Multiple Sclerosis

A Nursing Update

IOMSN
International Organization
of Multiple Sclerosis Nurses

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Provided to you by the International
Organization of Multiple Sclerosis Nurses

IOMSN

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Foreword

On behalf of the International Organization of Multiple Sclerosis Nurses (IOMSN), it is my pleasure to present this monograph designed especially for infusion nurses.

The ultimate goal of the IOMSN is to improve the lives of those affected by multiple sclerosis (MS) through the provision of appropriate healthcare services. Our mission focuses on educating the healthcare community about MS.

The objective of this monograph is to provide a basic understanding of MS and the treatment options available for patients. With the increase in pharmacologic treatments for MS, infusion nurses have become integral members of the MS care team. This monograph captures the shared experiences of MS nurse specialists and infusion nurse specialists. It provides information about the diagnosis, symptoms, and disease courses of MS.

In the past 10 years, the emergence of new and effective treatments has improved the lives of those with MS. Many of the treatment protocols are complex. This monograph details these treatments, including rationale for treatment, benefits, and side effects, as well as tips to manage these side effects. Additionally, treatment challenges specific to MS are addressed. The monograph ends with case studies to help illustrate the varied needs of people with MS. A list of resources and references is also provided for additional information.

The IOMSN is proud to present this type of MS educational material. It is our hope that this monograph will help answer questions you may have about MS and medications used in the treatment of this disease. We also hope to assist nurses in providing high-quality care for patients and families affected by MS.

We look forward to your comments about this monograph. Please feel free to visit us at www.iomsn.org.

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Overview of Multiple Sclerosis

Historical Overview of Multiple Sclerosis Treatment

Until the early 1990s, no therapies were proven to alter the natural history of multiple sclerosis (MS) in patients with relapsing forms of the disease. Treatment was limited to providing symptomatic relief, either pharmacologically or nonpharmacologically; intermittent access to rehabilitation services; and sporadic counseling and education. For example, fatigue was managed by advising people to alter their lifestyles to allow for frequent rest periods. Acute relapses were treated with either oral or intravenous corticosteroids, usually in the hospital. Home infusions became a norm during the 1990s due to reimbursement issues by third-party insurance carriers and consisted of intravenous methylprednisolone for 3 to 5 days, and in some areas of the world, intravenous immunoglobulin (IVIG). A chemotherapeutic agent, cyclophosphamide, was used for progressive disease but was not approved by the US Food and Drug Administration (FDA) for this indication, although it was administered intravenously usually in a hospital or an outpatient infusion center.

Although symptomatic relief is still a major part of MS treatment, new and unique medications known as disease-modifying therapies have been approved by the FDA and are available to offer hope that the natural course of disease progression may be halted or at least delayed for people with relapsing forms of MS. These medications, which are self-injected by patients and families, have been shown to reduce the number of relapses, preserve abilities, and sustain a full quality of life.[1-6]

What Is MS?

MS is an autoimmune disease that causes inflammation and tissue loss (demyelination and axonal damage) in the central nervous system (CNS). MS is most often diagnosed in young adulthood and occurs more often in women than in men.[7] The cause of MS is unknown, although genetic and environmental factors may contribute to a person's risk of developing the disease.[8] In MS, the body's immune system induces damage to neurons in the brain and spinal cord resulting in inflammatory lesions, which are hallmarks of the disease that can be seen on magnetic resonance imaging (MRI) scans. Inflammation causes ongoing destruction of myelin and can result in the deterioration and loss of axons, leading to a loss of communication among cells. Eventually, the loss of axons results in the death of affected neurons and loss of brain tissue (atrophy). Of note, axonal degeneration, which may lead to permanent neurological dysfunction, can occur early in the disease course.[9]

How Is MS Diagnosed?

A diagnosis of MS is made when there is evidence that the inflammatory lesions have occurred in more than one area of the brain or spinal cord and in more than one instance. A neurologist can make the diagnosis based on the person's report of neurologic symptoms and functional change, findings on a comprehensive neurologic examination, and the presence of typical lesions in the CNS as seen on MRI scans (Table 1).[10] Decades ago, it took months or years to diagnose MS. Today, with advances in our understanding of MS and improvements in diagnostic skills and MRI technology, MS can be diagnosed more promptly. Traditionally, a formal diagnosis of MS was made after 2 episodes or "attacks" of unexplained neurologic symptoms had occurred.[11]

Clinical isolated syndrome (CIS) or monosymptomatic onset is the term for a patient who has had just one of these attacks, plus MRI findings indicative of demyelination. A definitive diagnosis of MS may not have been made, but the findings are suggestive of the disease. For example,

Table 1. 2005 Revisions to the 2001 McDonald Criteria for Diagnosing MS[10,12]

Clinical Presentation	Additional Data Needed
• 2 or more attacks • 2 or more objective clinical lesions	None
• 2 or more attacks • 1 objective clinical lesion	1 in space, demonstrated by: • MRI, or • Positive CSF and 2 or more MRI lesions, or • Further clinical attack involving different site
• 1 attack • 2 or more objective clinical lesions	Dissemination in time, demonstrated by: • MRI, or • Second clinical attack
• 1 attack • 1 objective clinical lesion (monosymptomatic presentation; clinically isolated syndrome)	Dissemination in space, demonstrated by: • MRI, or • Positive CSF and 2 or more MRI lesions Dissemination in time, demonstrated by: • MRI, or • Second clinical attack
• Insidious neurologic progression suggestive of MS (primary progressive MS)	1 year of disease progression (retrospectively or prospectively determined) **and** 2 of the following: • Positive brain MRI (9 T2 lesions or 4 or more T2 lesions with positive VEP), • Positive spinal cord MRI (2 focal T2 lesions), and • Positive CSF

MRI = magnetic resonance imaging; CSF = cerebrospinal fluid; VEP = visual evoked potentials.

optic neuritis is a common first presenting symptom, seen alone or in combination with other symptoms in approximately 22% of newly diagnosed patients with MS.[13] According to American Academy of Neurology guidelines on the early diagnosis of MS,[14] the available evidence suggests that early treatment of CIS with MRI abnormalities lessens disease activity and severity and may significantly delay the onset of a second attack.[15-18] In fact, one study of patients treated following their first demyelinating event and followed for 5 years demonstrated a delay in the onset of the second event and, therefore, the diagnosis of clinically definite MS.[17] The relationship between lesion presence and the subsequent development of MS is highlighted in a long-term (14-year) study in which 88% of patients with at least one lesion (T2 hyperintense) at their first symptom presentation went on to develop clinically definite MS, compared with 19% of patients with no lesion at presentation.[19]

Additional diagnostic procedures may include evoked potential testing (ie, visual evoked potentials, brainstem auditory evoked potentials, or somatosensory evoked potentials), which may show slowed nerve conduction even when neurologic findings are not elicited on examination. Blood tests can help rule out the presence of other chronic or infectious illnesses as potential causes of MS symptoms. Analysis of the cerebrospinal fluid (CSF) may reveal increased immunoglobulins in the CNS, with separation into oligoclonal bands,[20,21] which is consistent with a diagnosis of MS.

The diagnosis of MS is getting more precise with better technology, particularly specialized MRI techniques, but there are still reports of misdiagnosis. Symptoms may not be specific to MS, since other conditions can mimic the condition. These include inflammatory diseases (such as systemic lupus erythematosus), other chronic conditions (such as complex migraine headaches and metabolic conditions), and infectious diseases (such as Lyme disease). A variety of other neurologic conditions (including granulomatous diseases, diseases of myelin, spinocerebellar disorders, and Arnold-Chiari malformation) can complicate the diagnostic picture. This is why some patients are said to have “possible MS” rather than a definitive diagnosis, until a thorough differential diagnostic process can be completed.

What Are the Symptoms of MS?

The symptoms experienced by people with MS vary according to the location of the lesions in the brain or spinal cord. Primary symptoms result from myelin and axonal damage in specific areas of the CNS. Fatigue is the most common, and often the most disabling, symptom of MS.[22] Weakness and decreased endurance are also frequently reported. Other primary symptoms include vision problems (eye pain, blurred vision, graying of vision, loss of vision), cognitive difficulty (problems with abstract conceptualization, recent memory, attention, information processing), difficulty in walking, bladder problems (urinary bladder urgency, incontinence, urinary retention), bowel problems (constipation, urgency, involuntary bowel movements), sexual dysfunction (erectile dysfunction, diminished libido, and vaginal dryness), numbness/tingling, pain, and spasticity. Depression is also common, with between 36% and 54% of patients with MS experiencing major depression at some time during their illness; rates are much higher than those seen in the general population.[22-24] Suicide rates are also much higher in the MS population than in the general population.[22,25,26]

Less common symptoms of MS include dizziness, headache, tremor, insomnia/sleep disturbance, and speech/swallowing problems; rarely, patients experience itching, hearing loss, and seizures. Primary symptoms can give rise to secondary symptoms such as urinary tract infections, urinary calculi, muscle contractures, upper respiratory infections, and poor nutrition. Tertiary symptoms include financial, social, emotional, and vocational problems and can be caused in part by lack of effective interventions aimed at primary symptoms.

Pain in MS may be neuropathic or neurologic in origin and acute or chronic in duration. Examples of acute pain that occur frequently in patients with MS are trigeminal neuralgia (a sharp, stabbing pain in the face) and burning dysesthesia (a burning, aching sensation). Chronic pain in patients with MS often manifests as a "pins and needles" sensation, or as a burning, aching pain. Spasticity, often manifested as stiffness or spasms (eg, "charley horse"), may involve pain and discomfort that can interfere with daily activities such as sitting, transferring, and bed positioning.

Minor symptom flares may occur during a relapse or may be the result of other reasons (pseudo-relapse). Heat, infections, and fevers may cause MS symptoms such as fatigue to worsen, and when the underlying cause is treated and the situation modified, symptoms will remit and function may improve substantially. Intense stress is another condition that has been linked to MS symptom flares, but these data remain controversial.[27,28]

Although fluctuations in type and severity of symptoms are common in MS, patients should call their healthcare professional if they experience any of the symptoms reported below, particularly when their functional status is substantially altered (Table 2).

Table 2. Reportable Symptom Checklist

Patients with MS should be instructed to contact their healthcare professional if they experience any of the following symptoms.

Symptom	√
New or worsening symptoms that persist for 24-48 hours • New onset of pain or marked worsening of pain • Difficulty with speech, swallowing, or breathing • New onset of vertigo, with or without nausea and vomiting • Change in bowel or bladder function (eg, incontinence, difficulty voiding)	
Increasing difficulty in self-care	
Marked changes in visual acuity (eg, double vision, blurred vision, graying of vision)	
Change in mobility	
Change in cognitive function	
Falling	
Change in mood (depression, agitation, mania)	
Worsening altered sensation with change in function	
Worsening fatigue	

What Is a Relapse?

New or recurrent symptoms that persist for at least 24 hours and sometimes worsen over 48 hours and that are separated by at least 1 month are referred to as a relapse (also called flare-ups, attacks, or exacerbations). Most of the time, symptoms reach their maximal intensity within 2 weeks and then begin to slowly resolve. At times, relapses may not remit (people may not recover fully) for up to 6 months, depending on the severity of the episode. The frequency of relapses is generally higher early in the disease but can vary greatly among individuals with MS. Improvement of symptoms for an individual, as well as the degree of recovery, is unpredictable with each relapse. Relapses are due to the occurrence of inflammation in some part of the CNS and may be seen on MRI scans as lesions with active inflammation. Complete recovery from a relapse is more typical early in the disease; later in the disease only partial improvement may be achieved.

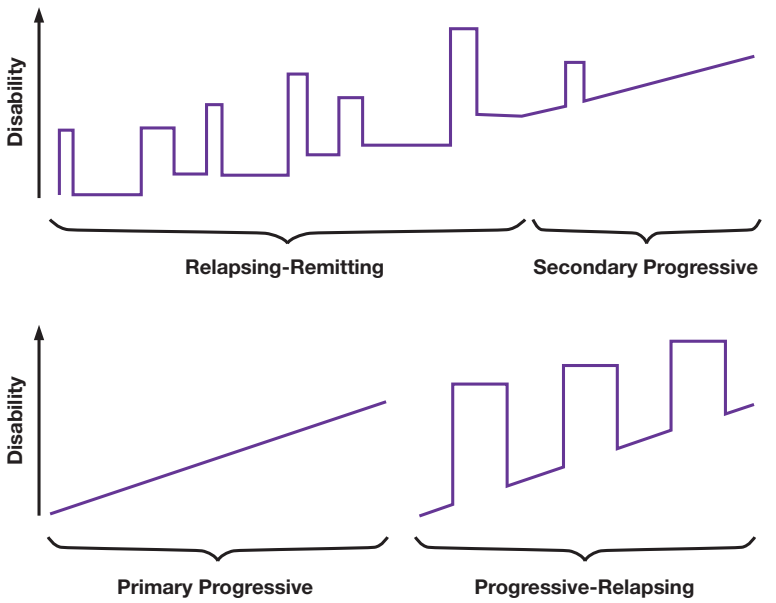
It is important to remember that an increase in symptoms and changes in function may not necessarily be a relapse. As mentioned previously, there are other factors that contribute to such changes (eg, hot weather, increased body temperature, infection). The worsening of symptoms may "look like" a relapse when in reality it is not. These episodes may be referred to as pseudoexacerbations or pseudorelapses. Once the underlying cause is addressed, pseudorelapses usually remit.

Relapses are usually treated promptly with corticosteroid medications (eg, high-dose methylprednisolone) commonly administered by intravenous infusion for 3 to 5 days, and may be followed by a reduced dose of an oral form of corticosteroids for several days. This treatment regimen may shorten a patient's recovery time from the acute relapse by reducing the inflammation occurring in the brain or spinal cord. There are no standardized protocols for treating relapses, although many healthcare professionals prefer intravenous over oral therapy.

Disease Course

The course of MS is unpredictable, differing from patient to patient and within a given individual over time. Four distinct clinical courses of MS have been identified: relapsing-remitting, primary progressive, secondary progressive, and progressive-relapsing (Figure 1).[29] The typical pattern of disease is relapsing-remitting—clearly defined relapses followed by periods of remission during which there is no apparent disease progression. Approximately 85% of people with MS begin with this form. In secondary progressive MS, patients begin with relapsing-remitting disease but at some point convert to a more progressive course, with fewer relapses but a steady worsening of symptoms and signs of MS. An estimated 75% of relapsing-remitting patients will change to a secondary course over time. However, the use of disease-modifying therapies may, in time, alter this estimate. Approximately 10% of patients experience primary progressive disease—nearly continuous worsening disease course, possibly interrupted by minor improvements, but otherwise characterized by steady deterioration. Progressive-relapsing disease is the rarest form, affecting an estimated 5% of patients. This classification is characterized by progressive disease from the point of diagnosis. Relapses occur, but the patient's disease progresses from each point without remitting or returning to baseline.

Figure 1. Clinical Courses of MS



What Is Disease Progression?

Living with MS means living with some amount of uncertainty or unpredictability. Most people with MS will initially experience a relapsing pattern of the disease due to inflammation in the CNS. As stated earlier, the majority of those diagnosed initially have a relapsing course where symptoms worsen and resolve completely, or nearly completely. But in some individuals the symptoms experienced during a relapse may not improve fully or at all. During the period between relapses, there may be steady worsening with increasing symptoms and diminishing functional status.

Sometimes, and often after living with MS for many years, individuals cease having relapses and begin to experience a gradual and continuous worsening of symptoms. When symptoms worsen, a person's abilities can be limited. For example, walking independently may become more difficult, and a cane may be needed. This walking difficulty may in turn progress to the need for a walker or another mobility device, such as a scooter or wheelchair, for longer distances.

The healthcare team recognizes that MS symptoms affect quality of life. Helping to manage those symptoms and cope with their consequences is an important part of patient care. The healthcare team is an ongoing source of assistance to help patients remain as independent as possible.

What Types of Lesions Are Seen in MS?

Lesions of MS are found in the white matter of the brain, spinal cord, and optic nerve, with the specific types of neurologic symptoms reflecting the area of the CNS affected. Lesions vary in size, generally from 1 mm to 4 cm in diameter, and are surrounded by plasma cells, immunoglobulins, macrophages, and lymphocytes. Each of the 3 types of lesions of MS—gadolinium-enhanced (Gd+), T2 hyperintense, and T1 hypointense—distinctly reflects a particular type of inflammatory activity that has occurred within the CNS.

Gd+ lesions show areas of blood-brain barrier disruption[30] and indicate acute inflammatory activity (Figure 2). Of note, Gd+ lesions are a weak predictor of disease progression and demonstrate a poor correlation with disability.[31] In addition, they are 5 to 10 times more frequent than relapses,[32] suggesting that MS activity can be present without clinical presentation. In one study, the number of new Gd+ lesions at baseline was the strongest predictor of the number of new, enlarging, and new plus enlarging lesions at study end.[33] Interestingly, a Gd+ lesion often goes through a "transient hypointensity stage," after which point it may develop into a permanent hypointensity (chronic black hole), recover partially due to remyelination and axonal survival (gray lesion), or resolve completely and become isointense to the surrounding white matter (temporary black hole).[34]

T2 hyperintense lesions are the hallmark of MS lesions. They show the "footprint" of prior inflammatory events,[35] representing the cumulative burden of disease (Figure 3).[36] Because of this, they have been found to be a useful measure of disease activity (new and/or enlarging T2 lesions).[30] A significant correlation has been found between total T2 lesion volume at baseline and severity of disability at 5-year follow-up.[37]

Figure 2. Gadolinium-Enhanced Lesion

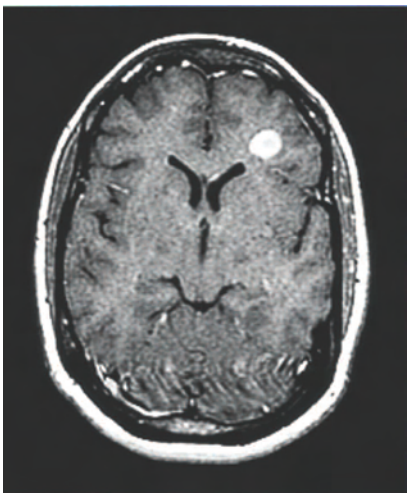
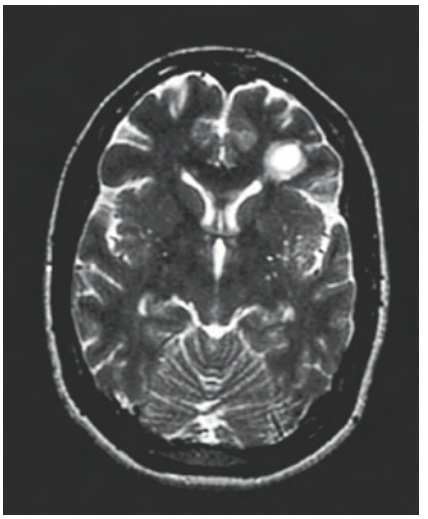
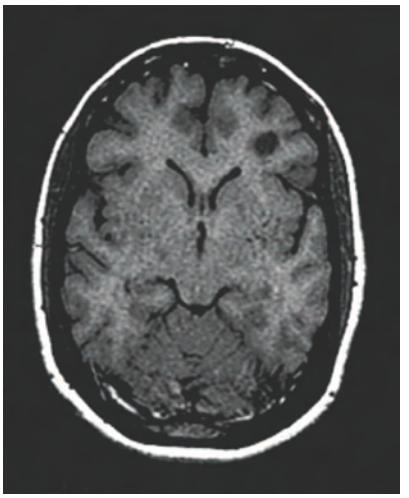


Figure 3. T2 Hyperintense Lesion



Chronic T1 hypointense lesions (also termed black holes) indicate irreversible axonal damage,[30] reflecting chronic MS lesions with demyelination and axonal loss (Figure 4).[38] A strong correlation has been found between T2 and chronic T1 lesion loads, with a subset of T2 lesions developing into T1 hypointense lesions.[39] However, there is a greater correlation between T1 lesion load and clinical disability than T2 lesion load and disability.[40] Interestingly, approximately half of newly formed T1 lesions disappear during the course of MS,[41,42] with these transient lesions suggesting reversible edema or partial inflammatory demyelination.[43,44]

Figure 4. T1 Hypointense Lesion



Disease-Modifying Therapies

The benefits of currently approved disease-modifying therapies have changed the vision of MS from one of relentless progression of disability to one of empowerment and hope. Healthcare professionals now believe, based on emerging evidence and long-term data, that an MS treatment is effective if it reduces relapses, stabilizes the MRI by reducing new lesions and decreasing inflammatory lesions (seen with gadolinium), and dampens or blocks the worsening of disability.[45] Although disease-modifying therapies may delay progression of the course of MS, individuals may see little or no improvement of their ongoing symptoms. This can be confusing unless people are well educated and healthcare providers reemphasize the difference between progression and symptomatic problems (ie, the disease versus the sequelae). It is important to remember that these medications are not curative or restorative, and people may continue to have relapses (breakthrough disease activity). However, the occurrence of breakthrough disease activity does not mean that the medication is not working, although it is important to recognize that each relapse can be discouraging.

Disease-Modifying Therapies Administered by Injection

Currently there are 4 injectable disease-modifying therapies approved by the FDA to treat relapsing forms of MS: 2 forms of interferon beta-1a (one administered intramuscularly [IM] and one administered subcutaneously [SC]), interferon beta-1b, and glatiramer acetate (Table 3). All three interferon-beta therapies interfere with MS by reducing the overall immune response, thereby reducing inflammation in the CNS. The interferon-beta drugs differ according to the route of administration, dose, and frequency with which they are injected. Glatiramer acetate works differently than the interferon-beta therapies. It is believed to shift the immune response to reduce the secretion of inflammatory cytokines (immune cell protein) and increase the secretion of anti-inflammatory cytokines.

Injectable disease-modifying therapies are generally well tolerated; however, as with all medications, there is the potential for side effects. Nevertheless, the benefits of these treatments generally outweigh the associated risks for those with active disease. Side effects are most commonly experienced within the first several months of therapy and often lessen or subside gradually thereafter. They are rarely serious and generally do not require discontinuation of therapy.

The most common side effects of injectable MS disease-modifying therapies are shown in Table 3.[46-53] In general, all interferon-beta therapies may cause elevated liver enzymes, headache, decreased white blood cell count, and injection-site reactions, although injection-site reactions are more common with SC than IM injections.[54] Injection-site reactions with SC injections can be managed by rotating the site of injection, adjusting the depth of the autoinjector, changing the needle gauge, and practicing good skin care. Topical use of corticosteroids can be helpful but should not be used long-term. Another common side effect of interferon-beta therapy is flu-like symptoms, which can be minimized by using a nonsteroidal anti-inflammatory medication

(acetaminophen, ibuprofen, naproxyn sodium). Common side effects of glatiramer acetate therapy include injection-site reactions, transient chest pain, and lipoatrophy (shrinkage of the fat cells underlying skin).

Patient adherence to injectable disease-modifying treatment can be an issue for various reasons. Adherence can be compromised because many patients find injections painful, difficult, and inconvenient. In addition, because individuals may see little or no improvement of their ongoing symptoms, patients may want to discontinue treatment. Setting realistic expectations that disease-modifying treatments help stabilize MS can assist in this situation. For some individuals, to help compensate for the potential cognitive problems associated with MS, preparing written or audiovisual instructions that can be referred to as necessary is a helpful intervention. Involving the family or caregiver to assist the patient in treatment administration can also be advantageous. Adherence can be facilitated by fostering the nurse-patient relationship as well as by enhancing a patient's support network by including the family in the management plan and providing support and networking opportunities for the patient. Other strategies that may facilitate adherence include the following:

- Educate patients about treatment recommendations and side effects
- Advocate on patients' behalf
- Help set realistic expectations
- Provide reassurance, support, and encouragement
- Re-educate and reassess side effects regularly

Table 3. Main Injectable Disease-Modifying Drugs for MS[46-53]

Generic name, Injection method	Interferon beta-1a (IM)	Interferon beta-1b (SC)	Glatiramer acetate (SC)	Interferon beta-1a (SC)
Indications	For treatment of patients with relapsing forms of MS, to slow the accumulation of physical disability and decrease the frequency of clinical exacerbations	For use in patients with relapsing-remitting MS, to reduce the frequency of relapses	For use in patients with relapsing-remitting MS, to reduce the frequency of relapses	For treatment of relapsing forms of MS, to decrease the frequency of clinical exacerbations and delay accumulation of physical disability. The efficacy of interferon beta-1a SC in chronic progressive MS has not been established.
Dosage & Frequency	30 mcg IM once per week	250 mcg SC every other day	20 mg SC every day	44 mcg SC 3 times / week

Table 3. Continued

Generic name, Injection method	Interferon beta-1a (IM)	Interferon beta-1b (SC)	Glatiramer acetate (SC)	Interferon beta-1a (SC)
How Drug Is Supplied	Package contains 4 administration dose packs (each with one vial of interferon beta-1a IM, one 10-mL diluent vial, 2 alcohol wipes, 1 gauze pad, one 3-mL syringe, 1 MicroPin vial access pin, one 23-gauge needle, and 1 adhesive bandage)	Package in a clear-glass, single-use vial (3-mL capacity); a prefilled single-use syringe containing 1.2 mL of diluent (sodium chloride, 0.54% solution), 2 alcohol pads, and 1 vial adapter with attached needle are included for each vial of drug	Supplied as a single-use, prefilled syringe containing 1.0 mL of sterile, nonpyrogenic solution containing 20 mg of glatiramer acetate and 40 mg of mannitol, USP, in cartons of 30 single-use, prefilled syringes, 33 alcohol preps (wipes), and instructions for use	Supplied as a single-use, prefilled syringe containing 44 mcg interferon beta-1a SC. Single-use, prefilled syringes containing 22 mg interferon beta-1a SC are also available in a Starter Pack. Supplied as a sterile, preservative-free solution packaged in graduated, ready-to-use 0.5-mL prefilled syringes with 27-gauge, 0.5-inch needle for SC injection.
Warnings	**Depression and suicide** have been reported with increased frequency in patients receiving interferon compounds, including interferon beta-1a IM. These patients should be monitored closely. Interferon beta-1a IM should be used with caution in patients with pre-existing depression. There have been post-marketing reports of depression, suicidal ideation, and/or development of new or worsening of other pre-existing psychiatric disorders (including psychosis). **Anaphylaxis and other allergic reactions** (dyspnea, bronchospasm, tongue edema, rash, urticaria) have been reported as a rare complication of interferon beta-1a IM use.	**Depression and suicide** have been reported with increased frequency in patients receiving interferon compounds, including interferon beta-1b. These patients should be monitored closely. Interferon beta-1b should be used with caution in patients with pre-existing depression. Injection-site necrosis has been reported, usually within the first 4 months of therapy. Time to healing of the lesion varies and may be associated with scarring. **Anaphylaxis and other allergic reactions** (dyspnea, bronchospasm, tongue edema, rash, urticaria) have been reported as a rare complication of interferon beta-1b use.	Glatiramer acetate should not be administered intravenously	**Depression, suicidal ideation, and suicide** have been reported with increased frequency in patients receiving interferon compounds, including interferon beta-1a SC. These patients should be monitored closely. Interferon beta-1a SC should be used with caution in patients with pre-existing depression. Interferon beta-1a SC should be used with caution in patients with **active liver disease**, alcohol abuse, SGPT >2.5 times the upper limits of normal, or a history of significant liver disease. **Allergic reactions including anaphylaxis**, skin rash, and urticaria have been reported, with no clear association to dose or duration of treatment.

Continued

Table 3. Continued

Generic name, Injection method	Interferon beta-1a (IM)	Interferon beta-1b (SC)	Glatiramer acetate (SC)	Interferon beta-1a (SC)
Warnings	**Decreased peripheral blood cell counts** in all cell lines, including rare pancytopenia and thrombocytopenia, have been reported from post-marketing experience. This product contains albumin, a derivative of human blood, which carries an extremely remote risk for transmission of viral diseases.	This product contains albumin, a derivative of human blood, which carries an extremely remote risk for transmission of viral diseases		This product contains albumin, a derivative of human blood, which carries an extremely remote risk for transmission of viral diseases.
Precautions	Should be used cautiously in patients with pre-existing seizure disorders, angina, congestive heart failure, or arrhythmia. Cases of idiopathic thrombocytopenia, hyper- and hypothyroidism, and rare cases of autoimmune hepatitis have been reported in patients taking interferon beta-1a IM. Regular monitoring of complete blood counts and blood chemistries, including liver function tests, is therefore recommended, as well as periodic thyroid function testing. Patients on interferon beta-1a IM should be monitored for signs of hepatic injury and caution should be exercised when taking other drugs associated with hepatic injury. There are no adequate controlled trials investigating the safety and efficacy of	Regular monitoring of complete blood counts and blood chemistries, including liver function tests, is recommended. Regular monitoring for thyroid abnormalities is also recommended. There are no adequate controlled trials investigating the safety and efficacy of interferon beta-1b in pregnant women and children. Nursing women should discontinue breastfeeding or discontinue the drug. Use of aseptic technique is required to administer this agent.	There are no adequate controlled trials investigating the safety and efficacy of glatiramer acetate in pregnant women and children. Caution should be exercised when glatiramer acetate is administered to nursing women. Use of aseptic technique is required to administer this agent. There is a possibility that this agent will interfere with immune function. Continued long-term use has not been evaluated.	Should be used cautiously in patients with pre-existing seizure disorders. Regular monitoring of complete blood counts and blood chemistries, including liver function tests, is recommended. Regular monitoring for thyroid abnormalities is also recommended. There are no adequate controlled trials investigating the safety and efficacy of interferon beta-1a SC in pregnant women and children. Exercise caution when administering interferon beta-1a SC to nursing women. Use of aseptic technique is required to administer this agent.

Continued

Table 3. Continued

Generic name, Injection method	Interferon beta-1a (IM)	Interferon beta-1b (SC)	Glatiramer acetate (SC)	Interferon beta-1a (SC)
Precautions	interferon beta-1a IM in pregnant women and children. Nursing women should discontinue breast-feeding or discontinue the drug. Use of aseptic technique is required to administer this agent.			
Common Adverse Reactions	Depression, suicidal ideation, and new or worsening other psychiatric disorders, including psychosis; flu-like symptoms, such as muscle aches, fever, chills, fatigue, headaches, nausea, and vomiting. Laboratory abnormalities include a decrease in peripheral blood cell counts.	Depression and suicidal ideation; injection-site reactions, such as inflammation, pain, edema, necrosis; flu-like symptoms, such as fever, chills, muscle aches, sweating; laboratory abnormalities including a decrease in white blood cell count and increases in total bilirubin and SGPT; menstrual irregularities.	Injection-site reactions, such as redness, itching, pain, welt, inflammation, and induration. Post-injection reactions consisting of flushing chest pain, palpitations, anxiety, dyspnea, throat constriction, urticaria, and transient chest pain.	Depression, suicidal ideation and attempts; injection-site reactions such as inflammation, pain, edema, necrosis; flu-like symptoms such as fever, chills, muscle aches, fatigue, and headache; and abdominal pain. Laboratory abnormalities include elevation of liver enzymes and decreases in leukocytes and platelets.
Storage Instructions	Refrigerate lyophilized powder vials. Reconstituted product should be refrigerated and used within 6 hours. If unreconstituted product cannot be refrigerated it can be stored at 25°C (77°F) for up to 30 days. Refrigerate prefilled syringes (2°C to 8°C/36°F to 46°F). Once removed from refrigerator, allow to warm to room temperature and use within 12 hours.	Room temperature until reconstituted. After reconstitution, if not used immediately, the product should be refrigerated and used within 3 hours. Avoid freezing.	Refrigerate prefilled syringes (2°C to 8°C/36°F to 46°F). Excursions from recommended storage conditions for unreconstituted drug to room temperature for up to 1 week are allowed.	Refrigerate, or may be stored at or below 25°C/77°F for up to 30 days away from heat and light. Interferon beta-1a SC contains no preservatives. It should not be used beyond the expiration date printed on packages.

IM = intramuscular; SC = subcutaneous; SGPT = serum glutamate pyruvate transaminase.

The Role of the Infusion Nurse in the MS Team

With the emergence of new and effective disease-modifying agents administered by infusion, the role of the infusion nurse to both patients and the MS team is integral in comprehensive care. The use of infusion therapies in MS is associated with several challenges that may be new to the infusion nurse, who may not be very familiar with MS. Such challenges include appropriate evaluation and monitoring of patients with MS, training in administration of MS therapies, managing side effects of these MS treatments, and patient scheduling and office logistics to support MS infusion therapy.

MS Therapies Administered by Infusion

Some medications can only be given by infusion. MS treatments that are administered by infusion include corticosteroids; chemotherapeutic agents such as mitoxantrone and cyclophosphamide; immunoglobulin; and natalizumab. Before the start of each infusion, the following pre-infusion checklist should be completed (Table 4), with the prescriber notified prior to the start of infusion if any of the characteristics on the checklist are present.

Table 4. Pre-Infusion Checklist

The infusion nurse should contact the prescriber prior to start of the infusion if any of the following are present.

Characteristic	√
Pregnancy or breastfeeding	
Elevated body temperature	
Untreated infection (UTI, URI)	
Vaccine within the past 2 weeks	
Abnormal vital signs (low or elevated blood pressure, irregular pulse, tachycardia)	
Skin changes (rash, pressure ulcer)	
Diabetes	
Other medical complaints (chest pain, edema, shortness of breath)	

UTI = urinary tract infection; URI = upper respiratory infection.

Corticosteroids

Corticosteroids (Table 5) are potent anti-inflammatory agents. Of the 2 corticosteroids frequently used in MS—methylprednisolone and dexamethasone—only the former is FDA-approved specifically for use in acute exacerbations of MS.[55,56] Corticosteroids may relieve symptoms and reduce the severity and duration of an MS relapse. Although corticosteroids reduce inflammation, recovery from an attack will be determined by the body's ability to heal. A patient's response to corticosteroids may differ with each attack. Sometimes corticosteroids are used on a regularly scheduled basis (pulse therapy) to modify the disease.

Table 5. Corticosteroids

Rationale for Use	• Potent anti-inflammatory agents that can reduce inflammation in the brain and spinal cord
Dose	• Methylprednisolone: 1 g/day intravenously (IV) every day for 3-5 days for relapse • Dexamethasone: 160-180 mg/day IV every day for 3-5 days for relapse • After the 3-5 days, a taper of the oral form of these drugs is common • Regularly scheduled corticosteroid treatment may be given long-term
Benefits	• May relieve symptoms and reduce the severity and duration of an MS relapse • A patient's response to corticosteroids may differ with each attack
Side Effects[55,56]	• During infusion: metallic taste in the mouth, flushing, headache, low back pain, and anxiety • After or between infusions: insomnia, indigestion, heartburn, nausea, fluid retention, mood changes, reduced potassium levels, temporary elevation in blood sugar levels, blood pressure elevation, delayed hives • Longer-term side effects: osteoporosis, cataracts, irregular menses, decreased resistance to infection, skin changes
Nursing Measures to Modify Side Effects	• During infusion: – Metallic taste: suggest hard candy – Flushing: will dissipate with time (usually a few days after the infusion is complete) – Headache and low back pain: slowing infusion rate and/or an analgesic • After or between infusions: – Insomnia: over-the-counter (OTC) drugs (eg, Tylenol® PM or Benadryl®) or a prescription sleep aid – Indigestion/heartburn: OTC gastrointestinal protective agents (eg, Pepcid®, Tums®)

Continued

Table 5. Continued

Nursing Measures to Modify Side Effects	• After or between infusions: – Fluid retention and swelling: decrease salt intake; drink more fluids – Potassium decrease: eat foods high in potassium (oranges, bananas, potatoes, broccoli) – Mood changes: may require pharmacologic intervention – Temporary elevation in blood sugar levels: low-sugar diet – Blood pressure elevation: check blood pressure prior to infusion – Delayed hives: should be immediately reported to the healthcare professional • Longer-term: – Corticosteroid-induced osteoporosis: calcium 1200-1500 mg/day with vitamin D • Administering corticosteroids before noon is recommended to mimic the patient's normal cortisol pattern
Alerts	• Unremitting hypertension – Marked changes in mood (euphoria, irritability, nervousness, restlessness) – Elevated temperature – Abnormally high blood sugar levels

Mitoxantrone

Mitoxantrone (Table 6) is a chemotherapeutic agent FDA-approved for clinical worsening MS.[57] It is beneficial in MS because it suppresses the number and activity of white blood cells that induce the MS attack in the CNS. Because mitoxantrone can suppress the immune system, those receiving treatment should avoid contact with people who are sick and avoid dental procedures for 2 to 3 weeks after each dose. A major limitation of mitoxantrone treatment is that, because of cumulative cardiotoxicity, lifetime use is restricted to 140 mg/m^2. This is most commonly administered in 8 to 12 doses over 2 to 3 years, but this may vary.

Table 6. Mitoxantrone

Rationale for Use	• Suppression of the activity of white blood cells that induce the MS attack in the CNS
Dose[57]	• 12 mg/m^2 intravenously (IV) every 3 months for up to 24 months (with a lifetime maximum allowable dose of 140 mg/m^2)
Benefits	• May reduce relapse rate and slow progression of disease
Side Effects[57,58]	• Blood: decreased resistance to infection, leukopenia • Cardiac: cumulative cardiotoxicity, shortness of breath • CNS: increased fatigue • Gastrointestinal: nausea, vomiting, diarrhea • Integumentary: temporary hair thinning, stomatitis, blue-tinted sclera • Endocrine: menstrual irregularities, amenorrhea • Genitourinary: urinary tract infection, blue-tinted urine
Nursing Measures	• Prior to each dose[59]: – Cardiac monitoring (history and physical examination, left ventricular ejection fraction [LVEF], congestive heart failure) – Hematologic monitoring (inform patient of signs of infection, complete blood count and platelets prior to each course and if signs of infection [only infuse if absolute neutrophil count is ≥1500 cells/mm^3]) – Hepatic monitoring (liver function test [do not treat if baseline LVEF <50%]) – Confirm negative pregnancy test/confirm not breast-feeding – Cumulative dose monitoring • In addition: – Obtain recent height and weight – Instruct patients to eat light meal – Use angiocath (22 gauge desirable); do not use butterfly needle – Verify blood return before and after infusion

Continued

Table 6. Continued

Nursing Measures	• In addition: – Check frequently for infiltration; if it occurs, no antidote, apply ice, report to healthcare professional immediately – Inform patients to avoid dental work/surgical procedures for first 2-3 weeks after each treatment – Inform patients to avoid contact with anyone sick for the first 12-14 days after each treatment – Inform patient on importance of post-infusion blood draws and monitoring – Follow standard chemotherapy precautions and use personal protective equipment
Alerts	• Medication extremely irritating to veins and skin (in the event of contact with skin, rinse with copious amounts of water and observe for irritation) – LVEF <50% or clinically significant reduction – Absolute neutrophil count <1500 cells/mm^3 – Signs/symptoms of infection – Extreme weakness – Infiltration – Receipt of chemotherapy for any other indication

Cyclophosphamide

Cyclophosphamide (Table 7) is a chemotherapeutic agent that is not FDA-approved for the treatment of MS (ie, its use in MS is off-label), although it has been studied since the early 1980s. Like mitoxantrone, its mechanism of action as a chemotherapeutic agent is suppression of white blood cells.

Table 7. Cyclophosphamide

Rationale for Use	• Suppression of the number and activity of white blood cells that induce the MS attack in the CNS
Dose	• Varies; adjusted based on number of white blood cells. May be administered by induction (several days in a row) or as pulse therapy (intermittently, usually monthly or every other month).
Benefits	• Modest improvement (at best) in patients with progressive MS
Side Effects	• Allergy: local histamine reaction (nasal congestion, sneezing, headache) during infusion • Gastrointestinal: nausea and/or vomiting (usually developing after infusion and lasting <24 hours), lack of appetite, mouth sores • Genitourinary: cystitis (including frequent urination), bleeding when voiding, bladder tumors

Continued

Table 7. Continued

Side Effects	• Endocrine: menstrual irregularities, low sperm count with possible sterility, possible risk to unborn child • Integumentary: hair loss (reversible), skin/nail color changes (reversible) • Blood: decreased resistance to infection, secondary malignancies (in some patients receiving cyclophosphamide for other diseases)
Nursing Measures	• Prior to each course: – Hematologic monitoring (inform patient of signs of infection, complete blood count and platelets prior to each course and if signs of infection [only infuse if white blood cell count ≥1500 cells/mm^3]) – Pregnancy testing/confirm not breast-feeding – Obtain recent weight • In addition: – Pre- and post-infusion hydration (post-infusion: 3 liters each day for 3 days) – Instruct patients to void after infusion – Instruct patients to eat light meal – Use angiocath (22 gauge desirable); do not use butterfly needle – Verify blood return before and after infusion – Check frequently for infiltration; if it occurs, no antidote, apply ice, report to healthcare professional immediately – Urinalysis with cytology yearly; after 3 years, cystoscopy yearly – Inform patients to avoid dental work/surgical procedures for first 2-3 weeks after each treatment – Inform patients to avoid contact with anyone sick for the first 12-14 days after each treatment – Follow standard chemotherapy precautions and use personal protective equipment – Advise patients who will be receiving influenza or pneumonia vaccines to do so in the week prior to their infusion (3 weeks after their last infusion)
Alerts	• White blood cell count <1500 cells/mm^3 – Signs/symptoms of infection – Abdominal pain – Extreme weakness – Receipt of chemotherapy for any other indication

Immunoglobulins

Immunoglobulins (IVIG or HIGG) (Table 8) are concentrated immune factors that temporarily modify the immune system, although the exact mechanism by which they work in MS is unknown. While some patients benefit from immunoglobulin, this medication is not FDA-approved for the treatment of MS and is expensive. Further clinical trials are needed to determine the usefulness of this treatment in MS. Immunoglobulins can be given in a number of different doses and on a number of different schedules. A common dosage is 400 mg/kg once daily for 3 to 5 days. A once-monthly infusion of 0.15 to 0.2 g/kg is also an option. Infusion time can range from 2 to 6 hours or more depending on the patient's dose and overall tolerance.

Table 8. Immunoglobulins

Rationale for Use	• May temporarily modify the immune system
Dose	• Common dosage is 400 mg/kg once daily for 3-5 days for initial course and varies thereafter depending on response
Benefits	• May slow the disease process
Side Effects	• CNS: anxiety, malaise, fatigue, headache* • Musculoskeletal: myalgia, arthralgia, abdominal pain • Flu-like: chills,* fever • Cardiac: blood pressure changes* • Chest heaviness • Rare: aseptic meningitis, seizures, acute encephalopathy, hypersensitivity reactions, congestive heart failure, acute renal failure
Nursing Measures	• Prior to each course: – Benadryl® or Tylenol® may be ordered – Check vital signs prior to each rate increase, then hourly – Monitor closely for signs of hypersensitivity reaction, fluid overload, and congestive heart failure • In addition: – Inform patient that intravenous immunoglobulin (IVIG) is a human blood product. Although there is a possibility for infection, the industry screens for viruses, and to date, no known cases of infection from IVIG have been reported in MS patients[60] – Assess for history of reaction to blood or blood products
Alerts	• Renal insufficiency • History of thrombosis, congestive heart failure, uncontrolled hypertension

*Symptoms may be rate-related.

Natalizumab

Natalizumab (Table 9) is FDA-approved as monotherapy for the treatment of patients with relapsing forms of MS to delay the accumulation of physical disability and reduce the frequency of clinical exacerbations. It works differently than any other disease-modifying agent; it is a monoclonal antibody that reduces the movement of active immune cells into the CNS. This reduces inflammation and demyelination in the CNS and slows the worsening of MS. Because natalizumab increases the risk of progressive multifocal leukoencephalopathy (PML; see below), it is generally recommended for patients who have had an inadequate response to, or are unable to tolerate, alternate MS therapies. In addition, because PML risk has been associated with concomitant exposure to immunomodulators, there may be a period of discontinuation after other MS therapies (ie, interferon beta, glatiramer acetate, immunosuppressants) prior to initiating natalizumab. Natalizumab is administered every 4 weeks as a 1-hour infusion.

Three cases of PML have been reported in patients treated with natalizumab for >2 years or who received it intermittently over 18 months (patients were concomitantly exposed to immunomodulators [eg, interferon beta] or were immunocompromised due to treatment with immunosuppressants [eg, azathioprine]). It is unclear whether the risk of PML is increased in patients treated with natalizumab in combination with interferon beta compared with natalizumab alone. A comprehensive safety analysis of 3,116 patients with a mean natalizumab exposure of approximately 18 months estimated the risk of PML as 1.0 case per 1,000 patients.[61]

A recent FDA warning advised the MS community that the risk of PML is increased after 24 months of administration requiring sustained monitoring and vigilance.

In order to ensure that patients at risk for PML do not receive natalizumab and that symptoms of PML are promptly identified in patients being treated with natalizumab, Biogen Idec, Inc. and Elan Pharmaceuticals, Inc. have developed the TOUCH™ program, a comprehensive risk-management plan. This program includes a mandatory enrollment process: a patient can only be enrolled and receive natalizumab if they meet all of the conditions of the program as assessed by a Preinfusion Patient Checklist. Every 6 months, the prescriber must complete a Reauthorization Form for the patient to continue therapy. Under the TOUCH program, only prescribers and infusion centers that have been educated about the risks and appropriate use of natalizumab and are registered with the program are able to prescribe and/or infuse the product. When a patient stops natalizumab therapy, a Discontinuation Form must be completed, with a Follow-Up Questionnaire completed 6 months after discontinuation. In addition, prescribers are requested to report all new cases of PML in their natalizumab-treated patients to Biogen Idec, with every potential PML case carefully evaluated.

Table 9. Natalizumab

Rationale for Use	• Reduces the movement of active immune cells into the CNS
Dose[62]	• Recommended: 300 mg every 4 weeks administered as a 1-hour infusion
Benefits	• Significantly reduces relapses, disability progression, and development of new lesions on magnetic resonance imaging (MRI)
Side Effects[62]	• Common: – General: headache, fatigue, arthralgia, allergic reaction, urinary urgency/frequency, chest discomfort, local bleeding, rigors – Infection: urinary tract infection, lower respiratory tract infection, gastroenteritis, vaginitis, tonsillitis – Psychiatric: depression – Gastrointestinal: abdominal discomfort, abnormal liver function test – Skin: rash, dermatitis, pruritus – Menstrual disorders: irregular menstruation/dysmenorrhea, amenorrhea – Neurologic: vertigo • Serious: infections, hypersensitivity reactions (mild, moderate, or severe; anaphylaxis/anaphlyactoid), depression, cholelithiasis, progressive multifocal leukoencephalopathy (PML)*
Nursing Measures	• Prior to starting treatment, the healthcare professional completes a required patient checklist to ensure that the patient meets all requirements for use of natalizumab • Prior to each infusion, the patient and infusion nurse complete a required† checklist to screen for symptoms suggestive of PML (weakness in one side of the body or limbs [sometimes very severe], blurred or loss of vision [possibly on one side], fatigue, language impairments [aphasia], memory loss, confusion, disorientation, or a loss of balance) • Gently invert the solution to mix completely; do not shake; inspect visually for particulates prior to administration • Natalizumab is only compatible with normal saline solution and must be used immediately after reconstitution, unless refrigerated, in which case it must be used within 8 hours after reconstitution • Infuse over 1 hour; do not administer as an intravenous push or bolus injection • Observe patients during the infusion and for 1 hour after infusion is complete (angiocath should remain in place in the event rescue medications are needed) • Monitor for signs of hypersensitivity; promptly discontinue the infusion upon first signs/symptoms consistent with a hypersensitivity-type reaction
Alerts[62]	• Hypersensitivity: usually occurs within 2 hours of start of infusion; if hypersensitivity reaction occurs, discontinue administration and consider the possibility of natalizumab antibodies • PML: obtain MRI scan prior to initiating therapy; prior to each infusion, the patient and infusion nurse complete a checklist to screen for symptoms suggestive of PML; suspend dosing at first signs/symptoms and perform Gd+ brain MRI; cerebrospinal fluid analysis for JC viral DNA may also be useful to confirm a diagnosis of PML • Immunosuppression: safety and efficacy of natalizumab in combination with antineoplastic or immunosuppressive agents have not been established; concurrent use of these agents with natalizumab may increase the risk of infections, including opportunistic infections

*PML is a rare and progressive demyelinating disease of the brain that often causes permanent disability or death.

Treatment Challenges Specific to MS

Treatment challenges specific to MS include patient issues (physical, cognitive, and emotional), potential problems with intravenous access in some patients, and a wide range of psychosocial issues. Mobility problems can prevent a patient from accessing clinical services, including treatment. Other physical symptoms, such as tremor and fatigue, can also impair a patient's ability to adhere to treatment regimens. Bladder dysfunction can be challenging because urinary frequency (a common MS symptom) may interfere with the administration of certain treatments infused over several hours (eg, immunoglobulins). In addition, bladder dysfunction can result in urinary tract infections, with the presence of any type of active infection precluding treatment with corticosteroids, mitoxantrone, or cyclophosphamide. Cognitive problems (including difficulty with learning/remembering new material and sequencing activities) are experienced by approximately half of patients with MS.[25,63] Cognitively impaired patients may have difficulty both in remembering to take their medication and in carrying out the multistep procedures of self-injection and self-infusion. Mood changes, including depression, may affect a patient's willingness or ability to adhere to treatment regimens. As depression is quite common in MS, all patients should routinely be screened, with treatment strategies including psychotherapy and antidepressant medication.

Problems with intravenous access often occur in patients with MS. Poor venous access may be due to poor hydration, scarring of the vein from overuse, decreased neurologic function, and/or decreased muscle tone. Because of intravenous access issues, it may be recommended that a peripherally inserted central catheter (PICC) line or port be placed prior to exhausting all of a patient's veins.

Due to its wide scope of disease burden, there are various psychosocial factors associated with MS, all of which can impede treatment adherence. Social isolation and the stigma associated with MS may have a negative impact on patient adherence. The diagnosis of MS carries with it an emotional impact that is lifelong, and may impair a patient's motivation or ability to adhere to treatment. A relatively common psychosocial factor in MS is financial in nature. Many patients are expected to take a wide variety of expensive medications and need costly equipment (such as wheelchairs and transfer devices). At the same time, a patient's income may be restricted due to inability to work secondary to physical and/or cognitive deficits. In addition, lack of adequate insurance coverage can interfere with a patient's capacity to adhere to a comprehensive management program.

Motivation, social support, and self-efficacy are keys to successful adherence. Interestingly, the term "adherence" has replaced "compliance" in the medical and nursing literature, as the latter implies a subordinate position of the patient in relation to the healthcare professional.[64] From the nursing prospective, adherence can best be defined as the active, voluntary, and collaborative involvement of the patient in a mutually acceptable course of behavior that results in a desired preventative or therapeutic outcome. As mentioned above, the numerous treatment challenges specific to MS can affect motivation for adherence. Initially, patients may be highly motivated in their treatment regimen, but over time lose their motivation because they may not feel better or may be getting worse. Patients should be frequently reminded that the occurrence of break-

through disease activity does not mean that the medication is not working. Self-efficacy (a person's judgment regarding his or her ability to implement a task) is also strongly linked to adherence, including continued use of injectable immunomodulatory agents in MS.[65-67] Because successful performance of a task enhances self-efficacy, education about the preparation and self-administration of injectable immunomodulatory agents, encouragement of hands-on practice in the presence of a nurse or other practitioner, and telephone support can empower individuals to achieve realistic expectations and adhere to their treatment. At times, a patient may become overwhelmed and may want to take a "holiday" from treatment. Most people feel this way at some point; patients should be encouraged to discuss these feelings with their healthcare professional.

Social support is especially important for patients with MS and in treatment adherence. Including family or other people within a patient's circle of support may reduce anxiety and help them during difficult times. Sharing feelings in a peer support group may also be helpful. There are numerous support groups and community programs available to help; the National Multiple Sclerosis Society (www.nmss.org), the Multiple Sclerosis Association of America (www.msaa.com), the Multiple Sclerosis Foundation (www.msfacts.org), the International Federation of MS Societies (www.msif.org), and Understanding MS (www.understandingms.com) are just a few of the excellent resources available. The Consortium of MS Centers (www.mscare.org) and the International Organization of MS Nurses (www.iomsn.org) are professional organizations that provide education, training, and support for nursing professionals in the field of MS.

Skin Care Issues

Because most MS disease-modifying therapies are injectables, skin care is an important issue for patients with MS.[54] Poor administration technique is a major cause of skin reactions at the injection site, which in turn may lead people to prematurely discontinue treatment. Therefore, it is imperative that patients are expertly instructed on how to prepare and inject their medications. As previously mentioned, SC injections are associated with more problems than deeper once-a-week IM injections,[54] although any break of the skin has some potential for pain. Reactions to SC injections are generally mild, though some may evolve into potentially serious lesions, culminating in infection and possible skin necrosis. Treatment usually requires antibiotic therapy, with surgical repair necessary in some cases. To minimize injection-site reactions, patients should be instructed to rotate their injection sites and avoid injecting at or near areas where an adverse skin reaction occurred in the past. The importance of careful observation and prompt communication with their healthcare professional to manage problems if they do occur should also be stressed.

Lifestyle Issues for Patients With MS

Lifestyle issues for patients with MS include diet and nutrition, exercise, smoking status, and employment/productivity. Good nutritional planning is important in all MS patients' health maintenance. However, no dietary supplement or elimination of certain foods has been proven to have an effect on the disease course, despite anecdotal claims to the contrary. Poor nutrition can make a patient prone to infection or complications, and fiber and fluid intake can have an impact on constipation, which is a common complaint in MS. Weight control is important in managing both the disease and the patient's overall health. Exercise is also an important component in MS wellness, although years ago patients were discouraged from exercising for fear that it would spark an exacerbation. Now, exercise is highly recommended, with some activities such as yoga, T'ai chi, walking, and swimming thought to be especially beneficial.[68] Although it is well known that smoking is detrimental to everyone's health, it has also been associated with an increased risk of MS (although no cause-and-effect relationship has been determined).[69]

Issues related to employment are a major concern for patients with MS. Fatigue and cognitive impairment can be detrimental to a person's ability to work, even if no visible disability is present. For patients with MS who desire to work, the Americans With Disabilities Act requires that workplace accommodations be made and may include allowing the employee to rest more often during the day or allowing some work to be done from home. For those patients who care for their children at home, the stress, guilt, and fatigue these people experience while keeping up with the physical and emotional demands of a young child or children can be particularly difficult to endure. Developing support systems and backup plans for when these patients may need extra rest or childcare assistance can help them manage their child-related responsibilities.

MS Nurse Resources

Numerous resources are available to both the MS nurse and the infusion nurse.

International Association of Multiple Sclerosis Nurses (IOMSN)

359 Main St. Suite A
Hackensack, NJ 07601
Phone: 201-487-1050
Fax: 201-678-2291
E-mail: info@iomsn.org
Website: www.iomsn.org

National Multiple Sclerosis Society (NMSS)

733 Third Avenue
New York, NY 10017
Phone: 800-FIGHT-MS (800-344-4867)
E-mail: generalmailbox@nmss.org
Website: www.nationalmssociety.org

Multiple Sclerosis Foundation (MSF)

6350 North Andrews Avenue
Fort Lauderdale, FL 33309
Phone: 888-MSFOCUS (888-673-6287)
Fax: 954-351-0630
E-mail: support@msfocus.org
Website: www.msfacts.org

Multiple Sclerosis Association of America (MSAA)

706 Haddonfield Road
Cherry Hill, NJ 08002
Phone: 800-532-7667
Fax: 856-661-9797
E-mail: webmaster@msaa.com
Website: www.msaa.com

Consortium of Multiple Sclerosis Centers (CMSC) c/o Gimbel MS Center

359 Main St. Suite A
Hackensack, NJ 07601
Phone: 201-487-1050
Fax: 201-678-2290
www.mscare.org/cmsc/index.php

Multiple Sclerosis Trust

Spirella Building
Bridge Road, Letchworth Garden City
Hertfordshire
SG6 4ET
Phone: 01462 476700
Fax: 01462 476710
E-mail: info@mstrust.org.uk
Website: www.mstrust.org.uk

Infusion Nurses Society (INS)

220 Norwood Park South
Norwood, MA 02062
Phone: 781-440-9408
Fax: 781-440-9409
E-mail: cheryl.miller@ins1.org
Website: www.ins1.org

Association of Vascular Access (AVA)

11441 South State Street
Suite A, #113
Draper, UT 84020
Phone: 888-576-2826
Fax: 801-553-9137
E-mail: info@avainfo.org
Website: www.avainfo.org

Association of Rehabilitation Nurses (ARN)

4700 W Lake Avenue
Glenview, IL 60025
Phone: 800-229-7530
Fax: 877-734-9384
E-mail: info@rehabnurse.org
Website: www.rehabnurse.org

American Association of Neuroscience Nurses (AANN)
4700 W Lake Avenue
Glenview, IL 60025
Phone: 888-557-2266
Fax: 877-734-8677
E-mail: info@aann.org
Website: www.aann.org

American Nurses Association (ANA)
8515 Georgia Avenue
Suite 400
Silver Spring, MD 20910
Phone: 800-274-4ANA (4262)
Fax: 301-628-5001
E-mail: memberinfo@ana.org
Website: www.nursingworld.org

UK Nurses
E-mail: uknurses@uk.msnusers.com
Website: uk.msnusers.com/uknurses

Case Studies

Relapsing-Remitting MS (Case 1)

Ursula is a 45-year-old woman with a 10-year history of MS and 2 grown children. She was forced to stop working during the early part of 2003 due to frequent MS exacerbations. She has previously been treated with oral, but not intravenous, corticosteroids. She has not been treated with disease-modifying therapy, as her neurologist feels that, due to the length of time she has had the disease, she would not benefit from such treatment. Her last MRI was in 2005, with the scan showing numerous enhancing lesions. However, she refused steroids. Her walking has deteriorated and she is subject to fatigue. In addition to her exacerbations, Ursula complains of urinary urgency, frequency, nocturia, and constipation. She comes to the MS center for help but states she does not like needles.

Possible interventions:

- Ursula would benefit from an educational overview of MS and a review of the current state-of-the-art treatment of relapsing MS, including the risks and benefits of disease-modifying agents.
- She requires a comprehensive assessment of her functional status, including elimination dysfunction and rehabilitation.
- Fatigue management may include medication(s) and rehabilitation services.
- The case manager would be a source of information, support, and appropriate referrals in this complex situation.

Relapsing-Remitting MS (Case 2)

Samantha has been on disease-modifying therapy for 2 years. She is a 28-year-old high school graduate; her husband is a truck driver. She has 2 small children and has problems making ends meet at home. She calls her case manager to state that her MS is stable and she wishes to stop treatment at this time. The nurse ascertains that the patient is also tired of self-injecting and that her husband is unwilling to assist her. Her husband also believes that since her relapses have stopped, there is no reason to continue therapy.

Possible interventions:

- Samantha would benefit from an update on the long-term benefit of disease-modifying therapy.
- It would be important to discuss the patient's financial concerns regarding daily expenses and the burden that injectable therapy is imposing on her.
- Referral to a patient support program for help with financial coverage of the medication may be warranted.
- A family meeting might be helpful at this time to educate the patient and family.
- Family counseling would be helpful throughout the family's adjustment to both a growing family and the uncertainty of MS.

Relapsing-Remitting MS (Case 3)

Charles is a 31-year-old male who has received disease-modifying treatment for 3 years. He previously experienced 1 to 2 relapses annually; this has been reduced to less than 1 per year. He lives alone and has intermittent assistance from a community program. He complains of short-term memory problems and difficulty with his activities of daily living. The patient calls early one Friday morning requesting a referral to a dentist, due to facial pain that started about 1 week ago. When questioned by the nurse, it was determined that the pain emanates from his ear to his chin and is worse at night.

Possible interventions:

- These symptoms may possibly be an exacerbation of the patient's MS.
- Charles must be advised to contact his healthcare provider for an immediate evaluation.

Primary Progressive MS (Case 4)

Edward is a 43-year-old male with a 4-year history of MS. He is on long-term disability through his workplace and is planning to apply for Social Security disability status. He has experienced a progressive disease course, despite interferon treatment. His last MRI demonstrated no enhancing lesions in the brain, but he had a plaque from C5 to C6. He is barely able to walk with a walker, is incontinent of bowel and bladder, and can no longer drive. In addition, he falls frequently and has no assistance at home. As he lives alone, he is very frightened about the future. He is requesting chemotherapy or natalizumab for his worsening disease.

Possible interventions:

- Edward requires a great deal of counseling, support, and individualized services.
- It would be important to ascertain the availability of programs via his insurance plan and through his community.
- Case management should include a discussion of the patient's potential long-term needs.
- For the short-term, it would be important to place home healthcare to prevent injury or falls.
- Environmental assessment should be provided to determine if there are safety issues in the home.

Newly Diagnosed MS (Case 5)

Susan is 26 years old with a 4-year history of MS. Her initial diagnosis was CIS based on MRI findings. Initially she had optic neuritis and was not treated with steroids or disease-modifying therapies. Recently she developed vertigo, diplopia, and truncal ataxia which, after 4 weeks, was treated with intravenous steroids. CSF analysis was positive and her MRI showed many new lesions, 50% of which enhanced. The patient is very angry about not being treated earlier. Her neurologist has prescribed a high-dose, high-frequency interferon for self-injection.

Possible interventions:

- Susan needs education and supportive counseling to help her cope with the disease and the decisions that were made regarding treatment.
- She will need assistance to obtain her therapy and receive training in self-injection.
- She will require ongoing monitoring to evaluate her adherence to therapy and adjustment to a life with chronic illness.

Conclusions

The infusion nurse is an integral member of the MS healthcare team. With the emergence of new and effective disease-modifying agents administered by infusion, the nurse-patient relationship is all-important and includes appropriate patient evaluation and monitoring, training in administration of infused MS therapies, and managing side effects of those therapies. Because adherence to treatment is such a prevalent issue in MS, the role of the infusion nurse in patient care becomes even more crucial. Specific MS-related educational materials (such as this monograph) may provide intravenous nurses with the fundamental tools necessary to empower patients with MS with a sense of control in the treatment of their disease.

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