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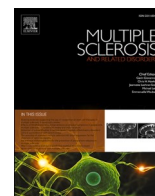
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Original article

Impact of telehealth on health care in a multiple sclerosis outpatient clinic during the COVID-19 pandemic



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A B S T R A C T

Background: The coronavirus disease 2019 (COVID-19) pandemic has precipitated expansion of telemedicine in outpatient management of chronic diseases including multiple sclerosis (MS). Studies conducted pre-pandemic, when telehealth was an alternative to in-person consultations, represent a different setting to current practice. The aim of this study was to assess the impact of telehealth on MS outpatient care in a tertiary metropolitan hospital in Melbourne, Australia during the COVID-19 pandemic.

Method: From March-December 2020, patients and clinicians in the MS outpatient clinic were surveyed regarding their attitudes towards telehealth. Scores on the Expanded Disability Status Scale (EDSS) from telehealth and face-to-face appointments during the study period were compared to scores from face-to-face consultations before and after this period. Medical records were reviewed to compare management decisions made during telehealth versus face-to-face consultations. Diagnoses and treatment of MS relapses were compared to 2019.

Results: Telehealth was used in 73% of outpatient appointments. Patient satisfaction was generally high. Patients and clinicians preferred face-to-face consultations but were willing to use telehealth longer term. Overall, there were no significant delays in identifying patients experiencing disability worsening via telehealth, but EDSS increase was recorded in more face-to-face than telehealth appointments particularly for those with lower baseline disability. Disease-modifying therapy commencement rates were similar, but symptomatic therapy initiation and investigation requests occurred more frequently in face-to-face visits. Comparable numbers of MS relapses were diagnosed and treated with corticosteroids in 2019 and 2020.

Conclusions: Patient satisfaction with telehealth was high, but both clinicians and patients preferred in-person appointments. Telehealth implementation did not lead to high rates of undetected disability worsening or undiagnosed acute relapses, but telehealth-based EDSS assessment may underestimate lower scores. Treatment inertia may affect some management decisions during telehealth consultations. Telehealth will likely play a role in outpatient settings beyond the COVID-19 pandemic with further studies on its long-term impact on clinical outcomes required.

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic has

precipitated expansion of telemedicine, particularly for outpatient management of chronic diseases including multiple sclerosis (MS). Previous studies on telehealth in MS have predominantly evaluated

Abbreviations: MS, multiple sclerosis; COVID-19, Coronavirus disease 2019; EDSS, expanded disability severity scale; IQR, interquartile range; CI, confidence interval; F2F, face-to-face.

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feasibility, cost-effectiveness and patient satisfaction (Robb et al., 2019; Yeroushalmi et al., 2019; D’Haeseleer et al., 2020), and in providing supportive care for patients (Paul et al., 2019; Plow et al., 2019), with less focus on clinician attitudes and importantly clinical outcomes. Studies conducted pre-pandemic, when telehealth was an alternative to in-person consultations, represent a different setting to current practice where face-to-face appointments have been restricted to limit virus transmission. Whilst there are considerable geographical differences in the impact of the COVID-19 pandemic on healthcare systems, telehealth has been widely adopted.

We aimed to evaluate the impact of telehealth on healthcare in the MS/neuroimmunology outpatient clinic during the COVID-19 pandemic at a tertiary metropolitan hospital in Australia. Telehealth became the preferred appointment modality, though patients could still be seen face-to-face at clinicians’ discretion. Specifically, we assessed patient and clinician attitudes, reliability of a telehealth-based disability assessment tool as a proxy for physical examination, clinical decision-making and management of MS relapses.

Telehealth remains a major part of outpatient practice, so evaluation of relevant clinical outcomes is important to maintain patient care.

2. Materials and methods

This was an observational study conducted from March-December 2020 at the MS/neuroimmunology outpatient clinic of the MS Centre, Royal Melbourne Hospital, approved by the Melbourne Health Human Research Ethics Committee (QA2020134).

Booking records were reviewed for appointment numbers, modalities (video/telephone/face-to-face) and encounter type (new/review).

Patient and clinician attitudes were surveyed by anonymised questionnaires using a five-point Likert scale ranging from strongly disagree (score 1) to strongly agree (score 5). Patients were posted or emailed the questionnaire covering accessibility and convenience, technical issues, willingness to use telehealth for future appointments, overall satisfaction and comparison to face-to-face consultations. The clinician questionnaire assessed overall satisfaction, comparison to face-to-face consultations, ability to perform an adequate assessment and confidence in diagnoses and treatment decisions.

The Expanded Disability Status Scale (EDSS) is a widely used scale ranging from 0 (no disability) to 10 (death from MS) for assessing neurological disability and typically requires physical examination (Kurtzke, 1983). During telehealth appointments, clinicians were asked to adopt a validated telephone-based EDSS questionnaire (Lechner-Scott et al., 2003) instead of physical EDSS where possible and record scores in an electronic database.

Telehealth-based EDSS scores from appointments between March-December 2020 were compared longitudinally to physical EDSS scores for the same patient obtained via face-to-face consultations immediately preceding and following this period. Direction of EDSS change (decrease/stable/increase) was assessed during each of three epochs:

- (1) Pre-study period – between two preceding face-to-face appointments [A and B].
- (2) Study period – between preceding face-to-face appointment [B] and appointment (either telehealth [C1] or face-to-face [C2]) during March to December 2020.
- (3) Post-study period – between index appointment during the study period [C1 or C2] and subsequent face-to-face appointment [D] (Fig. 1).

Records from routine follow-up appointments were reviewed for common management decisions: initiation/change in disease-modifying therapy, initiation/change in symptomatic treatment, request for new investigation (any that were ordered beyond those that are part of routine surveillance imaging or blood tests), referrals to other specialties and recruitment to a research study. Rates of diagnosis and treatment of MS relapses were determined by reviewing medical records and compared to March-December 2019.

Statistical analysis was performed in GraphPad Prism v9. Descriptive statistics were used to analyse questionnaire data. Differences between groups were assessed using Student’s *t*-test, ANOVA, Mann-Whitney *U* test or chi-square test of independence as appropriate. P-value <0.05 was considered statistically significant.

Data not published in this article can be made available by request from qualified investigators.

3. Results

3.1. Telehealth utilisation

From March-December 2020, there were 2023 MS/neuroimmunology clinic appointments: 555 (27%) face-to-face and 1468 (73%) telehealth (713 [35%] video, 755 [37%] telephone). Proportions of face-to-face versus telehealth appointments fluctuated, with the latter rising during Melbourne’s lockdowns (Fig. 2).

Most new referrals (*n* = 133) were face-to-face appointments (*n* = 88, 66%), rather than video (*n* = 20, 15%) and telephone (*n* = 25, 19%). Most follow-up appointments (*n* = 1890) were telehealth, with similar proportions by video (*n* = 693, 37%) and telephone (*n* = 730, 39%). Interpreters were used in a small number of appointments (*n* = 60, 3%), which were predominantly face-to-face (*n* = 27, 45%) or telephone (*n* = 24, 40%).

3.2. Patient questionnaires

Of 108 respondents, 86 (80%) were female, most commonly aged 30–39 years. English was the first language for 103 (95%) and self-rated technological competence was high (median score 5, interquartile range [IQR] 4–5).

56 (52%) had video consultations with the remainder by phone (*n* = 45, 42%) or a combination (*n* = 7, 6%). 100 (93%) experienced no technical issues (median 4 [IQR 4-5]). Ease of communication was high (median 4 [IQR 4–5]) and most concerns were adequately addressed

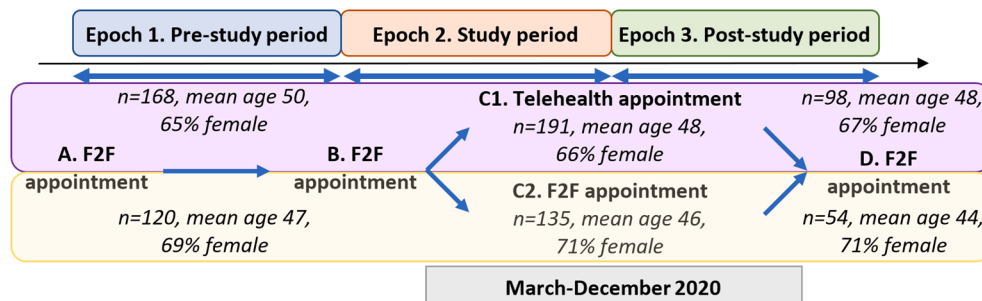


Fig. 1. Study schema. Schema of three epochs during which EDSS change was assessed during face-to-face (F2F) or telehealth appointments. This is the wrong image

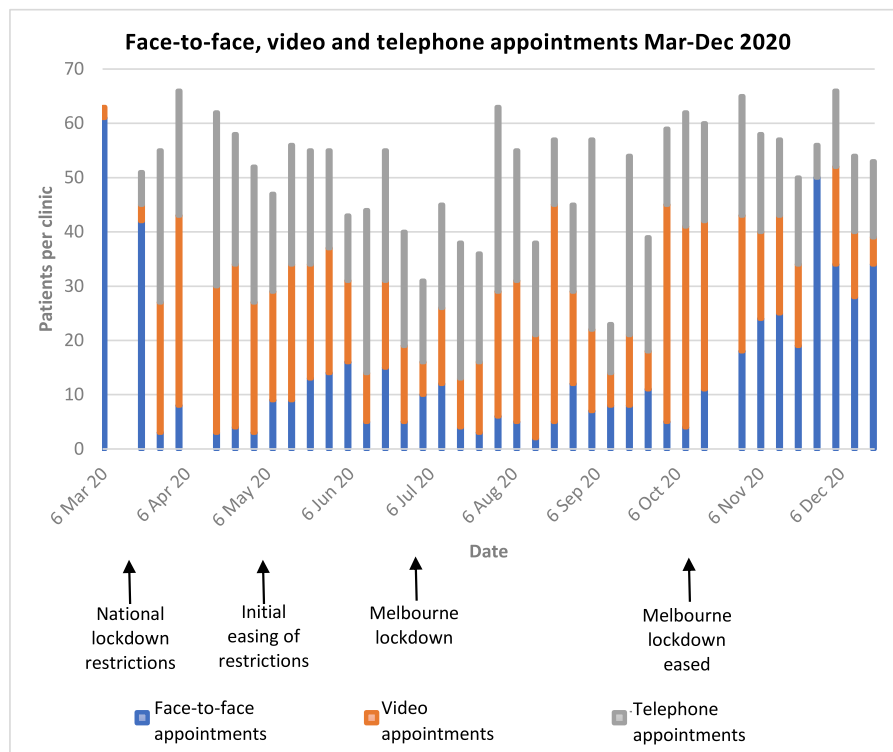


Fig. 2. Outpatient appointment modalities. Numbers of face-to-face, video and telephone MS/neuroimmunology outpatient clinic appointments between March-December 2020.

(median 4 [IQR 4-5]). Whilst over half ($n = 62$, 57%) felt telehealth appointments were as good as previous face-to-face visits (scores 4–5), a substantial minority ($n = 22$, 20%) disagreed (scores 1-2). Commonest reasons were preferring face-to-face contact ($n = 9$) and lack of physical examination ($n = 7$). Patients using telephone scored significantly lower than video (median 3 versus 4, $p = 0.032$, Mann-Whitney test). Safety during the COVID-19 pandemic was an important consideration (median 4 [IQR 4-5]). Overall satisfaction with telehealth was high (median 4 [IQR 4-5]).

Perceived advantages included less time/cost travelling ($n = 100$), convenience ($n = 84$), less time waiting ($n = 51$) and quicker access to

appointments ($n = 35$). Concerns included lack of physical examination ($n = 16$), technical issues ($n = 13$), confidence in diagnostic accuracy ($n = 12$) and confidence in treatment ($n = 11$). Many expressed a preference to alternate between telehealth and face-to-face follow-up in the long-term.

3.3. Clinician questionnaires

Amongst nine responses from MS Centre clinicians, self-rated technological competence was high (median 4 [IQR 4-5]). Compared to patients, scores for communication, ability to address patient concerns

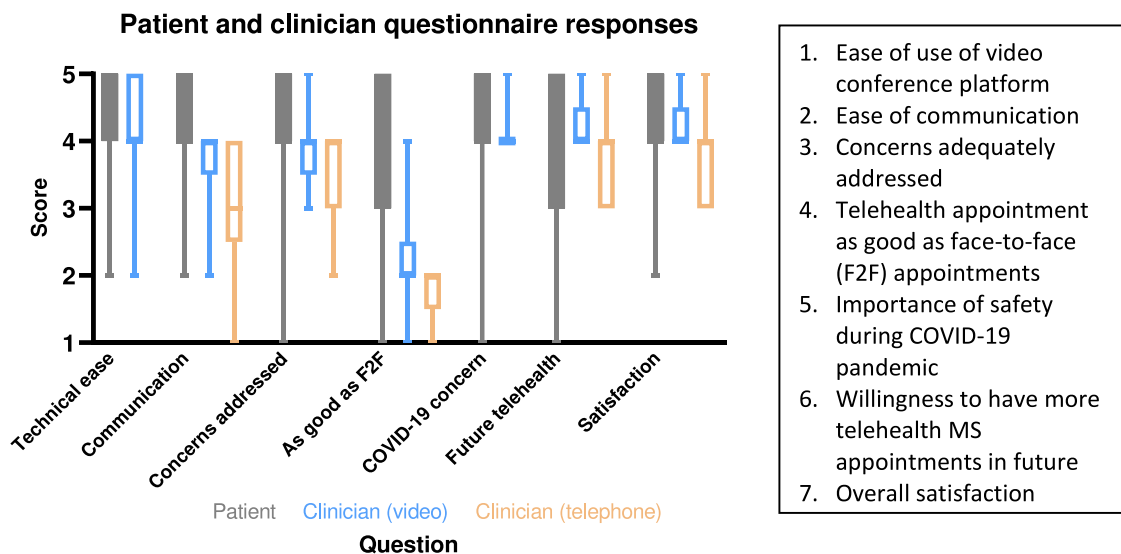


Fig. 3. Comparison of patient and clinician responses to questions on telehealth. Responses were scored on a five-point Likert scale ranging from strongly disagree (score 1) to strongly agree (score 5). Boxes and error bars represent median and interquartile range of response scores.

and general satisfaction (median 4 [IQR 4-4] for video, 3 [IQR 3-4] for telephone) were all lower, and telehealth was much less preferred to face-to-face consultations (median 2 versus 4) (Fig. 3). Despite this, most expressed willingness to use telehealth in the future.

Overall scores for telephone were significantly lower than video (median 3 versus 4, $p = 0.042$, Mann-Whitney test). Inability to elicit physical signs was the commonest concern, though most had reasonable confidence in decision-making (median 4 [IQR 3-4]) and a follow-up face-to-face consultation was generally not necessary. Telehealth, particularly via telephone, was considered inadequate for new patients (median 2). Safety during the COVID-19 pandemic was also an important factor (median 4 [IQR 4-5]).

3.4. Comparing telehealth versus physical EDSS

Between March-December 2020, 191 patients had telehealth EDSS (88 telephone, 103 video) ("telehealth" group) and 135 patients had face-to-face appointments with EDSS recorded ("face-to-face" group). Median EDSS for both groups was 2.5 (range 0–9.0 for telehealth group, 0–8.0 for face-to-face group).

EDSS score increase, representing worsening disability, occurred in significantly more face-to-face than telehealth group patients during epoch 2 (31% versus 20%, $p = 0.029$, Chi-square test). To assess whether this difference was explained by more patients with suspected relapses (and hence EDSS increase) being seen face-to-face, visits for relapse assessment were excluded. The same pattern remained, but of smaller magnitude.

A previous study found greater agreement between telehealth and physical EDSS at higher disability levels ($EDSS > 4.0$) where ambulation distance alone can determine EDSS, than for $EDSS \leq 4.0$ which requires physical examination for accurate scoring (Lechner-Scott et al., 2003). To assess whether reliability of telehealth-based EDSS differed for patients with lower versus higher disability scores, we stratified baseline EDSS from face-to-face visits immediately preceding the index visit into scores ≤ 4.0 versus > 4.0 and compared EDSS change in the telehealth and face-to-face groups during epoch 2. Amongst patients with lower baseline disability ($EDSS \leq 4.0$), subsequent increase in EDSS during epoch 2 was more frequent in face-to-face than telehealth visits (36% [95% confidence interval 27–45%] versus 16% [11–24%], $p < 0.001$, Chi-square test). This difference persisted even when relapse assessment visits were excluded (30% [22–40%] versus 13% [8–20%], $p = 0.0036$, Chi-square test) (Fig. 4). For patients with higher baseline disability ($EDSS > 4.0$), this difference was not observed.

Next, we assessed whether the lower frequency of disability worsening events recorded in telehealth appointments during epoch 2 was

due to under-recognition, generating a surge in rates of disability worsening (EDSS increase) upon subsequent in-person visit. In fact, similar proportions of EDSS increase (22% versus 19%) occurred in the telehealth and consecutive face-to-face visit groups during epoch 3, suggesting that using telehealth EDSS did not substantially delay identification of disability worsening events.

3.5. Management decisions in face-to-face versus telehealth appointments

In face-to-face compared to video or telephone appointments, there were greater frequencies of investigation requests (12% versus 3.2% and 5.2%, $p = 0.0023$, ANOVA) and symptomatic therapy initiation (13% versus 8.5% and 8.8%, $p = 0.04$, ANOVA) (Fig. 5). Frequency of disease-modifying therapy commencement or change, referrals to other specialties or discussion about research participation were similar.

3.6. MS relapse diagnosis and treatment

69 MS relapses were diagnosed between March-December 2020 compared to 75 in the same period in 2019. 72% of suspected relapse reviews occurred in-person, whilst 16% were via telehealth and 12% presented to the emergency department. Similar proportions of patients received high-dose corticosteroids (68% in 2020 versus 69% in 2019), but there was an increase in oral administration during 2020 (43% versus 25%, $p = 0.028$, Chi-square test) (Fig. 6).

4. Discussion

Telehealth was widely used in the MS/neuroimmunology outpatient clinic in a Melbourne metropolitan tertiary hospital during the initial months of the COVID-19 pandemic, particularly for follow-up appointments.

Patient attitudes towards telehealth were generally favourable, with infrequent technical issues, high overall satisfaction and willingness to use telehealth for future appointments. This is consistent with small studies of patients with MS pre-pandemic. A Belgian survey found 85% telehealth consultation completion rate, high satisfaction with technical quality, convenience and overall care (D'Haeseleer et al., 2020). A US study found equal willingness to have future consultations either in-person or by telehealth, few technical challenges and perceived advantages to be convenience and cost-effectiveness (Robb et al., 2019). This is reassuring given the ongoing pandemic worldwide and positive attitude of administrators to this modality. However, currently there is insufficient long-term follow-up data to determine whether the same quality-of-care can be maintained. A substantial minority of patients felt

EDSS change during epoch 2 where baseline EDSS ≤ 4.0

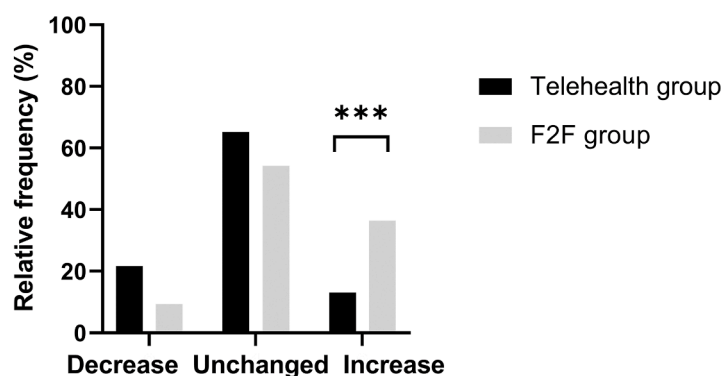


Fig. 4. EDSS change during epoch 2. Percentage of patients with decreased, unchanged or increased EDSS when assessed by telehealth versus face-to-face (F2F) appointments during the study period (epoch 2) showing more patients having F2F appointments had increase in EDSS (disability worsening). This is the wrong image.

Management decisions in F2F versus telehealth appointments

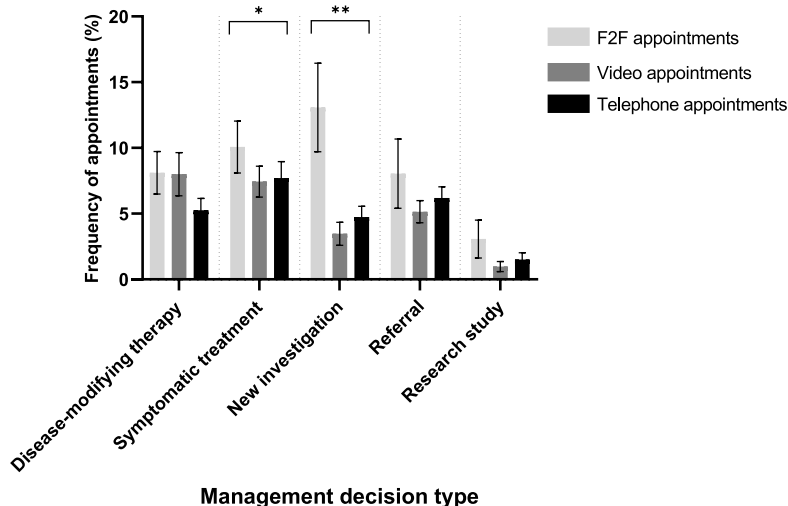


Fig. 5. Management decisions by appointment modality. Frequency of common management decisions made in face-to-face (F2F) versus video and telephone telehealth appointments, showing significantly more frequent initiation of symptomatic treatments and requests for new investigations in F2F visits (columns and error bars represent mean and standard error of the mean).

face-to-face appointments were superior. Furthermore, patients using video responded more positively than those using telephone, likely reflecting the more personable interaction. Despite this, telephone appointments were as frequent as video, perhaps due to easier access for patients less familiar with technology. In future, greater technical support could be provided to facilitate video consultations.

Clinicians' views of telehealth, particularly via telephone, were less favourable than patients'. Unsurprisingly, inability to perform a physical examination, a critical component of neurological consultations, was a major issue. Despite this, follow-up face-to-face visits to address outstanding issues were infrequently requested. Concerns about lack of examination was also described in a UK study of neurologists during the COVID-19 pandemic, finding lower levels of confidence in diagnoses and more investigation requests (Courtney et al., 2021). Within neurology, a Norwegian study found subspecialists in headache and epilepsy, where need for physical examination is lower, were more comfortable using telehealth than MS and movement disorders (Kristoffersen et al., 2021). Other explanations for lower clinician satisfaction, particularly with long-term telehealth use, may include greater

difficulties in overseeing treatment and monitoring safety associated with disease-modifying therapies including timely collection of blood tests, and lower personal interaction and lack of non-verbal communication especially via telephone that are important for challenging consultations. Safety related to the pandemic was a more consistent concern amongst clinicians than patients in whom perceptions varied more. Most clinicians felt telehealth has utility in follow-up of existing relatively stable patients but not new referrals.

One novel aspect of our study was evaluation of clinical outcomes and management decisions. We hypothesised that clinicians may experience therapeutic inertia, where there is lack of treatment change (Saposnik and Montalban, 2018), particularly when managing patients with equivocal clinical scenarios by telehealth. Whilst clinicians were equally likely to commence or change disease-modifying therapy during telehealth and face-to-face appointments, symptomatic therapies were initiated more frequently in the latter. Our finding that investigations were requested more often in face-to-face visits contrasted with the UK study (Courtney et al., 2021). One explanation is that additional clinical clues gained from in-person evaluation may generate more differential diagnoses prompting further investigation. Our findings were also derived from review of medical records documenting management plans, whilst the UK study was based on interviews which may produce recall bias. These findings do need to be interpreted in the context of potential confounding effects of the pandemic itself on treatment decisions.

We assessed whether telehealth-based assessments were an adequate proxy for physical examination. A previous study comparing EDSS scored by a non-specialist with neurological experience performing an examination, a remote neurologist guiding and a local neurologist observing the examination, found high inter-rater correlation across 20 patients (Kane et al., 2008). However, this setup is likely impractical for most real-world telehealth clinics particularly during the pandemic.

During the study period, more patients seen face-to-face recorded an increased EDSS, signifying disability worsening, compared to patients seen by telehealth. This difference was most evident in patients with less disability (baseline EDSS ≤ 4.0) and suggested possible underestimation of lower scores via telehealth. This concurs with a previous study where agreement between telephone and physical EDSS for scores ≤ 4.0 was lower than for higher scores (Lechner-Scott et al., 2003). There may also have been a bias towards seeing patients with suspected relapse (and hence EDSS increase) face-to-face despite the pandemic. Indeed,

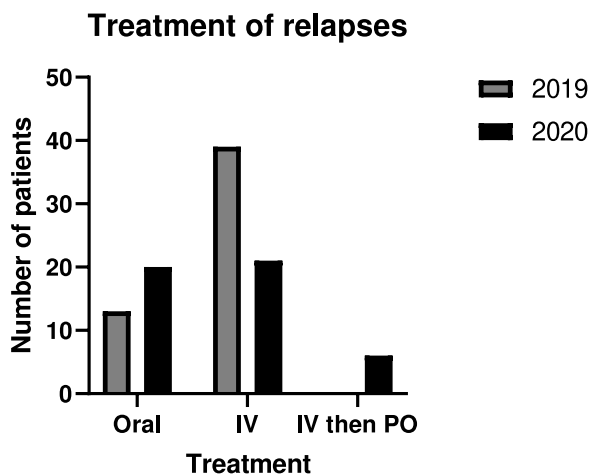


Fig. 6. MS relapse treatment in 2019 and 2020. Comparison of numbers of patients receiving short-term oral, intravenous (IV) or intravenous then oral (PO) corticosteroids for treatment of MS relapses in the periods of March-December 2019 and 2020.

when relapse visits were excluded, the difference became less apparent. However, the discrepancy amongst patients with baseline EDSS \leq 4.0 remained, suggesting both explanations may be contributing. It was reassuring there was no surge in EDSS worsening events amongst telehealth patients immediately after return to in-person visits to indicate many disability progression events had been missed. The interpretation of these findings does need to be tempered by the relatively low proportion of total appointments with EDSS scores recorded.

Diagnosing MS relapses generally requires physical assessment for neurological deterioration. Despite concern about potential COVID-19 exposure in hospital settings and immunosuppressive effects of high-dose corticosteroids, most patients with suspected relapse were evaluated face-to-face. Comparable numbers of relapses diagnosed and treated in 2019 and 2020 suggests many cases were not missed. Significantly more patients in 2020 received oral than intravenous corticosteroids, likely reflecting efforts to reduce hospital visits. Given that oral corticosteroids are non-inferior to intravenous treatment, this option could be offered more frequently in future in appropriate patients (Barnes et al., 1997), (Lattanzi et al., 2017).

There are some limitations. Numbers of questionnaire responses were relatively low compared to total patient numbers and may be skewed towards those with particularly positive or negative experiences. Numbers of clinicians surveyed within the MS Centre was also small. Rate of returned mailed surveys was low despite both paper-based and electronic versions being available and the survey was only available in English. Patients less familiar with technology, those with severe physical and cognitive impairments and linguistically diverse patients may be under-represented.

5. Conclusion

Our study examined not only attitudes towards telehealth, but also key components of chronic disease management, including treatment decisions and disability assessment. Despite being a single-centre study, our findings provide valuable lessons on the use of telehealth in managing MS as well as other chronic diseases in outpatient settings during and beyond the COVID-19 pandemic. Video was preferred over telephone by both patients and clinicians. New patients, acute clinical issues and challenging consultations such as delivering bad news and explaining complex management plans should ideally be managed in-person, whilst routine follow-up of patients with well-established diagnoses and chronic conditions are more appropriate for telehealth or could alternate between both modalities. Telemedicine-based physical assessments are feasible, but clinicians should be aware of limitations and how they compare with in-person examination. Clinicians should consider whether treatment inertia influence management decisions during telehealth consultations. Ambulatory-based treatments, if available, can be offered to reduce exposure to healthcare settings whilst being more cost-effective and convenient. Telehealth will likely play a role in outpatient settings beyond the COVID-19 pandemic and our study highlights the importance of evaluating clinical outcomes to

ensure patient care is optimally maintained.

CRediT authorship contribution statement

Vivien Li: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft. **Izanne Roos:** Writing – review & editing. **Mastura Monif:** Writing – review & editing. **Charles Malpas:** Writing – review & editing. **Stefanie Roberts:** Writing – review & editing. **Mark Marriott:** Writing – review & editing. **Katherine Buzzard:** Writing – review & editing. **Ai-Lan Nguyen:** Writing – review & editing. **Nabil Seery:** Writing – review & editing. **Lisa Taylor:** Writing – review & editing. **Tomas Kalincik:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Trevor Kilpatrick:** Conceptualization, Methodology, Writing – review & editing, Supervision.

Declarations of Competing Interest

None relevant to the reported work.

References

- Barnes, D., Hughes, R., Morris, R., et al., 1997. Randomised trial of oral and intravenous methylprednisolone in acute relapses of multiple sclerosis. *Lancet* 349 (9056), 902–906.
- Courtney, E., Blackburn, D., Reuber, M., 2021. Neurologists' perceptions of utilising tele-neurology to practice remotely during the COVID-19 pandemic. *Patient Educ. Couns.* 104 (3), 452–459.
- D'Haeseleer, M., Eelen, P., Sadeghi, N., et al., 2020. Feasibility of real-time internet-based teleconsultation in patients with multiple sclerosis: interventional pilot study. *J. Med. Internet Res.* 22 (8), e18178.
- Kane, R.L., Bever, C.T., Ehrmantraut, M., et al., 2008. Teleneurology in patients with multiple sclerosis: EDSS ratings derived remotely and from hands-on examination. *J. Telemed. Telecare* 14 (4), 190–194.
- Kristoffersen, E.S., Sandset, E.C., Winsvold, B.S., Faiz, K.W., Storstein, A.M., 2021. Experiences of telemedicine in neurological out-patient clinics during the COVID-19 pandemic. *Ann. Clin. Transl. Neurol.* 8 (2), 440–447.
- Kurtzke, J.F., 1983. Rating neurologic impairment in multiple sclerosis: an expanded disability status scale (EDSS). *Neurology* 33 (11), 1444–1444.
- Lattanzi, S., Cagnetti, C., Danni, M., Provinciali, L., Silvestrini, M., 2017. Oral and intravenous steroids for multiple sclerosis relapse: a systematic review and meta-analysis. *J. Neurol.* 264 (8), 1697–1704.
- Lechner-Scott, J., Kappos, L., Hofman, M., et al., 2003. Can the expanded disability status scale be assessed by telephone? *Mult. Scler. J.* 9 (2), 154–159. Available at: <https://journals.sagepub.com/doi/10.1191/1352458503ms8840a>. (Accessed 29 July 2020).
- Paul, L., Renfrew, L., Freeman, J., et al., 2019. Web-based physiotherapy for people affected by multiple sclerosis: a single blind, randomized controlled feasibility study. *Clin. Rehabil.* 33 (3), 473–484.
- Plow, M., Finlayson, M., Liu, J., et al., 2019. Randomized controlled trial of a telephone-delivered physical activity and fatigue self-management interventions in adults with multiple sclerosis. *Arch. Phys. Med. Rehabil.* 100 (11), 2006–2014.
- Robb, J.F., Hyland, M.H., Goodman, A.D., 2019. Comparison of telemedicine versus in-person visits for persons with multiple sclerosis: a randomized crossover study of feasibility, cost, and satisfaction. *Mult. Scler. Relat. Disord.* 36, 101258.
- Saposnik, G., Montalban, X., 2018. Therapeutic inertia in the new landscape of multiple sclerosis care. *Front. Neurol.* 9, 174.
- Yeroushalmi, S., Maloni, H., Costello, K., Wallin, M.T., 2019. Telemedicine and multiple sclerosis: a comprehensive literature review. *J. Telemed. Telecare*, 1357633X19840097.