

# **What influences healthcare professionals' prescribing of disease modifying treatments for multiple sclerosis in the UK?**

## **Final report**

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### **Executive Summary**

- Evidence suggests that the prescribing rate of disease modifying treatments (DMTs) in the UK is lower than other countries in Europe, and that there are large differences in prescribing rates between the four nations of the UK.
- We conducted this research to describe the factors influencing prescribing rates and prescribing practices around the UK.
- We explored the views and experiences of consultant neurologists who prescribe DMTs and MS nurses who facilitate access to DMTs in a qualitative interview study, and we quantified the proportion of prescribers experiencing various factors through a national questionnaire study.
- Eighteen consultant neurologists and 16 MS nurses took part in the qualitative interview study, and 46 DMT prescribers took part in the national questionnaire study.
- The qualitative data analysis resulted in five themes relating to factors influencing prescribing: 1) Determining eligibility for DMTs; 2) Prescribing readiness and cautiousness; 3) Making the prescribing decision; 4) Supporting patients' DMT choices; and 5) Influence of DMT prescribing peers.
- The national questionnaire study revealed wide individual and service-level variation in how prescribers determine eligibility for DMTs; the guidelines they use in their prescribing decisions; the role of general neurologists and MS nurses in supporting DMT delivery; approaches to DMT prescribing and standardised care within services; the ways in which DMTs are discussed with patients; the ways in which patient choice is managed; prescribers' attitudes and beliefs about DMTs; and the influence of other prescribers on individual prescribing practice through peer network comparisons.

## 1. Background

In 2008, it was estimated that only 11-12% of people with multiple sclerosis (MS) in the UK were prescribed one of five disease modifying treatments (DMTs) approved by the European Medicines Agency, compared to between 40 and 50% in France, Germany, Italy and Spain (Kobelt et al., 2009). Given that around 50-60% of people with MS have a relapsing form of MS eligible for disease modifying treatment, the authors concluded that the vast majority of people with relapsing MS were on treatment in these countries, while only a small proportion of potentially eligible people were taking DMTs in the UK.

By 2013 the estimated proportion of people with any type of MS on treatment in the UK had increased to 21%, but this was still substantially lower than 13 out of 14 other European countries where rates ranged from 39% to 69% (Wilsdon et al., 2014). The difference in treatment rates was similar for people with relapsing-remitting MS (RRMS), with 59% of these patients in the UK taking DMTs compared to between 75 and 91% in Sweden, Italy, Spain, Germany and France.

Moreover, surveys conducted by the MS Society in 2012-2013 (Dorning et al., 2013) and 2016 (Redfern-Tofts et al., 2016) found considerable differences in the proportion of people who “could potentially benefit” from a DMT (i.e. with a relapsing form of MS or who report taking a DMT) who were taking them in England, Scotland, Wales and Northern Ireland. The more recent survey reported that nearly 77% of eligible respondents were taking a DMT compared to just 49% in Wales, 56% in England and 57% in Scotland. These treatment rates demonstrate a considerable increase from those reported in the earlier survey, but also show that regional differences have persisted over the three-year period between surveys.

The above findings suggest that not only is DMT prescribing historically lower in the UK than comparable countries in Europe, but that treatment rates, as measured by self-report, vary widely across the UK. Yet the reasons for these international and intra-UK differences are unclear. Some authors have suggested that lower DMT prescribing rates in the UK may be due to early non-endorsement by NICE due to poor cost-effectiveness (Kobelt et al., 2009) or lower numbers of prescribing neurologists per person (Wilsdon et al., 2014). There is also anecdotal evidence that clinicians may experience barriers to prescribing DMTs, including local policies, funding restrictions, and lack of infrastructure and resources, which could potentially explain variation in different UK regions.

However, there has been very little systematic investigation into the factors influencing prescribing of DMTs for people with relapsing-remitting MS in the UK. Given the difficulties of objectively measuring effects of longstanding policies and guidelines, studies of clinicians’ views and experiences of prescribing these medications in the UK healthcare system would be particularly useful.

Prior to this research there were very few investigations of neurologists’ perspectives on prescribing DMTs, including one study on perceptions of natalizumab in Germany (Heesen et al., 2010), and factors affecting clinicians’ DMT decision-making in the USA (Hanson et al., 2014). Subsequently, the

MS Trust in the UK has published a report on improving efficiency of disease modifying drug provision (MS Trust, 2016), which included surveys of MS specialist nurses, consultant neurologists, and hospital pharmacists working in MS care. While this report highlights the main sources of inefficiency in services delivering DMTs (e.g. all-encompassing MS nurse roles, poor electronic information systems) it does not directly address perceived effects on prescribing or treatment rates.

Given the lack of relevant research in this area, we sought to elucidate potential reasons for the lower DMT prescription rate in the UK and for variation in regional prescription rates between the four UK nations, by conducting two linked studies: 1) Identifying factors influencing DMT prescribing practices and prescribing rates through interviews with clinicians, and 2) Quantifying the reported occurrence and distribution of these factors around the UK through a national survey of DMT prescribers.

The findings from these studies will support the MS Society's five-year objective to increase "the proportion of people with MS who have timely access to the medicines and treatments which are right for them" (MS Society, 2014).

## 2. Interviews with neurologists and nurses

### 2.1. *What were our aims?*

The objective of the qualitative interview study was to explore neurologists' and MS specialist nurses' views and experiences of prescribing or facilitating access to disease modifying treatments for people with relapsing forms of MS.

The research questions were:

- What factors influence prescribing of DMTs for people with relapsing-remitting MS in the UK?
- What do neurologists and MS nurses see as the **barriers and facilitators** to prescribing and otherwise enabling access to DMTs?
- What are neurologists and MS nurses' views on DMT **prescription rates in the UK** compared to other countries?
- What are neurologists and MS nurses' views on differences in **prescribing rates between the four UK nations**?

### 2.2. *What did we do?*

We aimed to interview healthcare professionals who worked in specialist MS services and those who worked in non-specialist services. We defined a specialist MS setting as one in which there were at least two consultant neurologists with expertise or special interest in MS based on the Association of British Neurologists (ABN) guidance that individuals working in isolation are likely to find it difficult to maintain specialist skills (Scolding et al., 2015). Settings in which there was only one consultant neurologist specialising in MS were classified as non-specialist services, regardless of their level of

expertise and regardless of whether they were supported by non-MS specialist DMT prescribers. Locations where DMTs were prescribed solely by general neurologists (i.e. without specific expertise or special interest in MS) were also classified as non-specialist.

From MS Society (2017) and MS Trust (2017) online maps of multiple sclerosis services cross-checked against NHS Trust websites, we identified and selected one site in each of the four UK nations fulfilling the criteria as a specialist setting and noted possible non-specialist settings. We gathered information from regional clinical research advisors and early participants on locations where DMTs were prescribed solely by general neurologists or by single-handed MS specialist consultant neurologists in order to select non-specialist sites.

All consultant neurologists prescribing DMTs for people with MS at each site were emailed and invited to take part in the research, either by the appropriate regional clinical research advisor (DR, GM, JO, OP) or by the main researcher (EC). We chose not to include neurologists in training in this study because although they may be involved in DMT prescribing in some services, the decision to initiate disease modifying treatment is usually the responsibility of a consultant in collaboration with the patient.

We also wanted to interview MS specialist nurses who facilitate access to DMTs through referrals to consultants, and who may have an impact on prescribing and uptake through regular interactions with neurologists and people with MS. After contacting consultant neurologists we used snowball sampling, in which existing participants or regional clinical research advisors suggest suitable potential participants, to identify MS nurses working in specialist and non-specialist settings.

Potential participants were offered a certificate of research participation and were reassured that interview responses would be completely anonymous and confidential. When selecting participants from those who subsequently expressed an interest in taking part we endeavoured to include individuals with varying degrees of experience as specialist clinicians in multiple sclerosis healthcare. All participants provided written informed consent prior to being interviewed.

The interview schedule was developed to include possible factors identified in previous research, and potential factors raised by clinical collaborators and people with MS acting as patient representatives. We also reviewed the Theoretical Domains Framework, a synthesis of behavioural theories (Cane et al., 2012), to ensure we had not overlooked any potentially important domains of behavioural determinants. The interview schedule was adapted into two versions with slightly different wording of questions for consultant neurologists who prescribe DMTs and MS nurses who facilitate DMT prescribing. The resulting schedules were pilot tested and refined with one consultant neurologist and one MS specialist nurse collaborator (see Appendices 1 and 2).

The majority of interviews took place in the participants' usual place of work, typically a hospital or primary care setting. Two interviews were carried out by telephone (informed consent forms were signed and returned prior to telephone interviews). Interviews were 65 minutes long on average, with the shortest being 31 minutes and the longest 102 minutes.

Audio-recordings of the interviews were transcribed verbatim by a professional transcription service bound by confidentiality agreements. All personally identifiable and identifying geographical information was removed from transcripts. The transcribed data were then analysed using a thematic framework approach. This involves five steps: familiarization with the data; identifying a thematic coding framework; systematically applying the coding framework to all of the data ('indexing'); creating a matrix of summarised data structured by codes and categories ('charting'); and developing the final thematic account by reviewing the matrix, seeking patterns, and generating more abstract concepts and explanatory theories to elucidate the data and answer the research question ('interpretation'). A subset of transcripts were coded and indexed by a second coder to improve rigour and credibility of the research.

Ethical approval for this study was received from a University of Manchester research ethics committee. The Health Research Authority (HRA) provided governance approval for NHS sites in England, while governance approval for sites in Wales, Scotland and Northern Ireland was sought and obtained from the local Research and Development department at each health trust or health board.

### *2.3. Who did we interview?*

We interviewed 34 healthcare professionals involved in prescribing or facilitating access to DMTs for people with relapsing-remitting MS, including 18 consultant neurologists and 16 MS nurses. The majority of participants were white British ( $n = 29$ ), with three identifying as 'white other', and two as Asian or Asian-British. Nineteen participants were female. Consultant neurologists ranged in age from 35 to 54 years old (mean = 45.7 years, SD = 6.0), while MS nurses were between 41 and 58 years old (mean = 50.4 years, SD = 5.0).

In terms of professional experience, neurologists had spent between 1 month and 20 years as a consultant (mean = 9.5 years, SD = 6.8), and the same range as an MS specialist, if applicable (mean = 10.7 years, SD = 5.9), and as a prescriber of DMTs (mean = 9.8 years, SD = 6.3). MS nurses had been working in the nursing profession for between 16 and 41 years (mean = 29.9 years, SD = 7.2), and as MS specialist nurses for between 10 months and 22 years (mean = 12.4 years, SD = 6.1).

Eleven interviews were conducted with clinicians working in England, 8 in Scotland, 8 in Northern Ireland, and 7 in Wales. Participants were recruited from 15 sites across the UK, including 7 specialist MS services according to our aforementioned definition.

### *2.4. What did we find?*

The qualitative data analysis resulted in five themes relating to factors influencing prescribing: 1) Determining eligibility for DMTs; 2) Prescribing readiness and cautiousness; 3) Making the prescribing decision; 4) Supporting patients' DMT choices; and 5) Influence of DMT prescribing peers.

## Theme 1: Determining eligibility for DMTs

### DMT prescribing guidelines

Prior to prescribing a disease modifying drug, the neurologist is responsible for determining whether the patient is eligible for DMTs according to criteria set out in national prescribing guidelines. Neurologists working in England were bound by NICE prescribing guidelines and viewed these as mandatory criteria which they were “*obliged to follow*” (P32, Consultant Neurologist (CN), England). The Association of British Neurologists (ABN) guidelines were seen as “*a useful adjunct*” (P25, CN, England), but were secondary to the NICE recommendations:

*“You cannot use it [the ABN guidance] in practice all the time because NHS England guidelines trumps all that.”* (P25, CN, England)

Neurologists in the devolved nations were familiar with the NICE reports. However, the guidance they used to support their decisions about DMT eligibility and prescribing varied. In Wales, one neurologist reported the ABN guidelines were the most important for making decisions about MS treatment, while two others more were similar to prescribers in England in their prioritising of the NICE guidance:

*“I think the ABN guidelines are guidelines, whereas I think there is more of an obligation to follow the NICE guidelines quite strictly and patients can expect to be offered things... that are recommended by the NICE guidelines.”* (P02, CN, Wales)

In Scotland, one neurologist described prescribing in line with the ABN guidelines, two adhered to the Scottish Medicines Consortium (SMC) guidance, and two suggested they “*don’t feel shackled by guidelines*” (P36, CN, Scotland) and that “*guidelines are guidelines, not really more than that*” (P41, CN, Scotland). This was due to a desire to do what was best for the person in front of them rather than prioritising recommendations based on cost-effectiveness. In Northern Ireland, participants reported generally prescribing in accordance with the principles set out in NICE guidelines, but also that local guidelines had been developed by neurologists in the region to “*adapt and involve*” the ABN and NICE guidelines, and “*put them all together in a sensible way*” (P04, CN, Northern Ireland).

While neurologists in England felt obligated to adhere to the nationally imposed NICE requirements, participants in the devolved nations described feeling more accountable to local managers and health boards:

*“...I think your managers if they found out they’d start to ask questions about, ‘Well, why are you using that when it’s not really under the NICE guidance?’”* (P05, CN, Wales)

### Defining and identifying relapses

Prescribing guidelines incorporate criteria for establishing eligibility for DMTs based on the number, frequency and severity of relapses experienced by the person with MS, in addition to evidence detected by magnetic resonance imaging (MRI). Requirements include statements such as “two or



more clinical relapses in the previous two years” and “two or more disabling relapses in the past year” for determining eligibility for certain DMTs. Several participants reported finding the language of these statements vague and “open to interpretation” (P22, CN, Scotland), for both ‘clinically significant’ and ‘disabling’ relapses:

*“The prescribing criteria are well described but a relapse is not well described and a disabling relapse is not very well described at all.” (P30, CN, Wales)*

*“What is a disabling relapse? If you're a piano player and your left hand goes numb well that might be disabling for you, but if my left hand went numb for a few days it may well not be at all disabling for me.” (P22, CN, Northern Ireland)*

It was felt by the interviewees that the vague nature of the criteria led to variation in prescribing between neurologists and between prescribing centres, as individuals each have their own “threshold for something needing to be a relapse” (P04, CN, Northern Ireland) and boundaries for deciding whether a patient’s experience counts as a clinically significant or disabling relapse:

*“I suppose that's where the individual biases come in as well. Some people may think that a relapse is a relapse irrespective. Others will say not really, it's not really disabling and the scans really don't show much, perhaps it's not very important.” (P25, CN, England)*

In addition to perceptions that the criteria are poorly defined, participants also reported difficulties in distinguishing relapses from pseudo-relapses and recurrences of previous symptoms:

*“... it can sometimes be difficult to say because if they've had a recent infection, is it a pseudo worsening, or is it a relapse triggered by infection? So yeah, I think relapses definitely are a bit of a minefield.” (P05, CN, Wales)*

*“... it is sometimes difficult to work out what is a relapse and what isn't... someone coming back with the same symptoms recurring periodically for a number of years that's almost certainly not a relapse because their imaging is not really changing very much.” (P22, CN, Northern Ireland)*

Some neurologists noted ways in which they handled these difficulties in identifying and defining relapses. One interviewee described the importance of really “getting to know the person” (P22, CN, Northern Ireland) including their history, their clinical examination and their disease activity on MRI, in order to more easily distinguish what constitutes a relapse for that individual. Another participant described discussing the relapse with the person with MS when it was unclear whether they had experienced a ‘disabling relapse’:

*“I think at some level you see what the patient thinks... ‘I wouldn't perhaps have called that disabling and so I might not use this treatment, what do you think?’ That sort of conversation or vice versa.” (P27, CN, Scotland)*

Routes for reporting relapses

Accurate reporting and identification of relapses is crucial for determining a person's eligibility for disease modifying treatment. Many neurologists provided quickly accessible relapse clinics or appointment slots so that patients could be clinically examined at the time of the neurological episode. Participants described the importance of seeing the patient in person in order to properly assess whether they are experiencing a relapse:

*"To be confident, the person really should be having a neurological examination to see what the differences are between that examination and the previous examination and to get an accurate history as well."* (P10, MSN, Wales)

However, not all interviewees had relapse clinics or rapid access clinics available for patients. Some relied on assessments by telephone:

*"We have a telephone line and we would assess most of it over the phone, so if somebody's having a relapse they would contact us and then we can assess the extent of it..."* (P08, MS Nurse (MSN), Northern Ireland)

One participant mentioned that sometimes people with MS "*pitch in to hospital*" to seek help for relapses, at which point the on-call neurologist in the medical assessment unit would make a decision about escalating treatment, giving steroids, and whether it was a "*genuine relapse*" (P09, CN, England).

Despite offering relapse clinics, telephone lines, or other means of reporting relapses as they occur, many participants still had patients who reported possible relapses retrospectively during scheduled review appointments. The interviewees highlighted the difficulties in adequately assessing historical relapses:

*"... it can be difficult retrospectively to decide whether or not it was a relapse, and you're going on the likelihood of it being a relapse from what the patient has told you. Ideally, you would see them at the time and find objective evidence of neurological signs that are new or worsened."* (P03, CN, Northern Ireland)

Regardless of whether relapses were identified through relapse clinics, telephone calls, hospital admissions, or retrospectively at review appointments, participants noted that relapse recording was wholly dependent on patients engaging with the service and reporting potential relapses. Some interviewees acknowledged that people with MS may either not be aware of the offered relapse reporting services or "*choose not to use it, and just consult their GPs*" (P05, CN, Wales). Others described ensuring their patients were aware of the process and importance of reporting relapses:

*"We always urge people to ring if there is even a suspicion of a relapse... We do drum this into patients from day one when they are newly diagnosed actually, the importance of relapse reporting."* (P10, MSN, Wales)



*Stopping treatment when MS becomes secondary progressive*

Participants discussed difficulties experienced when patients became no longer eligible for disease modifying treatments due to worsening disease and progression of disability. One difficulty was making the decision about when to take people off treatment. Some neurologists were concerned that despite meeting the criteria for stopping treatment, the drugs may still be having some benefit and removal of the medication could cause harm:

*“Although they might be hitting a criteria of stopping, with some of the trials where we've stopped some treatments people have then gone onto relapse. So we'll be anxious that the act of stopping precipitates a relapse. So I think in that sense we'd also be a little bit more conservative to leave them on it.” (P01, CN, England)*

*“Obviously if patients are non-ambulant, that's the time that we should be thinking about it in the secondary progressive phase, we should discuss stopping treatment at that point, but there may be some additional benefits to continuing treatment, perhaps cognitive function. Therefore, I don't feel that it's a black and white issue where we just automatically stop the treatment.” (P03, CN, Northern Ireland)*

The second concern shared by many interviewees was the difficulty in having a conversation with patients about the now progressive nature of their illness and the removal of treatment:

*“It's always very difficult for patients, and doctors to tell a patient that there's nothing to offer... Patients who were on DMTs, who have now developed a progressive stage and you're talking about taking away the treatment because it's not really having any worthwhile effect. But yet you're not giving anything back, you're not replacing it with anything, that's quite a difficult conversation.” (P07, CN, Scotland)*

Participants managed this difficulty in broaching the subject with patients by discussing the eventual possibility of ending treatment early in the course of their disease management:

*“It's part of our consent process to patients initiating treatment to say... this is the stopping criteria that may occur at some point in the future... I think that it helps force the discussion right at the beginning so that patients start treatment knowing that eventually it might stop.” (P30, CN, Wales)*

Others described introducing the concept of stopping treatment over the course of several appointments so that patients had time to get used to the idea:

*“That conversation normally takes two consultations. It's normally a first, 'I'm not sure this is the right medication for you'... Couple of months. Enough to get their head around it and realise what we're discussing, and then back in again to be reassessed.” (P04, CN, Northern Ireland)*

*"I do try and discuss it with patients whether or not to come off, but it might take me a year or two to get someone to agree to come off... So it can often be quite a slow, ongoing process to try and let them understand why you think it should be stopped and then get them to agree to it." (P27, CN, Scotland)*

### *Theme 2: Prescribing readiness and cautiousness*

Once eligibility for DMTs had been established according to relevant guidelines, participants asserted that people with MS would be offered the opportunity to start disease modifying treatment. However, the type of drugs offered and the strength of their recommendations to either accept or decline the offer of treatment varied between individual health professionals, and varied depending on the characteristics of the patient.

Some neurologists described themselves as an *"active prescriber"* (P36, CN, Scotland) or as *"fairly aggressive when it's needed"* (P01, CN, England) in terms of readiness to prescribe higher risk treatments. These clinicians often endorsed an 'induction' type approach to prescribing whereby eligible patients are prescribed a more effective, higher risk, DMT early in the course of the disease in order to disrupt the disease process during its most active phase. Others were more cautious prescribers who more often favoured an 'escalation' type approach, whereby patients are prescribed a 'milder', less risky, first line drug and monitored for ongoing disease activity so that treatment can be stepped up to a higher efficacy DMT if the condition is not brought under control:

*"I think that, unless there's really severe disabling relapses, then taking a less risky treatment initially is a good way forward... I think it's important just to take a more careful approach than going straight in with induction therapy in most people." (P03, CN, Northern Ireland)*

The majority of participants, however, saw value in both types of approach depending on the individual patient and their disease parameters:

*"There are some patients I would want to give them the best treatments, the strongest treatments early on and some the first line medications. And that depends largely on the severity of relapses, the number of lesions, how late are they into their illness and so on." (P25, CN, England)*

### *Unpredictability of the MS disease course*

There was consensus across participants that the disease course in relapsing MS is highly unpredictable making it very difficult to make prognoses and base treatment decisions on likely outcomes.

*"It's very difficult to prognosticate and say this patient is going to run this particular course, and therefore I'm going to use a milder treatment or a more efficacious treatment, and take less risk or more risk." (P07, CN, Scotland)*

However, participants differed in how this uncertainty informed their readiness to prescribe DMTs. More cautious interviewees felt that patients might naturally do better than expected and should not be exposed to higher risk treatments if not truly necessary, while the more 'ready' prescribers feared patients might do worse than expected if under-treated:

*"I don't want to see them two years down the line to put them on more robust therapy, but by then they've had a couple of relapses and they haven't fully recovered and I'm kicking myself." (P32, CN, England)*

These viewpoints were often reinforced by participants' prior experiences with their own or their colleagues' patients:

*"The risks worry me, and the uncertainty about what a particular person's MS will turn out to be. So I can think of someone who looked like they were going to have awful, awful, awful MS... and actually that person's done really, really well despite never having had Tysabri, Alemtuzumab or anything else." (P27, CN, Scotland)*

*"A previous consultant had refused to give them treatment saying that they didn't want to give it and they didn't think it was worth it. That person then had a subsequent further relapse that left them permanently incontinent and just spent the whole time cursing that doctor's name, in tears." (P41, CN, Scotland)*

#### Concerns about disease modifying treatments

Participants' readiness to prescribe or to recommend DMTs to people with MS was also influenced by the extent to which they had concerns about disease modifying drugs and how they managed those concerns. One major worry was the known risk of serious side-effects such as progressive multifocal leukoencephalopathy (PML) in patients taking natalizumab, and "secondary autoimmunity" and lifetime risk of "renal diseases" (P03, CN, Northern Ireland) in those taking alemtuzumab. Several participants also raised concerns about the unknown long-term effects of these immunosuppressant medications, including potential effects on reproductive health and cancer risk

*"What are the real risks of giving people these drugs over long periods of time? And we don't know, do we? We all talk about the higher effect of these drugs. Well, what is the risk of cancer? No one knows." (P36, CN, Scotland)*

A third concern related to a lack of evidence about the long-term effectiveness of DMTs on disability and progression of disease. One neurologist who said they "don't sell any of these treatments as wonder drugs", stated:

*"All [first line treatments] do is reduce the relapse a bit and I don't think they do anything else. I think the second line treatments probably do a bit more, but it's still only reduction of relapses... I don't believe that we have definite evidence that any of these treatments slow progression of disease." (P27, CN, Scotland)*

Participants concerns about known and unknown side-effects were somewhat lessened by the knowledge that patients on higher risk DMTs received “close monitoring” (P10, MSN, Wales) and in some places responsibility for patients on DMTs was shared across a multidisciplinary team:

*“I feel reassured by the multidisciplinary thing, I think if I was working in isolation I’d have more concerns about that [PML risk].” (P05, CN, Wales)*

Two neurologists described managing their concerns about the risk of serious side-effects by ensuring that patients made well-informed choices about starting treatment:

*“I think as long as you know that at the time you’ve taken the treatment decision you’ve done it in the patient’s best interests, and revisiting that decision, it was the right decision at the time and the patient was happy with that decision and knew the risks. That’s the most you can achieve really.” (P32, CN, England)*

*“The way you can sleep at night and not worry about that sort of thing [risk of PML] is knowing that the patient knows that risk and has accepted it.” (P39, CN, England)*

### *Theme 3: Making the prescribing decision*

When making decisions about which disease modifying drugs to recommend to people with MS, neurologists and nurses took into account clinical and medical factors, as well as patients’ lifestyles, preferences and behaviours. Their own familiarity and experience prescribing different DMTs also influenced their decisions.

Medical factors included disease activity, extent of recovery from prior relapses, comorbidities, previously experienced side-effects, and potential interactions with other medications. The two patient-related factors cited by many participants were pregnancy planning and anticipated likelihood of adhering to monitoring appointments. Interviewees described not prescribing certain DMTs to women who may wish to become pregnant, and were careful of prescribing DMTs with frequent monitoring requirements to patients whose “lifestyle is chaotic” (P02, CN, Wales) or with a history of poor attendance at appointments:

*“I’ve had a lady recently who wanted me to prescribe Lemtrada for her, but I didn’t really want to prescribe Lemtrada for her... She had delayed many times in the past and I was a bit worried about her reliability in terms of following up the monitoring of the disease.” (P07, CN, Scotland)*

Participants reported that the choice of which DMTs to recommend and prescribe was likely to be influenced by their familiarity and prior experiences with the drugs, and how comfortable they felt prescribing them. Familiarity with DMTs was attributed not only to the number of patients under their care prescribed the treatment so far, but was often linked to whether the individual or their MS service had been involved in clinical trials of a drug prior to national licensing:

*“You gain confidence, you gain a service that’s structured around the infusions, you have nurses that are trained in providing the infusions, recognising the side effects, you have pharmacists that are familiar with the drug, you have a service that’s set up for the monitoring... So, I think that is a natural thing, that if you’re a centre that’s been involved in a phase 3 study, quite often you end up using more of that drug... We probably do use more alemtuzumab than natalizumab, for that reason.” (P05, CN, Wales)*

*“If it’s just fresh from being licensed and you’re not familiar with it at all, you take a while to build up your experience and you start slowly... You don’t go and put ten people on a new drug that you’ve never used before.” (P02, CN, Wales)*

Confidence in prescribing certain DMTs was also said to be influenced by the positive and negative outcomes of clinicians’ patients taking the drugs:

*“I was aware that one of the patients died. So when you see that sort of thing, you’re a bit more hesitant about using it.” (P09, CN, England)*

*“It can be very possible so patients come back and say this drug’s been fantastic, it’s really well tolerated and that’ll sway us in a particular way.” (P01, CN, England)*

It was recognised that differences in participation in clinical trials had led to differences between prescribing centres in terms of the proportion of patients on each type of DMT, while personal experience and feedback from patients was perceived to lead to individual variation in the tendency to prescribe certain DMTs.

#### *Theme 4: Supporting patients’ DMT choices*

There was agreement across interviewees that whilst decisions about eligibility for DMTs fell to the prescribing neurologist, the decision about whether or not to start taking a disease modifying drug belonged entirely to the patient. Although some neurologists admitted to attempting to influence that decision and employing more persuasion when they felt a DMT was really necessary to preserve the person’s quality of life:

*“I try and persuade someone who I really think should take something... so maybe it’s a 75-25 [split between my decision and their decision]. If someone was having lots of relapses and had lost a lot of time from work, I would really be persuading them to take it.” (P27, CN, Scotland)*

The patients’ right to choose was prioritised by both neurologists and MS nurses partly because clinicians recognised the risks attached to taking the medications affected the patient alone:

*“At the end of the day the patients are taking the risk, not us.” (P22, CN, Northern Ireland)*

It was also seen as important that the choice was ultimately the patient's in order to increase the likelihood that the person would adhere to the medication regime and the strict monitoring requirements:

*"At the end of the day, any of these products it's commitment - quite a long commitment as well because this isn't just something that you take for a week or two, this is year in year out. They have to be happy then with the choices." (P10, MSN, Wales)*

*"There is a higher monitoring that they're accepting and a higher disease burden so if they're not really on board with that then there's no point in prescribing it." (P02, CN, Wales)*

Although participants believed the decision to take a DMT belonged to the person with MS, clinicians differed in their views on how this choice should be presented to patients. Some neurologists relied on MS nurses to discuss treatment options with patients and support them to make their decision, while others preferred to do this themselves:

*"I just feel that it is my role not to just say, 'Yeah, you're for treatment, off you go and speak to somebody else about it', but I think I should be the one who gives them at least an initial idea on the relative pros and cons of each." (P32, CN, England)*

Neurologists also differed in their views on 'how much choice' should be offered to patients, in terms of the number of treatment options presented. One described providing a very open choice to patients unless there were particular concerns the disease might be highly active:

*"I don't want to come across as preferring one from the other." // "I'm very upfront and tell them, look these are the drugs, these are the pros and cons of each... I honestly feel that you would do equally well on any one of that so I'm happy to be guided by you." (P32, CN, England)*

Some participants took the view that patients should be made aware of the range of options, but guided toward a smaller number of recommended DMTs:

*"I attempt to give them the overview and then hone in on the treatments that are most suitable for them. So I would guide them and maybe narrow it down to, say, if they were very keen on a tablet, so narrow it down to Tecfidera and Aubagio." (P03, CN, Northern Ireland)*

A small minority of clinicians felt they should offer a more limited range of choices. One neurologist felt this was important as a wide range of options made the decision too difficult for people with MS:

*"I think people can only decide between two things. I think when the decision gets more complicated, they just can't do it... Most people can cope with thinking of that dose, two [options]. Once you make it three, it's just impossible. And I think choice isn't that important. Not when you're ill... In a sense you want your hand held. A lot of people, although choice is very important on paper, really when people are in a fix they really want to come to you and*



*they say, 'Look if you were me, or if I were your cousin, what do you think would be best?'"*  
(P44, CN, England)

This concern about burdening patients with too much information and the difficulty of choosing between many options was echoed by other interviewees:

*"It's such a complex decision, you don't want to place it in their hands and burden them with something that's very complicated and they might worry about, but of course you want them to feel empowered and like they're shared partners in that decision."* (P05, CN, Wales)

*"I think some patients are overloaded and a bit overwhelmed by the information and they'd rather we just made the decision for them, but it's hard to do that."* (P22, CN, Northern Ireland)

The difficulties of supporting empowered patient decision-making in ways that don't overload the person with MS led to a call from one of these neurologists for the development of "*better decision aids*" (P05, CN, Wales).

#### *Theme 5: Influence of DMT prescribing peers*

##### *Peer networks*

Interviewees discussed the importance of having access to a network of peers who prescribe DMTs. These peer networks were sometimes situated within an organisation, or comprised a collection of prescribers and prescribing centres across a region, and were most often accessed through regular face-to-face meetings. Networks were seen as important for shared learning and achieving consensus on best approaches to prescribing DMTs:

*"The first thing we do is we look at other centres, and say, 'Well what are they doing? They've got a lot of patients on Tysabri, how do they manage this?' I think it's really important to have a network. I think if you work in isolation in such a complex field... you just run the risk of becoming... a victim of habit."* (P05, CN, Wales)

*"We meet regularly once a year across [region] where we discuss all of the MS treatments and things to make sure that we are quite similar in our approaches."* (P02, CN, Wales)

One neurologist pointed out their regional MS special interest group could act as a collective voice advocating for MS services in Northern Ireland:

*"Also then we come together as a group to represent the MS service of Northern Ireland with the Department of Health and provide a unified front."* (P03, CN, Northern Ireland)

Others found peer networks useful for informally checking their prescribing rates and practices against their peers:

*“We're setting up an MDT across the region to: one, discuss complex cases, two, to say, ‘Well, what would you do?’... I need that reassurance that other people are thinking the same.” (P01, CN, England)*

These networks seemed especially valuable to prescribers who worked apart from other neurologists specialising in care for people with MS:

*“I didn’t want to be out on a limb doing my own thing, I wanted to be in with the group and I wanted to be able to benchmark myself against the group. So there is differences in everyone, but I just would want to make sure as an outsider that I wasn’t outside in terms of prescribing as well, so to keep an eye on what everyone else is doing.” (P04, CN, Northern Ireland)*

#### Prescribing cultures

Participants noted that peers who prescribe DMTs also influence prescribing decisions at a local level through shared practices and organisational ‘prescribing cultures’. In some places, neurologists intentionally took a team approach to discussing cases and providing a standardised service:

*“You need to have some sort of multidisciplinary set up for discussing new cases, highlighting cases of concern or that need particular changes in therapy, and you need make sure that you have a demonstrably standardised way of managing your patients.” (P32, CN, England)*

However, at a centre where the prescribers were considered a collection of individuals in terms of their prescribing practice rather than taking a team approach, neurologists were perhaps less influenced by their peers:

*“The other thing is as well, at consultant level, [Dr A] doesn’t know what [Dr B] does in clinic. [Dr B] doesn’t know what [Dr C] does in clinic. [Dr A] doesn’t know what [Dr D] does in clinic... Nobody really knows what other people do.” (P41, CN, Scotland)*

One neurologist noted that shared prescribing practices also came about through local ‘habits’ and infrastructure:

*“The interferon that was routinely chosen in [Health Trust] was different to the interferon that was routinely chosen here... It’s just what you become familiar with and if everybody else is doing it, the nurses are familiar with it, that’s what you just end up using. And I have to say that I’ve started prescribing that same interferon out of habit since coming here... It’s just what a centre is familiar with, and just habit. Learning from your peers.” (P05, CN, Wales)*

Another clinician described how organisational prescribing cultures could be driven by local opinion leaders:

*“I think it’s culture and individuals that are part of that culture. I think if you have a fairly small centre with between five and ten neurologists you tend to have certain neurologists*

*who are more dominant and who influence the department, and if that neurologist or group of neurologists have a certain view then that tends to pervy the department.” (P36, CN, Scotland)*

#### *Participants’ views on national and international differences in prescribing*

In addition to the thematic findings described above, data relating to participants’ views of the reasons for differences in prescribing around the UK and between the UK and other countries were also extracted. When asked why there might be differences in prescribing between England, Scotland, Wales and Northern Ireland, most interviewees cited minor differences in prescribing approvals, guidelines and what they were ‘allowed to prescribe’.

*“In Scotland the ability to prescribe drugs varies from that in England, there are relatively fewer restrictions... There is less of a distinction between what’s active, what’s highly active disease, what should be a first or second line drug. So I know that having spoken to some of my colleagues who work in the Scottish centres of excellence for MS they do comment that they have the relative advantage of being less restricted in what they are able to prescribe.” (P32, CN, England)*

However, some suggested these differences were not sufficient to produce large variation in prescribing rates:

*“So, England, my impression is they’re much more bound by things like NICE. Whereas I think in Wales and I believe in Scotland, but I’m not quite sure, there is a little bit more flexibility to use the medication that you think’s most appropriate... But I don’t think that probably leads to much variation. I think most of the variation is just due to individual learnt differences in practice and behaviour, just habits really.” (P05, CN, Wales)*

When asked about differences in DMT prescribing between the UK and other countries, reasons given included different prescribing guidelines and a sense that a broader range of people would be considered eligible for treatment compared to the UK:

*“The UK traditionally have not treated people after a single episode... But I think historically Europe was always different in that they really acted on the, I think it was the BENEFIT and CHAMPS study where the showed that after a single event if you started interferon early you might delay the onset of MS and so on, whereas I think the UK guidance hasn’t really followed that.” (P05, CN, Wales)*

Differences in healthcare systems were also thought to play a role:

*“It makes a big difference the way your health system is set up, especially if you looked at the American system where they would essentially be paid for prescribing a drug, so it’s in their interest to prescribe... Whereas we’re all aware that there’s a national health system and*

*we're treating people, we've got to look at a whole service and whether it's affordable."*  
(P02, CN, Wales)

*"One is a National Health Service versus an insurance based market, versus a purely private, whereas if you're paying to see your doctor, if your doctor doesn't treat you, you move to another doctor. And therefore your doctor has a commercial interest in treating you."* (P30, CN, Wales)

However, this same participant also noted that, *"it's not just the healthcare systems that are different, it's society's view of health and wellbeing"* (P21, MSN, England) suggesting that cultural differences may have an influence.

Other interviewees concurred that there were perceived differences in the shared attitudes of UK neurologists compared to their European counterparts:

*"I think the risk aversion in certain populations is going to be very different. I think in general the risk averse nature of neurologists... is going to mean that we will always be much more conservative about doing stuff than, for example, our French colleagues or our German colleagues. That's just the way that the system is in terms of in my perception what the British neurologist is about."* (P01, CN, England)

*"I think one of the main reasons is that historically the way British neurologists have managed patients with MS has varied and one may say lagged behind the way in which our colleagues across the channel in centres like in the Netherlands, Germany, France and Italy have viewed and managed MS. For a long time until relatively recently many MS-ologists here in the UK or at least in England, from what I've seen, have adopted the view that you kind of let sleeping dogs lie and that if people don't declare any clinically overt new symptoms then it's reasonable to assume that they're not having new disease activity. Over in Europe they have been far more proactive in actively seeking out disease activity radiologically even if there is no clinical evidence of it."* (P32, CN, England)

Finally, there were perceived differences in the number of neurologists practicing in the UK compared to Europe, leading to variation in patients' access to treatment:

*"Certainly the number of neurologists per head of population is small in European wide comparisons. So patients can have difficulty in terms of accessing, getting an initial diagnosis and then getting appropriate treatment... I think France and Italy, they have something in the region of nine or ten times as many neurologists per head of population."* (P22, CN, Northern Ireland)

*"It could be just general lack of provision of neurology in the UK... In some parts of Europe you've probably got one per 20 to 30,000 of population. In [region of Scotland] it's one per 100,000 of population... I think if you've not got enough neurologists, neurologists won't see enough patients and they won't treat enough patients."* (P41, CN, Scotland)

When asked about reasons for the low numbers of neurologists in the UK, some participants suggested that there was insufficient teaching of neurology in UK medical schools and that medical students and young doctors perceived neurology to be a difficult and unappealing specialism:

*“Part of it is the way neurology is taught at medical school and subsequently, when you're a junior doctor. So in some universities, for example, you have four weeks of neurology, sometimes you have even less than that... The way you identify [a neurological problem] is by clinical examination. And clinical examination is poorly taught at medical school... So there's an inherent what's called neuro-phobia, which is that people are worried about neurology being complicated, when it isn't complicated when it's been taught properly.”*  
(P09, CN, England)

### 3. National survey of DMT prescribers

#### 3.1. What were our aims?

The main aim of the survey study was to quantify the proportion of DMT prescribers experiencing the factors identified in the interview study. A secondary aim was to explore the differences in factors experienced between UK nations and between types of DMT prescribers (e.g. MS specialist neurologists vs. general neurologists).

The research questions were:

- To what extent do DMT prescribers in the UK experience the factors identified in the qualitative study, which potentially influence prescribing?
- How does the experience of these factors vary between UK nations?
- How does the experience of these factors vary between types of prescriber?
- To what extent are these factors associated with clinicians' self-reported prescribing behaviours?

We also included questions in the survey addressing topics of interest to the MS Society including how and when clinicians approach people with MS about taking DMTs; local policies and practices around treatment decision-making (e.g. timing of decisions, use of indicators such as MRI scans); diagnostic criteria used for establishing DMT eligibility.

#### 3.2. What did we do?

We designed a questionnaire to be completed online by clinicians who prescribe DMTs in the UK for people with relapsing forms of MS. We stipulated that respondents should be independent prescribers of DMTs who make decisions with patients about starting disease modifying treatments (not merely completing repeat prescriptions or making decisions about switching DMTs), and who prescribe DMTs as part of their routine clinical practice, not only as part of clinical trials or other research.

We developed the questions based on the findings from the qualitative study and topics of interest to the MS Society as described in the commissioning brief for this research. Questions were reviewed by a patient representative, and pilot tested and refined with a clinical collaborator representative of the target respondents. Additional comments were received from regional clinical research advisors on specific questions and response categories.

The questionnaire contained 48 multiple-choice questions, two questions requiring numerical responses, and one free-text response box where respondents could describe any factors they believed were influencing their own DMT prescribing rates or practices. Questions were presented over 11 pages in 8 sections: 1) Information about them as a prescriber; 2) Discussing DMTs with patients; 3) Determining eligibility for DMTs; 4) Prescribing and diagnostic guidelines; 5) The MS service at their healthcare organisation; 6) Prescribing attitudes and beliefs; 7) Service characteristics; and 8) Prescribing rates (see Appendix 3). We did not collect demographic data on



age, gender or ethnicity as we did not believe this information to be relevant to answering our research questions and could have compromised the respondents' anonymity due to small numbers of DMT prescribers, particularly in the devolved nations.

The majority of potential participants were identified and invited to take part via snowball sampling, with a clinical collaborator, regional clinical research advisors, and some individuals who had participated in the interview study asked to share the research invitation with their colleagues and professional networks. We also shared an invitation to complete the questionnaire in the Association of British Neurologists (ABN) newsletter and on their website, and by the main researcher on Twitter.

Potential respondents were reassured that their responses would be entirely anonymous, that no personally identifiable information would be collected, that data would be reported in broad categories so responses could not be identified, and that data would be stored securely at the University of Manchester. We also offered participants the opportunity to save and print their own responses at the end of the questionnaire.

The questionnaire was created using web-based Select Survey software and hosted on the University of Manchester website. Data were collected between June and August 2017. The study information and documents were reviewed and approved by a University of Manchester proportionate review research ethics committee.

The questionnaire mainly consisted of multiple-choice questions in order to increase ease of completion and survey response rate. Thus, the main results are presented as frequencies and percentages. To test associations between variables, including comparisons between types of prescriber and associations between influencing factors and prescribing behaviours, Pearson's chi-square statistics were planned. However, where the numbers of expected respondents in each category were too small for Pearson's chi-square to give meaningful results, Fisher's exact test was used. The numbers of respondents from each of the devolved nations were too small for further statistical analyses to provide meaningful results, so comparisons between UK nations are provided descriptively in the text and tables as frequencies and percentages.

### *3.3. Who completed the survey?*

The questionnaire was filled in by 46 participants. A minimum of 106 consultant neurologists who prescribe DMTs were invited via email, giving an estimated response rate of 43.4% (although the total number of prescribers receiving the invitation was likely higher due to onward sharing within professional networks and advertising on Twitter and through the ABN). We are aware of at least 131 DMT prescribers in the UK from our qualitative study and the professional knowledge of our clinical collaborator. Our sample represents 35.1% of this known population.

All respondents identified themselves as consultant neurologists rather than neurologists in training or other health professionals. Thirty-six identified as MS specialist neurologists (78.3%), 9 as a neurologist with an interest in MS (19.6%), and 1 as a general neurologist (2.2%). Twenty-six

participants (56.5%) had academic roles in addition to their clinical roles and 13 (28.3%) had a secondary prescribing practice in a different healthcare organisation. The majority of respondents had undertaken additional professional activities in the preceding year (n=41, 89.1%), including conducting clinical trials (n=28, 60.9%), supporting clinical trials as a local investigator (n=31, 67.4%), advising regulatory bodies (n=10, 21.7%), and advising pharmaceutical companies (n=27, 58.7%).

Years of experience prescribing DMTs ranged from less than 1 year to more than 15 years, with 13 participants (28.3%) reporting 5 or fewer years of experience, 7 (15.2%) reporting between 6 and 10 years of experience, 10 (21.7%) reporting between 11 and 15 years of experience, and 16 (34.8%) reporting more than 15 years of experience. The median was 11.5 years of experience prescribing DMTs.

**Table 1. Participant characteristics**

Level of specialism	Number of respondents	Percentage of respondents
MS Specialist Neurologist	36	78.3%
Neurologist with special interest in MS	9	19.6%
General Neurologist	1	2.2%
<b>Balance of clinical and academic roles</b>		
Primarily an academic with honorary or part-time clinical contract	3	6.5%
Primarily a clinician with honorary or part-time academic contract	20	43.5%
Equally split between academic and clinical roles	3	6.5%
A clinician without academic contract	20	43.5%
<b>Professional activities in the preceding year</b>		
Clinical trial principal investigator	28	60.9%
Supporting clinical trial as local investigator	31	67.4%
Regulatory advisory board (e.g. NICE, ABN)	10	21.7%
Pharmaceutical advisory board	27	58.7%
<b>Years' experience prescribing DMTs for MS</b>		
0-5 years	13	28.3%
6-10 years	7	15.2%
11-15 years	10	21.7%
15 or more years	16	34.8%

### 3.4. What did we find?

One participant submitted the survey after 31.5 hours suggesting they began the questionnaire and returned to it the next day. Excluding this unusually long response time, the mean time to complete the survey was 17.33 minutes (SD = 10.4).

#### Location

England was the main place of prescribing practice for 35 participants (76.1%), with only 5 participants reporting their main place of practice to be in Wales (10.9%), 2 in Northern Ireland

(4.3%) and 4 in Scotland (8.7%). From the qualitative study we know there are 7 DMT prescribers working primarily in Wales, 6 in Northern Ireland, and approximately 19 in Scotland, giving response rates of 71.4%, 33.3% and 21.1% respectively.

Forty participants were working in regional neuroscience centres (87.0%), 5 in neurology centres (10.9%), and 1 in a general hospital (2.2%). No participants reported their main place of practice to be a primary care or private health organisation. Forty-two participants (91.3%) reported working in a specialist multiple sclerosis service and 4 reported working in a general neurology service (8.7%).

**Table 2. Participants' prescribing settings**

<b>UK nation</b>	<b>Number of respondents</b>	<b>Percentage of respondents</b>
England	35	76.1%
Wales	5	10.9%
Scotland	4	8.7%
Northern Ireland	2	4.3%
<b>Type of service</b>		
Specialist multiple sclerosis service	42	91.3%
General neurology service	4	8.7%
<b>Type of organisation of main prescribing practice</b>		
Regional neuroscience centre	40	87.0%
Neurology centre	5	10.9%
General hospital	1	2.2%
Primary care organisation	0	0.0%
Private health organisation	0	0.0%
<b>Type of organisation of secondary prescribing practice</b>		
Regional neuroscience centre	2	4.3%
Neurology centre	1	2.2%
General hospital	10	21.7%
Primary care organisation	0	0.0%
Private healthcare organisation	0	0.0%
No secondary practice	33	71.7%

#### *Service characteristics and caseload*

The number of DMT prescribers, MS specialist neurologists and MS nurses working in the survey respondents' services ranged from only one to ten or more. The median numbers were 5 DMT prescribers, 4.5 MS specialist neurologists and 5 MS nurses. Three participants (6.5%) worked in services where they were the only DMT prescriber, and four (8.7%) were the sole MS specialist neurologist in their service.

Fourteen respondents (30.4%) prescribed disease modifying drugs in general neurology clinics, 33 (71.7%) in clinics specifically for patients with multiple sclerosis, and 23 (50.0%) in dedicated DMT

clinics. Eleven participants (23.9%) reported prescribing the treatments only in dedicated DMT clinics, while two (4.3%) prescribed them only in general neurology clinics.

Respondents were asked approximately what proportion of their clinical workload was dedicated specifically to patients with MS. The most common (n=10, 21.7%) and median response was 31-40%. Two participants (4.3%) reported that only 0-10% of their workload was dedicated to patients with MS, and two (4.3%) indicated that MS patients comprised 91-100% of their clinical caseload.

The mean number of people with any type of MS under the personal care of these consultant neurologists was 542 (SD = 283.6), and the mean number under the care of their service was 2373 (SD = 1153.9). The largest number of MS patients under the personal care of one responding neurologist was 1200, and the largest number under the care of a service was 4500 reported by three participants. The smallest number of MS patients for one respondent was 30, and the smallest under the care of a service was 500.

#### *Prescribing rates*

Asked what proportion of patients with any type of MS under their personal care were currently prescribed any DMT, the most common response was 21-30% of all MS patients (n = 11, 23.9%) and the median response was 41-50%. No participants selected the lowest prescription rate of 0-10%, while one respondent (2.2%) reported that 91-100% of MS patients under their care were currently prescribed DMTs. However, it should be noted that these rates will be affected by the proportion of patients under their care with progressive forms of MS who are ineligible for treatment, and the proportion who are newly diagnosed who may be more likely to start treatment than those with established MS.

In England and Scotland the median response reflected the overall response with 41-50% of all MS patients reportedly prescribed any DMT. The four participants in Scotland reported four different prescribing rates of 11-20%, 31-40%, 51-60%, and 81-90%. In Wales the median response was lower at 21-30%, as three respondents reported prescribing rates for all MS patients at 21-30%, one at 31-40% and one at 41-50%. The two respondents in Northern Ireland reported prescribing rates of 41-50% and 71-80%.

Dimethyl Fumarate was ranked by 24 participants (52.2%) as the most commonly prescribed DMT for people with MS currently under their personal care. The other six types of DMTs were ranked as most commonly prescribed by between 3 (6.5%) and 10 (21.7%) respondents. A majority of respondents ranked the least commonly prescribed DMT as Teriflunomide (n = 32, 69.6%). No participants ranked either Beta Interferons or Fingolimod as least prescribed. Asked to rank the DMTs from most prescribed (1) to least prescribed (7), participants ranked Dimethyl Fumarate highest with a median ranking of 1, followed by Beta Interferons (median = 3), Glatiramer Acetate (median = 4), Natalizumab (median = 4), Alemtuzumab (median = 5), Fingolimod (median = 5) and Teriflunomide (median = 7).

The same general pattern of ranking was reported by participants in England and Scotland with Dimethyl Fumarate ranked as most prescribed, followed by Beta Interferons, and Teriflunomide as least prescribed. In Wales Beta Interferons were most prescribed with a median ranking of 1, and Dimethyl Fumarate was ranked second (median ranking = 2). In Northern Ireland one respondent ranked Dimethyl Fumarate most prescribed and Beta Interferons second most prescribed, and the other respondent ranked Beta Interferons as most prescribed and Dimethyl Fumarate as second most prescribed. One reported Teriflunomide as least prescribed and the other reported Alemtuzumab as least prescribed.

For people with MS receiving their *first* DMT prescription as a first-line treatment, the vast majority of respondents reported most often now prescribing Dimethyl Fumarate (n = 40, 87%). This included all five participants in Wales, both participants in Northern Ireland and three out of four participants in Scotland. One respondent in Scotland prescribed Beta Interferons most often. In England, while the majority (n = 30, 85.7%) most often prescribed Dimethyl Fumarate, three (8.6%) most often prescribed Glatiramer Acetate, and one participant (2.9%) each most often prescribed Alemtuzumab and Teriflunomide.

In England, five respondents (14.3%) reported that they were currently unable to prescribe Teriflunomide within their service, and one (2.9%) reported not being able to prescribe Alemtuzumab. The remaining 38 participants (82.6%) who completed this question, including all respondents in Scotland, Wales and Northern Ireland, were able to prescribe all seven types of DMTs within their service.

#### *Factors potentially influencing prescribing*

Results pertaining to participants' experience of factors potentially influencing prescribing are presented in the description below and attached tables. Results specific to each UK nation are displayed, however caution should be taken when drawing comparisons due to the very small numbers of participants from Scotland, Wales and Northern Ireland.

#### *Determining eligibility for DMTs*

All participants reported using magnetic resonance (MR) imaging to diagnose MS in "almost all" patients. The majority of respondents (n = 33, 71.7%) also used MR scanning when making decisions about prescribing DMTs, but a significant proportion (n = 13, 28.3%) reported using scans for DMTs decisions infrequently or rarely (Table 3). Almost two thirds (63.0%) of respondents, including all 5 participants in Wales, had dedicated relapse clinics as their main method of identifying and confirming relapses, while 23.9% of respondents relied on patient self-report by phone call and remote assessment. Only one participant (2.2%) reported retrospective patient reporting at scheduled follow-up appointments as their main method of identifying relapses, and 4 respondents (8.7%) assessed relapses at expedited appointments or day case admissions (Table 4).

Table 3. Use of magnetic resonance imaging in diagnosis and prescribing

<b>Extent magnetic resonance imaging used to diagnose MS</b>	<b>UK total (%)</b>	<b>England (%)</b>	<b>Scotland (%)</b>	<b>Wales (%)</b>	<b>Northern Ireland (%)</b>
Almost all patients scanned before diagnosis	46 (100.0%)	35 (100.0%)	4 (100.0%)	5 (100.0%)	2 (100.0%)
More than 50% of patients scanned before diagnosis	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Less than 50% of patients scanned before diagnosis	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Patients rarely scanned before diagnosis	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
<b>Extent magnetic resonance imaging used in DMT prescribing decisions</b>					
Almost all patients scanned before decision	18 (39.1%)	14 (40.0%)	1 (25.0%)	3 (60.0%)	0 (0.0%)
More than 50% of patients scanned before decision	15 (32.6%)	11 (31.4%)	2 (50.0%)	1 (20.0%)	1 (50.0%)
Less than 50% of patients scanned before decision	9 (19.6%)	7 (20.0%)	1 (25.0%)	0 (0.0%)	1 (50.0%)
Patients rarely scanned before decision	4 (8.7%)	3 (8.6%)	0 (0.0%)	1 (20.0%)	0 (0.0%)



Table 4. Primary method for identifying clinical relapses

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Clinical assessment at dedicated relapse clinic	29 (63.0%)	23 (65.7%)	1 (25.0%)	5 (100.0%)	0 (0.0%)
Clinical assessment at urgent non-relapse clinic appointment	3 (6.5%)	2 (5.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Patient self-report by phone call and remote assessment	11 (23.9%)	6 (17.1%)	3 (75.0%)	0 (0.0%)	2 (100.0%)
Retrospective self-report at follow-up appointment	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Other: "Expedited review on day case within one week"	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Other: "Varies according to sub-regional arrangements"	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Participants indicated which of eight factors they perceived as most important for assessing relapses and determining eligibility. The factor endorsed as most important by the highest number of participants was time since previous relapse ( $n = 15$ , 32.6%), followed by disease activity on MR scan ( $n = 12$ , 26.1%), impact on patient's daily functioning ( $n = 10$ , 21.7%), severity of symptoms ( $n = 4$ , 8.7%), type of symptoms ( $n = 3$ , 6.5%), and accumulated disability ( $n = 2$ , 4.3%). No participants indicated area of brain affected or duration of symptoms as most important in assessing relapses (Table 5).

Respondents were asked to indicate which of four criteria they use to define clinically significant relapses indicating eligibility for DMTs. The third response item on the questionnaire corresponded to the NHS England (2014) definition this type of relapse, which mentions motor, brainstem, and sphincter function, optic neuritis, intensive pain, and sensory impairment. Eleven (23.9%) participants reported using this definition as their criteria for clinically significant relapses indicating eligibility for DMTs. However, the majority ( $n = 26$ , 56.5%) reported using a less stringent criterion, the NHS England (2014) definition of *any* relapse (i.e. new symptoms or worsening of existing symptoms for at least 24 hours, at least 30 days after onset of previous relapses, with no alternative explanation). Three respondents (6.5%) employed a stricter criterion, corresponding to the NHS England (2014) definition of a *disabling* relapse (i.e. affecting the patient's ability to work, care for themselves, or necessitate hospital admission). A minority ( $n = 5$ , 10.9%) indicated that they considered evidence of a new lesion on an MR image to be sufficient basis for clinically significant relapse and eligibility for DMTs (Table 6).

Asked to report their views on the minimum definition of a disabling relapse, the majority of participants ( $n = 31$ , 67.4%) indicated that any relapse the patient finds inhibiting or distressing would be considered a disabling relapse suggesting eligibility for natalizumab (Tysabri). Seven (15.2%) considered relapses affecting social and leisure activities to be disabling, and six (13.0%) considered those affecting work or study to be disabling. Two respondents (4.3%) indicated they perceived disabling relapses to be those requiring hospital admission or treatment, but no respondents considered the minimum definition of a disabling relapse to include effects on the patient's ability to care for themselves in activities of daily living (Table 7).

The respondents were given a case scenario where a patient met the criteria for some DMTs of two relapses in two years, but could be considered borderline in terms of DMT eligibility due to the long interval between relapses, full and quick recovery, and no new lesions on MR imaging. Nearly half of participants reported they would be "somewhat likely" to prescribe a DMT in this scenario ( $n = 21$ , 45.7%). However, substantial proportions of respondents also indicated they would be "extremely likely" ( $n = 7$ , 15.2%), "somewhat unlikely" ( $n = 12$ , 26.1%), or "not likely at all" ( $n = 6$ , 13.0%) to prescribe, showing the wide individual variation in tendency to prescribe DMTs for less severe cases of MS. Interestingly, the two participants in Northern Ireland gave entirely opposing views with one indicating they would be extremely likely to prescribe in this scenario, and the other not likely to prescribe at all (Table 8).

Table 5. Perceived most important factor in assessing relapses and eligibility for DMTs

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Area of the brain implicated	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Disease activity as shown by MRI scan	12 (26.1%)	9 (25.7%)	2 (50.0%)	1 (20.0%)	0 (0.0%)
Type of symptoms (e.g. motor, sensory)	3 (6.5%)	3 (8.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Duration of symptoms	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Severity of symptoms	4 (8.7%)	3 (8.6%)	0 (0.0%)	1 (20.0%)	0 (0.0%)
Time since previous relapse	15 (32.6%)	11 (31.4%)	1 (25.0%)	2 (40.0%)	1 (50.0%)
Impact on patient's daily functioning	10 (21.7%)	7 (20.0%)	1 (25.0%)	1 (20.0%)	1 (50.0%)
Accumulated disability	2 (4.3%)	2 (5.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 6. Criteria used to define a clinically significant relapse indicating eligibility for DMTs

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Evidence of new lesion on MRI is sufficient	5 (10.9%)	5 (14.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Any relapse incorporating new symptoms or worsening of existing symptoms for at least 24 hours, at least 30 days after onset of previous relapse, with no alternative explanation <i>[NHSE 2014 definition of relapse]</i>	26 (56.5%)	18 (51.4%)	3 (75.0%)	3 (60.0%)	2 (100.0%)
Only relapses affecting motor, brainstem, or sphincter function, or presenting as optic neuritis, intensive pain for 48 hours, or sensory symptoms if they lead to functional impairment <i>[NHSE 2014 definition of clinically significant relapse indicating eligibility for DMTs]</i>	11 (23.9%)	9 (25.7%)	1 (25.0%)	1 (20.0%)	0 (0.0%)
Only relapses affecting the patient's ability to work, carry out activities of daily living, care for themselves, or requiring hospital admission or treatment <i>[NHSE 2014 definition of disabling relapse]</i>	3 (6.5%)	2 (5.7%)	0 (0.0%)	1 (20.0%)	0 (0.0%)
Did not answer	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 7. Perceived minimum definition of a disabling relapse

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
A relapse the patient finds inhibiting, distressing or unacceptable	31 (67.4%)	23 (65.7%)	4 (100.0%)	2 (40.0%)	2 (100.0%)
A relapse affecting the patient's enjoyment of social and leisure activities	7 (15.2%)	4 (11.4%)	0 (0.0%)	3 (60.0%)	0 (0.0%)
A relapse affecting the patient's ability to work or study	6 (13.0%)	6 (17.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
A relapse affecting the patient's ability to care for themselves (e.g. bathing, eating, dressing)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
A relapse requiring hospital admission or treatment	2 (4.3%)	2 (5.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 8. Likelihood of recommending a DMT for a patient on borderline of eligibility (i.e. two sensory relapses 23 months apart, quickly and fully recovered, no new lesions on MR scan in preceding 3 years)

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Not likely at all	6 (13.0%)	2 (5.7%)	1 (25.0%)	2 (40.0%)	1 (50.0%)
Somewhat unlikely	12 (26.1%)	9 (25.7%)	2 (50.0%)	1 (20.0%)	0 (0.0%)
Somewhat likely	21 (45.7%)	19 (54.3%)	0 (0.0%)	2 (40.0%)	0 (0.0%)
Extremely likely	7 (15.2%)	5 (14.3%)	1 (25.0%)	0 (0.0%)	1 (50.0%)

Regarding the participants' perceived aim of disease modifying treatment, the most commonly held view was that DMTs should aim to achieve 'no evidence of disease activity' (n = 24, 52.2%), followed by the aim to delay or prevent long-term disability (n = 14, 30.4%). A minority of respondents felt that the aim of treatment should be to reduce the number of relapses in the shorter term (n = 6, 13.0%) and two (4.3%) provided a written response stating that the treatment aim should encompass both disability and relapses (Table 9).

All respondents reported employing at least one procedure for managing the stopping of disease modifying treatment when patients no longer clinically benefit, and the mean number of procedures used was 2.6 (SD = 1.2). The most common approach was to discuss stopping DMTs over several appointments (n = 40, 87.0%). Other common methods were discussing treatment end prior to starting on DMTs (n = 30, 65.3%), reiterating stopping criteria at regular appointments (n = 18, 39.1%), offering patients treatment breaks prior to ending DMTs for good (n = 16, 34.8%), and increasing MS nurse support (n = 11, 23.9%). Four participants (8.7%) had dedicated transition clinics for people ending treatment, and all of these respondents were working in England (Table 10).

#### *Prescribing and diagnostic guidelines*

Participants were asked to indicate which guidelines they actively used when making DMT prescribing decisions. Only 80.4% (n = 37) of the sample overall and 82.9% (n = 29) of participants in England reported actively using the NICE technology appraisal reports for individual DMTs, despite permitted and funded use of these drugs being tied to the NICE criteria in England. Twenty-eight respondents (60.9%) also reported using the Association of British Neurologist (2015) guidelines. Respondents indicated use of local prescribing policies in their respective nations, including 4 (80.0%) prescribers in Wales using Welsh guidelines, 3 (75.0%) prescribers in Scotland using Scottish guidelines, and 2 (100.0%) prescribers in Northern Ireland using Northern Irish guidelines. Interestingly, one respondent in England also reported using the Northern Irish guideline (Table 11).

Considering the same list of guidelines, participants indicated the most important for them justifying their prescribing decisions. In England, the NICE guidelines were most commonly perceived as the primary source of guidance (n = 16, 45.7%), followed by NHS England policy documents (10, 28.6%), and ABN guidelines (n = 8, 22.9%). The UK sample overall reflected this pattern of responses in England. However, in Scotland 3 prescribers (75.0%) indicated that Scottish Medicines Consortium guidance was most important, in Wales the ABN (n = 3, 60.0%) and NICE (n = 2, 40.0%) guidelines were top, and in Northern Ireland one participant considered the NICE guidance to be most important while the other indicated that local Northern Irish guidelines were the main guideline (Table 12).

The vast majority of respondents (n = 42, 91.3%) use the most recent revised McDonald criteria (2010) for diagnosing MS. However, one participant reported using the 2001 McDonald criteria, two used the 2005 McDonald criteria, and one reported using "clinical judgement" rather than any of these diagnostic criteria. These four respondents using alternative criteria were all based in England (Table 13).



Table 9. Perceived aim of disease modifying treatment

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
No evidence of disease activity (NEDA) in terms of relapse, increased disability, or lesions on MRI scans	24 (52.2%)	19 (54.3%)	2 (50.0%)	2 (40.0%)	1 (50.0%)
To delay or prevent long-term disability	14 (30.4%)	11 (31.4%)	1 (25.0%)	2 (40.0%)	0 (0.0%)
To reduce the number of relapses in the shorter-term	6 (13.0%)	4 (11.4%)	1 (25.0%)	0 (0.0%)	1 (50.0%)
Other: "Both to reduce relapses and delay long-term disability"	2 (4.3%)	1 (2.9%)	0 (0.0%)	1 (20.0%)	0 (0.0%)

Table 10. Procedures for managing stopping of DMTs for patients who no longer clinically benefit

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Stopping criteria discussed and agreed with patients prior to treatment starting	30 (65.2%)	23 (65.7%)	2 (50.0%)	4 (80.0%)	1 (50.0%)
Stopping criteria reiterated at follow-up appointments	18 (39.1%)	13 (37.1%)	1 (25.0%)	4 (80.0%)	0 (0.0%)
Dedicated transition clinics	4 (8.7%)	4 (11.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Increased MS nurse support	11 (23.9%)	9 (25.7%)	2 (50.0%)	0 (0.0%)	0 (0.0%)
Stopping treatment broached discussed over several appointments	40 (87.0%)	29 (82.9%)	4 (100.0%)	5 (100.0%)	2 (100.0%)
Patients first offered treatment "breaks"	16 (34.8%)	10 (28.6%)	1 (25.0%)	5 (100.0%)	0 (0.0%)

Table 11. Prescribing guidelines actively used to make DMT prescribing decisions

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Association of British Neurologists guidelines (Scolding, 2015)	28 (60.9%)	21 (60.0%)	2 (50.0%)	3 (60.0%)	2 (100.0%)
NICE technology appraisal reports for individual DMTs	37 (80.4%)	29 (82.9%)	2 (50.0%)	4 (80.0%)	2 (100.0%)
NHS England policy documents (e.g. clinical commissioning policy, 2014)	30 (65.2%)	30 (85.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
All Wales Medicines Strategy Group reports	4 (8.7%)	0 (0.0%)	0 (0.0%)	4 (80.0%)	0 (0.0%)
Scottish Medicines Consortium reports	3 (6.5%)	0 (0.0%)	3 (75.0%)	0 (0.0%)	0 (0.0%)
Local prescribing guidelines for Northern Ireland (e.g for natalizumab and alemtuzumab)	3 (6.5%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	2 (100.0%)
Other: "Blueteq"	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 12. Primary guideline used to justify prescribing decisions

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Association of British Neurologists guidelines (Scolding, 2015)	12 (26.1%)	8 (22.9%)	1 (25.0%)	3 (60.0%)	0 (0.0%)
NICE technology appraisal reports for individual DMTs	19 (41.3%)	16 (45.7%)	0 (0.0%)	2 (40.0%)	1 (50.0%)
NHS England policy documents (e.g. clinical commissioning policy, 2014)	10 (21.7%)	10 (28.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
All Wales Medicines Strategy Group reports	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Scottish Medicines Consortium reports	3 (6.5%)	0 (0.0%)	3 (75.0%)	0 (0.0%)	0 (0.0%)
Local prescribing guidelines for Northern Ireland (e.g for natalizumab and alemtuzumab)	1 (2.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (50.0%)
Did not answer	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 13. Criteria used for diagnosing MS

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
McDonald criteria, 2001	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Revised McDonald criteria, 2005	2 (4.3%)	2 (5.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Revised McDonald criteria, 2010	42 (91.3%)	31 (88.6%)	4 (100.0%)	5 (100.0%)	2 (100.0%)
Other: "Clinical judgement"	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

### *Role of health professionals in MS services*

According to the prescribers taking part in this survey, MS specialist neurologists commonly undertake the majority of tasks involved in providing care for people with relapsing MS. All respondents reported that specialist neurologists discuss DMT options with patients and prescribe DMTs of greater efficacy and high efficacy within their service. More than 80% also reported that specialist neurologists regularly follow up people on DMTs, prescribe moderate efficacy DMTs, diagnose people with MS, prescribe drugs for symptom or relapse management, identify relapses, and monitor patients on DMTs. Slightly fewer participants (n = 35, 76.1%) indicated that specialist neurologists regularly followed up people with MS who are not taking DMTs (Table 14).

In comparison, participants indicated that general neurologists are usually involved in fewer roles in MS healthcare. General neurologists undertake diagnosis of people with MS in the services of 95.7% of respondents, prescribe drugs for symptom or relapse management in 50.0% of cases, identify relapses in 43.5% of services, and have regular follow-up appointments with people not taking DMTs in 37.0% of services. Other tasks such as regular appointments with patients on DMTs, discussing DMT options, monitoring patients on DMTs, and prescribing DMTs of varying effectiveness were undertaken by general neurologists in between only 6.5% to 13.0% of services (Table 15).

MS nurses were reportedly much more involved in MS care roles, with the majority of respondents indicating MS nurse involvement in follow-up appointments for those on DMTs (95.7%) and those not (76.1%), identifying relapses (91.3%), discussing DMT options (89.1%), monitoring patients on DMTs (89.1%), and delivering DMTs (69.6%). In terms of prescriptions, around half of participants reported that MS nurses independently prescribed drugs for symptom or relapse management (56.5%) and wrote repeat DMT prescriptions (45.7%), but only 15.2% of respondents indicated that nurses sign these repeat DMT prescriptions (Table 16).

### *Approaches to care and DMT prescribing in MS services*

There was wide variation in the frequency of team meetings in which DMTs are discussed with nearly one third of respondents (30.4%) reporting this occurs weekly, 15.2% fortnightly, 23.9% monthly, 13.0% several times per year, and 17.4% reporting that they rarely or never have these types of meetings. In Wales all five participants indicated they had such meetings weekly, while in Northern Ireland both participants indicated they rarely or never held such meetings. In Scotland and England, there was less agreement with a range of time frames represented (Table 17).

Similarly, 4 out of 5 prescribers in Wales reported actively working towards standardised care for patients within their service, while both prescribers in Northern Ireland stated they hoped people with MS would receive equitable care, but did not have procedures in place to achieve this. In Scotland they were more likely to indicate that their service did not strive for standardised care, as they worked as individual prescribers accountable for their own prescribing decisions (n = 3, 75%). In England (n = 14, 40.0%), and in the figures for the UK overall (n = 18, 39.1%), equal numbers of respondents indicated they either actively worked towards standardised care or hoped for an equitable service without specific procedures to achieve this. A smaller number in England reported

Table 14. Role of MS specialist neurologists in the MS service

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Diagnosing patients with MS	43 (93.5%)	32 (91.4%)	4 (100.0%)	5 (100.0%)	2 (100.0%)
Regular follow-up appointments for patients on DMTs	45 (97.8%)	34 (97.1%)	4 (100.0%)	5 (100.0%)	2 (100.0%)
Regular follow-up appointments for patients not on DMTs	35 (76.1%)	27 (77.1%)	4 (100.0%)	2 (40.0%)	2 (100.0%)
Identifying relapses	40 (87.0%)	31 (88.6%)	4 (100.0%)	4 (80.0%)	1 (50.0%)
Prescribing drugs for managing symptoms and/or relapse	41 (89.1%)	31 (88.6%)	3 (75.0%)	5 (100.0%)	2 (100.0%)
Discussing DMT options	46 (100.0%)	35 100.0%	4 (100.0%)	5 (100.0%)	2 (100.0%)
Prescribing DMTs of moderate efficacy (beta interferons, glatiramer acetate, teriflunomide)	44 (95.7%)	33 (94.3%)	4 (100.0%)	5 (100.0%)	2 (100.0%)
Prescribing DMTs of greater efficacy (dimethyl fumarate, fingolimod)	46 (100.0%)	35 (100.0%)	4 (100.0%)	5 (100.0%)	2 (100.0%)
Prescribing DMTs of high efficacy (natalizumab, alemtuzumab)	46 (100.0%)	35 (100.0%)	4 (100.0%)	5 (100.0%)	2 (100.0%)
Monitoring patients on DMTs (e.g. overseeing blood tests)	39 (84.8%)	29 (82.9%)	3 (75.0%)	5 (100.0%)	2 (100.0%)
Other: "Assessing patients for clinical trials"	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 15. Role of general neurologists in the MS service

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Diagnosing patients with MS	44 (95.7%)	33 (94.3%)	4 (100.0%)	5 (100.0%)	2 (100.0%)
Regular follow-up appointments for patients on DMTs	6 (13.0%)	4 (1.4%)	1 (25.0%)	0 (0.0%)	1 (50.0%)
Regular follow-up appointments for patients not on DMTs	17 (37.0%)	12 (34.3%)	1 (25.0%)	2 (40.0%)	2 (100.0%)
Identifying relapses	20 (43.5%)	15 (42.9%)	3 (75.0%)	0 (0.0%)	2 (100.0%)
Prescribing drugs for managing symptoms and/or relapse	23 (50.0%)	18 (51.4%)	2 (50.0%)	1 (20.0%)	2 (100.0%)
Discussing DMT options	3 (6.5%)	2 (5.7%)	1 (25.0%)	0 (0.0%)	0 (0.0%)
Prescribing DMTs of moderate efficacy (beta interferons, glatiramer acetate, teriflunomide)	5 (10.9%)	3 (8.6%)	1 (25.0%)	0 (0.0%)	1 (50.0%)
Prescribing DMTs of greater efficacy (dimethyl fumarate, fingolimod)	3 (6.5%)	2 (5.7%)	1 (25.0%)	0 (0.0%)	0 (0.0%)
Prescribing DMTs of high efficacy (natalizumab, alemtuzumab)	3 (6.5%)	2 (5.7%)	1 (25.0%)	0 (0.0%)	0 (0.0%)
Monitoring patients on DMTs (e.g. overseeing blood tests)	5 (10.9%)	3 (8.6%)	1 (25.0%)	0 (0.0%)	1 (50.0%)



Table 16. Role of MS nurses in the MS service

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Regular follow-up appointments for patients on DMTs	44 (95.7%)	34 (97.1%)	4 (100.0%)	5 (100.0%)	1 (50.0%)
Regular follow-up appointments for patients not on DMTs	35 (76.1%)	26 (74.3%)	4 (100.0%)	5 (100.0%)	0 (0.0%)
Identifying relapses	42 (91.3%)	31 (88.6%)	4 (100.0%)	5 (100.0%)	2 (100.0%)
Prescribing drugs for managing symptoms and/or relapse	26 (56.5%)	19 (54.3%)	3 (75.0%)	3 (60.0%)	1 (50.0%)
Referring patients to a neurologist for DMTs	38 (82.6%)	27 (77.1%)	4 (100.0%)	5 (100.0%)	2 (100.0%)
Discussing DMT options	41 (89.1%)	30 (85.7%)	4 (100.0%)	5 (100.0%)	2 (100.0%)
Monitoring patients on DMTs (e.g. overseeing blood tests)	41 (89.1%)	31 (88.6%)	4 (100.0%)	5 (100.0%)	1 (50.0%)
Delivering DMTs (e.g. giving infusions, injections)	32 (69.6%)	23 (65.7%)	3 (75.0%)	4 (80.0%)	2 (100.0%)
Writing repeat prescriptions	21 (45.7%)	17 (48.6%)	3 (75.0%)	1 (20.0%)	0 (0.0%)
Signing repeat prescriptions	7 (15.2%)	6 (17.1%)	0 (0.0%)	1 (20.0%)	0 (0.0%)

Table 17. Frequency of prescriber or multi-disciplinary team meetings in which DMT prescribing decisions are discussed

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Weekly	14 (30.4%)	9 (25.7%)	0 (0.0%)	5 (100.0%)	0 (0.0%)
Fortnightly	7 (15.2%)	6 (17.1%)	1 (25.0%)	0 (0.0%)	0 (0.0%)
Monthly	11 (23.9%)	9 (25.7%)	2 (50.0%)	0 (0.0%)	0 (0.0%)
Several times per year	6 (13.0%)	6 (17.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Annually	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Rarely/never	8 (17.4%)	5 (14.3%)	1 (25.0%)	0 (0.0%)	2 (100.0%)

independent prescribing (n = 5, 14.3%) or having no opportunity for standardised care as a solitary prescriber (n = 2, 5.7%) (Table 18).

The majority of participants (n = 38, 82.6%) reported their service as a whole was inclined to prescribe DMTs readily in order to obtain the potential benefits of these drugs. However, a substantial minority (n = 7, 15.2%) indicated they and their colleagues were cautious about prescribing DMTs due to the potential risks. This pattern was similarly reflected in the small numbers of participants completing the questionnaire in Scotland, Wales and Northern Ireland (Table 19).

#### *Discussing DMTs with people with MS*

Most prescribers reported discussing DMT options with people with MS on the day of their diagnosis (n = 25, 54.3%) and nearly a fifth of prescribers did so within 1 to 2 weeks of diagnosis (n = 9, 19.6%). A smaller number indicated that these discussions occurred in the 3 to 6 weeks following diagnosis (n = 4, 8.7%), 6 to 12 weeks after diagnosis (n = 5, 10.9%), or more than 12 weeks after diagnosis (n = 3, 8.6%) (Table 20).

Discussions with people previously diagnosed with MS who are newly eligible for disease modifying treatment (e.g. who now meet eligibility criteria of two relapses in two years) tend to occur earlier, with 73.9% (n = 34) of participants stating that this discussion occurs on the day that eligibility is confirmed, 13.0% (n = 6) in the following 1 to 2 weeks, 6.5% (n = 3) in the following 3 to 6 weeks. Three respondents indicated that these discussions took place more than 6 weeks after eligibility for DMTs is confirmed (6.5%) (Table 21).

The main health professional discussing DMTs with patients is the prescribing neurologist according to 73.9% of participants (n = 34). Both the prescribing neurologist and MS nurse are the main sources of discussion according to 23.9% of participants. Only one participant (2.2%) indicated that the MS nurse was the main health professional discussing DMTs with people with MS (Table 22).

#### *Managing patient choice about DMTs*

When asked to indicate the extent of choice they give to patients in selecting which DMTs to take, over half of prescribers reported providing a guided choice, directing the person from all DMTs available to those they would recommend (n = 26, 56.5%). The remaining participants were split between providing a free choice of all DMTs for which the person is eligible (n = 11, 23.9%) and providing a curated or limited choice of a small number of DMTs (n = 9, 19.6%) (Table 23).

There was a similar range of views regarding the extent to which participants believe DMT choices should be the decision of the prescriber or the patient. Over half indicated this decision should be equally the prescriber's and patient's choice (n = 26, 56.5%), 28.3% (n = 13) thought this should be mostly the patient's choice, and 13.0% (n = 6) thought this should mostly be the prescriber's choice. Just one respondent (2.2%) indicated that this should be completely the patient's decision (Table 24).

Table 18. Extent to which services aim to provide standardised care regardless of prescriber seen

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Very much (actively work towards providing similar care and prescribing decisions across prescribers)	18 (39.1%)	14 (40.0%)	0 (0.0%)	4 (80.0%)	0 (0.0%)
Somewhat (hope patients receive equitable service but do not have procedures in place to achieve this)	18 (39.1%)	14 (40.0%)	1 (25.0%)	1 (20.0%)	2 (100.0%)
Not at all (work as individual prescribers accountable for own independent prescribing decisions)	8 (17.4%)	5 (14.3%)	3 (75.0%)	0 (0.0%)	0 (0.0%)
Not applicable (e.g. solitary prescriber)	2 (4.3%)	2 (5.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 19. Perceived readiness of the participants' services to prescribe DMTs

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Cautious about prescribing DMTs due to potential risks	7 (15.2%)	5 (14.3%)	1 (25.0%)	1 (20.0%)	0 (0.0%)
Inclined to prescribe DMTs readily due to potential benefits	38 (82.6%)	29 (82.9%)	3 (75.0%)	4 (80.0%)	2 (100.0%)
Did not answer	1 (2.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 20. Timing of discussion about DMTs with people newly diagnosed with MS who are eligible for treatment

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
On the same day diagnosis is confirmed	25 (54.3%)	19 (54.3%)	3 (75.0%)	1 (20.0%)	2 (100.0%)
In the 1-2 weeks following diagnosis	9 (19.6%)	7 (20.0%)	1 (25.0%)	1 (20.0%)	0 (0.0%)
In the 3-6 weeks following diagnosis	4 (8.7%)	4 (11.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
In the 6-12 weeks following diagnosis	5 (10.9%)	2 (5.7%)	0 (0.0%)	3 (60.0%)	0 (0.0%)
More than 12 weeks after diagnosis is confirmed	3 (6.5%)	3 (8.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 21. Timing of discussion about DMTs with people previously diagnosed with MS who are newly eligible for treatment

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
On the same day eligibility is confirmed	34 (73.9%)	28 (80.0%)	3 (75.0%)	1 (20.0%)	2 (100.0%)
In the 1-2 weeks following diagnosis	6 (13.0%)	3 (8.6%)	1 (25.0%)	2 (40.0%)	0 (0.0%)
In the 3-6 weeks following diagnosis	3 (6.5%)	2 (5.7%)	0 (0.0%)	1 (20.0%)	0 (0.0%)
In the 6-12 weeks following diagnosis	2 (4.3%)	1 (2.9%)	0 (0.0%)	1 (20.0%)	0 (0.0%)
More than 12 weeks after eligibility for DMTs is confirmed	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 22. Main health professional discussing DMT decision with patients

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Prescribing neurologist	34 (73.9%)	25 (71.4%)	4 (100.0%)	3 (60.0%)	2 (100.0%)
MS nurse	1 (2.2%)	0 (0.0%)	0 (0.0%)	1 (20.0%)	0 (0.0%)
Both prescribing neurologist and MS nurse	11 (23.9%)	10 (28.6%)	0 (0.0%)	1 (20.0%)	0 (0.0%)
Other	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 23. Extent of choice presented to patients when selecting DMTs

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Free choice of all DMTs for which person is eligible	11 (23.9%)	10 (28.6%)	1 (25.0%)	0 (0.0%)	0 (0.0%)
Guided choice from all permitted DMTs to those recommended by prescriber	26 (56.5%)	18 (51.4%)	2 (50.0%)	4 (80.0%)	0 (0.0%)
Curated choice of limited number of DMTs	9 (19.6%)	7 (20.0%)	1 (25.0%)	1 (20.0%)	2 (100.0%)
Only one choice of DMT	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)



Table 24. Beliefs about the extent to which DMT choice should be the decision of the prescriber or the patient

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Completely the prescriber's decision	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Mostly the prescriber's decision, but taking the patient's views into account	6 (13.0%)	5 (14.3%)	0 (0.0%)	1 (20.0%)	0 (0.0%)
Equally the prescriber's and patient's decision	26 (56.5%)	20 (57.1%)	2 (50.0%)	2 (40.0%)	2 (100.0%)
Mostly the patient's decision, but taking the prescriber's views into account	13 (28.3%)	9 (25.7%)	2 (50.0%)	2 (40.0%)	0 (0.0%)
Completely the patient's decision	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

### *Prescriber's attitudes and beliefs about prescribing DMTs*

The majority of participants reported they were more inclined to try and minimise risk of harm from the disease (n = 37, 80.4%), while a substantial minority were more inclined to minimise risk of harm from DMTs (n = 9, 19.6%) meaning they may be more cautious in their prescribing. Similar proportions indicated they would be more likely to regret *not* prescribing a DMT and their patient suffering poor health outcomes (n = 36, 78.3%), or more likely to regret prescribing a DMT and their patient suffering serious side-effects (n = 10, 21.7%) (Table 25).

The vast majority of participants believe that DMTs are often necessary to managing relapsing forms of MS (n = 37, 80.4%) or always necessary (n = 6, 13.0%). However, there were two (4.3%) respondents who believe DMTs are only sometimes necessary, and one (2.2%) participant in England who believes that DMTs are never necessary. Around one quarter of respondents reported being either very concerned (n = 9, 19.6%) or extremely concerned (n = 2, 4.3%) about the unknown long-term effects of DMTs. The remaining participants reported being concerned (n = 25, 54.3%) or only a little concerned (n = 10, 21.7%) (Table 25).

### *Comparing prescribing practice across peer networks*

For half of respondents, the most important peer network for benchmarking their prescribing practice was other prescribers from across the UK (n = 23, 50.0%). Only 10 participants (21.7%) indicated that prescribers within their own organisation were most important and 5 (10.9%) that prescribers from nearby organisations were most important. Eight participants (17.4%) indicated that prescribers from across their wider UK region were most important for comparing their prescribing practice with others (Table 26).

When asked how their prescribing compared to other prescribers within this peer network, 52.2% (n = 24) stated they prescribed at around the same rate as others. Thirteen (28.3%) felt they prescribed at somewhat higher rates, and one (2.2%) felt they prescribed much more than others. Six (13.0%) felt they prescribed at somewhat lower rates, and one (2.2%) felt they prescribed at a much lower rate (Table 27). The majority of respondents believed that other prescribers would approve of their prescribing rates and think they should prescribe around their current rate (n = 33, 71.7%), but 8 participants (17.4%) believed other prescribers think they should prescribe a little more often and one (2.2%) that others think they should prescribe much more often. Three respondents (6.5%) believed that other prescribers would think they should prescribe a little less often (Table 28).

### *Statistical comparisons between types of prescriber*

MS specialist neurologists and neurologists with a special interest in MS were compared across a number of variables to test associations between level of specialism and prescribing beliefs and behaviours. There were no associations between level specialism and perceived most important factor for assessing relapses in terms of DMT eligibility (p = .507, Fisher's exact test, or FET), criteria used to define clinically significant relapses (p = .958, FET), criteria used to define a disabling relapse (p = .642, FET), perceived aim of treatment (p = .917, FET), or likelihood of prescribing for a

Table 25. Attitudes and beliefs about prescribing DMTs for people with relapsing MS

Attitude towards managing risk of harm from DMTs versus risk of harm from the disease	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Inclined to minimise risk of harm from DMTs	9 (19.6%)	6 (17.1%)	2 (50.0%)	1 (20.0%)	0 (0.0%)
Inclined to minimise risk of harm from the disease	37 (80.4%)	29 (82.9%)	2 (50.0%)	4 (80.0%)	2 (100.0%)
<b>Anticipated regret about prescribing DMTs or not prescribing DMTs</b>					
More likely to regret prescribing a DMT resulting in serious side-effects	10 (21.7%)	6 (17.1%)	2 (50.0%)	1 (20.0%)	1 (50.0%)
More likely to regret not prescribing a DMT resulting in poor health outcomes	36 (78.3%)	29 (82.9%)	2 (50.0%)	4 (80.0%)	1 (50.0%)
<b>Beliefs about necessity of DMTs for managing relapsing MS</b>					
Always necessary	6 (13.0%)	6 (17.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Often necessary	37 (80.4%)	27 (77.1%)	3 (75.0%)	5 (100.0%)	2 (100.0%)
Sometimes necessary	2 (4.3%)	1 (2.9%)	1 (25.0%)	0 (0.0%)	0 (0.0%)
Rarely necessary	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Never necessary	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 25. (Continued)

<b>Extent of concern about unknown long-term effects of DMTs</b>	<b>UK total (%)</b>	<b>England (%)</b>	<b>Scotland (%)</b>	<b>Wales (%)</b>	<b>Northern Ireland (%)</b>
Extremely concerned	2 (4.3%)	2 (5.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Very concerned	9 (19.6%)	5 (14.3%)	3 (75.0%)	0 (0.0%)	1 (50.0%)
Concerned	25 (54.3%)	19 (54.3%)	1 (25.0%)	4 (80.0%)	1 (50.0%)
A little concerned	10 (21.7%)	9 (25.7%)	0 (0.0%)	1 (20.0%)	0 (0.0%)
Not concerned at all	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 26. Perceived most important peer network for participants benchmarking their prescribing practice

	<b>UK total (%)</b>	<b>England (%)</b>	<b>Scotland (%)</b>	<b>Wales (%)</b>	<b>Northern Ireland (%)</b>
Prescribers within own organisation	10 (21.7%)	7 (20.0%)	1 (25.0%)	1 (20.0%)	1 (50.0%)
Prescribers from nearby organisations	5 (10.9%)	5 (14.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Prescribers from across UK region	8 (17.4%)	5 (14.3%)	1 (25.0%)	1 (20.0%)	1 (50.0%)
Prescribers from across the UK	23 (50.0%)	18 (51.4%)	2 (50.0%)	3 (6.0%)	0 (0.0%)

Table 27. Perceptions of participants' own prescribing rates compared to other prescribers in their self-identified peer network

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Much higher than others in this peer network	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Somewhat higher than others in this peer network	13 (28.3%)	12 (34.3%)	1 (25.0%)	0 (0.0%)	0 (0.0%)
About the same as others in this peer network	24 (52.2%)	16 (45.7%)	2 (50.0%)	4 (80.0%)	2 (100.0%)
Somewhat lower than others in this peer network	6 (13.0%)	4 (11.4%)	1 (25.0%)	1 (20.0%)	0 (0.0%)
Much lower than others in this peer network	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Did not answer	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

Table 28. Perception of other prescribers' views of the participants' prescribing rates

	UK total (%)	England (%)	Scotland (%)	Wales (%)	Northern Ireland (%)
Others think they should prescribe DMTs much more often	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Others think they should prescribe DMTs a little more often	8 (17.4%)	6 (17.1%)	0 (0.0%)	2 (40.0%)	0 (0.0%)
Others think they should prescribe DMTs around the same amount as now	33 (71.7%)	24 (68.6%)	4 (100.0%)	3 (60.0%)	2 (100.0%)
Others think they should prescribe DMTs a little less often	3 (6.5%)	3 (8.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Others think they should prescribe DMTs much less often	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Did not answer	1 (2.2%)	1 (2.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)



“borderline” case ( $p = .524$ , one-tailed FET). Nor were there any significant associations between level of specialism and prescribers’ attitudes toward prescribing DMTs, including perceptions of risk ( $p = .586$ , one-tailed FET), anticipated regret about prescribing or not prescribing ( $p = .659$ , FET), perceived necessity of DMTs for managing relapsing MS ( $p = .409$ , FET), and concern about long-term effects of DMTs ( $p = .196$ , FET).

However, there was a significant association between level of specialism and most important peer network for benchmarking prescribing practice, when peer networks were grouped into local (own organisation and neighbouring organisations) and national (across the region and across the UK) ( $p = .017$ , FET). MS specialist neurologists were more likely to report benchmarking their practice against national peer networks, while neurologists with a special interest in MS were more likely to report benchmarking against local peer networks. There were no associations between level of specialism and proportion of DMTs prescribed ( $p = .266$ , FET) or which DMT was prescribed most often for first-time prescriptions ( $p = .344$ , FET).

Only one general neurologist completed the questionnaire, so statistical analyses to compare the responses of these prescribers with those of more specialised neurologists were not possible.

#### *Statistical associations between influencing factors and prescribing behaviours*

We tested whether prescribers’ attitudes toward prescribing DMTs were related to the primary prescribing guideline they use to justify their prescribing decisions. However, there were no significant associations between primary prescribing guideline and perceptions of risk ( $p = .875$ , FET), anticipated regret ( $p = .334$ , FET), perceived necessity of DMTs, ( $p = .842$ , FET), concern about long-term effects of DMTs ( $p = .591$ , FET), or extent to which their service provided standardised care ( $p = .128$ , FET).

We also tested whether the likelihood of prescribing for a “borderline” case may be related to the criteria used to determine eligibility for DMTs and perceived aim of treatment. For the variable ‘likelihood of prescribing for a “borderline” case’ (a person who has had two sensory relapses in 23 months from which they have fully recovered with no new lesions on MR scan), neurologists were grouped into two categories based on their responses: likely to prescribe (comprising somewhat likely and extremely likely responses) and unlikely to prescribe (comprising somewhat unlikely and extremely unlikely). There were no significant associations between this collapsed variable and criteria used to define clinically significant relapses ( $p = .129$ , FET), criteria used to define a disabling relapse ( $p = .901$ , FET), and perceived aim of treatment ( $p = .255$ , FET).

However, there was a significant association between likelihood of prescribing for a “borderline” case and the perceived most important factor for assessing relapses in terms of DMT eligibility ( $p = .023$ , FET). Where a neurologist thought the most important factor was impact on the patient (combined accumulated disability and impact on daily functioning responses), they were *less* likely to report that they would prescribe for this hypothetical patient. Where a neurologist thought the most important factor was time since previous relapse or other factors (type of symptoms or severity of symptoms), they were *more* likely to report they would prescribe. Those who perceived

disease activity on MR scans to be the most important factor were equally likely to report they would prescribe or not prescribe.

### 3.5 Summary of key results

- The questionnaire was completed by 46 consultant neurologists who prescribe disease modifying treatments. 43.4% of prescribers invited by email participated in the research.
- On average, 41-50% of people with MS under the care of these neurologists were estimated to be currently prescribed DMTs.
- Dimethyl fumarate (Tecfidera) and Beta Interferons (Avonex, Betaferon, Extavia, Plegridy, Rebif) were ranked the most prescribed drugs for people with MS currently taking a DMT.
- Time since previous relapse, disease activity on MR scan, and impact on daily functioning were rated the most important factors for assessing relapses in terms of eligibility for DMTs.
- Over half of neurologists reported using less stringent criteria to define *clinically significant* relapses indicating eligibility for DMTs, and more than two thirds reported using less stringent criteria to define *disabling relapses* indicating eligibility for natalizumab (Tysabri).
- Nearly 40% of neurologists reported they would be unlikely to prescribe a DMT for a patient meeting the eligibility criteria of two relapses within two years, but who might be considered “borderline” in terms of severity, type of symptoms, and MR scan activity.
- Half of neurologists believed that the aim of disease modifying treatment should be to achieve ‘no evidence of disease activity’. One third aimed for delayed long-term disability.
- More than one fifth of neurologists in England reported the ABN (2015) guidelines as the most important policy for them justifying prescribing decisions, over and above the individual NICE assessment for individual DMTs.
- Three responding neurologists reported using outdated McDonald criteria for diagnosing MS, and one reported using clinical judgement rather than any McDonald criteria.
- General neurologists are involved in identifying relapses in 44% of services, while MS nurses identify relapses in 91% of services and discuss DMT options with patients in 89% of services.
- Seventeen percent of neurologists reported rarely or never having team meetings in which DMT prescribing decisions are discussed.
- A small minority of neurologists reported that people with MS who are eligible for treatment typically wait more than 12 weeks after diagnosis to have a discussion about DMT options.
- There is substantial variation in how neurologists manage patient choice about DMTs. Over half provide a guided choice, nearly a quarter give free choice, and a fifth give limited choice.
- Around 15% of neurologists indicated their MS service team was cautious in prescribing DMTs due to potential risks, and around one fifth reported caution in their own prescribing, in terms of minimising risk of harm from DMTs and anticipating regret over serious DMT side effects. A similar proportion was very concerned about unknown long-term effects of DMTs.
- Two neurologists reported their belief that DMTs are only sometimes necessary for managing relapsing forms of MS, and one reported that DMTs are never necessary.
- Neurologists most often reported the most important peer network for benchmarking their prescribing practice was other prescribers from across the UK.

- MS specialist neurologists were more likely to report benchmarking their practice against national peer networks, while neurologists with a special interest in MS were more likely to report benchmarking against local peer networks.
- The likelihood of a neurologist prescribing for patients on the borderline of DMT eligibility may depend on which factors they perceive as most important in eligibility assessment (e.g. time since previous relapse, impact on the person with MS) as well as the patient's clinical presentation.

#### **4. Recommendations**

Having reviewed the findings from both the qualitative and questionnaire phases of this research, we provide the following recommended actions:

- Improved definitions in prescribing guidelines of what constitutes a ‘clinically significant relapse’ and a ‘disabling relapse’, and more detailed guidance on how to distinguish true relapses from other phenomena
- Improved access to face-to-face relapse assessment at the time of the neurological episode, such as rapid access relapse clinics and appointments
- Increased awareness among people with MS of the importance of reporting possible relapses at the time of their occurrence, and the importance of relapse assessments for determining eligibility for treatment
- Improved guidance on when and how to take someone off disease modifying treatment, and guidelines and support for managing this process
- Acknowledgement that clinicians will differ in their readiness to prescribe, and their personal views on managing the uncertainties of MS and the risks of disease modifying treatment, but that the patient’s right to make an informed choice between any DMT for which they are eligible should remain paramount
- Development of methods to increase prescribers’ familiarity and confidence to prescribe the full range of disease modifying treatments, including shared learning and experiences
- Further research and development of guidelines for the best ways of supporting patient choices about DMTs, including whether people with MS should be offered a free choice of all DMTs for which they are eligible or a limited choice curated by the prescriber, how much information should be provided, and how to tailor this process to individual patient needs and preferences
- Encouraging and maximizing use of professional peer networks for shared learning, consensus building, standardising practice, and advocating for local services, particularly for prescribers working in isolation or outside of regional specialist centres
- Acknowledgement of differences in organisational prescribing ‘cultures’ and habits, and encouraging clinicians to regularly query whether the local ‘culture’ sufficiently meets their patients’ needs
- Developing strategies for increasing the number of neurologists, and those specialising in MS, practicing in the UK, including assessing teaching of neurology in medical schools and promotion of neurology as a worthwhile specialism for junior doctors
- Improved support for non-prescribing general neurologists with people with MS under their care in keeping up-to-date with DMT eligibility criteria, identifying relapses, and knowing when to refer patients on to MS specialist neurologists



The University of Manchester



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*University Teaching Hospital*

## Appendix 1: Interview schedule for consultant neurologists

[N.B. Prompts/sub-questions are flexible and not all will be covered in each interview]

### Prescription rates

1. How do you think the DMT prescription rate at this centre compares to other centres in (England/Scotland/Wales/Northern Ireland)?
2. How much do you think prescription rates differ between England, Wales, Scotland and NI?
  - What do you think are the reasons for these differences?
3. How much do you think DMT prescription rates differ between the UK and other European countries?
  - What do you think are the reasons for these differences?
4. How do you think your own personal DMT prescription rate compares to your colleagues' rates here at this centre?
  - How are your prescription rates audited and shared?

### Service provision

5. What do you think of the service model for treating MS in this area?
  - What are your views on the DMT referral pathways?
  - Would you say this is a *specialist* MS service?
6. Which DMTs are prescribed, administered, and monitored at this centre?
  - Which are *not* available at this centre?
7. How adequate are resources in this area for assessing DMT eligibility and monitoring people on DMTs (e.g. MRI scans)?
8. Thinking about how many people on DMTs you are responsible for, how manageable would you say this number is?
9. How often are patients on DMTs seen by a DMT prescriber?
  - How often are those *not on DMTs* seen by a DMT prescriber?
  - How often are patients seen by an MS nurse?
10. As a prescriber, what do you think your role should be with regards to DMTs?

### Determining eligibility for DMTs

11. How do you decide whether a person with MS is eligible to take a DMT?
  - How easy or difficult do you find it to determine eligibility?
12. How much do the NICE guidelines on DMTs influence your decisions about prescribing?
  - What are your views of these guidelines?
13. How much do the ABN guidelines influence your decisions about prescribing?
  - What are your views of these guidelines?
14. What local policies are there for deciding whether a person with MS is eligible for a DMT?

15. Do you have any personal rules of thumb you use to decide whether a person is eligible for a DMT?

#### Prescribing decisions

16. What are the key factors influencing your decision to prescribe a DMT or not?

17. What incentives are there for you to prescribe DMTs?

- What disincentives are there?

18. Do you ever feel any pressure to prescribe DMTs?

- If yes, from whom?

19. What barriers hinder you prescribing DMTs?

- What helps you to prescribe DMTs, or makes prescribing easier?

20. What approach do you believe in when it comes to prescribing DMTs, an induction or escalation approach?

- Why?

21. How do you feel when you prescribe a DMT?

- Do you ever feel worry or regret?

#### Discussing DMTs with patients

22. How often do you discuss DMTs with a patient?

23. How easy or difficult do you find talking to patients about the decision to take DMTs?

- How confident do you feel talking to patients about this?

24. To what extent is the decision to prescribe a DMT your decision or the patient's decision?

- How involved are patients in the decision? How involved are others?
- What information is given to patients to help with this decision?

#### Accessing DMTs

25. Of your patients with relapsing MS not currently taking DMTs, what proportion do you think might be eligible to take them?

- What reasons are there for these people not being on DMTs?

26. What do you think of patients' access to MS nurses within this service?

- What do you think of access to specialist neurologists within this service?

27. What barriers are there for nurses or other healthcare professionals trying to facilitate access to DMTs for patients?

28. Are there any other barriers to patients accessing DMTs?

#### Views on DMTs

29. What are your views on the DMTs currently available in the UK?

- How necessary do you think DMTs are for treating relapsing MS?



Links with pharmaceutical companies

30. What relationships do pharmaceutical companies have with DMT prescribers in this area?

Clinical and demographic questions

31. Could you tell me how long you have been a consultant neurologist?

- How long as an MS specialist?
- How long as a prescriber of DMTs?

32. Could you confirm for me your age, gender and ethnicity?

33. Are there any other issues we haven't covered that you think are important factors in prescribing DMTs or for patients accessing DMTs?

## Appendix 2: Interview schedule for MS nurses

[N.B. Prompts/sub-questions are flexible and not all will be covered in each interview]

### Prescription rates

1. How do you think the DMT prescription rate at this centre compares to other centres in (England/Scotland/Wales/Northern Ireland)?
2. How much do you think prescription rates differ between England, Wales, Scotland and NI?
  - What do you think are the reasons for these differences?
3. How much do you think DMT prescription rates differ between the UK and other European countries?
  - What do you think are the reasons for these differences?

### Service provision

4. What do you think of the service model for treating MS in this area?
  - What are your views on the DMT referral pathways?
  - Would you say the centre to which you refer patients for DMTs is a *specialist* MS service?
5. Which DMTs are prescribed, administered, and monitored at the centre you refer to?
  - Which are *not* available at this centre?
6. How adequate are resources in this area for assessing DMT eligibility and monitoring people on DMTs (e.g. MRI scans)?
7. Thinking about how many people with MS you provide care for, how manageable would you say this number is?
  - How much of your time do you spend discussing or managing DMTs?
8. How often are patients on DMTs seen by a DMT prescriber?
  - How often are those *not on DMTs* seen by a DMT prescriber?
  - How often are patients seen by an MS nurse?
9. As an MS specialist nurse, what do you think your role should be with regards to DMTs?

### Discussing DMTs with patients

10. How often do you discuss DMTs with a patient?
11. How easy or difficult do you find talking to patients about the decision to take DMTs?
  - How confident do you feel talking to patients about this?

### Determining eligibility for DMTs

12. How do you assess whether a person with MS might be eligible to take a DMT?
  - How easy or difficult do you find it to assess if a person might be eligible?
  - How does this affect a patient's referral for DMTs?

13. What are your views on the national guidelines for prescribing DMTs?
  - How knowledgeable of them do you feel? How relevant are they for you?
14. What local policies are there for deciding whether a person with MS is eligible for a DMT?
15. Do you have any personal rules of thumb you use to decide whether a person is potentially eligible for a DMT?

#### Referral decisions

16. What are the key factors influencing your decision to recommend/refer a patient for DMTs or not?
17. What incentives are there for you to recommend/refer patients for DMTs?
  - What disincentives are there?
18. Do you ever feel any pressure to recommend/refer patients for DMTs?
  - If yes, from whom?
19. What barriers hinder you making referrals for DMTs?
  - What helps you to refer DMTs, or makes referring easier?
20. How do you feel when you refer a patient for DMTs?
  - Do you ever feel worry or regret?

#### Views on prescribing

21. What approach do you believe in when it comes to prescribing DMTs, an induction or escalation approach?
  - Why?
22. To what extent is the decision to prescribe a DMT the neurologist's decision or the patient's decision?
  - How involved are patients in the decision? How involved are others?
  - What information is given to patients to help with this decision?

#### Accessing DMTs

23. Of your patients with relapsing MS not currently taking DMTs, what proportion do you think might be eligible to take them?
  - What reasons are there for these people not being on DMTs?
24. What do you think of patients' access to MS nurses within this service?
  - What do you think of access to specialist neurologists within this service?
25. What barriers are there for nurses or other healthcare professionals trying to facilitate access to DMTs for patients?
26. What barriers are there for neurologists prescribing DMTs?
27. Are there any other barriers to patients accessing DMTs?

Views on DMTs

28. What are your views on the DMTs currently available in the UK?

- How necessary do you think DMTs are for treating relapsing MS?

Links with pharmaceutical companies

29. What relationships do pharmaceutical companies have with DMT prescribers in this area?

Clinical and demographic questions

30. Could you tell me how long you have been an MS specialist nurse?

31. Could you confirm for me your age, gender and ethnicity?

32. Are there any other issues we haven't covered that you think are important factors in prescribing DMTs or for patients accessing DMTs?

### **Appendix 3: Online questionnaire for DMT prescribers in the UK**

#### **Information about you as a DMT prescriber**

1. As a prescriber of DMTs, what is your job role? (Please choose one)
  - Consultant neurologist
  - Neurologist in training
  - MS specialist nurse
  - Other (Please specify)
  
2. For approximately how many years have you been prescribing DMTs for people with MS?  
(Please choose one)
  - Less than 1 year
  - 1 year
  - 2 years
  - 3 years
  - 4 years
  - 5 years
  - 6 years
  - 7 years
  - 8 years
  - 9 years
  - 10 years
  - 11 years
  - 12 years
  - 13 years
  - 14 years
  - 15 years
  - More than 15 years
  
3. Which of the following best describes you? (Please choose one)
  - An MS specialist neurologist
  - A neurologist with an interest in MS
  - A general neurologist
  - Other (Please specify)
  
4. In which types of clinics do you prescribe DMTs? (Please select all that apply)
  - Dedicated DMT clinics
  - Multiple sclerosis clinics
  - General neurology clinics
  - Other (please specify)

5. Approximately what proportion of your clinical workload is dedicated specifically to patients with MS (e.g. MS clinics rather than general neurology clinics)? (Please choose one)
- 0-10%
  - 11-20%
  - 21-30%
  - 31-40%
  - 41-50%
  - 51-60%
  - 61-70%
  - 71-80%
  - 81-90%
  - 91-100%
6. Which of the following best describes you? (Please choose one)
- Primarily an academic with honorary or part-time clinical contract
  - Primarily a clinician with honorary or part-time academic contract
  - Equally split between academic and clinical roles
  - A clinician without academic contract
7. In the past year, which of the following activities have you undertaken? (Please select all that apply)
- Conducted a clinical trial as a principal investigator
  - Supported a clinical trial as a local investigator (e.g. enrolling patients, collecting data)
  - Sat on a regulatory body advisory board (e.g. NICE, ABN, NHS England)
  - Sat on a pharmaceutical company advisory board
  - Other (Please specify)

The following questions refer to your main place of DMT prescribing practice.

**Discussing DMTs with patients**

8. For **newly diagnosed** patients with relapsing MS who are eligible for DMTs, how soon after diagnosis is the decision to take DMTs typically discussed? (Please choose one)
- On the same day diagnosis is confirmed
  - In the 1-2 weeks following diagnosis
  - In the 3-6 weeks following diagnosis
  - In the 6-12 weeks following diagnosis
  - More than 12 weeks after diagnosis is confirmed

9. For existing patients with relapsing MS who are **newly eligible for DMTs**, when is the decision to take DMTs typically discussed? (Please choose one)
- On the same day eligibility is confirmed
  - In the 1-2 weeks following diagnosis
  - In the 3-6 weeks following diagnosis
  - In the 6-12 weeks following diagnosis
  - More than 12 weeks after eligibility for DMTs is confirmed
10. In your service, who discusses the decision to take DMTs in detail with the patient? (Please choose one)
- The prescribing neurologist
  - An MS specialist nurse
  - Both the prescribing neurologist and an MS nurse
  - Other health professional (Please specify)
11. How do you **typically** present the choice of DMTs to patients? (Please choose one)
- I provide a **free choice** of all DMTs for which they eligible, up to the maximum 11
  - I provide a **guided choice**, steering the patient from all permitted DMTs to the ones I recommend
  - I provide a **curated choice** of a limited number of suitable DMTs for which the patient is eligible
  - I provide only one choice of DMT
12. To what extent do you think the decision on **which DMT** to start taking (of those for which the patient is eligible) should be the prescriber's decision versus the patient's decision? (Please choose one)
- Completely the prescriber's decision
  - Mostly the prescriber's decision, but taking the patient's views into account
  - Equally the prescriber's and patient's decision
  - Mostly the patient's decision, but taking the prescriber's views into account
  - Completely the patient's decision

### **Determining eligibility for DMTs**

13. To what extent do you use magnetic resonance (MR) imaging to **diagnose** MS?
- I scan all patients before diagnosing MS
  - I scan more than 50% of patients before diagnosing MS
  - I scan less than 50% of patients before diagnosing MS
  - I rarely scan patients before diagnosing MS
14. To what extent do you use MR imaging when deciding to prescribe DMTs?



- I scan all patients before deciding to prescribe a DMT
  - I scan more than 50% of patients before deciding to prescribe a DMT
  - I scan less than 50% of patients before deciding to prescribe a DMT
  - I rarely scan patients before deciding to prescribe a DMT
15. What is the **main** way in which clinical relapses are identified in your service? (please choose one)
- Clinical assessment at dedicated relapse clinic
  - Clinical assessment at urgent non-relapse clinic appointment
  - Patient self-report by phone call and remote assessment
  - Retrospective self-report at follow-up appointment
  - Other (please specify)
16. In your opinion, which of these aspects is **most important** for assessing relapses in terms of whether a patient is eligible for DMTs? (Please choose one)
- Area of the brain implicated
  - Disease activity as shown by MRI scan
  - Type of symptoms (e.g. motor, sensory)
  - Duration of symptoms
  - Severity of symptoms
  - Time since previous relapse
  - Impact on patient's daily functioning
  - Accumulated disability
17. What criteria do you use to define a **clinically significant** relapse indicating eligibility for DMTs? (Please choose one)
- Evidence of new lesion on MRI is sufficient
  - Any relapse incorporating new symptoms or worsening of existing symptoms for at least 24 hours, at least 30 days after onset of previous relapse, with no alternative explanation
  - Only relapses affecting motor, brainstem, or sphincter function, or presenting as optic neuritis, intensive pain for 48 hours, or sensory symptoms if they lead to functional impairment
  - Only relapses affecting the patient's ability to work, carry out activities of daily living, care for themselves, or requiring hospital admission or treatment
  - Other (Please specify)
18. NHS England has recommended that natalizumab (Tysabri) should be prescribed for patients who have had two disabling relapses in the past year. In your opinion, what is the **minimum** definition of a **disabling** relapse? (Please choose one)
- A relapse that the patient finds inhibiting, distressing or unacceptable
  - A relapse that affects the patient's enjoyment of social and leisure activities

- A relapse that affects the patient's ability to work or study
  - A relapse that affects the patient's ability to care for themselves (e.g. bathing, eating, dressing)
  - A relapse requiring hospital admission or treatment
19. On seeing a patient who has had two sensory relapses 23 months apart from which they have quickly and fully recovered, with MR scan showing no new lesions compared to 3 years previously, how likely would you be to recommend treatment with a DMT? (Please choose one)
- Not likely at all
  - Somewhat unlikely
  - Somewhat likely
  - Extremely likely
20. In your opinion, what should be the aim of disease modifying treatment? (Please choose one)
- No evidence of disease activity (NEDA) in terms of relapse, increased disability, or lesions on MRI scans
  - To delay or prevent long-term disability
  - To reduce the number of relapses in the shorter-term
  - Other (Please specify)
21. What protocols and procedures do you have in place for managing the **stopping of treatment** for patients who no longer clinically benefit from a DMT? (Please select all that apply)
- Stopping criteria are discussed and agreed with patients prior to treatment starting
  - Stopping criteria are reiterated at follow-up appointments
  - These patients are seen in a dedicated transition clinic
  - These patients are offered increased MS nurse support
  - Stopping treatment is broached and discussed over the course of several appointments to give patients time to accept the idea of stopping
  - Patients are first offered treatment "breaks" to test the consequences of stopping

### Using guidelines

22. Which prescribing guidelines do you actively use when making DMT prescribing decisions? (Please select all that apply)
- Association of British Neurologists guidelines (Scolding, 2015) for prescribing DMTs
  - NICE technology appraisal reports for individual DMTs
  - NHS England policy documents (e.g. clinical commissioning policy, 2014)
  - All Wales Medicines Strategy Group reports
  - Scottish Medicines Consortium reports
  - Local prescribing guidelines for Northern Ireland (e.g for natalizumab and alemtuzumab)

- Other (Please specify)

23. Which of these guidelines is your **primary** source of evidence should you need to justify any prescribing decision? (Please choose one)

- Association of British Neurologists guidelines (Scolding, 2015) for prescribing DMTs
- NICE technology appraisal reports for individual DMTs
- NHS England policy documents (e.g. clinical commissioning policy, 2014)
- All Wales Medicines Strategy Group reports
- Scottish Medicines Consortium reports
- Local prescribing guidelines for Northern Ireland (e.g for natalizumab and alemtuzumab)
- Other (Please specify)

24. Which diagnostic criteria do you follow for deciding whether a patient has MS? (Please choose one)

- McDonald criteria, 2001
- Revised McDonald criteria, 2005
- Revised McDonald criteria, 2010
- Other (please specify)

### The MS service

25. In your service, what roles do MS specialist neurologists typically play in the care of people with MS? (Please select all that apply)

- Diagnosing patients with MS
- Regular follow-up appointments for patients on DMTs
- Regular follow-up appointments for patients not on DMTs
- Identifying relapses
- Prescribing drugs for managing symptoms and/or relapses
- Discussing DMT options
- Prescribing DMTs of moderate efficacy (beta interferons, glatiramer acetate, teriflunomide)
- Prescribing DMTs of greater efficacy (dimethyl fumarate, fingolimod)
- Prescribing DMTs of high efficacy (natalizumab, alemtuzumab)
- Monitoring patients on DMTs (e.g. overseeing blood tests)
- Other (please specify)

26. In your service, what roles do general neurologists typically play in the care of people with MS? (Please select all that apply)

- Diagnosing patients with MS
- Regular follow-up appointments for patients on DMTs
- Regular follow-up appointments for patients not on DMTs

- Identifying relapses
- Prescribing drugs for managing symptoms and/or relapses
- Discussing DMT options
- Prescribing DMTs of moderate efficacy (beta interferons, glatiramer acetate, teriflunomide)
- Prescribing DMTs of greater efficacy (dimethyl fumarate, fingolimod)
- Prescribing DMTs of high efficacy (natalizumab, alemtuzumab)
- Monitoring patients on DMTs (e.g. overseeing blood tests)
- Other (please specify)

27. In your service, what roles do MS nurses typically play in the care of people with MS? (Please select all that apply)

- Regular follow-up appointments for patients on DMTs
- Regular follow-up appointments for patients not on DMTs
- Providing symptom and relapse management support
- Identifying relapses
- Prescribing drugs for managing symptoms and/or relapses
- Referring patients to a neurologist for DMTs
- Discussing DMT options
- Monitoring patients on DMTs (e.g. overseeing blood tests)
- Delivering DMTs (e.g. overseeing infusions)
- Writing repeat prescriptions
- Signing repeat prescriptions
- Other (Please specify)

28. In your service, how often are there prescribers' meetings or multi-disciplinary team meetings in which DMT prescribing decisions are discussed? (Please choose one)

- Weekly
- Fortnightly
- Monthly
- Several times per year
- Annually
- Rarely/never

29. As a service, to what extent do you aim to provide **standardised care** for patients regardless of which prescriber they see? (Please choose one)

- Very much, we actively work towards providing similar care and prescribing decisions across prescribers
- Somewhat, we hope that patients receive an equitable service but do not have procedures in place to achieve this

- Not at all, we work as individual prescribers accountable for our own independent prescribing decisions
- Not applicable (e.g. if you are a solitary prescriber)

30. **As a group** of prescribers, would you say that your service is generally (Please choose one):

- We are **cautious** about prescribing DMTs due to potential risks
- We are inclined to prescribe DMTs **readily** due to potential benefits

**Prescribing attitudes and beliefs**

31. When making DMT prescribing decisions, which of the following best describes **you** personally?  
(Please choose one)
- I'm more inclined to try and minimise the risk of long-term harm from **the DMTs**
  - I'm more inclined to try and minimise the risk of long-term harm from **the disease**
32. Which of the following best describes you? (Please choose one)
- I'm more likely to regret prescribing a DMT that resulted in serious side-effects
  - I'm more likely to regret **not** prescribing a DMT, which resulted in poor health outcomes
33. How **necessary** do you think DMTs are for managing relapsing MS in general? (Please choose one)
- DMTs are **always** necessary to manage MS
  - DMTs are **often** necessary to manage MS
  - DMTs are **sometimes** necessary to manage MS
  - DMTs are **rarely** necessary to manage MS
  - DMTs are **never** necessary to manage MS
34. How **concerned** are you about the unknown long-term effects of these immuno-modulating drugs? (Please choose one)
- Extremely concerned
  - Very concerned
  - Concerned
  - A little concerned
  - Not concerned at all
35. Which of the following peer networks is most important to you for informally "benchmarking" your DMT prescribing practice against others' prescribing? (Please choose one)
- Prescribers within your own organisation
  - Prescribers from nearby or neighbouring organisations
  - Prescribers from across your region of the UK
  - Prescribers from across the UK
  - Other (Please specify)
36. How does your personal DMT prescribing rate compare to the DMT prescribing rates of other prescribers in the peer network you have identified above? (Please choose one)
- **Much higher** than other prescribers in this peer network
  - **Somewhat higher** than other prescribers in this peer network
  - **About the same** as other prescribers in this peer network
  - **Somewhat lower** than other prescribers in this peer network

- **Much lower** than other prescribers in this peer network

37. What do you think other prescribers in your peer network think of the rate at which you prescribe DMTs? (Please choose one)

- They think I should prescribe DMTs **much more** often
- They think I should prescribe DMTs **a little more** often
- They think I should prescribe DMTs **around the same** amount as now
- They think I should prescribe DMTs **a little less** often
- They think I should prescribe DMTs **much less** often

### Service characteristics

38. In which part of the UK is your main place of practice for prescribing DMTs? (Please choose one)

- England
- Wales
- Scotland
- Northern Ireland
- Other (Please specify)

39. Thinking about your **main** place of DMT prescribing practice, in which type of organisation does this service sit? (Please choose one)

- Regional neuroscience centre
- Neurology centre
- General hospital
- Primary care organisation
- Private health organisation
- Other (Please specify)

40. Which of the following best describes the service in which you prescribe DMTs? (Please choose one)

- A specialist multiple sclerosis service
- A general neurology service
- Other (Please specify)

41. Within this service, how many **DMT prescribers** are there (including yourself, and all full-time, part-time, honorary and locum neurologists who prescribe DMTs)? (Please choose one)

- 1 DMT prescriber
- 2
- 3
- 4
- 5



- 6
- 7
- 8
- 9
- 10 or more DMT prescribers

42. Within this service, how many **MS specialist neurologists** are there (including you if applicable)?  
(Please choose one)

- 1 MS specialist neurologist
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 or more MS specialist neurologists

43. Within this service, how many MS nurses are there? (Please choose one)

- 1 MS specialist nurse
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10 or more MS specialist nurses

44. Do you also have a **secondary** prescribing practice for a different organisation in the UK (not different clinics or services within the same organisation)? (Please select all that apply)

- Yes, I also prescribe DMTs in a **regional neuroscience centre**
- Yes, I also prescribe DMTs in a **neurology centre**
- Yes, I also prescribe DMTs in a **general hospital**
- Yes, I also prescribe DMTs in a **primary care organisation**
- Yes, I also prescribe DMTs in a **private healthcare organisation**
- **No**, I only prescribe DMTs in one health organisation

**Prescribing rates**

45. Approximately how many people with any type of diagnosed MS are currently under the care of this service?

- .....

46. Approximately how many people with diagnosed MS (including those with relapsing and progressive types) are currently under **your** direct care as a neurologist?

*This may be the same number as above, for example if you are the sole prescriber within the service*

- .....

47. Approximately **what proportion** of MS patients under **your** personal care are currently prescribed any DMT? (Please choose one)

- 0-10%
- 11-20%
- 21-30%
- 31-40%
- 41-50%
- 51-60%
- 61-70%
- 71-80%
- 81-90%
- 91-100%

48. For the MS patients under **your** personal care who are currently prescribed a DMT, Please rank the DMTs currently licensed in the UK in order of **most prescribed** (1) to **least prescribed** (7). (Please allocate each DMT a different number)

- Alemtuzumab (Lemtrada)
- Beta interferons (Avonex, Betaferon, Extavia, Plegridy, Rebif)
- Dimethyl fumarate (Tecfidera)
- Fingolimod (Gilenya)
- Glatiramer acetate (Copaxone)
- Natalizumab (Tysabri)
- Teriflunomide (Aubagio)

49. Of the DMTs currently licensed in the UK, are there any that you currently **cannot** prescribe within your service? (Please select all that apply)

- Alemtuzumab (Lemtrada)
- Beta interferons (Avonex, Betaferon, Extavia, Plegridy, Rebif)
- Dimethyl fumarate (Tecfidera)

- Fingolimod (Gilenya)
- Glatiramer acetate (Copaxone)
- Natalizumab (Tysabri)
- Teriflunomide (Aubagio)

50. For MS patients under your personal care who are receiving their **first DMT prescription**, which one of the DMTs are you now **most often** prescribing as a first line treatment? (Please choose one)

- Alemtuzumab (Lemtrada)
- Beta interferons (Avonex, Betaferon, Extavia, Plegridy, Rebif)
- Dimethyl fumarate (Tecfidera)
- Fingolimod (Gilenya)
- Glatiramer acetate (Copaxone)
- Natalizumab (Tysabri)
- Teriflunomide (Aubagio)

**Please use the box below to discuss any other factors you believe have an influence on your DMT prescribing decisions, practices, or prescription rates:**

- .....