

MENACTRIMS practice guideline for COVID-19 vaccination in patients with multiple sclerosis.

Title: MENACTRIMS practice guideline for COVID-19 vaccination in patients with multiple sclerosis.

Publication year: 2021

Journal: Multiple sclerosis and related disorders

Authors: Neurology Institute and Multiple Sclerosis Center, Harley Street Medical Center, Abu Dhabi, United Arab Emirates.

Society: American College of Cardiology

Origin country: United States

Target countries: United States

DOI: 10.1016/j.msard.2021.103225

PMID: 34479111

Source: <https://pubmed.ncbi.nlm.nih.gov/34479111/>

pmc Mult Scler Relat Disord Mult Scler Relat Disord 3815 pelsevier 101580247 Multiple Sclerosis and Related Disorders 2211-0348 2211-0356 pmc-is-collection-domain yes pmc-collection-title Elsevier - PMC COVID-19 Collection PMC8386106 PMC8386106.1 8386106 8386106 34479111 10.1016/j.msard.2021.103225 S2211-0348(21)00492-2 103225 1 Article MENACTRIMS practice guideline for COVID-19 vaccination in patients with multiple sclerosis Yamout Bassem I a Zakaria Magd b Inshasi Jihad c Al-Jumah Mohammad d Zeineddine Maya a ■ Dahdaleh Maurice e Bohlega Saeed f Gouider Riadh g Alroughani Raed h a Neurology Institute and Multiple Sclerosis Center, Harley Street Medical Center, Abu Dhabi, United Arab Emirates b Ain Shams University, Cairo, Egypt c Department of Neurology, Rashid Hospital and Dubai Medical College, Dubai Health Authority, Dubai, United Arab Emirates d King Fahad Medical City, MOH, Riyadh, Saudi Arabia e Al Khalidi Hospital, Amman, Jordan f King Faisal Specialist Hospital and Research Centre, Riyadh, Saudi Arabia g Service de Neurologie, Hôpital Razi, Manouba, Tunisia h Amiri Hospital, Arabian Gulf Street, Sharq, Kuwait ■ Corresponding author. 11 2021 25 8 2021 56 388610 103225 103225 6 8 2021 20 8 2021 23 8 2021 25 08 2021 25 08 2021 28 12 2022 © 2021 Elsevier B.V. All rights reserved. 2021 Elsevier B.V. Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website. Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active. Patients with multiple sclerosis (MS) should be vaccinated against COVID-19.

All COVID-19 vaccines are effective and do not appear to carry any additional risk for patients with MS. Patients with MS should get a COVID-19 vaccine as soon as it becomes available. The risks of COVID-19 disease outweigh any potential risks from the vaccine.

Even if vaccinated, patients with MS should continue to practice standard and recommended precautions against COVID-19, such as wearing a face mask, social distancing and washing hands.

There is no evidence that patients with MS are at higher risk of complications from the mRNA, non-replicating viral vector, inactivated virus or protein COVID-19 vaccines, compared to the general population.

COVID-19 Vaccines are safe to use in patients with MS treated with disease-modifying therapies (DMTs).

The effectiveness of vaccination may be affected by few of the DMTs but yet some protection is still provided.

For certain DMTs we may consider coordinating the timing of the vaccine with the timing of the DMT dose to increase vaccine efficacy.

Multiple sclerosis (MS) is an autoimmune, demyelinating, neurodegenerative disease of the central nervous system (CNS) that might cause significant and irreversible disability (Compston and Coles, 2008). Patients with MS are at increased risk for acquiring infections and disease-modifying therapies (DMTs), which suppress or modulate the immune system, have been associated with increased risk of infections (Castelo-Branco et al., 2020 ; Persson et al., 2020 ; Epstein et al., 2018). For this reason, vaccination as the most efficient measure to prevent infections is imperative in this population. This is particularly pertinent in the era of emerging novel vaccines against severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2), causative agent of the COVID-19 disease pandemic.

Several COVID-19 vaccines with various mechanisms of action and diverse immunogenic properties are currently available worldwide, authorized to varying degrees by the Food and Drug Administration (FDA), European Medicine Agency (EMA) and World Health Organization (WHO) under emergency use authorizations (EUAs), with many others in development (World Health Organization, 2021). As the COVID-19 vaccine repertoire is becoming complex, questions regarding potential interactions between the novel vaccines against COVID-19 and different DMTs are arising among MS patients and clinicians.

Immunological studies have shown that the coordinated interactions between T and B lymphocytes of the adaptive immune system are essential to the successful generation of immunological memory and production of neutralizing antibodies following recognition of vaccine antigens by innate immune cells (Siegrist, 2013 ; Luckheeram et al., 2012 ; Bonilla and Oettgen, 2010 ; Tay et al., 2021 ; Lubbers et al., 2017 ; Siegrist and Lambert, 2016 ; Whitmire et al., 2009). CD4 $\blacksquare$ T cells facilitate CD8 $\blacksquare$ T cell and B cell activation, while B cells drive and sustain T cell memory. Previous studies of conventional vaccines in MS patients have highlighted how each DMT or class of DMTs might impact the efficacy of a COVID-19 vaccine (Lebrun and Vukusic, 2019 ; Riva et al., 2021 ; Coyle et al., 2021 ; Ciotti et al., 2020). DMTs such as interferons, glatiramer acetate, dimethyl fumarate, teriflunomide, and natalizumab may not impair the immune response to vaccination, whereas, DMTs that rely on sequestration or depletion of T cells, B cells or both such as shingosine-1-phosphate (S1P) receptor modulators, cladribine, alemtuzumab and anti-CD20 therapies may reduce vaccine efficacy.

Although robust data to support evidence-based recommendations on COVID-19 vaccinations is not yet available, this practice guideline aim is to offer guidance on vaccinating MS patients during the COVID-19 pandemic based on previous vaccine studies, mechanism of action of each DMT, currently available COVID-19 vaccine studies, and expert opinion.

A group of regional experts selected by MENACTRIMS (Middle East North Africa Committee for Treatment and Research in Multiple Sclerosis) held two consecutive meetings and several subsequent discussions to review all available evidence regarding COVID-19 vaccines in MS patients. The aim was to develop practical recommendations that would support clinical practice in the region. After reviewing all of the evidence, preliminary recommendations were developed by a subcommittee. Using the Delphi methodology through online meetings, the final version of this guideline was developed.

There are several COVID-19 vaccines currently in use in different countries under EUAs, with many more currently under trial. There are currently four different types of COVID-19 vaccine in use or in development that work in different ways (Table 1). Table 1 Types of COVID-19 vaccines.

- Patients with MS should be vaccinated against COVID-19 .

Available studies show that COVID-19 vaccines are safe, effective and unlikely to trigger an MS relapse. Vaccines can cause fever which in turn may exacerbate MS symptoms. Patients with MS should get a COVID-19 vaccine as soon as it becomes available. The risks of COVID-19 disease outweigh any potential risks from the vaccine.

There is no theoretical reason or evidence from clinical trials to indicate that any of the currently available vaccines can pose any particular risk to patients with MS (Louapre et al., 2020 ; Sormani et al., 2021 ; Salter et al., 2021).

Progressive MS, older age, higher level of disability and comorbidities (e.g., diabetes, high blood pressure, obesity, heart and lung disease, pregnancy), increase the risk for hospitalization due to COVID-19 24–26 . Patients with MS in these high-risk groups are especially encouraged to get vaccinated as soon as vaccines becomes available.

Most of the COVID-19 vaccines require two doses. Following full vaccination (both doses), it may take at least 2 weeks for the vaccination to achieve full effect.

If a patient had COVID-19 and recovered, he/she should also get the vaccine, because prior infection does not appear to protect from future COVID-19 infection indefinitely. However, recent studies (Callegaro et al., 2021 ; Malek et al., 2021 ; Amit et al., 2021 ; Pawlowski et al., 2021) have shown that a single dose of the mRNA vaccines might provide adequate immunity in previously infected patients.

Even if vaccinated, patients with MS should continue to take precautions against COVID-19, such as wearing a face mask, social distancing and washing hands.

We do not know how long a person is protected from COVID-19 after being vaccinated, although clinical trial data (Hansen et al., 2021) indicate that protection is high for at least 6–7 months. Repeated doses of the COVID-19 vaccines may be required in the future, similar to the flu vaccine, especially in case of emergence of new variants.

Patients with MS should avoid receiving live attenuated vaccines.

- COVID-19 Vaccines are safe to use in patients with MS treated with DMTs.

The Astra-Zeneca and Johnson & Johnson (J&J) COVID-19 vaccines have recently been associated with thrombotic events, mostly venous sinus thrombosis, and mainly in young females. The J & J vaccine has also been recently associated with Guillain-Barre Syndrome. Such events, however, are rare and benefits of the vaccine still outweigh its risks. It does not appear that there is any additional risk for patients with MS.

Some DMTs (Ciotti et al., 2020 ; Baker et al., 2020) may make the vaccine less effective but it might still provide some protection.

It is important to note that most studies evaluating the effect of DMTs on vaccine efficacy, have measured serum antibodies. However T-cell mediated immunity might still be able to provide protection against infection with COVID-19 even if antibody response to the vaccine is reduced.

For certain DMTs we may consider coordinating the timing of the vaccine with the timing of the DMT dose to increase vaccine efficacy (Table 2). Table 2 Timing of COVID-19 vaccine in patients treated with DMTs.

The decision of when to give the COVID-19 vaccine and whether to delay the DMT dose should include a risk/benefit evaluation balancing the risk of COVID-19, (see the risk factors for severe COVID-19 infection above) including the current state of the pandemic in the area, vs the current state of the patient's MS. Another factor to be taken into consideration in certain countries is the availability of vaccines for a limited period of time depending on the patient risk category.

If the risk of MS worsening outweighs the risk of COVID-19, then DMT schedule should not be altered and the vaccine should be given when it is available to the patient. On the other hand, if the patient's MS is stable, and vaccine availability is flexible, consider the following adjustments in DMT administration to enhance the effectiveness of the vaccine: i Interferons, glatiramer acetate, teriflunomide, dimethyl fumarate, diroximel fumarate, natalizumab

For patients about to start one of these DMTs, there is no need to delay treatment for vaccination. For patients already taking one of these DMTs, no adjustments to DMT administration are needed (Ciotti et al., 2020).

For patients about to start fingolimod, siponimod or ozanimod, it is recommended to obtain full vaccination 2–4 weeks before starting treatment (Kappos et al., 2015). For patients already taking fingolimod, siponimod or ozanimod, treatment should continue as prescribed and patients can get vaccinated as soon as the vaccine is available . However, recent data has shown that patients on fingolimod have a significantly decreased humoral response to COVID-19 vaccines (Achiron et al., 2021).

For patients about to start alemtuzumab, it is recommended to obtain full vaccination

4 weeks before starting treatment. For patients already taking alemtuzumab, consider starting the vaccine injections at least 6 months after the last alemtuzumab dose (McCarthy et al., 2013). When possible, resume alemtuzumab at least 4 weeks after full vaccination. It is acceptable to delay the second cycle of alemtuzumab for up to 2 months to obtain full vaccination.

For patients about to start cladribine, it is recommended to obtain full vaccination 2–4 weeks before starting treatment. Recent data showed that the efficacy of COVID-19 vaccines in patients on cladribine was similar to healthy controls when vaccination was initiated 4.4 months after the last dose of cladribine, even in patients with Grade III lymphopenia (Achiron et al., 2021). Other studies have also shown that patients on cladribine with Grade I or II lymphopenia mount adequate antibody response to influenza vaccines (Roy and Boschert, 2021 ; Wu et al., 2021). However, the number of patients in those studies was small. For patients already taking cladribine, consider giving the vaccine whenever available since timing does not seem to affect vaccine efficacy. For patients due for their second course, administer cladribine 2–4 weeks after full vaccination. It is acceptable to delay the second cycle of cladribine for up to 2 months to obtain full vaccination.

For patients about to start ocrelizumab or rituximab, it is recommended to obtain full vaccination 2-4 weeks before starting treatment. Recent data showed a significantly decreased response to COVID-19 and other types of vaccines in patients on ocrelizumab (Achiron et al., 2021 ; Bar-Or et al., 2020). In patients on rituximab, the ability to respond to the influenza vaccine was significantly decreased but appeared to be related to the degree of B cell recovery at the time of vaccination, which starts by 7–9 months following the last dose (Eisenberg et al., 2013). For patients already taking ocrelizumab or rituximab consider delaying the next dose, allowing for early B cell recovery by monitoring the CD-19 count, if the patient's disease status and vaccine availability permit. When possible, resume ocrelizumab or rituximab at least 3–4 weeks after the last vaccine injection. This suggested scheduling is not always possible and a case by case approach is advisable.

COVID-19 vaccination is recommended for all MS patients, and currently available vaccines are safe and effective. Attenuated but potentially partially protective vaccine response is expected in MS patients taking S1P modulators and B cell-depleting therapies. Other DMTs are not expected to significantly impact efficacy of COVID-19 vaccines. Coordinating vaccine timing with dosing regimens for some therapies may optimize vaccine efficacy.

Bassem I Yamout: Conceptualization, Writing – original draft, Writing – review & editing. Magd Zakaria: . Jihad Inshasi: . Mohammad Al-Jumah: . Maya Zeineddine: Conceptualization, Writing – original draft, Writing – review & editing. Maurice Dahdah: . Saeed Bohlega: . Riadh Gouider: . Raed Alroughani: .

The authors received honoraria, consulting/speaker fees, and research grants from Biologix (the distributor for Biogen Idec across the Middle East and North Africa region) and from other pharmaceutical companies including Novartis, GSK, Genpharm, Hikma, Bayer, Merck, Sanofi-Genzyme and Roche. The manuscript represents the views and opinions of the members involved in the development of the guidelines. There is no industrial or pharmaceutical support or bias in the selection of the members or the recommendations reached. This effort was sponsored and carried out under the supervision of MENACTRIMS (The Middle East and North Africa Committee for Treatment and Research In Multiple Sclerosis).

Compston A. Coles A. Multiple sclerosis Lancet 372 9648 2008 1502 1517 18970977
10.1016/S0140-6736(08)61620-7 Castelo-Branco A. Chiesa F. Conte S. Bengtsson C. Lee S. Minton N. Infections in patients with multiple sclerosis: a national cohort study in Sweden Mult. Scler. Relat. Disord. 45 2020 102420 10.1016/j.msard.2020.102420 32736217 Persson R. Lee S. Ulcickas Yood M. Wagner Usn M.C. Minton N. Niemcryk S. Infections in patients diagnosed with multiple sclerosis: a multi-database study Mult. Scler. Relat. Disord. 41 2020 101982 10.1016/j.msard.2020.101982 32070858 Epstein D.J. Dunn J. Deresinski S. Infectious complications of multiple sclerosis therapies: implications for screening, prophylaxis, and management Open Forum Infect. Dis. 5 8 2018 ofy174 30094293 10.1093/ofid/ofy174
PMC6080056 World Health Organization Draft Landscape and Tracker of COVID-19 Candidate Vaccines 2021 WHO
<https://www.who.int/publications/m/item/draftlandscape-of-covid-19-candidate-vaccines> Accessed Jun 5, 2021 Siegrist C.A. Plotkin S.A. Orenstein W.A. Offit P.A. Vaccine immunology editors Vaccines 6th ed. 2013 Saunders Philadelphia 14 32 Luckheeram R.V. Zhou R. Verma A.D. Xia B. CD4+T cells: differentiation and functions Clin. Dev. Immunol. 2012 2012 925135 10.1155/2012/925135 PMC3312336 22474485 Bonilla F.A. Oettgen H.C. Adaptive immunity J. Allergy Clin. Immunol. 125 2 2010 S33 S40 Suppl 2 20061006 10.1016/j.jaci.2009.09.017 Tay R.E. Richardson E.K. Toh H.C. Revisiting the role of CD4⁺ T cells in cancer immunotherapy-new insights into old paradigms Cancer Gene Ther. 28 1–2 2021 5 17 32457487 10.1038/s41417-020-0183-x PMC7886651 Lubbers R. van Essen M.F. van Kooten C. Trouw L.A. Production of complement components by cells of the immune system Clin. Exp. Immunol. 188 2 2017 183 194 28249350 10.1111/cei.12952 PMC5383442 Siegrist C.A. Lambert P.H. Bloom B.R. Lambert P.H. Chapter 2—how vaccines work The Vaccine Book 2016 Academic San Diego 33 42 Whitmire J.K. Asano M.S. Kaech S.M. Sarkar S. Hannum L. Schlomchik M. Requirement of B cells for generating CD4⁺ T cell memory J. Immunol. 182 4 2009 1868 1876 19201839 10.4049/jimmunol.0802501 PMC2658628 Lebrun C. Vukusic S. French Group for recommendations in multiple sclerosis (France4MS) and the Société francophone de la Sclérose en plaques (SFSEP). Immunization and multiple sclerosis: recommendations from the French multiple sclerosis society Mult. Scler. Relat. Disord. 31 2019 173 188 31159998 10.1016/j.msard.2019.04.004 Riva A. Barcella V. Benatti S.V. Capobianco M. Capra R. Cinque P. Vaccinations in patients with multiple sclerosis: a Delphi consensus statement Mult. Scler. 27 3 2021 347 359 32940128 10.1177/1352458520952310 Coyle P. Gocke A. Vignos M. Newsome S. Vaccine considerations for multiple sclerosis in the COVID-19 era Adv. Ther. 38 7 2021 3550 3588 Online ahead of print 34075554 10.1007/s12325-021-01761-3 PMC8169434 Ciotti J. Valtcheva M. Cross A. Effects of MS disease-modifying therapies on responses to vaccinations: a review Mult. Scler. Relat. Disord. 45 2020 102439 10.1016/j.msard.2020.102439 PMC7395588 32769063

Jackson L.A. Anderson E.J. Rouphael N.G. Roberts P.C. Makhene M. Coler R.N. An mRNA vaccine against SARS-CoV-2 — preliminary report *N. Engl. J. Med.* 383 20 2020 1920 1931 32663912 10.1056/NEJMoa2022483 PMC7377258 Polack F.P. Thomas S.J. Kitchin N. Absalon J. Gurtman A. Lockhart S. Safety and efficacy of the BNT162b2 mRNA Covid-19 vaccine *N. Engl. J. Med.* 383 27 2020 2603 2615 33301246 10.1056/NEJMoa2034577 PMC7745181 Sadoff J. Le Gars M. Shukarev G. Heerwegh D. Truysers C. de Groot A.M Interim results of a phase 1–2a Trial of Ad26.COV2. S Covid-19 vaccine *N. Engl. J. Med.* 384 19 2021 1824 1835 33440088 10.1056/NEJMoa2034201 PMC7821985 Folegatti P.M. Ewer K.J. Aley P.K. Angus B. Becker S. Belij-Rammerstorfer S. Safety and immunogenicity of the ChAdOx1 nCoV-19 vaccine against SARS-CoV-2: a preliminary report of a phase 1/2, single-blind, randomised controlled trial *Lancet* 396 10249 2020 467 478 32702298 10.1016/S0140-6736(20)31604-4 PMC7445431 Logunov D.Y. Dolzhenko I.V. Shcheblyakov D.V. Tukhvatulin A.I. Zubkova O.V. Dzharullaeva A.S. Safety and efficacy of an rAd26 and rAd5 vector-based heterologous prime-boost COVID-19 vaccine: an interim analysis of a randomised controlled phase 3 trial in Russia *Lancet* 397 2021 671 681 33545094 10.1016/S0140-6736(21)00234-8 PMC7852454 Wang H. Zhang Y. Huang B. Deng W. Quan Y. Wang W. Development of an inactivated vaccine candidate, BBIBP-CorV, with potent protection against SARS-CoV-2 *Cell* 182 3 2020 713 721 32778225 10.1016/j.cell.2020.06.008 PMC7275151 Keech C. Albert G. Cho I. Robertson A. Reed P. Neal S. Phase 1–2 trial of a SARS-CoV-2 recombinant spike protein nanoparticle vaccine *N. Engl. J. Med.* 383 24 2020 2320 2332 32877576 10.1056/NEJMoa2026920 PMC7494251 Louapre C. Collongues N. Stankoff B. Giannesini C. Papeix C. Bensa C. Clinical characteristics and outcomes in patients with coronavirus disease 2019 and multiple sclerosis *JAMA Neurol.* 77 9 2020 1079 1088 32589189 10.1001/jamaneurol.2020.2581 PMC7320356 Sormani P. De Rossi N. Schiavetti I. Carmisciano L. Cordioli C. Muiola L. Disease modifying therapies and COVID-19 severity in multiple sclerosis *Ann. Neurol.* 89 4 2021 780 789 33480077 10.1002/ana.26028 PMC8013440 Salter A. Fox R. Newsome S. Halper J. K B Li D. Kanellis P. Outcomes and Risk Factors Associated With SARS-CoV-2 Infection in a North American Registry of Patients With Multiple Sclerosis *JAMA Neurol.* 2021 e210688 10.1001/jamaneurol.2021.0688 Online ahead of print PMC7980147 33739362 Callegaro A. Borleri D. Farina C. Napolitano G. Valenti D. Rizzi M. Antibody response to SARS-CoV-2 vaccination is extremely vivacious in subjects with previous SARS-CoV-2 infection *J. Med. Virol.* 2021 10.1002/jmv.26982 Online ahead of print PMC8250392 33788281 Malek A. Dagher H. Hachem R. Chaftari A. Raad I. Is a single dose of mRNA vaccine sufficient for COVID-19 survivors? *J. Med. Virol.* 2021 10.1002/jmv.26915 10.1002/jmv.26915. Online ahead of print PMC8013396 33666244 Amit S. Regev-Yochay G. Afek A. Kreiss Y. Leshem E. Early rate reductions of SARS-CoV-2 infection and COVID-19 in BNT162b2 vaccine recipients *Lancet* 397 10277 2021 875 877 10.1016/S0140-6736(21)00448-7 PMC7906709 33610193 Pawlowski C. Lenehan P. Puranik A. Agarwal V. Venkatakrishnan J. Niesen M. FDA-authorized COVID-19 vaccines are effective per real-world evidence synthesized across a multi-state health system *MedRxiv* 2021 10.1101/2021.02.15.21251623 Online ahead of print PMC8238652 34223401 Hansen C. Michlmayr D. Gubbels S. Mølbak K. Ethelberg S. Assessment of protection against reinfection with SARS-CoV-2 among 4 million PCR-tested individuals in Denmark in 2020: a population-level observational study *Lancet* 397 2021 1204 1212 33743221 10.1016/S0140-6736(21)00575-4 PMC7969130 Ciotti J. Valtcheva M. Gross A. Effects of MS disease-modifying therapies on responses to vaccinations: a review *Mult. Scler. Relat. Disord.* 45 2020 102439 10.1016/j.msard.2020.102439 PMC7395588 32769063 Baker D. Roberts C. Pryce G. Kang A. Marta M. Reyes S. COVID-19 vaccine-readiness for anti-CD20-depleting therapy in autoimmune diseases *Clin. Exp. Immunol.* 202 2 2020 149 161 32671831 10.1111/cei.13495 PMC7405500 Kappos L. Mehling M. Arroyo R. Izquierdo G. Selmaj K. Curovic-Perisic V. Randomized trial of vaccination in fingolimod-treated patients with multiple sclerosis *Neurology* 84 9 2015 872 879 25636714 10.1212/WNL.0000000000001302 Achiron A. Mandel M. Dreyer-Alster S. Harari G. Magalashvili D. Sonis P. Humoral immune response to COVID-19 mRNA vaccine in patients with multiple sclerosis treated with high-efficacy disease-modifying therapies *Ther. Adv. Neurol. Disord.* 14 2021 1 8 10.1177/17562864211012835 PMC8072850 34035836 McCarthy C.L. Tuohy O. Compston D.A.S. Kumararatne D.S. Coles A.J. Jones J.L. Immune competence after alemtuzumab treatment of multiple sclerosis *Neurology* 81 10 2013 872 876 23925762 10.1212/WNL.0b013e3182a35215 PMC3885219 S. Roy and U. Boschert. Analysis of influenza and varicella zoster virus vaccine antibody titers in patients with relapsing multiple sclerosis treated with

cladribine tablets. Poster presented at ACTRIMS, 25–27 February 2021, Virtual Congress. G.F. Wu, U. Boschert, B. Hayward, L.A. Lebson, A.H. Cross. Evaluating the impact of cladribine tablets on the development of antibody titers: interim results from the CLOCK-MS influenza vaccine sub-study. Poster presented at ACTRIMS, 25–27 February 2021, Virtual Congress. Bar-Or A. Calkwood J.C. Chognot C. Effect of ocrelizumab on vaccine responses in patients with multiple sclerosis: the VELOCE study *Neurology* 95 14 2020 e1999 e2008 32727835 10.1212/WNL.0000000000010380 PMC7843152 Eisenberg R. Jawad A. Boyer J. Maurer K. McDonald K. Luning Prak E.T. Rituximab-treated patients have a poor response to influenza vaccination *J. Clin. Immunol.* 33 2013 388 396 23064976 10.1007/s10875-012-9813-x PMC3565069 Authors' Contributions All authors participated as members of the panel of experts in the meetings that led to the development of the manuscript. All authors actively contributed to the discussion and the consensus reached. Bassem Yamout and Maya Zeineddine drafted the initial version of the manuscript and all authors discussed and reviewed the final version of the manuscript. All authors read and approved the final manuscript.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.