapist is to identify and make the most of movement. The physiotherapist will assess any physical problems you have identified examples such as reduced balance, limb weakness, stiffness, spasms. Discussion around current levels of activity/exercise/physical care programmes and advice regarding prevention, treatment and rehabilitation.

You are encouraged to take an active role to help make the best of your independence and function.

Referral to local services for further input or for provision of some aids such as walking sticks, hand supports, wheelchairs can be made.

Occupational Therapist (OT)

The role of the occupational therapist is to maintain your independence in everyday activities that you want and need to do. This includes activities that you may be finding difficult or have stopped doing due to your symptoms, such as fatigue, personal care, domestic tasks, hobbies and employment activities. Occupational therapists work with you to problem solve and find different ways of doing things or suggest alternative activities to maintain your independence and well-being.

Clinical Psychologist

The role of a Clinical Psychologist is to support people with the emotional adjustment to having NMO or being close to someone with NMO. Psychologists are different from psychiatrists in that they don't diagnose mental health problems or prescribe medication. By looking at emotional problems in the context of the whole of your life, they can discuss strategies to start to address problems. They can also assess memory and thinking problems and suggest strategies that can compensate.

Some self-help information can be offered and we will discuss what psychological support you could access near where you live.

The Dietitian

The role of the dietitian is to provide advice on nutrition and health. Dietitians also advise about food related problems. For people with NMO, advice may be given for weight management (weight gain or loss) or for optimising nutritional status.

Continence Adviser

Due to the nature of the condition, people may experience symptoms relating to bowel and bladder function. Bladder and bowel problems can restrict employment, educational and leisure opportunities and lead to social embarrassment and isolation affecting both physical and mental health. The continence adviser will assess bladder and bowel problems, review medication regime, suggest pelvic floor and anal sphincter exercises to improve urinary and faecal incontinence and provide advice regarding healthy living especially diet and drinking appropriate fluids.

Pain management team

Most patients with chronic pain problems find pain stressful to deal with. It is frustrating to be limited physically and makes people feel miserable at times. Pain interferes with social activities and can start to affect our relationships with other people.

Many patients who have long term pain problems report that they have been to a variety of specialist clinics in the past with a range of different experiences. The staff in the Pain Management Team often includes Consultants, Nurses, Physiotherapists Occupational Therapists and Psychologists function in an 'interdisciplinary' way. This approach ensures that your care is co-ordinated, and they will help you to understand your pain problem and your treatment goals.

Other contacts

NMO Service Coordinator

To ensure that the service is administered effectively, the NMO Coordinator has close contact with all the healthcare professionals previously mentioned. They also arrange clinics, admissions, investigations requested by the neurologists (such as MRI) and the transfer of information between these healthcare professionals. You may also receive calls from the coordinator to remind you of your appointments.

They should be contacted to arrange appointments, request letters/patient information or as a point of contact if you are unsure who to direct a query to. The NMO Coordinator has daily contact with the clinical team and is therefore an excellent resource for patients.

Volunteer Patient Liaison

The role of the patient liaison is to offer informal support to individuals and their families affected by NMO and arrange contact with others in a similar position.

Useful contacts

The National Specialist Services have recognised NMO and NMO spectrum as a rare condition and have funded a UK NMO service .

Contact the NMO Service at Liverpool

NMO Specialist Nurse

Tel: **0151 529 8357**

Email: nmo.advice@thewaltoncentre.nhs.uk

Contact NMO service at Oxford

NMO Nurse Specialist

Tel: **01865 231905**

Email: nmo.advice@orh.nhs.uk

How to get appointments for clinic

A letter from GP or consultant neurologist asking for a clinic appointment.

NMOUK

Provide information on diagnosis, treatment and management of NMO and answer some of your questions. There are sections for different aspects of living with NMO Latest news and reviews of NMO. We hope this becomes an interactive website.

www.nmouk.nhs.uk

The Guthy-Jackson Charitable Foundation

The Guthy-Jackson Charitable Foundation is an American charity dedicated to funding basic science research to find answers that will lead to the prevention, clinical treatment programs and a potential cure for Neuromyelitis Optica (NMO) Spectrum Disease.

www.guthyjacksonfoundation.org

The Transverse Myelitis Society

Support and information on transverse myelitis

35 Avenue Rd

Brentford

TW8 9NS

www.myelitis.org.uk

Royal National institute for the Blind RNIB

Supporting blind or partially sighted people

105 Judd Street,

London WC1H 9NE

0303 1123 9999

www.rnib.org.uk

Brain and Spine Helpline

Run by neuroscience nurses, providing support and information on all aspects of neurological conditions for patients, their families and carers and health professionals.

Brain and Spine Foundation

Tel: 0808 808 1000

www.brainandspine.org.uk

Children and Adolescence

Inflammatory Demyelinating diseases are a group of illnesses which affect the coating (myelin) of nerve cells in the brain and spinal cord, (including NMO) and can occur, though they are rare, in childhood and adolescence. Many children recover well from a demyelinating event which may cause muscles to become weak or senses like vision to become poor.

www.childdemyelination.org.uk

Glossary of terms

We hoped to cover most definitions within the text; however you may find this page useful to refer to as you read.

Antibody – A protein that recognises foreign cells in the body and initiates their destruction.

Aquaporin-4 – A protein which allows water to leave and enter certain cells in the central nervous system.

Autoimmunity – the failure of the body in recognizing its own parts as self, which allows an immune response against its own cells and tissues, causing damage.

Astrocyte – A supporting cell in the central nervous system, which appears to be targeted in NMO.

Blood-Brain Barrier (BBB) – junction between the blood supply and the central nervous system, which regulates what comes in and out.

Brainstem – junction that connects the brain with the spinal cord. This is rarely affected in NMO.

Central nervous system – the brain and spinal cord.

Demyelination – the break down of the myelin sheath.

Immune system – the various cells and organs that protect the body from viruses, bacteria and other illness.

Immunosuppression – Medication that purposefully weakens the immune system. This is the aim of NMO treatment.

Inflammation – a protective attempt by the organism to remove the cause of damage and to initiate the healing process.

Longitudinally Extensive Transverse Myelitis (LETM) – an inflammatory and demyelinating attack on the spinal cord causing symptoms.

Myelin – a layer of insulation around a nerve, speeding up the transfer of electrical messages.

Optic Neuritis (ON) – an inflammatory and demyelinating attack on the optic nerve, causing visual symptoms.

Relapse – a new “attack” of NMO, which can affect optic nerves, spinal cord or brain/brainstem. Occasionally more than one area can be affected at once.

Symptom – an impairment that is left after recovery from a relapse, for example pain or reduced vision.

White blood cells – the group of cells within the blood that regulate the immune system and mount the immune response to illness.

Notes

Feedback Form

This booklet was written to ensure people received well researched and accurate information on their condition.

We would be very grateful if you could send back this anonymous tear out feedback page to the provided address. It may be best to do this a few weeks after you have started using the book, so you have a good idea about its uses and limitations.

Please circle the answer most appropriate to you.

How easy was the booklet to understand in terms of the words used?

too simplistic	very easy	easy	difficult	too difficult
-------------------	--------------	------	-----------	------------------

Can you give examples?

Did the diagrams help your understanding of NMO?

no	somewhat	yes
----	----------	-----

Can you give examples?

Did this booklet answer the questions you had about NMO?

no somewhat yes

Can you give examples?

This is the first booklet in a series. We plan to write information sheets, covering a wide range of topics.

Which three topics would you like to see covered in these information sheets?

- 1) _____
- 2) _____
- 3) _____

Please leave any comments in the section below

We would greatly appreciate you posting this questionnaire to:

**NMO Service, John Radcliffe Hospital, West Wing
Headley Way, Oxford OX3 9DU**

Thank you for your feedback.

About the Authors

Kerry Mutch – NMO Nurse Specialist

Kerry spent 9 years as an MS Specialist nurse, after gaining experience in many other areas of nursing, including neuro rehabilitation. Kerry has worked tirelessly to ensure equal access to the specialist services for NMO patients across the UK. Kerry has previously involved in using her clinical experience to develop information for MS patients and outside of work can usually be found in her hiking boots in the Lake District.

Jon Revis – NMO Nurse Specialist

Jon has spent his years since graduating as a nurse working in the neurology department at The John Radcliffe Hospital in Oxford. He has a longstanding interest in Multiple Sclerosis, working as a MS Specialist nurse for 2 years prior to helping develop the National Neuromyelitis Optica service. He has a keen interest in the effects of mood on wellbeing and outside of work can be usually found cycling.

We would like to thank the following people for their contributions:

Dr A. Jacob
Dr J. Palace
Dr M.I. Leite
Dr J. Kitley
Dr L. Elson
Dr P. Waters
Kay Day

Thank you also to the clinicians who helped guide this publication.



www.nmouk.nhs.uk