**e-Reefernces**

e1. Ciampi E, Uribe-San-Martín R, Soler B, et al. COVID-19 in MS and NMOSD: A multicentric online national survey in Chile. Multiple Sclerosis and Related Disorders 2020.

e2. Montero-Escribano P, Matías-Guiu J, Gómez-Iglesias P, Porta-Etessam J, Pytel V, Matias-Guiu JA. Anti-CD20 and COVID-19 in multiple sclerosis and related disorders: A case series of 60 patients from Madrid, Spain. Multiple Sclerosis and Related Disorders 2020.

e3. Crescenzo F, Marastoni D, Bovo C, Calabrese M. Frequency and severity of COVID-19 in multiple sclerosis: a short single-site report from northern Italy. Multiple Sclerosis and Related Disorders 2020:102372.

e4. Moss BP, Mahajan KR, Bermel RA, et al. Multiple sclerosis management during the COVID-19 pandemic. Multiple sclerosis (Houndmills, Basingstoke, England):1352458520948231.

e5.Mantero V, Abate L, Balgera R, Basilico P, Salmaggi A, Cordano C. Assessing the susceptibility to acute respiratory illness COVID-19-related in a cohort of multiple sclerosis patients. Multiple Sclerosis and Related Disorders 2020;46:102453.

e6. Nesbitt C, Rath L, Yeh WZ, et al. MSCOVID19: using social media to achieve rapid dissemination of health information. Multiple sclerosis and related disorders 2020;45:102338.

e7. Vogel AC, Schmidt H, Loud S, McBurney R, Mateen FJ. Impact of the COVID-19 pandemic on the health care of> 1,000 People living with multiple sclerosis: A cross-sectional study. Multiple sclerosis and related disorders 2020;46:102512.

e8. Capasso N, Palladino R, Montella E, et al. Prevalence of SARS-CoV-2 Antibodies in Multiple Sclerosis: The Hidden Part of the Iceberg. Journal of Clinical Medicine 2020;9:4066.

e9. Jack D, Nolting A, Galazka A. Favorable outcomes after COVID-19 infection in multiple sclerosis patients treated with cladribine tablets. Multiple Sclerosis and Related Disorders 2020;46.

e.10 Hughes R, Pedotti R, Koendgen H. COVID-19 in persons with multiple sclerosis treated with ocrelizumab–a pharmacovigilance case series. Multiple Sclerosis and Related Disorders 2020;42:102192.

e11. Meca-Lallana V, Aguirre C, Río B, Cardeñoso L, Alarcon T, Vivancos J. COVID-19 in 7 multiple sclerosis patients in treatment with ANTI-CD20 therapies. Multiple Sclerosis and Related Disorders 2020:102306.

e12. Mantero V, Abate L, Basilico P, et al. COVID‐19 in dimethyl fumarate‐treated patients with multiple sclerosis. Journal of Neurology 2020:1-3.

e13. Matías-Guiu J, Montero-Escribano P, Pytel V, Porta-Etessam J, Matias-Guiu JA. Potential COVID-19 infection in patients with severe multiple sclerosis treated with alemtuzumab. Multiple Sclerosis and Related Disorders 2020:102297.

e14. Maghzi AH, Houtchens MK, Preziosa P, et al. COVID-19 in teriflunomide-treated patients with multiple sclerosis. Journal of Neurology 2020:1.

e15. Luca B, Tommaso G, Bavaro DF, et al. Seroconversion and indolent course of COVID-19 in patients with multiple sclerosis treated with fingolimod and teriflunomide. Journal of the Neurological Sciences 2020;416:117011.

e16. Guevara C, Villa E, Cifuentes M, Naves R, de Grazia J. Mild COVID-19 infection in a patient with multiple sclerosis and severe depletion of T-lymphocyte subsets due to alemtuzumab. Multiple Sclerosis and Related Disorders 2020;44.

e17. Thornton JR, Harel A. Negative SARS-CoV-2 antibody testing following COVID-19 infection in Two MS patients treated with ocrelizumab. Multiple Sclerosis and Related Disorders 2020:102341.

e18. Mallucci G, Zito A, Dal Fabbro B, Bergamaschi R. Asymptomatic SARS-CoV-2 infection in two patients with multiple sclerosis treated with fingolimod. Multiple sclerosis and related disorders 2020.

e19. Möhn N, Saker F, Bonda V, et al. Mild COVID-19 symptoms despite treatment with teriflunomide and high-dose methylprednisolone due to multiple sclerosis relapse. Journal of Neurology 2020:1.

e20. Valencia-Sanchez C, Wingerchuk DM. A fine balance: Immunosuppression and immunotherapy in a patient with multiple sclerosis and COVID-19. Multiple Sclerosis and Related Disorders 2020:102182.

e21. Rejdak K, Grieb P. Adamantanes might be protective from COVID-19 in patients with neurological diseases: multiple sclerosis, parkinsonism and cognitive impairment. Multiple Sclerosis and Related Disorders 2020:102163.

e22. Carandini T, Pietroboni AM, Sacchi L, et al. Alemtuzumab in multiple sclerosis during the COVID-19 pandemic: A mild uncomplicated infection despite intense immunosuppression. Multiple Sclerosis Journal 2020:1352458520926459.

e23. Gemcioglu E, Davutoglu M, Ozdemir EE, Erden A. Are Type 1 Interferons treatment in Multiple Sclerosis as a potential therapy against COVID-19? Multiple Sclerosis and Related Disorders 2020:102196.

e24. Conte WL. Attenuation of antibody response to SARS-CoV-2 in a patient on ocrelizumab with hypogammaglobulinemia. Multiple sclerosis and related disorders 2020;44.

e25. Suwanwongse K, Shabarek N. Benign course of COVID-19 in a multiple sclerosis patient treated with Ocrelizumab. Multiple Sclerosis and Related Disorders 2020.

e26. Gomez‐Mayordomo V, Montero‐Escribano P, Matías‐Guiu JA, González‐García N, Porta‐Etessam J, Matías‐Guiu J. Clinical exacerbation of SARS‐CoV2 infection after fingolimod withdrawal. Journal of medical virology 2020.

e27. Devogelaere J, D’hooghe MB, Vanderhauwaert F, D’haeseleer M. Coronavirus disease 2019: favorable outcome in an immunosuppressed patient with multiple sclerosis. Neurological Sciences 2020:1-3.

e28. Fernández-Díaz E, Gracia-Gil J, García-García JG, Palao M, Romero-Sánchez CM, Segura T. COVID-19 and multiple sclerosis: A description of two cases on alemtuzumab. Multiple sclerosis and related disorders 2020:102402.

e29. Novi G, Mikulska M, Briano F, et al. COVID-19 in a MS patient treated with ocrelizumab: does immunosuppression have a protective role? Multiple Sclerosis and Related Disorders 2020:102120.

e30. Aguirre C, Meca-Lallana V, Barrios-Blandino A, del Río B, Vivancos J. Covid-19 in a Patient With Multiple Sclerosis Treated With Natalizumab: May the Blockade of Integrins Have a Protective Role? Multiple Sclerosis and Related Disorders 2020:102250.

e31. Barzegar M, Mirmosayyeb O, Nehzat N, et al. COVID-19 infection in a patient with multiple sclerosis treated with fingolimod. Neurology-Neuroimmunology Neuroinflammation 2020;7.

e32. Borriello G, Ianniello A. COVID-19 occurring during Natalizumab treatment: a case report in a patient with extended interval dosing approach. Multiple Sclerosis and Related Disorders 2020:102165.

e33. Ghajarzadeh M, Mirmosayyeb O, Barzegar M, et al. Favorable outcome after COVID-19 infection in a multiple sclerosis patient initiated on ocrelizumab during the pandemic. Multiple Sclerosis and Related Disorders 2020.

e34. Chiarini M, Paghera S, Moratto D, et al. Immunologic characterization of a immunosuppressed multiple sclerosis patient that recovered from SARS-CoV-2 infection. Journal of Neuroimmunology 2020:577282.

e35. Lucchini M, Bianco A, Del Giacomo P, De Fino C, Nociti V, Mirabella M. Is serological response to SARS-CoV-2 preserved in MS patients on ocrelizumab treatment? A case report. Multiple Sclerosis and Related Disorders 2020:102323.

e36. Foerch C, Friedauer L, Bauer B, Wolf T, Adam EH. Severe COVID-19 infection in a patient with multiple sclerosis treated with fingolimod. Multiple Sclerosis and Related Disorders 2020:102180.

e37. Woo MS, Steins D, Häußler V, et al. Control of SARS-CoV-2 infection in rituximab-treated neuroimmunological patients. Journal of Neurology 2020:1-3.

e38. Ciardi MR, Zingaropoli MA, Pasculli P, et al. The peripheral blood immune cell profile in a teriflunomide-treated multiple sclerosis patient with COVID-19 pneumonia. Journal of Neuroimmunology 2020;346:577323.

e39. Louapre C, Maillart E, Roux T, et al. Patients with MS treated with immunosuppressive agents: across the COVID-19 spectrum. Revue Neurologique 2020;176:523.

e40. Iannetta M, Cesta N, Stingone C, et al. Mild clinical manifestations of SARS-CoV-2 related pneumonia in two patients with multiple sclerosis under treatment with ocrelizumab. Multiple sclerosis and related disorders 2020;45:102442-102442.

e41. Wurm H, Attfield K, Iversen AK, Gold R, Fugger L, Haghikia A. Recovery from COVID-19 in a B-cell-depleted multiple sclerosis patient. Multiple Sclerosis Journal 2020:1352458520943791.

e42. Dersch R, Wehrum T, Fähndrich S, Engelhardt M, Rauer S, Berger B. COVID-19 pneumonia in a multiple sclerosis patient with severe lymphopenia due to recent cladribine treatment. Multiple Sclerosis Journal 2020:1352458520943783.

e43. Fiorella C, Lorna G. COVID-19 in a multiple sclerosis (MS) patient treated with alemtuzumab: insight to the immune response after COVID. Multiple Sclerosis and Related Disorders.

e44. Olivares Gazca JC, Gómez Almaguer D, Gale RP, Ruiz Argüelles GJ. Mélange intéressante: COVID-19, autologous transplants and multiple sclerosis. Hematology 2020;25:320-320.

e45. Mantero V, Baroncini D, Balgera R, et al. Mild COVID‐19 infection in a group of teriflunomide‐treated patients with multiple sclerosis. Journal of Neurology 2020:1-2.

e46 De Angelis M, Petracca M, Lanzillo R, Morra VB, Moccia M. Mild or no COVID-19 symptoms in cladribine-treated multiple sclerosis: Two cases and implications for clinical practice. Multiple sclerosis and related disorders 2020;45:102452.

e47. Celius EG. Normal antibody response after COVID-19 during treatment with cladribine. Multiple Sclerosis and Related Disorders 2020;46:102476.

e48. Șerban G, Bălașa R. SARS-CoV2 Infection in a Multiple Sclerosis Patient Treated with Natalizumab–A Case Presentation. Acta Marisiensis-Seria Medica 2020;66:110-112.

e49. Kataria S, Tandon M, Melnic V, Sriwastava S. A case series and literature review of multiple sclerosis and COVID-19: Clinical characteristics, outcomes and a brief review of immunotherapies. Eneurologicalsci 2020:100287.

e50. Moghadasi AN. Encephalopathy associated with COVID-19 in a patient with multiple sclerosis. Journal of neurovirology 2020:1-3.

e51. Margoni M, Gallo P. Natalizumab safety in paediatric-onset multiple sclerosis at the time of SARS-Cov-2 pandemic. Multiple Sclerosis Journal–Experimental, Translational and Clinical 2020;6:2055217320966346.

e52 Preziosa P, Rocca MA, Nozzolillo A, Moiola L, Filippi M. COVID-19 in cladribine-treated relapsing-remitting multiple sclerosis patients: a monocentric experience. Journal of neurology 2020:1-3.

e53. Florea AA, Sirbu CA, Ghinescu MC, et al. SARS‑CoV‑2, multiple sclerosis, and focal deficit in a postpartum woman: A case report. Experimental and Therapeutic Medicine;21:1-1.

e54. Meca-Lallana V, Aguirre C, Diaz C, Del Rio B, Martin R, Vivancos J. Experience in multiple sclerosis patients with sars cov-2 infection. Presented at the 8th ACTRIMS-ECTRIMS; December 01, 2020; Washington (virtual).

e55. Radaelli M, Barcella V, Conti M, Sessa M. Sars-cov-2 infection in multiple sclerosis patients: a single center experience in the province of bergamo, Italy. Presented at the 8th ACTRIMS-ECTRIMS; December 01, 2020; Washington (virtual).

e56. Guevara C, Villa E, Cifuentes M, et al. Multiple sclerosis during covid-19 pandemic in santiago, chile. Presented at the 8th ACTRIMS-ECTRIMS; December 01, 2020; Washington (virtual).

e57. Schreiner T, Chitnis T, Tillema JM. Demographic and clinical profile of pediatric patients with multiple sclerosis infected with sars-cov2. Presented at the 8th ACTRIMS-ECTRIMS; December 01, 2020; Washington (virtual).

e58. Omerhoca S, Yıldırım Z, Kaya Tutar N, Kale N. Managing multiple sclerosis patients diagnosed with covid-19 infection; into the field of unknown. Presented at the 8th ACTRIMS-ECTRIMS; December 01, 2020; Washington (virtual).

e59. Mallucci G, Zito A, Dal Fabbro B, Gastaldi M, Franciotta D, Bergamaschi R. Frequency of sars-cov-2 antibodies and covid-19 severity in a cohort of italian multiple sclerosis patients on dmts inhibiting immune cell trafficking. Presented at the 8th ACTRIMS-ECTRIMS; December 01, 2020; Washington (virtual).

e60. Hervas-Garica JV, Gil-Sanchez A, Gonzalez-Mingot C. Seroprevalence of sars-cov-2 in multiple sclerosis patients under immunomodulatory treatment in lleida (study emcovid-19). Presented at the 8th ACTRIMS-ECTRIMS; December 01, 2020; Washington (virtual).

e61. Wallach A, Melvin S, Schiebel M, Picone M. The presence of sars cov2 antibodies in ms patients. Presented at the 8th ACTRIMS-ECTRIMS; December 01, 2020; Washington (virtual).

e62. Oreja-Guevara , Meca-Lallanaa V, Brieva L, et al. Covid-19 in cladribine-treated patients with multiple sclerosis. Presented at the 8th ACTRIMS-ECTRIMS; December 01, 2020; Washington (virtual).

e63. Karan R, Roy S, N. Alexandri. Clinical outcomes in patients with covid-19 infection during phase iv studies of cladribine tablets for treatment of multiple sclerosis. Presented at the 8th ACTRIMS-ECTRIMS; December 01, 2020; Washington (virtual).

Table e-1a. Quality assessment of cross-sectional studies

|  |  |
| --- | --- |
| First author | Questions |
| Q1 | Q2 | Q3 | Q4 | Q1 | Q1 | Q2 |
| Sormani et al 12 | a\* | a\* | c | a\*\* | a\* | a\*\* | b |
| Ciampi et al e1 | a\* | a\* | c | a\*\* | a\* | c\* | b |
| Barzegar et al 14  | a\* | a\* | b | a\*\* | a\* | a\*\* | b |
| Montero-Escribano et al e2 | c | b | c | b\* | a\* | b\*\* | b |
| Safavi et al 13 | a\* | a\* | b | a\*\* | a\*\* | c\* | a\* |
| Crescenzo et al e3 | a\* | a\* | c | a\*\* | a\* | c\* | b |
| Moss et al e4 | a\* | a\* | b | a\*\* | a\*\* | c\* | a\* |
| Mantero et al e5 | c | b | c | b\* | a\*\* | c\* | a\* |
| Sahraian et al 16 | a\* | a\* | a\* | a\*\* | a\*\* | c\* | a\* |
| Álvarez et al 15 | a\* | a\* | c | a\*\* | a\* | a\*\* | b |
| Nesbitt et al e6 | a\* | a\* | c | c | N/A | c\* | b |
| Vogel et al e7 | a\* | a\* | b | a\*\* | a\*\* | c\* | a\* |
| Capasso et al e8 | a\* | a\* | c | b\* | a\*\* | a\*\* | a\* |

Table e-1b. Quality assessment of cohort studies

|  |  |
| --- | --- |
| First author | Questions |
| Q1 | Q2 | Q3 | Q4 | Q1 | Q1 | Q2 | Q3 |
| Louapre et al 20 | a\* | c | a\* | b | a\* | a\* | a\* | a\* |
| Parrotta et al 19 | a\* | c | a\* | b | a\* | a\* | a\* | a\* |
| Loonstra et al 21 | b | c | a\* | b | a\* | a\* | a\* | a\* |
| Costa et al 23 | a\* | c | a\* | b | a\* | a\* | a\* | a\* |
| Chaudhry et al 22 | b | c | a\* | b | a\* | a\* | b | d |
| Evangelou et al 47 | a\* | c | a\* | a\* | a\*\* | a\* | a\* | a\* |
| Kovvuru et al 24 | a\* | c | a\* | b | a\* | a\* | b | d |

|  |
| --- |
| Table e2-a. Characteristics of original studies included in the investigation |
| First Author | Location | Date of first publication | Type of study | Confirmed/suspected | Positive PCR | Age,Mean or median (SD or range) | Sex | Disease duration,Mean or (SD or range) | EDSS,Mean or median (SD or range) | Course of disease | DMTs | Comorbidity | Symptoms | Severity of COVID-19 |
| Louapre et al 20 | France | 6/26/2020 | Cohort | 347 | 146/191 | 44.60 (12.80) | F 249M 98 | 13.50 (10.00) | 2.0(0.0-9.5) | RRMS 276SPMS 48PPMS 17CIS 6 | IFN 20GA 33RTX 17OCR 38Fingolimod 42Natalizumab 57DMF 35TFL 33Cladribine 3Alemtuzumab 1MMF 3CP 1MTX 1No treatment 63 | Any comorbidity: 113CVD 23DM 16Lung Diseases: 15Obesity 24Smoking 33 | Asthenia 290Cough 266Fever 260Headache 180Dyspnea 162Anosmia/Ageusia 150GI Symptoms: 88Dizziness 54Asymptomatic 2 | Hospitalized 73 (21.0)Death 12 (3.5) |
| Parrotta et al 19 | USA | 07/09/2020 | Cohort | 76 (72 MS) | 37 | 44 .9 (15.2) | F 47M 29 | 15.20 (10.70) | NR | RRMS 55SPMS 15PPMS 2NMO 1MOGAD 1Neurosarcoidosis 1CRION 1 | IFN 3GA 6RTX 18OCR 16Fingolimod 8Natalizumab 4DMF 4Siponimod 2IVIG 3No treatment 12 | CAD 3HTN 17Malignancy 4Smoking 2Obesity 23VTE 4DM 8 | Fever 52Cough 52Fatigue 29Dyspnea 24Myalgia/arthralgia 20Anosmia 17Ageusia 15Headache 16Neurological worsening 16 | Hospitalized 15/72 (20.8)Death 6/72 (8.3) |
| Parrotta et al 19# | USA | 07/09/2020 | Cohort | 9 | 4 | 19.44 (4.12) | F 7M 2 | 6.11 (3.55) | NR | RRMS 9 | GA 1RTX 4OCR 2Natalizumab 1No treatment 1 | DM 2Lung Diseases 1Obesity 3 | NR | Hospitalized 2 (22.3)Death 0 |
| Loonstra et al 21  | Netherlands | 7/14/2020 | Cohort | 86 | 37 | 45.50 (20-71) | F 60M 26 | NR | 3.0 (0-8) | RRMS 69SPMS 9PPMS 5Baló’s MS 1Unknown 2 | IFN 5GA 4OCR 19Fingolimod 15Natalizumab 5DMF 18TFL 5Alemtuzumab 1IVIG 1Stem cell 1No treatment 12 | Any comorbidity: 23 | NR | Hospitalized 22 (25.6)death 4 (4.6) |
| Costa el al 23 | Multicenter | 07/02/2020 | Cohort | 52 | 4 | NR | NR | NR | NR | NR | NR | NR | NR | Hospitalized 1 (2.0%)Death 0 |
| Evangelou el al 47 | UK | 08/27/2020 | Cohort | 237 | 37 | NR | NR | NR | NR | NR | Interferon 11GA 18OCR 14Fingolimod 15Natalizumab 19DMF 32TFL 2Cladribine 2Alemtuzumab 5No treatment 116 | NR | NR | Hospitalized 3 (1.3%)Death 0 |
| Chaudhry el al 22 | USA | 09/19/2020 | Cohort | 40 | 40 | 52.0 (45.5-61) | F 24M 16 | 12 (6.5-19) | NR | RRMS 30Progressive 9 | Interferon 2GA 3OCR 12Fingolimod 2Natalizumab 2DMF 6TFL 3Alemtuzumab 1No treatment 8 | HTN 16DM 9Lung diseases 2Smoking 6HLP 7 | Fever 26Cough 26Dyspnea 20Headache 7Myalgia 14Sore throat 4Diarrhea 4Altered Mental Status 4 | Hospitalized 19 (47.5%)Death 4 (10%) |
| Kovvuru et al 24 | USA | 11/27/2020 | Cohort | 115 | NR | 52 (15.5) | F 83M 32 | NR | NR | NR | DMF 12OCR 15Interferon beta-1a ≤10Interferon beta-1b ≤10GA ≤10Fingolimod ≤10TFL ≤10Natalizumab ≤10Alemtuzumab ≤10Mitoxantrone ≤10 | NR | NR | Hospitalized 38 (33.0%)Death 5 (4.3%) |
| Sormani et al 12 | Italy | 4/30/2020 | Cross-sectional | 232 | 57 | 44.00 (19-82) | F 159M 73 | 11.6 (0-38) | 2.60 (0-9) | RRM 204SPMS 21PPMS 7 | IFN 22GA 24RTX 2OCR 26Fingolimod 31Natalizumab 25DMF 57TFL 16Cladribine 5Alemtuzumab 1Azathioprine 1Ponesimod 1No treatment 21 | NR | NR | Hospitalized: NRDeath 5 (2.1) |
| Ciampi et al e1 | Chile | 07/12/2020 | Cross-sectional | 14 | 11 | 34.71 (17-57) | F 10M 4 | 6.46 (2-14) | 1.428 (0-4) | RRMS 14 | IFN 1OCR 2Fingolimod 5Natalizumab 1DMF 2TFL 2Alemtuzumab 2\* | Any comorbidity: 14Insulin resistance 4Depression 5Migraine 3Hypothyroidism 3HTN 1DM 1Thyroiditis 1Obesity 2cutaneous amyloidosis 1Lung diseases 1 | Fever 6Cough 1Dyspnea 1Myalgia/arthralgia 7Anosmia 4Sore throat 1Headache 3Diarrhea 1Rhinorrhea 1Pneumonia 2Asymptomatic 2 | Hospitalized 3 (21.4)Death 0 |
| Barzegar et al 14 | Iran | 06/08/2020 | Cross-sectional | 9 | 2 | 38.55 (29-50) | F 8M 1 | 10.30 (1-27) | 1.83 (0-8) | RRMS 6SPMS 2CIS 1 | IFN 4GA 1RTX 1Fingolimod 1No treatment 2 | Any comorbidity: 4Hashimoto's disease 1Epilepsy 1Amnesia 1Hypothyroidism 1 | Fever 5Cough 4Dyspnea 6Anosmia 1Sore throat 3Diarrhea 2 | Hospitalized 2 (22.3)Death 1 (11.2) |
| Montero-Escribano e2 | Spain | 05/07/2020 | Cross-sectional | 8 | 2 | 46.0 (41-55) | F 6M 2 | NR | NR | RRMS 4SPMS 1PPMS 3 | RTX 6OCR 2 | NR | Fever 6Cough 4Fatigue 2Dyspnea 2Anosmia 3Ageursia 2GI symptoms 3Myalgia/arthralgia 1Odynophagia 2Chest pain 1Pneumonia 1 | Hospitalized 1 (12.5)Death 0 |
| Safavi et al 13 | Iran | 05/13/2020 | Cross-sectional | 34 | No PCR | 34.8 (8) | F 27M 7 | 6.6 (4.2) | NR | RRMS 27Progressive 7 | IFN 3RTX 21Fingolimod 5DMF 2TFL 1No DMT 2 | NR | Fever 32Cough 29Dyspnea 16Sore throat 16Sneezing 18Diarrhea 6Nausea/vomiting 11 | Hospitalized 2 (5.3)Death 0 |
| Crescenzo et al e3 | Italy | 07/04/2020 | Cross-sectional | 29 | 11 | 39 (10) | F 15M 14 | 9.2 (6.7) | 2.5 (0-7.5) | RRMS 23Progressive 6 | OCR 7Fingolimod 4Natalizumab 2DMF 12TFL 2Azathioprine 1No treatment 1 | Any comorbidity 13 | NR | Hospitalized 2 (6.9)Death 0 |
| Moss et al e4 | Multicenter | 08/10/2020 | Cross-sectional | 77 | 17 | 46.79 (10.84) | F 62M 15 | 16.60 (10.15) | 2.30 (1.97) | RRMS 57Progressive MS 20 | NR | Any comorbidity: 37Smoking 16 | NR | Hospitalized 5 (6.5%)Death 0 |
| Álvarez el al 15 | Spain | 10/01/2020 | Cross-sectional | 12 | 9 | 47.91 (22-74) | F 9M 3 | NR | 1.92 (0-8) | RRMS 9Progressive 3 | Interferon 2Fingolimod 1DMF 2TFL 2Cladribine 1Alemtuzumab 1No treatment 3 | NR | Fever 8Anosmia 1Dyspnea 1Headache 3Asthenia 4Myalgia 5Sore throat 7 | Hospitalized: NRDeath 1 (8.3%) |
| Mantero el al e5 | Italy | 11/01/2020 | Cross-sectional | 15 | 1 | 40.5 (13.7) | F 10M 5 | 11.5 (9.2) | 2.0 (1.5, 3.0) | RRMS 14Progressive 1 | Interferon 3Fingolimod 1Natalizumab 1DMF 7TFL 2No treatment 1 | NR | NR | Hospitalized 0Death 0 |
| Sahraian et al 16 | Iran | 08/29/2020 | Cross-sectional | 68 | NR | 37.27 (9.10) | F 56M 12 | 6.86 (6.21) | NR | RRMS 60Progressive 3 | Interferon 10GA 5RTX 38OCR 1Fingolimd 4Natalizumab 2DMF 2TFL 2Azathioprine 1No treatment 2 | NR | NR | Hospitalized 17 (25%)Death 2 (2.9%) |
| Nesbitt et al e6 | Multicenter | 06/24/2020 | Cross-sectional | 25 | NR | 41.4 (13.2) | F 11M 4 | NR | 6.7 (1.0) | RRMS 4Progressive 3 | IFN 2GA 2RTX 1OCR 6Fingolimod 4DMF 2TFL 1Natalizumab 1Cladribine 4Alemtuzumab 3 | NR | NR | Hospitalized 7 (28%)Death 0 |
| Vogel et ale7 | USA | 19/09/2020 | Cross-sectional | 7 | 7 | 43 (29-64) | F 5M 2 | NR | NR | NR | RTX 1OCR 1DMF 2No treatment 2 | HTN 3CVD 1DM 2Lung diseases 1 | NR | Hospitalized 0Death 0 |
| Capasso et al e8 | Italy | 12/16/2020 | Cross-sectional | 9 | NR | 41.4 (12.8) | F 6M 3 | NR | 3.0 (1.0-6.5) |  NR | TFL 1Natalizumab 3Almtuzumab 3Cladribine 1No DMT 1 | Any comorbidity: 0 | Cough 1Fever 1Anosmia 1Asymptomatic 7 | Hospitalized 0ICU 0Ventilation 0Death 0 |
| Jack el al e9 | Merck KGaAGlobal Patient Safety Database | 08/27/2020 | Pharmacovigilance study | 46 | 15 | NR | F 26M 12 | NR | NR | NR | Cladribine 46 | NR | Asymptomatic 2 | Hospitalized 4 (8.7%)Death 0 |
| Hughes et al e10 | Roche/Genentech global safety databases | 05/16/2020 | Pharmacovigilance study | 100 | 32 | 42.3 (23-59) | F 48M 28 | NR | NR | RRMS 30Progressive 15 | OCR 100 | NR | Asymptomatic 1 | Hospitalized 26 (26)Death 0 |
| Meca-Lallana et al e11 | Spain | 06/15/2020 | Case report/series | 7 | 5 | 46.71 (25-60) | F 3M 4 | 10.71 (5-19) | 4.42 (1.0-8) | RRMS 4Progressive 3 | OCR 6RTX 1 | Any comorbidity: 1Smoking 1 | Fever 5Cough 4Fatigue 1Dyspnea 3Myalgia/arthralgia 1Anosmia 1Headache 2Asymptomatic 2 | Hospitalized 3 (42.9)Death 0 |
| Bowen et al 8 | USA | 05/26/2020 | Case report/series | 8  | 7 | 51.5 (11.4) | F 6M 2 | NR | 3.62(1-8.5) | RRMS 5SPMS 3 | IFN 1GA 1Fingolimod 2DMF 2TFL 1No treatment 1 | Any comorbidity: 4CAD 1HTN 1DM 2Lung diseases 2Obesity 1Myotonic dystrophy 1Cardiomyopathy 1 | Fever 7Cough 6Fatigue 2Dyspnea 2Anosmia 2Sneezing 2Headache 4disequilibrium 1Altered mental status 2Chills 1Nausea 1 | Hospitalized 3ˠ (37.5)Death 2 (25) |
| Mantero et al e12 | Italy | 06/25/2020 | Case report/series | 7 | No PCR | 35.90(11.4) | F 5M 2 | 6.71 (5.6) | 1.5 (1.5-2.0) | RRMS 7 | DMF 7 | Any comorbidity: 0 | Fever 6Cough 4Dyspnea 2Anosmia 5Ageusia 1Asthenia 2Pseudo-relapse 1 | Hospitalized 0Death 0 |
| Matías-Guiu et al e13 | Spain | 06/11/2020 | Case report/series | 2 | No PCR | 52.50 (51-54) | F 2 | 29.50 (23-36) | 6.5 (6.5-6.5) | RRMS 2 | Alemtuzumab 2 | NR | Fever 2Anosmia 1Ageusia 1Asthenia 1Headache 1Diarrhea 2 | Hospitalized 0Death 0 |
| Maghzi et al e14 | USA | 05/21/2020 | Case report/series | 5 | 4 | 53.6 (38-79) | F 2M 3 | 12.80 (2-28) | 2.5 (0.0-6.0) | RRMS 3SPMS 1RIS 1 | TFL 5 | Any comorbidity : 3HTN 1ADHD 1Anxiety 1HLP 1Sleep apnea 1Recurrent UTI 1 | Fever 5Cough 2Fatigue 1Dyspnea 1Myalgia/arthralgia 1Anosmia 2Sore throat 2Asthenia 1Headache 2Diarrhea 2Nausea 1 | Hospitalized 0Death 0 |
| Luca et al e15 | Italy | 07/04/2020 | Case report/series | 2 | 2 | 46.0 (34-58) | F 2M 0 | 4.5 (4-5) | 2.5 (2.5-2.5) | RRMS 2 | TFL 1Fingolimod 1 | NR | Fever 2Sore throat 1Diarrhea 1 | Hospitalized 2Death 0 |
| Guevara et al e16 | Chile | 06/20/2020 | Case report/series | 1 | 1 | 35.0 | M  | 2 | 1.0 | RRMS  | Alemtuzumab  | No comorbidity | Fever 1Cough 1 | Hospitalized 0Death 0 |
| Thornton et al e17 | USA | 06/26/2020 | Case report/series | 2 | 2 | 40.5 (39-42) | F 1M 1 | 4.5 (4-5) | NR | RRMS 2 | OCR 2 | No comorbidity | Fever 1Cough 2Dyspnea 1Ageusia 1 | Hospitalized 0Death 0 |
| Mallucci et al e18 | Italy | 07/19/2020 | Case report/series | 2 | 2 | 43.0 (37-49) | NR | 19.0 (15-23) | 2.5 (2.5-2.5) | NR | Fingolimod 2 | NR | Asymptomatic 2 | Hospitalized 0Death 0 |
| Mohn et al e19 | Germany | 05/28/2020 | Case report/series | 1 | 1 | 42.0 | M  | 7.0 | NR | RRMS  | TFL  | No comorbidity | Fever Sore throat NauseaVomiting general weaknessNeurological worsening  | Hospitalized 1Death 0 |
| Valencia-Sanchez et al e20  | USA | 05/08/2020 | Case report/series | 1 | 1 | 58 | F  | 13 | 6.0 | RRMS  | Fingolimod  | HTN DM Obesity HLPTIAMigraine | Fever Cough Anosmia Hyposmia Dysgeusia Dyspnea | Hospitalized 1Death 0 |
| Rejdak et al e21 ‡ | Poland | 04/30/2020 | Case report/series | 10 | 10 | 38.0(10) | F 7M 3 | 9.0(4.0) | NR | NR | GA 2Fingolimod 2Natalizumab 2DMF 4 | NR | Asymptomatic 10 | Hospitalized 0Death 0 |
| Carandini et al e22  | Italy | 05/28/2020 | Case report/series | 1 | 1 | 25 | F  | NR | NR | RRMS | Alemtuzumab 1 | NR | Fever Cough Fatigue  | Hospitalized 0Death 0 |
| Gemcioglu et al e23 | Turkey | 05/16/2020 | Case report/series | 1 | 1 | 31 | M  | 2 | NR | NR | IFN | Seasonal allergic rhinitis | Cough Dyspnea  | Hospitalized 1Death 0 |
| Conte et al e24 | USA | 06/20/2020 | Case report/series | 1 | 1 | 48 | F  | NR | NR | NR | OCR  | NR | Fever DyspneaUpper respiratory Malaise  | Hospitalized 1Death 0 |
| Suwanwongse et al e25 | USA | 05/15/2020 | Case report/series | 1 | 1 | 31 | M  | NR | NR | NR | OCR  | Obesity | Cough Dyspnea Diarrhea NauseaVomiting  | Hospitalized 1Death 0 |
| Gomez-Mayordomo et al e26 | Spain | 07/09/2020 | Case report/series | 1 | 1 | 57 | M  | 24 | 6 | RRMS | Fingolimod | NR | Fever Dyspnea Malaise  | Hospitalized 1Death 0 |
| Devogelaere et al e27 | Belgium | 06/20/2020 | Case report/series | 1 | 1 | 33 | F | 16 | 8 | NR | RTX | No comorbidity | Fever 1Cough 1Dyspnea 1Headache 1 | Hospitalized 1Death 0 |
| Fernandez-Dıaz et al e28 | Spain | 07/17/2020 | Case report/series | 2 | 2 | 36.5 (30-43) | F 1M 1 | 8.25 (2.5-14) | 1.25 (0.0-2.5) | RRMS 2 | Alemtuzumab 2 | No comorbidity | Fever 2Cough 2Dyspnea 1Myalgia/arthralgia 1 | Hospitalized 1Death 0 |
| Novi et al e29 | Italy | 04/15/2020 | Case report/series | 1 | 1 | 58 | M | 12 | 6 | PPMS 1 | OCR | Allergic rhinitis, AsthmaPeptic ulcer | Fever Cough | Hospitalized 1Death 0 |
| Aguirre et al e30 # | Spain | 06/03/2020 | Case report/series | 1 | 1 | 18 | M | 7 | 1.5 | NR | Natalizumab | No comorbidity | Fever Cough Malaise | Hospitalized 1Death 0 |
| Barzegar et al e31 | Iran  | 05/05/2020 | Case report/series | 1 | 1 | 42 | F | 19 | 1 | RRMS | Fingolimod | Hypothyroidism Recurrent UTI MDDPTEMyasthenia gravis | Fever 1Cough 1Dyspnea 1Neurological worsening | Hospitalized 1Death 0 |
| Borriello et al e32  | Italy | 04/30/2020 | Case report/series | 1 | 1 | 28 | M  | 20 | 1.5 | RRMS | Natalizumab | No comorbidity | Fever Dyspnea | Hospitalized 1Death 0 |
| Ghajarzadeh et al e33 | Iran | 05/23/2020 | Case report/series | 1 | 1 | 39 | F | 10 | 2.0 | RRMS | OCR | Epilepsy | FeverDyspnea | Hospitalized 0Death 0 |
| Chiarini et al e34 | Italy | 05/29/2020 | Case report/series | 1 | 1 | 45 | F | 24 | 6.5 | RRMS | Fingolimd | Obesity | FeverAsthenia | Hospitalized 1Death 0 |
| Lucchini et al e35 | Italy | 06/22/2020 | Case report/series | 1 | 1 | 60 | F | 8 | 2.5 | RRMS | OCR | NR | Fever Cough Sore throatNasal congestion | Hospitalized 0Death 0 |
| Foerch et al e36 | Germany | 05/06/2020 | Case report/series | 1 | 1 | 57 | F  | 10 | 2.0 | RRMS | Fingolimd | Any comorbidity: 1(not available in detail) | Fever Cough Dyspnea  | Hospitalized 1Death 0 |
| Woo et al e37 | Germany | 07/11/2020 | Case report/series | 1 | 1 | 44 | F  | 21 | 2.0 | RRMS | RTX | History of malignancy | Fever Cough DyspneaMalaiseMuscle ache | Hospitalized 1Death 0 |
| Ciardi et al e38 | Italy | 07/15/2020 | Case report/series | 1 | 1 | 62 | F | NR | 6.0 | RRMS | TFL | NR | Fever Cough DyspneaFatigue Diarrhea  | Hospitalized 1Death 0 |
| Louapre et al e39 | France | 06/08/2020 | Case report/series | 2 | 2 | 54.5 (53-56) | F 2 | 24.5 (21-28) | 7.0 (6-8) | RRMS 1SPMS 1 | OCR 1Natalizumab 1 | Any comorbidity: 2HTNAcute pancreatitis CholecystectomyCOPDEpilepsySmoking | Asymptomatic 1Fever 1Cough 1 | Hospitalized 1Death 0 |
| Iannetta et al e40 | Italy | 08/04/2020 | Case report/series | 2 | 2 | 45.0 (36-54) | F 1M 1 | 14.5 (2-17) | 6.25 (5.5-7.0) | RRMS 1SPMS 1 | OCR 2 | Any comorbidity: 2Malignancy 1DVT 1 | Fever 2Cough 1Sneezing 1Coryza 1 | Hospitalize 2Death 0 |
| Wurm et al e41 | Germany | 08/07/2020 | Case report/series | 1 | 1 | 59 | F | 4 | 6.0 | Progressive  | RTX | NR | Fever Cough Fatigue DyspneaHeadache Nausea  | Hospitalize 1Death 0 |
| Dersch et al e42 | Germany | 08/07/2020 | Case report/series | 1 | 1 | 55 | M | 4 | NR | RRMS | Cladribine | NR | Fever  Malaise Thoracic pain Respiratory symptoms | Hospitalize 1Death 0 |
| Fiorella et al e43  | Chile | 08/10/2020 | Case report/series | 1 | 1 | 24 |  F 1 | 2 | 0.0 | RRMS | Alemtuzumab | Depression | CoughMyalgia Sore throat  | Hospitalize 0Death 0 |
| Gazca et al e44 | Mexico | 08/12/020 | Case report/series | 4 | 0 | 46.25 (6.18) | F 3M 1 | NR | NR | NR | Autologous transplants 4 | NR | Fever 3Cough 4Dyspnea 3Headache 3Diarrhea 1 | Hospitalized 1Death 0 |
| Mantero et al e45 | Italy | 08/31/2020 | Case report/series | 6 | 3 | 45 (8.6) | F 4M 2 | 15.8 (9.6) | 1.75 (1-4.5) | RRMS 6 | TFL 6 | Any comorbidity: 0 | NR | Hospitalized 0Death 0 |
| Angelis et al e46 | Italy | 08/16/2020 | Case report/series | 2 | 2 | 45.00 (29-61) | F 1M 1 | 9.00 (2-26) | 2.00 (1.5-2.5) | RRMS 2 | Cladribine 2  | Any comorbidity: 1HTN 1Dyslipidemia 1 | Fever 1Anosmia 1dysgeusia 1Diarrhea 1Asymptomatic 1 | Hospitalized 0Death 0 |
| Celius et al e47 | Norway | 08/29/2020 | Case report/series | 1 | 1 | 35 | F | 2.0 | NR | NR | Cladribine 1 | NR | Fever 1Anosmia 1Common cold | Hospitalized 0Death 0 |
| Șerban e48 | Romania | 09/29/2020 | Case report/series | 1 | 1 | 45 | M  | 7 | 5.5 | NR | Natalizumab | NR | FeverCoughHeadacheArthralgia | Hospitalized 1Death 0 |
| Kataria et al e49 | USA | 11/02/2020 | Case report/series | 3 | 3 | 62 (8.88) | F 1M 2 | 17.3 (4.6) | 3.8 (2.3) | RRMS 3 | GA 1OCR 1DMF 1 | Any comorbidity: 3HTN 3DM 1HLP 1Smoking 1 | Fever 3Cough 2Dyspnea 2Fatigue 1Neurological worsening 2 | Hospitalized 2Death 0 |
| Moghadasi et al e50 | Iran | 10/28/2020 | Case report/series | 1 | 1 | 34 | F | 15 | NR | Progressive 1 | CP | Recurrent tract infection | FeverCoughDyspneaNauseaGeneralized weakness | Hospitalized 1Death 0 |
| Rimmer et al 9 | USA | 08/10/2020 | Case report/series | 1 | 1 | 51 | F | 14 | 6.5 | RRMS | Natalizumab 1 | HTNRecurrent tract infection | Fever CoughNeurological worsening | Hospitalized 1Death 1 |
| Margoni et al e51 # | Italy | 10/12/2020 | Case report/series | 1 | 0 | NR | NR | NR | NR | NR | Natalizumab 1 | NR | FeverCough | Hospitalized 0Death 0 |
| Preziosa et al e52 | Italy | 11/20/2020 | Case report/series | 2 | NR | 35 (30-40) | F 1M 1 | 7.4 (1.4-13.4) | 2.5 (1.5-3.5) | RRMS 2 | Cladribine 2 | Any comorbidity: 0 | Fever 2Anosmia 1Ageusia 2Cough 2Dyspnea 1Fatigue 2 | Hospitalized 0Death 0 |
| Florea et al e53 | Romania | 11/26/10 | Case report/series | 1 | 1 | 40 | F  | 8 | NR | RRMS | No treatment | Any comorbidity: 0 | Asymptomatic | Hospitalized 1Death 0 |

|  |
| --- |
| Table e2-a. Characteristics of conference abstracts included in the investigation |
| First Author | Location | Date of first publication | Type of study | Confirmed/suspected | Positive PCR | Age,Mean or median (SD or range) | Sex | Disease duration,Mean or (SD or range) | EDSS,Mean or median (SD or range) | Course of disease | DMTs | Comorbidity | Symptoms | Severity of COVID-19 |
| Meca-Lallana et al e54 | Spain | 2020 | Cohort | 41 | 18 | 39.4 (10.3) | F 21M 20 | 9.0 (1.4) | 2.5 (0.7) | RRMS 38Progressive 3 | IFN 2GA 2OCR 4RTX 1TFL 10DMF 3Fingolimod 3Cladribine 3Natalizumab 9No treatment 2 | Any comorbidity: 3 | Asymptomatic 6 | Hospitalized 7 (17.1%)Death 0 |
| Radaelli et al e55 | Italy | 2020 | Cohort | 153 | 7 | 45 (20-71) | F 124M 29 | NR | 2.5 (1-8.5) | NR | NR | NR | NR | Hospitalized 3 (2.0%)Death 0 |
| Guevara et al  e56 | Chile | 2020 | Cohort | 5 | 5 | 43.25 (6.97) | F 3M 2 | NR | 2.14 (1.3) | RRMS 5 | GA 2Fingolimod 1Alemtuzumab 2 | Obesity 1No comorbidity 4 | Fever 4Cough 3Dyspnea 1Headache 2Anosmia 1Ageusia 1Myalgia 3Malaise 1Pneumonia 2Sneezing 1Nasal congestion 1Odynophagia 1Pseudo relapse 1 | Hospitalized 2Death 0 |
| Moreno-Torres et al 25 | Spain | 2020 | Cohort | 219 | 88 | 45.3 (12.4) | F 138M 81 | 11.9 (8.9) | 2.74 (2.28) | RRMS 181SPMS 23PPMS 15 | IFN 16GA 10RTX 13OCR 16Fingolimod 18Natalizumab 27TFL 33DMF 32Alemtuzumab 11Cladribine 9No DMT 30 | DM 5/83Lung disease 2/85CVD 2/85HTN 11/76Cancer 4/83Smoking 7/62 | Fever 65/87Cough 63/87Fatigue 42/86Dyspnea 37/86Anosmia 19/79Ageusia 16/79Diarrhea 12/86Myalgia 44/85Sore throat 23/85Pneumonia 53/74 | Hospitalized 51 (23.3%)Death 5 |
| Zabalza1 et al 26 | Spain | 2020 | Cohort | 93 | 47 | NR | NR | 14.45 (13.1) | NR | NR | NR | Any comorbidity 33 | NR | Hospitalized 19 (20.4%)Death 2 (2.1%) |
| Klineova et al 27 | USA | 2020 | Cohort | 349 | NR | 45 (13-76) | F 247M 102 | 11.5 (9.1) | NR | NR | NR | NR | NR | Hospitalized 48 (13.7%)Death 13 (3.7%) |
| Schreiner et al  e57 # | USA | 2020 | Cohort | 17 | 12 | 20.6 | F 13M 4 | NR | NR | MS 14CIS 1 | GA 1RTX6OCR 1Fingolimod 3Natalizumab 1DMF 1MF 1No DMT 2 | Any comorbidity 4DM 1Other 3 | Fever 9Cough 9Fatigue 9Dyspnea 5Anosmia 8Ageusia 6Diarrhea 4Chills 5Headache 1Sore throat 2Asymptomatic 1 | Hospitalized 4 (23.5%)Death 0 |
| Mendes et al 28 | Brazil | 2020 | Cohort | 94 | 32 | 40.6 (10.2) | F 73M 21 | 9.9 (8.6) | NR | NR | IFN 9GA 5Natalizumab 20TFL 5DMF 17Fingolimod 16OCR 5RTX 2Alemtuzumab 1No treatment 14 | Any comorbidity: 19DM 1HTN 8Dyslipidemia 6CAD 1Lung disease 3Obesity 2Thyroid disease 2Cancer 2Smoker 9 | Fever 68Cough 55Dyspnea 36Headache 51Fatigue 43Diarrhea 17Anosmia or Ageusia 43Myalgia 55 | Hospitalized 12 (12.8%)Death 1 (1.1%) |
| Salter et al 29 | North America | 2020 | Cohort | 734 | NR | 48.2 (13.5) | F 539M 195 | 13.8 (9.9) | NR | NR | NR | NR | NR | Hospitalized 229 (31.2%)Death 45 (6.1%) |
| Dillon et al 30 O | USA(Optum® de-identified COVID-19 ElectronicHealth Record dataset) | 2020 | Cohort | 47 | NR | 47 | F 32M 15 | NR | NR | NR | OCR 47 | NR | NR | Hospitalized 12 (25.5%)Death 1 (2.1%) |
| Dillon et al 30 | (USAOptum® de-identified COVID-19 ElectronicHealth Record dataset) | 2020 | Cohort | 357 | NR | NR | F 266M 91 | NR | NR | NR | NR | HTN 193DM 85Obesity 93Malignancy 79Lung disease 103CAD 43Liver disease 21Renal disease 47 | NR | Hospitalized 87 (24.4%)Death 13 (3.6%) |
| Omerhoca et al e58 | Turkey | 2020 | Cross sectional | 7 | 7 | 38.8 (7.5) | F 5M 2 | NR | 1.7 (0.5) | RRMS 7 | IFN 4GA 1DMF 1No treatment 1 | Any comorbidity 2 | NR | Hospitalized 0Death 0 |
| Kieseier et al 17 | USA( IBM ® Explorys ® dataset) | 2020 | Cross sectional | 170 | NR | NR | F 128M 42 | NR | NR | NR | NR | HTN 95DM 56CAD 25Cancer 33COPD 32Kidney disease 26 | NR | Hospitalized 51 (30%)Death 5 (3.0%) |
| Poursadeghfard et al 18 | Iran | 2020 | Cross sectional | 76 | 8 | 38.08 | F 53M 23 | NR | NR | RRMS 60PPMS 9SPMS 1CIS 2 | IFN 27GA 5DMF 8TFL 1RTX 12Fingolimod 11No DMT 12 | HTN 5DM 2Hypothyroidism 6Hyperthyroidism 2Lung disease 3CAD 7 | Fever 28Cough 29Dyspnea 20Sore throat 30Headache 10Diarrhea 2Anosmia 1Ageusia 1 | Hospitalized 12 (15.8%)Death 2 (2.6%) |
| Mallucci et al e59 | Italy | 2020 | Cross sectional | 37 | NR | NR | NR | NR | NR | NR | Natalizumab 22Fingolimod 15 | NR | Asymptomatic 13 | Hospitalized 0Death 0 |
| Hervás-García et al e60 | Spain | 2020 | Cross sectional | 19 | NR | 42.7 | NR | NR | NR | NR | IFN 3RTX 2OCR 3Fingolimod 2Natalizumab 2DMF 5Cladribine 1Alemtuzumab 1 | NR | Asymptomatic 17 | Hospitalized 2 (11.8%)Death 0 |
| Freedman et al 10 | Merck KGaAGlobal Patient Safety Database | 2020 | Pharmacovigilance case series | 102 | NR | NR | F 70M 24 | NR | NR | NR | IFN 102 | NR | NR | Hospitalized 12 (11.8%)Death 2 |
| Reder et al 11 | Bayer database | 2020 | Pharmacovigilance case series | 23 | NR | 49 (27-65) | F 17M 5 | NR | NR | NR | IFN 23 | NR | NR | Hospitalized NRDeath 2 (8.7%) |
| Wallach et al e61 | USA | 2020 | Case report/series | 11 | 9 | 50.5 (34-64) | F 10M 1 | NR | NR | NR | IFN 1RTX 1OCR 6TFL 1No treatment 2 | NR | NR | Hospitalized 4 (36.4%)Death 0 |
| Oreja-Guevara et al e62 | Spain | 2020 | Case report/series | 14 | 6 | 40.1 (12.0) | F 9M 5 | 9.7 (8.9) | 2 (1.9) | RRMS 13SPMS 1 | Cladribine 14 | Any comorbidity 5HBP 1DM 1Obesity 2Smoking 1Anxiety 1Depression 1Hypothyroidism 1Talassemia trait 1DLP 2 | Fever 9Cough 8Dyspnea 1Anosmia 7Ageusia 3Asthenia 4Myalgia 6Diarrhea 1Rash 1Pneumonia 1Asymptomatic 2 | Hospitalized 1 (7.1%)Death 0 |
| Karan et al e63 | CLARIFY-MS and MAGNIFY-MS studies | 2020 | Case report/series | 3 | 1 | 40.0 (14.7) | F 3 | 10.0 (9.8) | 2.5 (1.8) | RRMS 3 | Cladribine 3 | Any comorbidity 2Asthma 1CVD 1DVT 1 | NR | Hospitalized 2Death 0 |

Note: ND: not determine, F: female, M: male, NR: not-report, EDSS: Expanded Disability Status Scale, CVD: cardiovascular disease, HT: hypertension, DM: diabetes mellitus, RRMS: relapsing-remitting MS, SPMS: secondary-progressive MS, PPMS, primary-progressive MS, CIS: clinically isolated syndrome, RIS: radiologically isolated syndrome VTE: Venous thromboembolism, IFN: interferon, GA: glatiramer acetate, RTX: rituximab, OCR: ocrelizumab, DMF: dimethyl fumarate, TFL: teriflunomide, MMF: mycophenolate mofetil MTX: methotrexate, CP: cyclophosphamide

\*One patients receive both ocrelizumab and alemtuzumab

ˠ One patient hospitalized for primary observation

🟓 One patient self-confirmed

★One patient nor reported

‡ All patients received Amantadine

# Studies on MS patients with pediatric onset

O All atients received OCR

Table e3-a. Demographic and clinical characteristics of COVID-19 infection in patients with MS from published articles

|  |  |  |  |
| --- | --- | --- | --- |
| Characteristics | N (%) or Mean (SD) | Number of patients | Study reporting characteristics |
| Age | 44.25 (4.85) | 1358 | 63 |
| Sex, female/male | 987/422 (2.34:1) |  1447 | 63 |
| Disease duration | 12.20 (3.10) | 1025 | 49 |
| EDSS | 2.51 (0.98) | 923 | 43 |
| **Course of MS** |  |
| Relapsing | 950 (75.9) | 1251 | 52 |
| progressive  | 210 (16.8) |
| CIS | 7 (0.6) |
| **Comorbidity** |  |
| Patients with any comorbidity | 230 (36.2) | 636 | 36 |
| HTN | 45 (7.9)  | 569 | 34 |
| CAD | 28 (4.9) |
| DM | 42 (7.4) |
| Malignancy | 6 (1.0) |
| Lung diseases | 24 (4.2) |
| **Symptoms** |  |
| Fever | 462 (71. 7) | 644 | 53 |
| Cough | 432 (67.1) | 644 | 53 |
| Fatigue/asthenia | 340 (52.8) | 644 | 53 |
| Shortness of breath | 263 (40.8) | 644 | 53 |
| Headache | 224 (34.8) | 644 | 53 |
| GI complication | 112 (18.4) | 610 | 52 |
| Anosmia\* | 42 (14.5) | 289 | 51 |
| Ageusia\* | 24 (8.3) | 289 | 51 |
| Asymptomatic | 31 (3.9%) | 790 | 55 |
| **DMTs** |  |
| B-cell depleting agents | 391 (24.3) | 1610 | 65 |
| Dimethyl fumarate | 209 (13.0) |
| Fingolimod | 150 (9.3) |
| Natalizumab | 131 (8.1) |
| Glatiramer acetate | 101 (6.3) |
| Interferon | 90 (5.6) |
| Teriflunomide | 87 (5.4) |
| Cladribine | 68 (4.2) |
| Alemtuzumab | 25 (1.5) |
| No DMT | 249 (15.5) |
| PCR positive test | 541 (36.5) | 1481 | 58 |
| Hospitalized | 279 (18.7) | 1495 | 64 |
| Death | 39 (2.2) | 1739 | 67 |

Table e3-b. Demographic and clinical characteristics of COVID-19 infection in patients with MS from conference abstracts

|  |  |  |  |
| --- | --- | --- | --- |
| Characteristics | N (%) or Mean (SD) | Number of patients | Study reporting characteristics |
| Age | 45.41 (3.80) | 1891 | 16 |
| Sex, female/male | 1751/662 (2.64:1) | 2413 | 19 |
| Disease duration | 12.52±1.42 | 1454 | 7 |
| EDSS | 2.58 (0.20) | 442 | 7 |
| **Course of MS** |  |
| Relapsing | 291 (83.6) | 348 | 5 |
| progressive  | 51 (14.6) |
| CIS | 3 (0.9) |
| **Comorbidity** |  |
| Patients with any comorbidity | 69 (25.2) | 274 | 8 |
| HTN | 312 (29.7) | 1052 | 10 |
| CAD | 79 (7.5) |
| DM | 151 (14.3) |
| Malignancy | 118 (11.2) |
| Lung diseases | 144 (13.7) |
| **Symptoms** |  |
| Fever | 183 (62.5) | 293 | 6 |
| Cough | 167 (57.0) | 293 | 6 |
| Fatigue/asthenia | 98 (46.4) | 211 | 4 |
| Shortness of breath | 100 (36.4) | 275 | 6 |
| Headache | 64 (33.3) | 192 | 5 |
| GI complication | 36 (12.3) | 292 | 6 |
| Anosmia | 36 (18.8) | 191 |  5 |
| Ageusia | 27 (14.1) | 191 | 5 |
| Asymptomatic | 39 (7.5) | 522 | 9 |
| **DMTs** |  |
| B-cell depleting agents | 119 (16.6) | 715 | 15 |
| Dimethyl fumarate | 67 (9.4) |
| Fingolimod | 69 (9.6) |
| Natalizumab | 81(11.3) |
| Glatiramer acetate | 26 (3.6) |
| Interferon | 187 (26.1) |
| Teriflunomide | 50 (7.0) |
| Cladribine | 30 (4.2) |
| Alemtuzumab | 15 (2.1) |
| No DMT | 63 (8.8) |
| PCR positive test | 222 (32.1) | 692 | 11 |
| Hospitalized | 558 (21.9) | 2548 | 19 |
| Death | 91 (3.5) | 2571 | 20 |

Table e4-a. Risk of hospitalization by DMTs class

|  |  |  |  |
| --- | --- | --- | --- |
|  | Published articles | Conference abstracts | All studies |
| B-cell depleting agents | 29.3% (98/334)  | 28.8% (19/66) | 29.2% (117/400) |
| Dimethyl fumarate | 13.9% (14/101)  | 14.3% (1/7) | 13.9% (15/108) |
| Fingolimod | 17.0% (17/101)  | 4.8% (1/21) | 14.7% (18/122) |
| Natalizumab | 13.1% (11/84)  | 0 (0/25) | 10.1% (11/109) |
| Glatiramer acetate | 13.8% (8/58)  | 25.0% (1/4) | 14.5% (9/62) |
| Interferon | 9.3% (5/54)  | 11.8% (13/110) | 11.0% (18/164) |
| Teriflunomide | 20.1% (13/62)  | 0 (0/1) | 20.6% (13/63) |
| Cladribine | 11.9% (7/59)  | 16.7% (3/18) | 13.0% (10/77) |
| Alemtuzumab | 13.3% (2/15)  | 0 (0/3)  | 11.1% (2/18) |
| No DMT | 44.9% (48/107)  | 0 (0/5) | 42.9% (48/112) |

Note: Sixty published articles and 10 conference abstracts were included

DMT: disease modifying therapies

Table e4-b. Risk of mortality by DMTs class

|  |  |  |  |
| --- | --- | --- | --- |
|  | Published articles | Conference abstracts | All studies |
| B-cell depleting agents | 2.1% (8/376) | 3.6% (4/112) | 2.5% (12/488) |
| Dimethyl fumarate | 1.0% (2/194) | 0 (0/42) | 0.8% (2/236) |
| Fingolimod | 0.7% (1/150) | 0 (0/42) | 0.5 (1/192) |
| Natalizumab | 1.6% (2/128) | 0 (0/61) | 1.1% (2/189) |
| Glatiramer acetate | 0.9% (1/101) | 0 (0/16) | 0.8% (1/117) |
| Interferon | 0 (0/90) | 2.6% (4/151) | 1.7% (4/241) |
| Teriflunomide | 2.4% (2/83) | 0 (0/44) | 1.6% (2/127) |
| Cladribine | 0/67 (0) | 0 (0/30) | 0 (0/97) |
| Alemtuzumab | 0 (0/22) | 0 (0/14) | 0 (0/36) |
| No DMT | 7.3% (18/248) | 16.2% (6/37) | 8.4% (24/285) |

DMT: disease modifying therapies

 

Figure e-1. Number of study and confirmed/suspected COVID-19 patients in each country

Number of study and patients were extracted from abstract. USA: 6 studies and 1685 patients; Turkey: 1 study and 7 patients; Spain: 5 studies and 386 patients; Italy: 2 studies and 190 patients; Iran: 1 study and 76 patients; Chile: 1 study and 5 patients; Brazil: 1 study and 94 patients; Multicenter: 1 study and 3 patients; pharmacovigilance: 2 studies and 125 patients