Rehabilitation post-COVID-19: cross-sectional observations using the Stanford Hall remote assessment tool

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ABSTRACT

Introduction The multisystem COVID-19 can cause prolonged symptoms requiring rehabilitation. This study describes the creation of a remote COVID-19 rehabilitation assessment tool to allow timely triage, assessment and management. It hypotheses those with post-COVID-19 syndrome, potentially without laboratory confirmation and irrespective of initial disease severity, will have significant rehabilitation needs.

Methods Cross-sectional study of consecutive patients referred by general practitioners (April–November 2020). Primary outcomes were presence/absence of anticipated sequelae. Binary logistic regression was used to test association between acute presentation and post-COVID-19 symptomatology.

Results 155 patients (n=127 men, n=28 women, median age 39 years, median 13 weeks post-illness) were assessed using the tool. Acute symptoms were most commonly shortness of breath (SOB) (74.2%), fever (73.5%), fatigue (70.3%) and cough (64.5%); and post-acutely, SOB (76.7%), fatigue (70.3%), cough (57.4%) and anxiety/mood disturbance (39.4%). Individuals with a confirmed diagnosis of COVID-19 were 69% and 63% less likely to have anxiety/mood disturbance and pain, respectively, at 3 months.

Conclusions Rehabilitation assessment should be offered to all patients suffering post-COVID-19 symptoms, not only those with laboratory confirmation and considered independently from acute illness severity. This tool offers a structure for a remote assessment. Post-COVID-19 programmes should include SOB, fatigue and mood disturbance management.

INTRODUCTION

The COVID-19 pandemic has led to significant levels of mortality and morbidity.[1 2] Some long-term effects were predicted in those who survived serious disease, using data from previous coronavirus epidemics and early data from COVID-19.[3 4] However, it is apparent that those who have experienced mild to moderate disease may also have significant ongoing symptoms that may require rehabilitation.[5]

Residual symptoms, often related to intrusive fatigue, cognitive dysfunction or ongoing shortness of breath (SOB), have potential to limit activities of daily living (ADLs) and prevent return to work.[5 6] Rehabilitation can improve the course of post-COVID-19 illness with a focus on physical symptoms and pacing to avoid 'boom and bust',

Key messages

► Patients can suffer from long-term symptoms following an acute illness from COVID-19, even if the initial illness is mild.
► Patients suffering from ongoing symptoms should be offered rehabilitation in a timely manner, regardless of testing status; delay in assessment can contribute to symptoms worsening.
► In this population, the most common acute symptoms were shortness of breath (SOB), fever, fatigue and cough; and post-acute, SOB, fatigue, cough and mood disturbance.
► Those with a confirmed diagnosis of COVID-19 were less likely to have mood disturbance and pain at 3 months.
► This tool offers a framework for remote rehabilitation assessment using telemedicine platforms.

aiming for a symptom-titrated return to physical activity, while also offering psychological support such as patient education and peer support to reduce anxiety.[5]

Not all patients who have suffered from COVID-19 will need the support of rehabilitation services; most will fully recover after a mild self-limiting illness.[5] However, early indications suggested up to 50% of patients might need support with targeted COVID-19 rehabilitation.[7–13]

The Defence Medical Rehabilitation Centre (DMRC) Stanford Hall has experience of managing patients with complex rehabilitation needs, including those with prolonged post-viral symptoms requiring specialist rehabilitation. DMRC Stanford Hall has been running such a service for COVID-19 since May 2020, including a 2-week residential multidisciplinary rehabilitation course. Other post-COVID-19 pathways have been developed by adapting existing programmes such as those for pulmonary rehabilitation,[14 15] or creating new online patient education resources, such as 'Your COVID-19 Recovery' and 'Post COVID-19 Hub'.[16 17]

According to the guidance from the National Institute of Health and Care Excellence (NICE), patients with rehabilitation needs are likely to benefit from an early initial assessment using a multidisciplinary team (MDT) approach.[18] The

use of telemedicine platforms to deliver virtual medical care has significantly increased during COVID-19. Virtual rehabilitation is known to be effective within the both civilian and military settings,[19] [20] with systematic reviews demonstrating similar outcomes and patient satisfaction to those delivered face-to-face, recognising the inability to perform examinations.[21] [22]

A remote COVID-19 rehabilitation assessment tool was created by MDT clinicians at DMRC Stanford Hall to allow timely triage, assessment and management. A key consideration in the development of new services is the inclusion criteria for access to care. Patient groups have highlighted potential unmet need, particularly for those initially managed in the community.[5] [23] Anecdotally, a pattern of delayed presentation for those without laboratory-confirmed diagnoses was noticed and hypothesised that this may be associated with highly prevalent rehabilitation needs. As such, analysis was performed according to the availability of either antigen or antibody confirmation of COVID-19.

The current study aims to report its creation and outcomes in 8 months of clinical use, with a secondary aim to describe association of testing status to both timing of initial assessment and post-acute symptoms.

METHOD

In early April 2020, an MDT working group convened to develop the remote COVID-19 rehabilitation assessment tool. Led by a rehabilitation medicine consultant, and cognisant of video-teleconferencing (VTC) limitations, the team included: an occupational therapist, consultant pain nurse, physiotherapist and exercise rehabilitation instructor. The tool was modelled on the current understanding of COVID-19 using the experience of the rehabilitation and management of other post-viral syndromes, with reference to the International Classification of Functioning, Disability and Health domains.[24] An initial draft of the tool was produced and reviewed within the DMRC Stanford Hall clinical delivery group, comprised of the clinical director and all head of services for allied health professionals. A final stage of adjustment by the panel of rehabilitation medicine consultants using the tool was subsequently performed.

The assessment tool (online supplemental file 1) incorporates a medical screening, identifying the acute course, severity and management of COVID-19. The existence of post-COVID-19 symptoms, including pain, fatigue, sleep and mood, and functional limitations such as SOB, exercise intolerance or cognitive problems on ADLs or occupation are identified. From this problem list, and in conjunction with the patient's ideas, concerns and expectations, rehabilitation management was arranged.

The tool was introduced into clinical practice in late April 2020, using the NHSX-approved web-based VTC platform, Attend Anywhere (Attend Anywhere, Australia), the first such tool in clinical use in the UK. In parallel to the creation of the remote COVID-19 rehabilitation assessment tool, a pan-DMRC group also generated a patient information and remote intervention pack. The pack contained educational resources on COVID-19 and its potential long-term effects (later described as 'post-COVID-19 syndrome'[25]); and interventions such as breathing, nutrition, sleep, pain, activity pacing and self-managed psychological strategies. This pack was offered to patients, independently to their VTC assessment outcome.

A cross-sectional study design of consecutive patients referred from Defence primary healthcare (DPHC) to DMRC Stanford Hall was used. UK Defence personnel were assessed at the point of remote consultation having met the following pragmatic

referral criteria: an acute illness characterised by either persistent cough, fever or anosmia in association with ongoing rehabilitation needs as assessed by their general practitioner.

In December 2020, a reviewer coded all remote COVID-19 rehabilitation assessment VTC consultations performed from April to November 2020 using the electronic health record system, Defence medical information capability programme. Anonymised data were extracted, compiled and analysed using SPSS (IBM, V.27) and independently reviewed. Continuous data for age and time-to-VTC were tested for normality using the Shapiro-Wilk test. Time-to-VTC data were not normally distributed and therefore compared between those with/without laboratory confirmation using the Mann-Whitney U test. All other data were binary coded.

Levels/location of treatment were entered into separate binary logistic regression models with laboratory confirmation (y/n) as the dependent variable. Laboratory confirmation was then switched to the independent variable to assess association with post-acute symptoms. For the most prevalent post-acute symptoms (>30%), further independent variables were tested as predictors initially using univariate binary logistic regressions. Where significant associations were found, these were entered into a hierarchical multiple model in order of effect size (OR) and the four most common acute symptoms. To accommodate eight variables (age, time-to-VTC, laboratory confirmation, location of treatment and the four most common acute symptoms) assuming a 50% ratio for the dependent variable (presence/absence of symptoms at VTC), a sample size of 80–144 was sought to allow for five to nine events per predictor in the smaller group.[26] This threshold was reached in November 2020.

There was no patient involvement in the initial working group which predated receipt of referrals with this novel condition, however feedback was used from patients to tailor the ongoing use of the tool.

RESULTS

Rehabilitation VTC assessments were completed for 155 patients (n=127 men and n=28 women, median age of 39 years), between April and November 2020, at a median of 13 weeks of follow-up (Table 1). Thirty-nine patients were admitted to hospital, of whom 28 received ward-level care and 11 intensive care.

COVID-19-laboratory confirmation was available for 60 patients at the time of assessment (Table 2). Those with laboratory confirmation had a VTC sooner following the onset of

Table 1 Demographics of 155 patients at the point of video-teleconference (VTC)

Age (years)	39* (17)
Gender (m/f)	81.9%/18.1% (n=127/28)
Time-to-VTC (weeks)	13† (12)
Proportion of patients with either Ag OR Ab positive tests	38.7% (n=60)
Proportion of patients Ag tested	62.6% (n=97)
Proportion of patients Ag positive	34.2% (n=53)
Proportion of patients Ab tested	9.68% (n=15)
Proportion of patients Ab positive	5.8% (n=9)

*Median data with IQR presented as data not normally distributed; $W_{(155)}=0.975$, p=0.006.
†Median data with IQR presented as data not normally distributed; $W_{(155)}=0.936$, p<0.005.
Ab, antibody; Ag, antigen.

Table 2 Location of acute care

	Whole cohort (n=155)	Cases with Ag or Ab positivity (n=60 LC)	Cases without Ag or Ab positivity (n=95 NLC)	OR LC versus NLC	95% CI	Sig
Laboratory confirmation (dependent variable) with location of acute care as a predictor						
Home	64.5% (100)	45% (27)	76.8% (73)	0.25	0.12 to 0.50	<0.01*
Bedding down facility	1.3% (2)	1.7% (1)	1.0% (1)	†	†	†
Attended ED	9.0% (14)	8.3% (5)	9.5% (9)	0.87	0.28 to 2.73	0.81
Admitted to ward	18.1% (28)	31.7% (19)	9.5% (9)	4.43*	1.84 to 10.63*	<0.01*
Admitted to ITU	7.1% (11)	13.3% (8)	3.2% (3)	4.72*	1.20 to 18.56*	0.03*

*Statistically significant OR between subgroups.
†Sample size <10 not included in binary logistic regression.
Ab, antibody; Ag, antigen; ED, emergency department; ITU, intensive care unit; LC, laboratory-confirmed cases; NLC, non-laboratory-confirmed cases.

symptoms than those without (median 8.5 vs 16 weeks, respectively, U=1574.0, p<0.01).

Patients who self-managed at home (n=100, 64.5%) were 75% less likely to receive laboratory confirmation (OR 0.25 (0.12 to 0.50), p<0.01) (Table 2). Patients admitted to hospital wards and intensive care unit were more likely to receive laboratory confirmation (OR 4.43 (1.84 to 10.63), p<0.01 and OR 4.72 (1.20 to 18.56), p=0.03, respectively).

Symptoms during the acute illness were most commonly SOB (n=115, 74.2%), fever (n=114, 73.5%), fatigue (n=109, 70.3%) and cough (n=100, 64.5%) (Table 3).

Post-acutely, at the time of VTC assessment, 119 patients complained of SOB, occurring in 10 patients at rest, 62 on mild activity and 47 on moderate activity. Fatigue (n=109, 70.3%), cough (n=89, 57.4%) and anxiety/mood disturbance were also prevalent (n=61, 39.4%) across the whole cohort. Patients who received a laboratory confirmation for COVID-19 were 69% less likely to experience anxiety/mood disturbance and 63% less likely to experience pain than those who did not receive laboratory confirmation (OR 0.31 (0.15 to 0.64), p<0.01, and OR 0.37 (0.15 to 0.92), p=0.03) (Figure 1)), respectively. When admission to hospital was included along with laboratory confirmation as a predictor of anxiety/mood disturbance, the step change was not significant (χ^2=0.956, p=0.33) hence the univariate model was retained (Table 4). Other univariate tests were not significant for association with anxiety/mood disturbance including

age, time-to-VTC, acute SOB, fever, fatigue or cough (online supplemental data).

In the remaining univariate analyses, acute SOB was associated with post-acute cough (OR 2.61 (1.25 to 5.45), p=0.01), and increased time-to-VTC was associated with SOB on moderate activity (OR 1.04 (1.00 to 1.08), p=0.04) (online supplemental data).

Ninety-nine (63.8%) patients were recommended for residential rehabilitation after their VTC assessment. Of those not admitted for residential rehabilitation following assessment, 15.5% (24 of 155) required a further VTC to determine if symptoms had resolved satisfactorily with the self-help pack and 16.8% (26 of 155) required no further input from rehabilitation services. A further three patients declined further rehabilitation input, and three patients had no outcome recorded. Given the uncertainty of the clinical course of post-COVID-19 syndrome, patients were reassured that re-referral from primary care was welcomed where necessary. Further involvement of specialist services, including dietitians, psychology or DMRC COVID-19 Recovery Service,[27] was also performed when needed.

DISCUSSION

Three months after acute COVID-19 illness, SOB, fatigue, cough and anxiety/mood disturbances were the most commonly reported ongoing symptoms. This study also shows anxiety/mood disturbance and pain are more likely in patients who did not receive laboratory confirmation of their diagnosis. The acute and post-acute symptoms experienced within the military population mirror those detected by other self-reported studies,[23 28] suggesting potentially similar rehabilitation requirements. These principal symptoms should be a key consideration for the rehabilitation of individuals with post-COVID-19 syndrome.

Those without laboratory confirmation had a delay in their time-to-VTC compared with those with confirmation. The relationship between time-to-VTC and SOB on moderate activity may indicate that delay exacerbates such symptoms and that early intervention, as recommended by NICE, is favourable. Given the reported difficulty of this group accessing medical support without a confirmed diagnosis, efforts should be made to give access to services based on clinical need, not testing status.[23]

Cases from early in the pandemic are less likely to receive laboratory confirmation, due to UK testing policy and testing unreliability, especially for those self-isolating at home. This diagnostic uncertainty, allied to a poorly understood disease process, especially in the post-acute phase, is likely to contribute to prevalent mood disturbance and pain, reinforcing the need for education and rehabilitation of patients without a positive test where clinical suspicion is high.

Table 3 Presenting symptoms during the acute phase of illness

	Whole cohort (n=155)	Cases with Ag or Ab positivity (n=60 LC)	Cases without Ag or Ab positivity (n=95 NLC)
SOB	74.2% (115)	75.0% (45)	73.6% (70)
Fever	73.5% (114)	78.3% (47)	70.5% (67)
Cough	64.5% (100)	65.0% (39)	64.2% (61)
Fatigue	70.3% (109)	63.3% (38)	74.7% (71)
Myalgia	61.3% (95)	61.7% (37)	61.1% (58)
Loss of smell/taste	32.9% (51)	38.3% (23)	29.4% (28)
Arthralgia	31.0% (48)	31.7% (19)	30.5% (29)
Sore throat	26.5% (41)	26.7% (16)	26.3% (25)
Headache	14.8% (23)	25.0% (15)	8.4% (8)
Runny nose	9.7% (15)	11.7% (7)	8.4% (8)
Local pain	11.6% (18)	15% (9)	9.5% (9)
Widespread pain	3.2% (5)	5.0% (3)	2.1% (2)
Other	24.5% (38)	23.3 (14)	25.2% (24)

Ab, antibody; Ag, antigen; LC, laboratory-confirmed cases; NLC, non-laboratory-confirmed cases; SOB, shortness of breath.
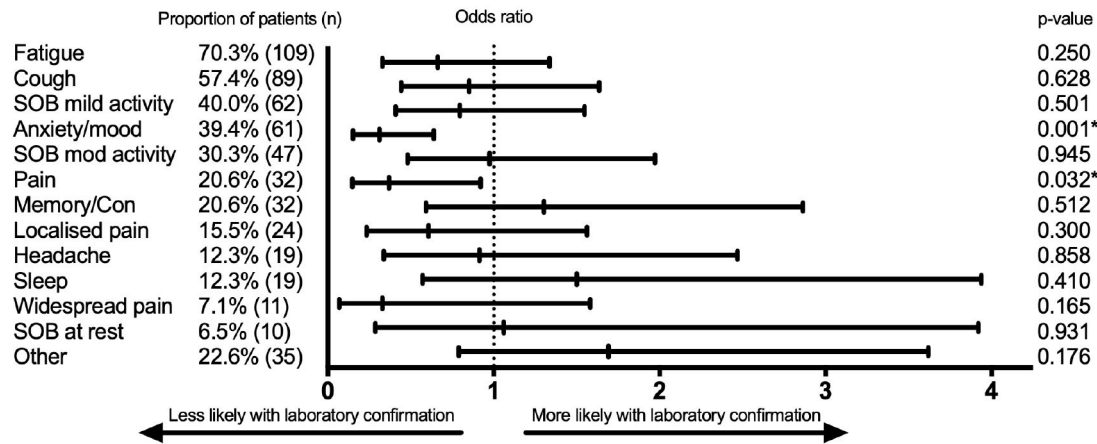
Figure 1 Post-acute symptoms (dependent variable) occurring at the time of video-teleconference at a median of 13 weeks since COVID-19 symptom onset with laboratory confirmation as a predictor. *Statistically significant OR between subgroups. Con, concentration; SOB, shortness of breath (categories are mutually exclusive: on mild/moderate activity/at rest).

The recently published NICE COVID-19 guidance (NG 188) recommends *do not exclude people from referral for multidisciplinary assessment…based on the absence of a positive SARS-CoV-2 test*.[25] Our findings support this statement and highlight the need to plan rehabilitation services for all patients with symptoms consistent and high clinical suspicion of post-COVID-19 syndrome, irrespective of test results, as there may be the potential for deterioration in symptoms for patients experiencing difficulties accessing rehabilitation.

The location of acute care could be used as a proxy marker for the severity of the acute illness. Existing services cater for this population, on the expectation of severe post-acute and chronic symptoms in those requiring increased acute management. The current study has not shown acute symptoms or location of care to be predictive of post-COVID-19 symptoms. Although both admission and laboratory confirmation were negatively associated with symptoms of anxiety and mood, when combined in a multiple model, only laboratory confirmation remained significant. Therefore, lack of laboratory confirmation may have a contributory effect on mood disturbance. These results highlight the need for rehabilitation services tailored to those with less severe acute illness who have ongoing issues post-COVID-19.

With the use of telemedicine, DMRC Stanford Hall has been able to offer innovative and timely assessment, accessible to patients, with triage and interventions in line with recommendations from professional bodies and other UK rehabilitation centres.[9 11 25 29 30] Issues encountered at DMRC Stanford Hall during creation and delivery of this tool have been seen elsewhere, with similar findings described by preliminary use of telemedicine in 196 consultations by Canadian Armed Forces.[31] Robitaille and MacRae describe the need for reliable technological platforms (preferably VTC over telephone), with standardised patient information and using patient feedback to improve services, and specific equipment, training and location requirements.[31]

Given the likely demand of post-COVID-19 care, with estimate of 10% of individuals suffering prolonged symptoms,[8] it is likely that some of this will be provided by non-rehabilitation specialists, as part of their parent specialty (such as respiratory medicine), or in the new models of care recently commissioned by NHS England.[32] The findings from this study have relevance for the commissioning and development of these much-needed clinical services, and any individual training required to meet this demand.

The approach of instigating early rehabilitation prescription is thought to be safe and effective and is the focus of ongoing UK Defence medical research, with the longitudinal study, Military COVID-19 Observational outcomes and Complications in Viral Infectious Disease (M-COVID, Study No. 1061/MODREC/20), following up patients for a year to understand the longer term complications of COVID-19.

Strengths and limitations

Having a single standardised assessment and referral system within DPHC against a known denominator (2807 cases as of 4 December 2020[33]) gives a genuine insight of the true prevalence of post-COVID-19 symptoms, accepting that prevalence was not the primary aim of the current study. However, a risk of selection bias remains in this study population. The military population have admission health standards, therefore are less likely to have existing comorbidities, and there is a significant gender imbalance within the Armed Forces (89.1% men in Regular forces as of 1 April 2020) contributing to the predominance of men in this study.[34]

Furthermore, there is potential for type 1 error having made multiple analyses in this paper. This was mitigated by outlining the hypotheses surrounding laboratory testing. In part, type 1

Table 4 Multiple hierarchical binary logistic model predicting anxiety/mood disturbance with laboratory confirmation/no laboratory confirmation (LC/NLC) and admission to hospital as covariates

		95% CI for OR		
	b (SE)	Lower	Odds	Upper
(A) Coefficients of the model predicting anxiety/mood disturbance: model 1				
Constant	−0.021 (0.205)			
LC/NLC	−1.169* (0.368)	0.151	0.311	0.639
(B) Coefficients of the model predicting anxiety/mood disturbance: model 2				
Constant	0.033 (0.213)			
LC/NLC	−1.041* (0.388)	0.165	0.353	0.756
Admitted	−0.430+ (0.444)	0.272	0.650	1.552

(A) R^2=0.092 (Nagelkerke). Model (1) χ^2=10.916, p=0.001, *p=0.001.
(B) R^2=0.100 (Nagelkerke). Model (2) χ^2=11.872, p=0.003, *p=0.007,+p=0.332.
Block (2) χ^2=0.956, p=0.328. Model 1 retained as final model.
N=3 standardised residuals >2, no Cook's distances >1, n=10 leverage >300% of average, no DFbeta >1.

error is a risk in observational studies, particularly in a novel condition where time and data to form more nuanced hypotheses are limited.

During the coding process, if a tick box pertaining to an individual symptom was not checked, the inference was taken that the symptom was not present. The effect of this on the current study would be an underestimate of symptom prevalence. In addition, three assessment tools had incomplete outcomes recorded.

With the exception of occasional VTC platform failures, at which point, a telephone call was performed, there were no reported adverse effects with the delivery of the tool. Further detail on comorbidities, ethnic background, medication history and other risk factors for more severe COVID-19 infection would have been helpful to explore links between post-COVID-19 pathology and initial disease process. Due to the clinical focus of the rehabilitation tool, this was beyond the scope of the current study and further studies are ongoing within DMRC.

Conclusions

Post-COVID-19 symptoms should be considered in all patients, regardless of the acute illness severity and whether they have had laboratory confirmation. A significant proportion of patients require assessment and management, with symptoms such as SOB, fatigue and mood disorders impacting on ADLs and return to work, amenable to bespoke rehabilitation programmes. The creation and development of the DMRC Stanford Hall remote COVID-19 rehabilitation assessment tool early in the pandemic have allowed timely MDT rehabilitation and support. This tool offers a structure to remote assessment appropriate for any experienced or inexperienced rehabilitation providers.

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REFERENCES

1 John Hopkins School of Medicine. Coronavirus resource centre. Available: https://coronavirus.jhu.edu [Accessed 5 Mar 21].
2 Department of Health and Social Care. Direct and indirect impacts of COVID-19 on excess deaths and morbidity: executive summary. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/918738/S0650_Direct_and_Indirect_Impacts_of_COVID-19_on_Excess_Deaths_and_Morbidity.pdf[Accessed 5 Mar 21].
3 O'Sullivan O. Long-term sequelae following previous coronavirus epidemics. *Clin Med* 2021;21:e68–70.
4 Wang D, Hu B, Hu C, *et al*. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA* 2020;323:1061.
5 National Institute for Health Research. Living with covid-19. A dynamic review of the evidence around ongoing covid-19 symptoms, 2020. Available: https://evidence.nihr.ac.uk/themedreview/living-with-covid19 [Accessed 14 Mar 21].
6 Barker-Davies RM, O'Sullivan O, Senaratne KPP, *et al*. The Stanford Hall consensus statement for post-COVID-19 rehabilitation. *Br J Sports Med* 2020;54:949–59.
7 National Health Service England. *COVID-19 hospital discharge service requirements*, 2020.
8 Greenhalgh T, Knight M, A'Court C, *et al*. Management of post-acute covid-19 in primary care. *BMJ* 2020;370:m3026.
9 Salawu A, Green A, Crooks MG, *et al*. A proposal for multidisciplinary Tele-Rehabilitation in the assessment and rehabilitation of COVID-19 survivors. *Int J Environ Res Public Health* 2020;17:4890.
10 The National Post-Intensive Care Rehabilitation Collaborative. Responding to COVID-19 and beyond: a framework for assessing early rehabilitation needs following treatment in intensive care. Available: https://members.ics.ac.uk/ICS/ICS/Guidelinesand Standards/Framework_for_assessing_early_rehab_needs_following_ICU.aspx [Accessed 12 Mar 21].
11 British Society of Rehabilitation Medicine. Rehabilitation in the wake of Covid-19 – a Phoenix from the ashes. Available: https:// www. bsrm. org. uk/ publications/ latest-news/ post/ 39- covid- 19- bsrm- position- onrehabilitation [Accessed 02 Mar 21].
12 Royal College of Occupational Therapy. A quick guide for occupational therapists: rehabilitation for people recovering from COVID-19. Available: https://www.rcot.co.uk/sites/default/files/Quick%20guide%20for%20OTs%20People%20recovering%20from%20COVID-19.pdf [Accessed 14 Mar 21].
13 Chartered Society of Physiotherapists. COVID-19 rehabilitation standards rehabilitation of adults who hospitalized due to COVID-19: physiotherapy service delivery [RS1]. Available: www.csp.org.uk/publications/rehabilitation-adults-who-are-hospitalised-due-covid-19-physiotherapy-service-delivery [Accessed 16 Mar 21].
14 Liu K, Zhang W, Yang Y, *et al*. Respiratory rehabilitation in elderly patients with COVID-19: a randomized controlled study. *Complement Ther Clin Pract* 2020;39:101166.
15 British Thoracic Society. Delivering rehabilitation to patients surviving COVID-19 using an adapted pulmonary rehabilitation approach – BTS guidance. Available: https://www.brit-thoracic.org.uk/covid-19/covid-19-information-for-the-respiratory-community/ [Accessed 5 Mar 21].
16 National Health Service. Your COVID recovery. Available: https://www.yourcovidrecovery.nhs.uk [Accessed 7 Mar 21].
17 Asthma UK and British Lung Foundation. Get support after COVID 19. Post-COVID hub, 2020. Available: https://www.post-covid.org.uk/get-support [Accessed 8 Mar 21].
18 National Institute of Health and Care Excellence. Rehabilitation after critical illness in adults, Clinical guideline [CG83], 2009. Available: https://www.nice.org.uk/guidance/cg83 [Accessed 20 Mar 21].
19 Cottrell MA, Russell TG. Telehealth for musculoskeletal physiotherapy. *Musculoskelet Sci Pract* 2020;48:102193.
20 Poropatich R, Lappan C, Gilbert G. Telehealth in the department of defense. In: Rheuban K, Krupinski EA, eds. *Understanding telehealth*. New York, NY: McGraw-Hill, 2017. http://accessmedicine.mhmedical.com/Content.aspx?bookid=2217&sectionid=187795495
21 Cottrell MA, Galea OA, O'Leary SP, *et al*. Real-Time telerehabilitation for the treatment of musculoskeletal conditions is effective and comparable to standard practice: a systematic review and meta-analysis. *Clin Rehabil* 2017;31:625–38.
22 Mani S, Sharma S, Omar B, *et al*. Validity and reliability of Internet-based physiotherapy assessment for musculoskeletal disorders: a systematic review. *J Telemed Telecare* 2017;23:379–91.
23 Assaf G, Davis H, McCorkell L. What does COVID-19 recovery actually look like? an analysis of the prolonged COVID-19 symptoms survey by Patient-Led research team. patient led research for COVID-19. Available: https://patientresearchcovid19.com/research/report-1/ [Accessed 14 Mar 21].
24 World Health Organisation. Toward a common language for functioning, disability and health. Available: https://www.who.int/classifications/icf/icfbeginnersguide.pdf [Accessed 12 Mar 21].

25 National Institute of Health and Care Excellence. COVID-19 rapid guideline: managing the long term effects of COVID-19 [NG 188]. Available: https://www.nice.org.uk/guidance/ng188/resources/covid19-rapid-guideline-managing-the-longterm-effects-of-covid19-pdf-66142028400325 [Accessed 5 Mar 21].

26 Vittinghoff E, McCulloch CE. Relaxing the rule of ten events per variable in logistic and COX regression. *Am J Epidemiol* 2007;165:710–8.

27 O'Sullivan O, Barker-Davies RM, Chamley R. Defence medical rehabilitation centre (DMRC) coronavirus disease 2019 (COVID-19) recovery service. *BMJ Mil Health* 2021.

28 Menni C, Valdes AM, Freidin MB, *et al*. Real-time tracking of self-reported symptoms to predict potential COVID-19. *Nat Med* 2020;26:1037–40.

29 British Medical Association. COVID-19 video consultations and homeworking. Available: https://www.bma.org.uk/advice-and-support/covid-19/adapting-to-covid/covid-19-video-consultations-and-homeworking

30 Sivan M, Halpin S, Gee J, *et al*. Assessing long-term rehabilitation needs in COVID-19 survivors using a telephone screening tool (C19-YRS tool). *ACNR* 2020;19:14–17.

31 Robitaille E, MacRae M. Delivering rehabilitation services during the COVID-19 pandemic: How CAF Physiotherapy is using telehealth to ensure "physical and measurable solutions to maintain and enhance operational readiness, anywhere, anytime". *J Mil Veteran Fam Health* 2020;6:44–9.

32 NHS England. Long Covid patients to get help at more than 60 clinics. Available: https://www.england.nhs.uk/2020/12/long-covid-patients-to-get-help-at-more-than-60-clinics/ [Accessed 13 Mar 21].

33 Ministry of Defence. Coronavirus cases in defence: Number of COVID-19 tests in defence & positive cases in the UK armed forces. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/944405/20201217_-_ANNEX_A_COVID_Official_Statistic_O.pdf [Accessed 28 Mar 21].

34 Ministry of Defence. Uk armed forces biannual diversity statistics. Available: https://www.gov.uk/government/publications/uk-armed-forces-biannual-diversity-statistics-2020/uk-armed-forces-biannual-diversity-statistics-1-april-2020 [Accessed 4 Mar 21].