A randomised pilot feasibility study of Eye Movement Desensitisation and Reprocessing Recent Traumatic Episode Protocol, to improve psychological recovery following intensive care admission for COVID-19 infection.

Journal:	*Journal of the Intensive Care Society*
Manuscript ID	INC-22-0089.R1
Manuscript Type:	Original Article
Date Submitted by the Author:	20-Sep-2022
Complete List of Authors:	Bates, Andrew; University Hospital Southampton NHS Foundation Trust, Critical Care Research Area, Southampton National Institute for Health Research and Biomedical Research Council; University of Southampton Faculty of Medicine Golding, Hannah; University Hospital Southampton NHS Foundation Trust, Critical Care Research Area, Southampton National Institute for Health Research and Biomedical Research Council Rushbrook, Sophie; Dorset HealthCare NHS Foundation Trust, Intensive Psychological Therapies Service Shapiro, Elan; Independent EMDR Europe Consultant Practitioner Pattison, Natalie; University of Hertfordshire, Department of Health and Social Work; East and North Hertfordshire NHS Trust, Baldwin, David; University of Southampton Faculty of Medicine; Southern Health NHS Foundation Trust Grocott, Michael; University of Southampton, Southampton NIHR Biomedical Research Centre Cusack, Rebecca; University Hospital Southampton NHS Foundation Trust, Critical Care Research Area, Southampton National Institute for Health Research and Biomedical Research Council; University of Southampton Faculty of Medicine
Keywords:	Intensive care, PTSD, EMDR, R-TEP, Psychology
Abstract:	Background: Approximately 50% of intensive care survivors experience persistent psychological symptoms. Eye-movement desensitisation and reprocessing (EMDR) is a widely recommended trauma-focussed psychological therapy, which has not been investigated systematically in a cohort of intensive care survivors: We therefore conducted a randomised pilot feasibility study of EMDR, using the Recent Traumatic Episode Protocol (R-TEP), to prevent psychological distress in intensive care survivors. Findings will determine whether it would be possible to conduct a fully-powered clinical effectiveness trial and inform trial design. Method: We aimed to recruit 26 patients who had been admitted to intensive care for over 24-hours with COVID-19 infection. Consenting participants were randomised (1:1) to receive either usual care plus remotely delivered EMDR R-TEP or usual care alone (controls). The primary outcome was feasibility. We also report factors related to safety and symptom changes

	in post-traumatic stress disorder, (PTSD) anxiety and depression. Results: We approached 51 eligible patients, with 26 (51%) providing consent. Intervention adherence (sessions offered/sessions completed) was 83%, and 23/26 participants completed all study procedures. There were no attributable adverse events. Between baseline and six-month follow-up, mean change in PTSD score was -8 (SD=10.5) in the intervention group vs. +0.75 (SD=15.2) in controls (p=0.126). There were no significant changes to anxiety or depression. Conclusion: Remotely delivered EMDR R-TEP met pre-determined feasibility and safety objectives. Whilst we achieved group separation in PTSD symptom change, we have identified a number of protocol refinements that would improve the design of a fully powered, multi-centre randomised controlled trial, consistent with currently recommended rehabilitation clinical pathways.

INTRODUCTION

Intensive care survivors frequently experience a range of health sequelae, widely referred to as 'Post Intensive Care Syndrome'.[1] In addition to physical and cognitive impairment, meta-analyses show that 20-25% experience symptoms of post-traumatic stress disorder (PTSD), in the year following hospital discharge,[2,3] and the prevalence of anxiety and depressive symptoms is 32-40%[4] and 28-30%, respectively.[5] These symptoms frequently co-exist[6] and are associated with reduced quality of life,[4,5,7] increased healthcare use,[8] delayed or no return to work[9] and unhealthy coping behaviours.[10] The survivorship phase is frequently overlooked by healthcare providers, and psychological services are widely lacking.[11]

During the severe acute respiratory syndrome coronavirus 2 (SARS CoV-2) pandemic, admission illness severity was higher than in previously documented populations.[12] Intensive care services were stretched by unprecedented demand, acute staff shortages, and high levels of personal protective equipment.[13] **Data from previous infective outbreaks[14], suggest that clinicians may witness an increased incidence of post-ICU psychopathology, following the pandemic.[15]**

Research into attenuating strategies, such as patient diaries[16], follow-up clinics[17], and nurse-led psychological care[18] has provided mixed evidence of benefit. More recently, calls have grown for collaboration with our colleagues in mental health.[19,20] Eye movement desensitisation and reprocessing (EMDR) is a trauma-focussed psychotherapy believed to reduce distress by facilitating recall, processing and integration of traumatic memories within a positive emotional and cognitive framework.[21] Meta-analyses report reductions in post-traumatic, anxiety and depressive symptoms following a range of traumatic events, including life-threatening medical events.[22,23] International organisations recommend EMDR as an effective and cost-effective treatment for PTSD.[24,25] EMDR reduces post-traumatic symptoms in patients with co-morbid psychotic, depressive, anxiety and substance misuse disorders;(26) an important consideration given the association between pre-existing psychiatric diagnosis and post-intensive care psychopathology.[27] **In 2018, Hulme reported reductions in PTSD symptom severity, following EMDR therapy, in a non-randomised**

pilot study of ten ICU-survivors.[28] Two recent case studies describe positive treatment effect following ICU admission.[29,30]

The Recent Traumatic Episode Protocol, (R-TEP)[31] is an EMDR intervention, adapted for early delivery, that allows for processing of fragmented, traumatic memories; frequently reported by ICU survivors and associated with post-ICU PTSD development.[32] EMDR R-TEP has reduced PTSD symptoms following missile attacks,[33,34] and life-threatening medical events.[35,36] The aforementioned, case study[30] described a positive treatment response to EMDR R-TEP, following ICU admission.

A number of systematic reviews report uncertainty regarding the timing of psychological interventions, to prevent or ameliorate traumatic stress symptoms. An International Society of Traumatic Stress Studies (ISTSS) review, concluded that there is no strong evidence for early, preventative intervention irrespective of symptomology.[37] Reviews focussing on life-threatening medical events[38] and ICU-survivorship specifically,[39,40] could not identify optimal timing of preventative interventions. Moreover, none of the reviewed studies investigated a protocolised, trauma-focussed psychological therapy aimed at prevention of downstream post-ICU mental health morbidity.

Given the pervasiveness of post-ICU PTSD, paucity of robust evidence, and partial support for preventative interventions, we identified both timing of intervention and pre-screening for symptoms, as key uncertainties in our study programme. We therefore elected to investigate delivery of an early EMDR R-TEP intervention, offered to all survivors, to prevent development of PTSD, symptom entrenchment and to avoid excessive suffering.

This study investigated the feasibility of conducting a randomised controlled trial of online EMDR R-TEP with a cohort of intensive care survivors. Through the inclusion of a control group (CG) who received usual care, we aimed to gather preliminary evidence of possible clinical effectiveness. Findings will inform the development and delivery of a subsequent, fully-powered randomised controlled trial (RCT), in a broader

cohort of intensive care survivors, which may inform psychological care pathways for this underserved population.

METHOD

Trial design

COVEMERALD was an investigator-initiated, single-centre, pilot feasibility **study**. Registered on ClinicalTrials.gov (NCT04455360), in advance of beginning the trial: London-Fulham Research Ethics Committee granted ethical approval on 24th August 2020 (Reference: 20/HRA/3633). At the time of this study, only COVID-19 related research would be considered by UK Health Research Authority. The full study protocol has been published elsewhere.[41] The study was conducted according to Medical Research Council (MRC) guidance on developing complex interventions[42] and is reported according to Consolidated Standards of Reporting Trials (CONSORT) extension to randomised pilot and feasibility trials.[43] All study activity was undertaken at University Hospital Southampton (UHS) National Health Service Foundation Trust (NHS FT), a large regional centre servicing a population of 1.9 million in central southern United Kingdom.

Patients

Patients were eligible to enrol in the study if they had been admitted to intensive care for at least 24 hours following a positive COVID-19 test (polymerase chain reaction), were aged 18 years or over, had capacity to provide informed consent, and had been discharged from hospital for less than three months. Patients were excluded if they had cognitive impairment, a pre-existing diagnosis of psychosis, suffered acute brain injury, or were not expected to survive beyond hospital discharge. Initial inclusion criteria included 24 hours of mechanical ventilation, but this was removed on the advice of our patient and public involvement (PPI) group, following reports of distress associated with non-invasive positive pressure ventilation.

Recruitment occurred between October 2020 and April 2021. Consecutive patients were screened for eligibility, following hospital-discharge. The Chief Investigator telephoned potential participants once eligibility criteria were confirmed. Patient information sheets were posted or e-mailed, and a follow-up phone

call arranged. If the patient expressed a desire to participate in the study, research staff documented the conversation and recorded consent in writing. Consenting participants were emailed a link to complete a demographic questionnaire and baseline assessments on an electronic data management system, ALEA Clinical™. All trial procedures were completed remotely due to ongoing COVID-19 restrictions.

Randomisation and treatment

We assigned participants in a 1:1 ratio to receive either usual care (control group CG) or usual care plus online EMDR (Intervention) **using computer generated random permutation (ALEA Clinical™):** no stratification factors were applied. A brief description of usual care is provided in **Supplementary file: Usual care description.** Following consent, the study team provided contact details of participants in the intervention arm to the Intensive Psychological Therapies Service (IPTS) at Dorset Healthcare University NHS FT: all sessions took place via Zoom ™ videoconferencing platform. The EMDR R-TEP intervention is described in detail according to the Template for Intervention Description and Replication Checklist [44] **(see Supplementary file: TIDieR Checklist).** Briefly, the sessions consisted of eight phases: history taking; preparation with attention to safety and containment; assessment of points of disturbance (using 0-10 scale of Subjective Units of Distress [SUD] 0=no distress, 10=highest anxiety/distress ever felt); focussed processing and desensitisation with bilateral stimulation; installation of positive cognition with bilateral stimulation; episode body scan; episode closure; re-evaluation of SUD and validity of positive cognition. Each session lasted between 60-90 minutes. Additional sessions were offered if SUD scores were ≥2 on re-evaluation. Up to 8 sessions of EMDR were offered. If no points of disturbance were identified (SUD ≤1), sessions were discontinued. Participant flow through the study is shown in **Fig 1: Participant flow diagram.**

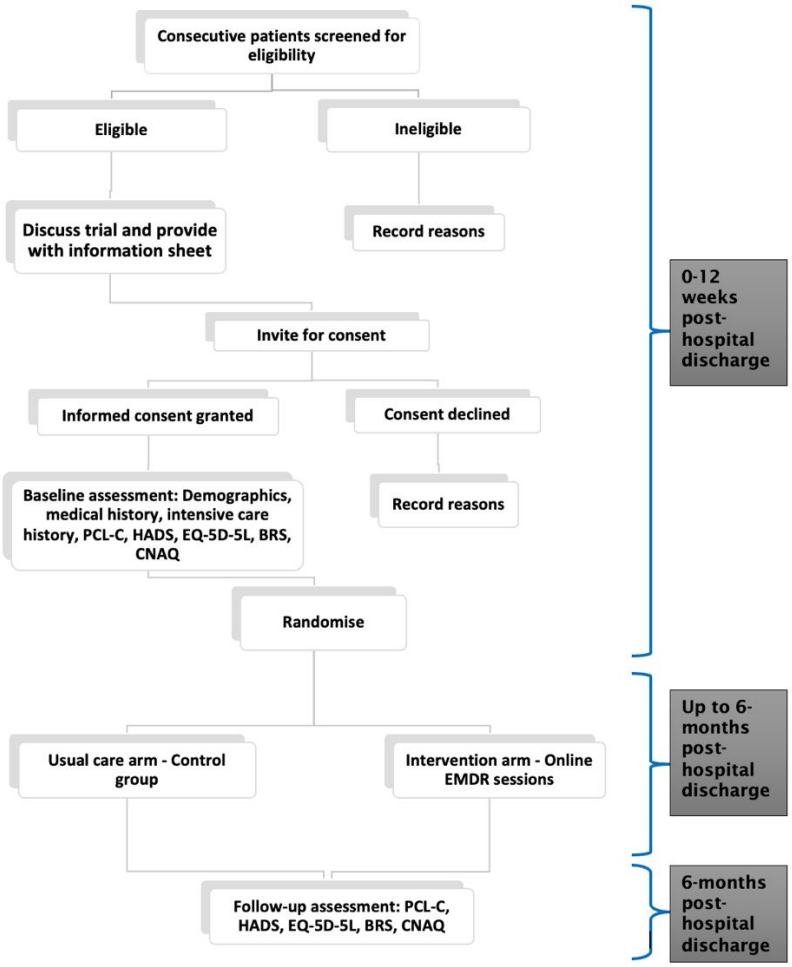

Figure 1: Participant flow diagram

Outcome measures and data collection

Our primary aim was to assess the feasibility of delivering online EMDR to adult survivors of COVID-19 related critical illness. Feasibility objectives were selected from MRC and National Institute for Health and Care Research guidance[45] and pre-published[41]: i) recruitment rate >30% of patients approached; ii) intervention session adherence >75%, calculated from sessions completed as a proportion of sessions offered; iii) protocol adherence >75% of all participants, based upon deviations and violations; iv) trial completion of >75% of study activities completed; and v) review of serious events attributable to trial procedures. These were not defined as progression criteria but would inform refinement of study design.

We recorded baseline demographic data, ICU-admission history and medical history; comorbidities, intensive care bed days, length of hospital inpatient stay, total benzodiazepine use, total days of ventilation, (intubated

and non-invasive positive pressure ventilation) and illness severity using the Acute Physiology and Chronic Health Evaluation (APACHE) II score. **Secondary clinical outcomes** were assessed by comparing change in self-reported symptoms from Baseline to Follow-up (6-months post-hospital discharge), between the control (CG) and intervention groups. **The Post-traumatic Stress Disorder Checklist-Civilian version (PCL-C); is a 17 question, patient-reported outcome measure, widely-used and validated in populations including intensive care survivors.**[6,46,47] **Participants report frequency of experiencing PTSD symptoms, giving a total score between 17-85. PCL-C has estimated sensitivity and specificity for PTSD caseness, in primary care populations of 28-30,**[48] **with an estimated minimal clinically important difference (MCID) in the range of 5.7-10.2 (midpoint of 7.9) based upon comparison with clinician assessment.**[49]

Anxiety and depressive symptoms were measured by the Hospital Anxiety and Depression Scale (HADS)[50]**; HADS was the most frequently used assessment tool in a meta-analysis of post-ICU depressive symptoms**[51] **and was used in the UK's largest study of post-ICU mental health outcomes.**[6] **Scores can be reported separately for anxiety and depression sub-scales, with ≥8**[52] **defining caseness for each. HADS MCID, for both subscales, is estimated between 1.7**[53] **and 2**[54] **points.**

PTSD is associated with a range of sequelae, which will be of interest in the main trial and future research workstreams. The following exploratory outcomes were measured in order to explore uncertainty around follow-up rates, questionnaire response rate and time needed to clean and analyse the data; Quality of life was measured using EuroQol Five Dimension-Five level scale (EQ-5D-5L)[55]**; We used the Brief Resilience Scale (BRS)**[56] **to assess resilience. Emerging research is exploring whether bolstering resilience, may offer innovative techniques in ameliorating PTSD symptoms.**[57] **We used the Council of Nutrition Appetite Questionnaire (CNAQ)**[58] **to measure appetite and predicted weight change, as PTSD is independently associated with both weight gain and loss.**[59] We originally intended to assess cognitive function, physical activity, functional disability, and report episodes of delirium in ICU: however, lack of researcher time meant we were unable to perform remote cognition testing, our PPI group recommended removal of functional disability assessment due to participant burden, COVID restrictions denied the opportunity to use physical activity monitors, and delirium episodes had been recorded in the ICU notes only rarely, due to necessary

adaptation of clinical practices. Full details and definitions of outcome variables are available in **Supplementary file: Table S1**. Patient reported outcomes were completed online. All other data were collected by research staff and stored securely, using ALEA Clinical™.

Statistical analysis

This was a feasibility trial in which the effectiveness of EMDR was not evaluated, so a formal power calculation is not appropriate. Sample size was based upon recommendations for feasibility studies,[60] and previously-reported ICU recovery feasibility studies of complex interventions.[61] Twenty-six consenting participants ensured a comprehensive evaluation of feasibility, with 13 randomised to CG and 13 to EMDR. The study statistician was blind to group allocation and downloaded data from ALEA™ to IBM SPSS™ to perform statistical analyses of clinical outcomes. Demographics and baseline characteristics were compared using the Pearson Chi-Square test, or the Fisher's exact test, if nominal, or the Student's t test, or Mann-Whitney U test, if quantitative. Demographic data are reported as numbers (percentage), mean (standard deviation (SD)) and median (inter-quartile range (IQR)) where appropriate. Clinical outcome data are reported as change from Baseline to Follow-up. These data were assessed for normal distribution using the Shapiro-Wilk test.[62] Normally distributed variables are reported as mean (SD). Non-normally distributed variables are reported as median (IQR). Where appropriate, variables are reported as number (percentage) of the study population.

RESULTS

Feasibility

Seventy-five consecutive, discharged patients were screened for inclusion between October 2020 and April 2021. **Nine did not meet inclusion criteria. We could not find contact details for 10 patients and five were missed due to lack of research time for the CI. Fifty-one eligible patients were approached, with 26(51%) consenting to participation over the 7-month recruitment period.** Thirteen participants were allocated to the CG, and 13 to the intervention group. Recruitment, randomisation, retention and trial completion data are shown in **Figure 2: Study flowchart (CONSORT) diagram.** Sixteen (62%) males and 10 (38%) females were

recruited, matching the proportion of patients admitted with severe COVID-19. Demographic and clinical characteristics are summarised in **Table 1.** There were no significant differences between groups in age, gender, ethnicity, BMI, admission severity (APACHEII), median ICU and hospital length of stay (LOS). Benzodiazepine use was higher in the EMDR R-TEP group (46%) vs CG (23%), although this was not statistically significant.

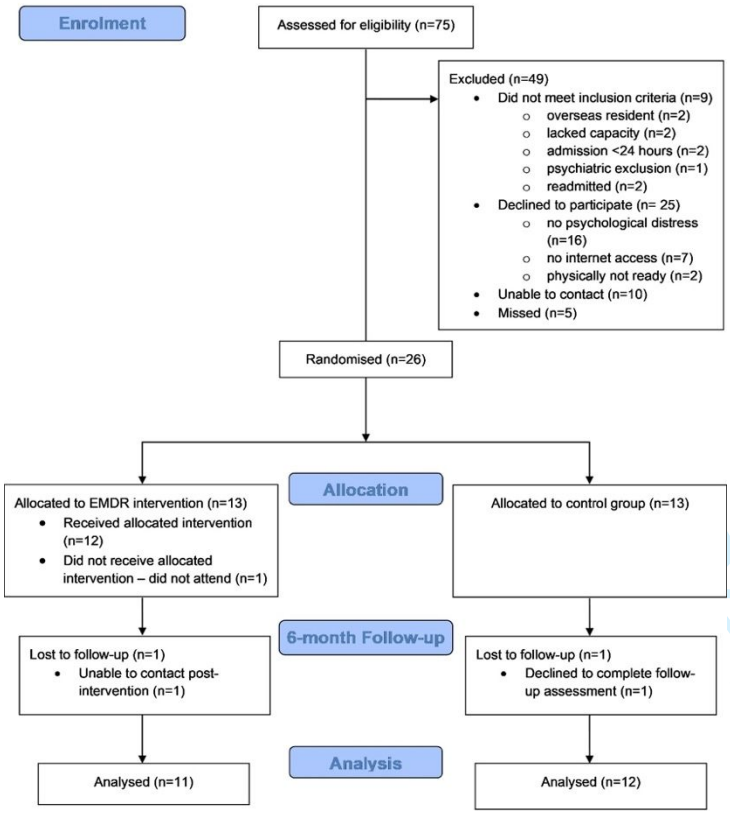

Figure 2. Study flowchart (CONSORT diagram)

Table 1. Demographic and clinical characteristics at Baseline

Variables	All (N=26)	Control (N=13)	EMDR (N=13)	p-value
Age, mean (SD), years	58.0 (15.3)	58.3 (16.5)	57.7 (14.8)	0.923
Gender, male n (%)	16 (61.5)	8 (61.5)	8 (61.5)	1.00
BMI	32.7 (6.82)	32.5 (6.70)	32.9 (7.21)	0.885
Ethnicity n (%)				0.593
White (British)	23 (88.5)	11 (84.6)	12 (92.3)	
White (Other)	2 (7.7)	1 (7.7)	1 (7.7)	
Unknown	1 (3.8)	1 (7.7)	0 (0.0)	
Medical History n (%)				

Anxiety	1 (3.8)	0 (0.0)	1 (7.7)	0.308
Bipolar	1 (3.8)	0 (0.0)	1 (7.7)	0.308
Cancer	1 (3.8)	1 (7.7)	0 (0.0)	0.308
Cardiovascular	4 (15.4)	4 (30.8)	0 (0.0)	0.030*
Depression	1 (3.8)	1 (7.7)	0 (0.0)	0.308
Endocrine	5 (19.2)	2 (15.4)	3 (23.1)	0.619
Gastrointestinal	3 (11.5)	1 (7.7)	2 (15.4)	0.539
Musculoskeletal	3 (11.5)	2 (15.4)	1 (7.7)	0.539
Neurological	1 (3.8)	1 (7.7)	0 (0.0)	0.308
PTSD	1 (3.8)	0 (0.0)	1 (7.7)	0.308
Renal	1 (3.8)	0 (0.0)	1 (7.7)	0.308
Respiratory	4 (15.4)	3 (23.1)	1 (7.7)	0.277
APACHE II Score^	11 (7,13)	11 (8,12)	11 (7,13)	0.757
ICU LoS^	8 (5,18)	6 (5,18)	9 (7,17)	0.719
Hospital LoS^	16 (10,30)	13(10,30)	9(7,17)	0.976
Total ventilation days^	6 (4,15)	6 (4,19)	5 (3,13)	0.881
Benzodiazepine use n (%)	9 (34.6)	3 (23.1)	6 (46.2)	0.216

SD: Standard deviation; IQR: Inter-quartile range; BMI: Body mass index; PTSD: Post-traumatic stress disorder; APACHE: Acute Physiology and Chronic Health Evaluation; ICU: Intensive Care Unit; LoS: Length of Stay. Data are presented as mean (SD), ^median (IQR) or n (%).

One participant allocated to intervention did not undertake any EMDR sessions and did not give a reason: the 12 remaining participants attended 34 of 41 arranged sessions, giving an intervention session adherence of 83%. Five sessions were missed due to physical ill health, one due to denial of psychological disturbance, and one due to confusion over appointment date. Mean session attendance was 3.25 per participant. Five participants needed only one session as their Baseline SUD was 1/10. One patient from each group did not complete the 6-month follow-up assessments. One declined but gave no reason and one could not be contacted. Twenty-three participants (88%) completed all study procedures. There were no protocol deviations and no reported adverse events.

Secondary outcomes

The mean Baseline PCL-C score for the whole intervention group was 29.2 although 48.7 in the 7 participants who required more than one session. Clinical outcomes are summarised in **Table 2.** Mean PCL-C score decreased by 8 points (Standard deviation (SD) 10.49) in the intervention group but increased by 0.75 (SD 15.17) in the CG (p=0.126). There was wide variability in response among participants in the intervention

group: 9 reported a reduction in PCL-C scores, (from -3 to -29), one participant reported no change, and one reported an increase of 10 points (a combat veteran with previously reported PTSD diagnosis). In the CG, 3 of 12 participants reported a reduced PCL-C score (ranging from -5 to -37), 3 reported no change, 6 reported increased PCL-C scores (from +3 to +24).

Mean change in overall HADS scores was comparable between groups, with a reduction of 0.91 (SD 4.21) in intervention group and a reduction of 0.42 (SD 6.63) in the CG (p=0.835). Mean HADS-Anxiety scores decreased by 0.45 (SD 2.30) in the intervention group and 0.83 (SD 4.02) in the CG (p=0.787); median HADS-Depression scores fell by 2 (Inter Quartile Range (IQR) -3,1) in the intervention but increased by 1 (IQR -1.5,2) in the CG (p=0.263). Median change in resilience score was -0.17 (IQR -0.03,0.50) in the intervention group, and 0 (IQR -.33,0.17) in the CG (p=0.658). Mean change in CNAQ was 1.6 (SD 3.95) in intervention group and 1.5 (SD 2.54) in the CG (p=0.943). Mean EQ-5D-5L scores declined by 0.04 (SD 0.14) in the intervention group and -0.02 (SD 0.15) in the CG (p=0.657): mean change in EQ-5D-5L visual analogue score was 11.2 (SD 13.10) in the intervention group and 10.33 (SD 15.33) in the CG (p=0.889).

Table 2. Change from Baseline to six-months in clinical outcomes in intervention and control groups

Questionnaire	Control (N=12)	Intervention (N=11)	p-value
PCL-C	0.75 (15.17)	-8.00 (10.49)	0.126
HADS Overall	-0.42 (6.63)	-0.91 (4.21)	0.835
HADS Anxiety	-0.83 (4.02)	-0.45 (2.30)	0.787
HADS Depression*	1.00 (-1.50, 2.00)	-2.00 (-3.00, 1.00)	0.263
BRS*	0.00 (-0.33, 0.17)	-0.17 (-0.33, 0.50)	0.658
CNAQ	1.50 (2.54)	1.6 (3.95)	0.943
EQ-5D-5L Score	-0.02 (0.15)	-0.04 (0.14)	0.657
EQ-5D-5L VAS	10.33 (15.33)	11.2 (13.10)	0.889

Data are presented as mean (Standard Deviation) and p-value reported from t-test, or *median (Inter Quartile Range) and p-value reported from Wilcoxon rank-sum test. PCL-C: Post traumatic stress disorder Checklist: Civilian; HADS: Hospital Anxiety and Depression Scale; BRS: Brief resilience scale; CNAQ: Council of nutrition and appetite questionnaire; EQ-5D-5L: EuroQol 5 dimensions-5 levels; VAS: Visual analogue scale.

DISCUSSION

To our knowledge COVEMERALD is the first investigation of a protocolised EMDR intervention, following an intensive care admission. We exceeded our pre-published feasibility thresholds and safely delivered online EMDR R-TEP to a cohort of intnesive care survivors. **We report findings that will inform design changes, and improve the chances of delivering a future fully-powered effectiveness RCT. Our clinical findings indicate that such an investigation of EMDR is warranted, in a broader cohort of intensive care survivors.**

The primary outcome of this study was feasibility. We met recruitment target in 7-months, with a mean of 3.7 particpants per month, during a period of unprecedented clincial pressure. We were able to recruit 51% of eligible patients approached, exceding our published target of 30%. To achieve our recruitment target (n=26) we screened 75 patients. Accounting for exclusions, missed patients and trial decliners, 35% of screened patients consented to trial particpation. Meaningful comparison of recruitment rates, are difficult due to the novelty of this intervention in this cohort. However, a review of publically funded trials in the UK noted that the median recruitment rate was 0.98 particpants per centre per month, with 50% of RCTs failing to meet recruitment targets.[63]

Consecutive patients were approached for COVEMERALD participation and the demographic characteristics of the study sample were largely representative of the wider patient population: however, the self-declared ethnicity of study participants (96% white) indicates an under-representation of other ethnic groups, based on ICU patient populations. Between September 2020 and April 2021, 28% of patients admitted to UK intensive care units with COVID-19, were of black, asian, mixed or other ethnicity[12]: 23% of patients admitted to our unit during the recruitement period were black, asian, mixed or other ethnicity yet in this study >90% of participants were white. Furthermore, 14% of patients who we approached declined participation in our online intervention study, due to lack of digital access. Widely recognised as a social determinant of health,[64] and exacerbated by the COVID-19 requirement for social distancing, the digital divide presents an increasing risk of exacerbating health inequality.[65] Recently the UK National Institute for Health and Care Research (NIHR) has published guidance for ensuring inclusivity in research,[66] which will inform the approach to recruitment in future studies.

A key uncertainty of our trial was whether EMDR R-TEP, delivered early (within 3-months of hospital discharge), could work as a protective intervention against development of persistent post-traumatic stress symptoms, irrespective of symptomology at the time of recruitment. Eligibile patients most frequently cited lack of psychological distress as the main reason for trial decline. Moreover, of the 12 particpants who received the intervention, five patients only had one session, due to no psychological distress. Our cohort was too small to undertake meaningful sub-group analysis, comparing symptom resolution between those above and below clincial cut-offs. We believe our findings assert that future studies should focus on screening for PTSD symptoms before offering EMDR, consistent with international treatment guidance.[24,25,67] Screening for psychological symptoms at 3-months is further supported by our experience of intervention session adherence: although 34 of 41 (83%) organised sessions were completed suggesting that participants found the intervention accceptable, 5 of these 7 missed sessions were due to physical illness in the early rehabilitation phase. To promote RCT scalability and clinical implementation, we propose aligning the psychological screening with the 3-month post-hospital discharge follow-up visit, recommended in ICU rehabilitation clincial pathways.[68] **A recently published survey reported increasing provision of UK follow-up services, yet highlighted important gaps, most commonly in psychological support[11]. Our work supports the author's conclusion that improving the evidence base will be key to expanding service delivery and impacting upon patient-centred outcomes.**

The known relationship between EMDR intervention fidelity and treatment effect size[69] has important implications for future studies of clinical effectiveness. The COVEMERALD EMDR R-TEP intervention was performed by a Consultant clinical psychologist and two trained, experienced psychological therapists. An EMDR consultant offered clinical supervision: however, we could not formally check intervention fidelity due to time and resource constraints. Future studies should consider using an EMDR fidelity rating scale,[70,71] to ensure validity and enable replication, and provide an account of possible relationships between intervention fidelity and treatment effect size, including individual dose-response variability. **Moreover, there are fewer EMDR R-TEP practitioners than those trained in standard protocol EMDR. Careful consideration should be given to which EMDR protocol is most useful and scalable in this context.**

There were no protocol deviations or safety incidents, consistent with systematic reviews of EMDR, incuding those studies in survivors of life-threatening medical events.[72] COVEMERALD exceeded the reported mean completion rate (75%) of 7 other studies investigating psychological interventions for ICU survivors[39]

Clinical outcomes

Our study was not powered to detect efficacy of the intervention compared to usual practice. The reported values do match findings from a systematic review of studies of EMDR in survivors of other life-threatening medical events[72] and show a trend towards symptom reduction in PTSD (-8) and depressive symptoms (-2). These are in the ranges defined as MCID of 5.7-10.2[49] and -2[53] respectively, however, clinical relevance should not be ascribed to these results, given the study design limitations. We do, however, believe these results support the case for further investigations of EMDR for symptom reduction in survivors of critical illness.

This trial was conducted during an ongoing global pandemic, with recognised adverse effect on population mental health. To adequately explore interaction between our patient cohort, contextual and cultural factors, we recommend that future researchers adopt a mixed-methods approach, in larger samples. This would enhance understanding of when, how and under which circumstances EMDR is effective **and may offer insight into the wide treatment response variability**.

Limitations

The study has a number of design limitations which may affect generalisability, many of which have been outlined in the discussion; **this was a small,** single-centre study, with inadequate representation of under-served populations, failure to address digital exclusion, and lack of intervention fidelity checks. Moreover, there is a high risk of bias associated with non-blinded clincial outcome measures. **Our follow-up period was limited to 6-months due to lack of funding. Given the uncertain mental health trajectory following ICU discharge, future studies should report clincial outcomes up to a minimum of 12-months post-discharge, preferably longer.** Our study was undertaken during a period of unprecedented clincial pressure, using a patient population limited to

sufferers of COVID-19. Rapid changes to the UK's research rules meant that we were limited to undertaking research in this cohort. While this may limit generalisability of our study, emerging evidence suggests that post-discharge challenges faced by COVID patients are comparable to those in wider ICU-survivor cohorts.[73] However, this study does need to be repeated in a more representative cohort of ICU-survivors. Remaining uncertainties require refinement of trial design, before proceeding to a definitive RCT of clinical effectiveness.

CONCLUSION

This study met feasibility and safety targets. However, fundamental design changes will need to be applied before progression to an adequately powered, multi-centre RCT of clinical effectiveness. A future trial of EMDR for intensive care survivors should consider a larger number of simultaneously recruiting sites, and adopting strategies to ensure representative inclusion of under-served ethnic, socio-economic and digitally-excluded populations. We recommend psychological screening of participants, consistent with recommended ICU clinical rehabilitation pathways. The EMDR intervention should be fidelity-checked, and offered online or face-to-face. To support scalability and rapid translation of findings, the RCT should be embedded within established clinical referral pathways. A mixed-methods approach, should be adopted, in order to capture the complexity of interaction between the intervention, outcome, context, culture and mechanisms of change.

List of abbreviations:

APACHE: Acute physiology and chronic health evaluation

BRS: Brief resilience scale

CG: Control group

EMDR: Eye-movement desensitisation and reprocessing

EQ-5D-5L: EuroQol Five Dimension-Five level scale

HADS: Hospital Anxiety and Depression Scale

ICU: Intensive care unit

LOS: Length of stay

MRC: Medical Research Council

NHS: National Health Service

PCL-C: Post-traumatic Stress Disorder Checklist-Civilian

PTSD: Post-traumatic stress disorder

RCT: Randomised controlled trial

R-TEP: Recent traumatic episode protocol

SARS: Severe acute respiratory syndrome

SUD: Subjective unit of distress

UHS: University Hospital Southampton

UK: United Kingdom

Declarations:

Ethics approval and consent to participate

London-Fulham Research Ethics Committee, United Kingdom granted ethical approval on 24th August 2020. (Reference: 20/HRA/3633). The full study protocol has been published elsewhere(41). Due to the ongoing requirement to maintain social distancing during the pandemic, verbal consent was obtained and documented during telephone consultation between participants and research staff. Consent forms were posted to all participants.

Consent for publication

Individual's data is not included in this manuscript, therefore consent for publication is not required.

Availability of data and materials

Datasets used in preparation of this manuscript can be accessed from the corresponding author on reasonable request.

Authors' contributions

AB conceived and designed the study, acquired and interpreted the data, and led manuscript preparation, under the supervision of NP, DSB, RC and MPWG. HG acquired and interpreted the data, designed and formatted the tables. SR conceived and designed the study and led intervention delivery and supervision. ES

developed the EMDR R-TEP intervention, trained the psychological therapists and participated in study design. NP provided intellectual input and critical revision of the manuscript. DSB contributed to study design, intellectual input and critical revision of the manuscript. MPWG designed the study, provided intellectual input and critical revision of the manuscript. RC conceived and designed the study, acquired and interpreted the data, provided intellectual input and critical revision of the manuscript. All authors contributed to, edited and approved the final manuscript.

Acknowledgements

We would like to thank the Intensive care staff and patients at University Hospital Southampton, for their advice, support, and patience during this period of unprecedented pressure. In particular we acknowledge the efforts of Fiona Hall (UHS NHSFT ICU follow-up senior sister) and Dr Kathleen Nolan (UHS NHSFT ICU and follow-up Consultant), Janet Hathaway, project manager at Dorset Healthcare University NHSFT, Lesley Hawkins, senior project manager at UHS NHSFT, Tara Walker and Nicola Coulter for delivering the intervention and participating in invaluable trial team meetings. This trial was possible because of their unfailing enthusiasm and support.

Bibliography}

1. Flaatten H, Waldmann C. The Post-ICU Syndrome, History and Definition. In Preiser J-C, Herridge M, Azoulay, E. Editors. *Post-Intensive Care Syndrome*. Springer; Cham, Switzerland 2020. p. 3-12
2. Righy C, Rosa RG, Da Silva RTA, et al. Prevalence of post-traumatic stress disorder symptoms in adult critical care survivors: A systematic review and meta-analysis. *Crit Care* 2019. Jun 11;23(1):213.
3. Parker AM, Sricharoenchai T, Raparla S. Posttraumatic stress disorder in critical illness survivors: a meta-analysis. *Crit Care Med*. 2015;43(5):1121-1129.
4. Nikayin S, Rabiee A, Hashem MD, et al. Anxiety symptoms in survivors of critical illness: a systematic review and meta-analysis. *Gen Hosp Psychiatry*. 2016 Nov;43:23-9.
5. Davydow DS, Gifford JM, Desai S V. Posttraumatic stress disorder in general intensive care unit survivors: a systematic review. *Gen Hosp Psychiatry*. 2008;30(5):421-34.
6. Hatch R, Young D, Barber V, et al. Anxiety, Depression and Post Traumatic Stress Disorder after critical illness: a UK-wide prospective cohort study. *Crit Care.* Nov 2018;22,310
7. Davydow DS, Gifford JM, Desai SV, et al. Depression in general intensive care unit survivors: a systematic review. *Intensive Care Med.* 2009 May 23;35(5):796-809.

8. Davydow DS, Hough CL, Zatzick D, et al. Psychiatric symptoms and acute care service utilization over the course of the year following medical-surgical ICU admission: a longitudinal investigation*. *Crit Care Med*. 2014 Dec;42(12):2473-81.

9. McPeake J, Mikkelsen ME, Quasim T, et al. Return to Employment after Critical Illness and Its Association with Psychosocial Outcomes. A Systematic Review and Meta-Analysis. *Ann Am Thorac Soc.* 2019;16(10):1304-11.

10. Davydow DS, Zatzick D, Hough CL, et al. A Longitudinal Investigation of Alcohol Use over the Course of the Year Following Medical-Surgical Intensive Care Unit Admission. *Psychosomatics.* 2013 Jul-Aug; 54(4): 304-316.

11. Connolly B, Milton-Cole R, Adams C, et al. Recovery, rehabilitation and follow-up services following critical illness: an updated UK national cross-sectional survey and progress report. *BMJ Open.* 2021 Oct 1;11(10):e052214

12. Intensive care national audit and research centre. ICNARC report on COVID-19 in critical care: England, Wales and Northern Ireland. [Accessed 17th December 2021]. Available from: https://www.icnarc.org/Our-Audit/Audits/Cmp/Reports

13. Neville TH, Hays RD, Tseng C-H, et al. Survival After Severe COVID-19: Long-Term Outcomes of Patients Admitted to an Intensive Care Unit. *J Intensive Care Med.* 2022 Apr 5;8850666221092687

14. Gardner PJ, Moallef P. Psychological impact on SARS survivors: Critical review of the English language literature. *Can Psychol Can*. 2015 Feb;56(1):123-35.

15. 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 Aug;54(16):949-59.

16. McIlroy PA, King RS, Garrouste-Orgeas M, et al. The Effect of ICU Diaries on Psychological Outcomes and Quality of Life of Survivors of Critical Illness and Their Relatives: A Systematic Review and Meta-Analysis. *Crit Care Med*. 2019;47(2):273-9.

17. Cuthbertson BH, Rattray J, Campbell MK, et al. The PRaCTICaL study of nurse led, intensive care follow-up programmes for improving long term outcomes from critical illness: a pragmatic randomised controlled trial. *BMJ*. 2009 Oct 16;339:b3723.

18. Wade DM, Mouncey PR, Richards-Belle A, et al. Effect of a Nurse-Led Preventive Psychological Intervention on Symptoms of Posttraumatic Stress Disorder Among Critically Ill Patients. *JAMA*. 2019 Feb 19;321(7):665.

19. Bieber ED, Philbrick KL, Shapiro JB, et al. Psychiatry's role in the prevention of post-intensive care mental health impairment: stakeholder survey. *BMC Psychiatry*. 2022;22(1):198.

20. Fernando SM, Ranzani OT, Herridge MS. Mental health morbidity, self-harm, and suicide in ICU survivors and caregivers Mental health morbidity among ICU survivors. *Intensive Care Medicine* 48, pages 1084-1087 (2022)

21. Novo Navarro P, Landin-Romero R, Guardiola-Wanden-Berghe R, et al. 25 years of Eye Movement Desensitization and Reprocessing (EMDR): The EMDR therapy protocol, hypotheses of its mechanism of action and a systematic review of its efficacy in the treatment of post-traumatic stress disorder. *Rev*

Psiquiatr y Salud Ment. 2018 Apr 1;11(2):101–14.

22. Mavranezouli I, Megnin-Viggars O, Daly C, et al. Psychological treatments for post-traumatic stress disorder in adults: a network meta-analysis. *Psychol Med.* 2020 Mar 17;50(4):542–55.

23. Bisson JI, Roberts NP, Andrew M, et al. Psychological therapies for chronic post-traumatic stress disorder (PTSD) in adults. *Cochrane Database Syst Rev.* 2013 Dec 13;(12).

24. Van Ommeren M. Guidelines for the Management of Conditions Specifically Related to Stress. World Health Organisation. [Accessed Jan 2022] Available from: https://www.who.int/publications/i/item/guidelines-for-the-management-of-conditions-that-are-specifically-related-to-stress.

25. National Institute for Health and Care Excellence. Post-traumatic stress disorder: NICE guideline. 2018 Dec [Accessed Jan 2022] Available from: https://www.nice.org.uk/guidance/NG116

26. Valiente-Gómez A, Moreno-Alcázar A, Treen D, Cedrón C, Colom F, Pérez V, et al. EMDR beyond PTSD: A Systematic Literature Review. *Front Psychol*. 2017 Sep 26;8:1668.

27. Patel MB, Jackson JC, Morandi A, et al. Incidence and Risk Factors for Intensive Care Unit–related Post-traumatic Stress Disorder in Veterans and Civilians. *Am J Respir Crit Care Med.* 2016 Jun 15;193(12):1373–81.

28. Hulme T. Using eye movement therapy to reduce trauma after intensive care. *Nursing Times.* 2018;114(3):18–21.

29. Wake S, Kitchiner D. Post-traumatic stress disorder after intensive care. *BMJ*. 2013 May 22;346:f3232.

30. Clarke R. The EMDR Recent Traumatic Episode Protocol With an Intensive Care Survivor: A Case Study. *J EMDR Pract Res*. 2022 Apr 1;16(2):50–60.

31. Shapiro E, Yishay R, Laub IB. Early EMDR Intervention (EEI): A Summary, a Theoretical Model, and the Recent Traumatic Episode Protocol (R-TEP). *J EMDR Pract Res*. 2008;2(2):79.

32. Jones C, Griffiths RD, Humphris G, Skirrow PM. Memory, delusions, and the development of acute posttraumatic stress disorder-related symptoms after intensive care. *Crit Care Med*. 2001 Mar;29(3):573–80.

33. Shapiro E, Laub B. Early EMDR Intervention Following a Community Critical Incident: A Randomized Clinical Trial. *J EMDR Pract Res*. 2015;9(1):17–27.

34. Shapiro, E., Laub, B., & Rosenblat O. Early EMDR intervention following intense rocket attacks on a town: A randomised clinical trial. *Clin Neuropsychiatry J Treat Eval.* 2018;15(3):194–205.

35. Tofani LR, Wheeler K. The Recent-Traumatic Episode Protocol: Outcome Evaluation and Analysis of Three Case Studies. *J EMDR Pract Res.* 2011 Jan 1;5(3):95–110.

36. Gil-Jardiné C, Evrard G, Al Joboory S, et al. Emergency room intervention to prevent post concussion-like symptoms and post-traumatic stress disorder. A pilot randomized controlled study of a brief eye movement desensitization and reprocessing intervention versus reassurance or usual care. *J Psychiatr Res.* 2018 Aug 1;103:229–36.

37. Roberts NP, Kitchiner NJ, Kenardy J, et al. Early psychological intervention following recent trauma: A

systematic review and meta-analysis. *Eur J Psychotraumatol.* 2019 Dec 31;10(1):1695486.

38. Birk JL, Sumner JA, Haerizadeh M, et al. Early interventions to prevent posttraumatic stress disorder symptoms in survivors of life-threatening medical events: A systematic review. J Anxiety Disord. 2019;64:24-39.

39. Wade DM, Moon Z, Windgassen SS, Harrison M, et al. Non-pharmacological interventions to reduce ICU-related psychological distress: a systematic review. *Minerva Anestesiol.* 2016 Apr;82(4):465-78. Epub 2015 Oct 27. PMID: 26505225.

40. Roberts MB, Glaspey LJ, Mazzarelli A, Jones CW, Kilgannon HJ, Trzeciak S, et al. Early Interventions for the Prevention of Posttraumatic Stress Symptoms in Survivors of Critical Illness: A Qualitative Systematic Review. *Crit Care Med*. 2018;46(8):1328-33.

41. Bates A, Rushbrook S, Shapiro E, Grocott M, Cusack R. CovEMERALD: Assessing the feasibility and preliminary effectiveness of remotely delivered Eye Movement Desensitisation and Reprocessing following Covid-19 related critical illness: A structured summary of a study protocol for a randomised controlled trial. *Trials.* 2020 Dec 17;21(1):929.

42. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ*. 2008 Sep 29;337.

43. Eldridge SM, Chan CL, Campbell MJ, et al. CONSORT 2010 statement: extension to randomised pilot and feasibility trials. *BMJ.* 2016 Oct 24;355:i5239.

44. Hoffmann TC, Glasziou PP, Boutron I, Milne R, Perera R, Moher D, et al. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ*. 2014 Mar 7;348:g1687.

45. Skivington K, Matthews L, Simpson SA, Craig P, Baird J, Blazeby JM, et al. A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance. *BMJ*. 2021;374(n2061).

46. Karstoft KI, Andersen SB, Bertelsen M, Madsen T. Diagnostic accuracy of the Posttraumatic Stress Disorder Checklist-Civilian Version in a representative military sample. *Psychol Assess.* 2013 Mar;26(1):321.

47. Blevins CA, Weathers FW, Davis MT, Witte TK, Domino JL. The Posttraumatic Stress Disorder Checklist for *DSM-5* (PCL-5): Development and Initial Psychometric Evaluation. *J Trauma Stress.* 2015 Dec;28(6):489-98.

48. Lang AJ, Laffaye C, Satz LE, et al. Sensitivity and specificity of the PTSD checklist in detecting PTSD in female veterans in primary care. *J Trauma Stress.* 2003 Jun;16(3):257-64. doi: 10.1023/A:1023796007788. PMID: 12816338.

49. Stefanovics EA, Rosenheck RA, Jones KM, et al. Minimal Clinically Important Differences (MCID) in Assessing Outcomes of Post-Traumatic Stress Disorder. *Psychiatr Q.* 2018 Mar 21;89(1):141-55.

50. Zigmond AS, Snaith RP. The Hospital Anxiety and Depression Scale. *Acta Psychiatr Scand.* 1983;67.

51. Rabiee A, Nikayin S, Hashem MD, et al. Depressive Symptoms After Critical Illness: A Systematic Review and Meta-Analysis. *Critical Care Medicine.* 2016 Sep;44(9):1744-1753.

52. Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the Hospital Anxiety and Depression Scale. An updated literature review. *J Psychosom Res.* 2002 Feb;52(2):69-77. doi: 10.1016/s0022-3999(01)00296-3

53. Lemay KR, Tulloch HE, Pipe AL, Reed JL. Establishing the Minimal Clinically Important Difference for the Hospital Anxiety and Depression Scale in Patients With Cardiovascular Disease. *J Cardiopulm Rehabil* Prev. 2019;39(6):E6-11.

54. Wynne SC, Patel S, Barker RE, et al. Anxiety and depression in bronchiectasis: Response to pulmonary rehabilitation and minimal clinically important difference of the Hospital Anxiety and Depression Scale. *Chron Respir Dis.* 2020 Jan-Dec;17:1479973120933292.

55. Herdman M, Gudex C, Lloyd A, Janssen M, Kind P, Parkin D, Bonsel G, Badia X. Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). *Qual Life Res.* 2011 Dec;20(10):1727-36. doi: 10.1007/s11136-011-9903-x.

56. Smith BW, Dalen J, Wiggins K, et al. The brief resilience scale: Assessing the ability to bounce back. *Int J Behav Med*. 2008 Sep;15(3):194-200.

57. Horn SR, Charney DS, Feder A. Understanding resilience: New approaches for preventing and treating PTSD. *Exp Neurol.* 2016 Oct 1;284:119-32.

58. Wilson M-MG, Thomas DR, Rubenstein LZ, Chibnall JT, Anderson S, Baxi A, et al. Appetite assessment: simple appetite questionnaire predicts weight loss in community-dwelling adults and nursing home residents. *Am J Clin Nutr.* 2005 Nov 1;82(5):1074-81.

59. LeardMann CA, Woodall KA, Littman AJ, et al. Post-traumatic stress disorder predicts future weight change in the Millennium Cohort Study. *Obesity* (Silver Spring). 2015 Apr;23(4):886-92.

60. Hertzog MA. Considerations in determining sample size for pilot studies. *Res Nurs Health.* 2008 Apr 1;31(2):180-91.

61. Sosnowski K, Mitchell ML, White H, Morrison L, Sutton J, Sharratt J, et al. A feasibility study of a randomised controlled trial to examine the impact of the ABCDE bundle on quality of life in ICU survivors. *Pilot Feasibility Stud.* 2018 Dec 11;4(1):32.

62. Mohd Razali N, Bee Wah Y. Power comparisons of Shapiro-Wilk, Kolmogorov-Smirnov, Lilliefors and Anderson-Darling tests. Vol. 2, *Journal of Statistical Modeling and Analytics*. 2011. 21-33 p.

63. Walters SJ, Bonacho Dos Anjos Henriques-Cadby I, Bortolami O, Flight L, Hind D, Jacques RM, et al. Recruitment and retention of participants in randomised controlled trials: a review of trials funded and published by the United Kingdom Health Technology Assessment Programme. *BMJ Open*. 2017 Mar 20;7(3):e015276.

64. Ramsetty A, Adams C. Impact of the digital divide in the age of COVID-19. *J Am Med Informatics Assoc.* 2020 Jul 1;27(7):1147-8.

65. Stone E, Nuckley P, Shapiro R. Digital Inclusion in Health and Care: Lessons learned from the NHS Widening Digital Participation Programme (2017-2020). London, UK; 2020 https://www.goodthingsfoundation.org/insights/digital-participation-lessons-learned/. Accessed 17th July 2022

66. Witham MD, Anderson E, Carroll C, et al. Developing a roadmap to improve trial delivery for under-served groups: results from a UK multi-stakeholder process. *Trials*. 2020 Dec 1;21(1):694.

67. Forbes D, Bisson JI, Monson CM, et al. Effective treatments for PTSD : practice guidelines from the international society for traumatic stress studies. 2020. 3rd Ed. The Guildford Press:UK

68. National Institute for Health and Care Excellence. Rehabilitation after critical illness in adults. Quality standard [QS158] NICE 2017 07 Sep. [Accessed Jan 2022] Available from: https://www.nice.org.uk/guidance/QS158

69. Maxfield L, Hyer L. The relationship between efficacy and methodology in studies investigating EMDR treatment of PTSD. *J Clin Psychol.* 2002 Jan;58(1):23-41.

70. Korn D, Maxfield L, Stickgold R, Smyth NJ. EMDR Fidelity Rating Scale | EMDR Foundation [Internet]. 2018 [cited 2021 Jun 10]. Available from: https://emdrfoundation.org/research-grants/emdr-fidelity-rating-scale/

71. Shapiro E, Laub B. EMDR recent traumatic episode protocol (EMDR R-TEP) fidelity scale. EMDR Foundation. [Accessed Jan 2022] Available from: https://emdrfoundation.org/toolkit/rtep-fidelity-checklist.pdf

72. Haerizadeh M, Sumner JA, Birk JL, Gonzalez C, Heyman-Kantor R, Falzon L, et al. Interventions for posttraumatic stress disorder symptoms induced by medical events: A systematic review. *J Psychosom Res.* 2020;129:109908.

73. Hodgson CL, Higgins AM, Bailey MJ, Mather AM, Beach L, Bellomo R, et al. Comparison of 6-Month Outcomes of Survivors of COVID-19 versus Non-COVID-19 Critical Illness. *Am J Respir Crit Care Med.* 2022 May 15;205(10):1159-68.

Figures and tables (within manuscript):

Figure 1. Participant flow

Figure 2. Study flowchart (CONSORT diagram)

Table 1. Demographic and clinical characteristics at Baseline

Table 2. Change from Baseline to six-months in clinical outcomes in intervention and control groups

Supplementary file:

- **Usual care description.**
- **TIDieR Checklist: Template for Intervention Description and Replication: EMDR R-TEP intervention**
- **Table S1: Detailed outcome measure description**

Supplementary file: Usual care description.

The severe acute respiratory syndrome coronavirus 2 necessitated rapid re-organisation of clinical and follow-up services at our hospital. All patients discharged from intensive care during the study period (October 2020-April 2021) were contacted by the UHS NHSFT follow up team, to arrange a telephone clinic, within 3-months of hospital discharge. Ventilated patients were prioritised to attend an online multi-disciplinary clinic, consisting of the follow-up nurse, ICU consultant with occasional attendance by physiotherapy and occupational therapy. Patients were asked to complete a set of screening questionnaires, related to physical and psychological health. Where physical need was determined urgent, patients would be escalated for referral to the hospital COVID medical clinic. Patients with evidence of incomplete physical or psychological recovery were offered generic advice, emailed leaflets specific to COVID and ICU recovery, and signposted to established online resources and information. In addition, patients and their relatives were invited to attend online peer group support sessions, facilitated by the follow-up nurse.

Supplementary file: TIDieR Checklist: Template for Intervention Description and Replication: EMDR Recent Traumatic Episode Protocol intervention

COVEMERALD Online EMDR R-TEP for survivors of Covid-19 relayed critical illness:

Template for intervention description and replication (TIDieR) checklist and guide [1].

1. Brief name: EMDR (Eye Movement Desensitisation and Reprocessing) R-TEP (Recent Traumatic Episode Protocol)

2. Why: The Covid-19 pandemic has resulted in a significant number of patients being admitted to Intensive Care for life-saving treatment. Research has revealed that a significant proportion of patients who survive their stay at Critical Care develop complications in their mental health, which can include symptoms of post-traumatic stress disorder (PTSD), depression, and anxiety, with long-term negative effects for patients and their families. In addition, patients who have survived a coronavirus related disease experience significant and persistent psychopathologies. There are currently very few NHS services that offer post-critical care support for patients, and those who do offer such support tend to focus more on the physical element of rehabilitation rather than the mental health recovery.

Some studies have reported significant improvement in psychological health for survivors of trauma following Eye Movement Desensitisation and Reprocessing (EMDR) therapy. EMDR is used to treat psychological trauma by targeting the way a traumatic event is stored and processed in the patient's memory. Using bilateral stimulation, the aim is to help the patient reprocess the events, changing a disturbing memory into one that is no longer emotionally distressing and is perceived by the patient to have taken its appropriate place in the historical past.

Comparison studies have shown that EMDR can be an effective, efficient and cost effective therapy for reducing level of psychological complications relating to trauma. Use of EMDR has been recommended by guidelines from the National Institute for Health and Care Excellence and the International Society for Traumatic Stress Studies in relation to treating PTSD symptoms [44] and it is receiving increasing endorsement as an evidence-based psychological treatment for trauma and often ensuing anxiety and depression.

The recent traumatic episode protocol (R-TEP) is a version of EMDR, developed to help with the processing of traumatic events before the psychological damage becomes entrenched. Using EMDR R-TEP, an individual's psychological trauma is addressed in a matter of a few therapy sessions, targeting the trauma in its early stages. There is emerging evidence that EMDR R-TEP may be applicable to trauma treatment in survivors of critical care. A pilot study carried out in France used EMDR R-TEP sessions in emergency room patients, which led to significant reduction in PTSD symptoms compared to reassurance and control groups.

Social distancing guidelines and the potentially long-term nature of the Covid-19 epidemic require the adoption and robust testing of technological solutions, to ensure access to best possible psychological care.

With a clear need to address post-critical care psychological complications, and emerging evidence of EMDR R-TEP's effectiveness in reducing trauma levels in related populations, there is a compelling case to understand whether an online EMDR R-TEP intervention may be effective in reducing psychological complications in survivors of Covid-19 related critical illness in the UK.

3. What (materials): The online EMDR R-TEP intervention follows a protocol . The clinician and participant progress through the protocol in a gradual manner, following the 8-phase approach of the R-TEP.

In addition, the following hard copy outcome measures were used in the study:

- PTSD Checklist-Civilian Version (PCL-C)
- Hospital Anxiety and Depression Scale (HADS)
- Quality of life health questionnaire (EQ-5D-5L)
- Brief Resilience Scale (BRS)
- Subjective Units of Distress (SUDs)

4. What (procedure): Twenty-six eligible participants from a UK critical care unit were recruited for the study. After granting consent, they completed a baseline assessment of the outcome measures mentioned in point 3 above. If randomised to EMDR R-TEP participants were referred to the Intensive Psychological Therapies Service in Poole where the online EMDR R-TEP intervention will be arranged. The intervention itself will involve up to eight 60 – 90 minute sessions.

EMDR R-TEP has an 8-phase approach. In essence it is an adaptation of EMDR for early intervention, integrating existing adaptive coping skills while addressing some additional issues of the trauma. EMDR R-TEP conceptualises the traumatic event as a fragmented experience which has not yet been consolidated, so no single image represents the entire event. It enables the processing of the points of disturbance linked to the target memory or disturbing episode, in order to facilitate integration and consolidation.

The procedures of EMDR R-TEP include:

1) Client history: Obtaining information about the client's previous pathology, exploring their severity, motivation and strengths.

2) Preparation: using stabilisation exercises (e.g. 4 elements, Safe/Calm Place) followed by a narrative of the trauma episode.

3) Assessment: The client introspectively scans the trauma episode to identify a disturbing target, a negative cognition and a positive cognition, the emotion and body sensations, together with measurements of their subjective distress and the validity of the positive cognition.

4) Desensitisation: doing sets of bilateral stimulation to reduce the client's subjective units of distress (SUD) from 10 being the most disturbed they could feel to 0 when they can think of the target yet remain calm.

5) Installation: involves the installation of a positive cognition, with the validity of that cognition (VoC) being evaluated until the preferred cognition is perceived to be true at 6 or 7 out of 7. Where 7 is completely true and 1 is not perceived to be true at all. This is accompanied by bilateral stimulation

6) Procedures 3-5 are repeated until an episode scan reveals no more disturbance.

7) The SUD level for the whole trauma episode is assessed to check for completion of the trauma processing

8) A positive cognition is now installed for the integrated trauma episode

9) Episode Body scan: the client is asked to notice body sensations while bringing the entire trauma episode to mind, with any residual body tension being reprocessed by the clinician

10) Closure: ensures a strong closure to target processing especially for unfinished sessions and a return to the stabilisation exercises is conducted at the end of every session.

11) Re-evaluation: the client's subjective units of distress and the validity of their positive cognition are re-evaluated followed by a re-administration of the IES-R trauma screen

5. Who provided: The intervention was delivered by experienced clinicians who have been trained in EMDR R-TEP (2-day training workshop) by the treatment developer (Elan Shapiro) and have completed Part I and Part II and III of basic EMDR training. These will include a Consultant Clinical Psychologist and Psychological Therapists who have expertise working with clients presenting with complex trauma and enduring mental health difficulties such as PTSD and Personality Disorder.

6. How: EMDR R-TEP was delivered online, via Skype or Zoom, on an individual basis for each participant. This will be over the course of 2-8 sessions. Following completion of R-TEP, participants will be contacted through post for their 4-month follow-up to complete the repeat outcome measures.

7. Where: Eligible participants who have consented to participate in the study, were referred to the Intensive Psychological Therapies Service (IPTS) team located in Poole (Dorset). Because of ongoing social distancing guidelines, EMDR R-TEP sessions took place remotely, using the participant's preferred platform of Skype or Zoom, in accordance with NHS Digital guidance. The environment is remote from the scene of the trauma (i.e. hospital) and we are hoping that this would cause less distress to participants while engaging in the intervention. In addition, the use of an online platform will enable access to a broad population of patients who may be physically unable to travel to a psychological service clinic. IPTS is a tertiary service for outpatients, who present with complex trauma and enduring mental health difficulties, and is part of the Dorset HealthCare University NHS Foundation Trust. The service consists of a multi-disciplinary team of therapists from a variety of core professional backgrounds such as Clinical Psychology, Nursing and Occupational Therapy. All staff are professionally trained, post qualification, in a minimum of two therapies that are delivered at the service.

8. When and how much: The EMDR R-TEP intervention for this study consisted of 1-8 weekly sessions per participant. Each session lasted 60-90 minutes. At 6-months post-hospital discharge all patients

were contacted via telephone, to arrange a repeat of the baseline assessments completed following consent. Patients completed these assessment questionnaires by post or over the telephone.

9. Tailoring: The number of therapy sessions can vary on an individual basis depending on the participant's severity of the identified trauma and how able they are to address it during treatment. This was discussed with the treating clinician and mutually agreed prior to establishing the therapeutic framework of the intervention. Another aspect which can be tailored is whether the 3-month follow-up session is completed face-to-face or through telephone depending on the participant's needs.

10. Modifications: None expected

11. How well (planned): All clinicians who delivered EMDR R-TEP in this study have been trained in the delivery of the intervention and adhered to a standardised protocol of treatment. The number of therapy sessions varied depending on each participant and this is an aspect of the study which can be difficult to control or plan in advance. We collected adherence data as part of our primary outcome. These will inform the design of a future randomised controlled trial.

12. How well (actual): reported in the main manuscript.

Reference:

1. Hoffmann TC, Glasziou PP, Boutron I, Milne R, Perera R, Moher D, et al. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. BMJ. 2014 Mar 7;348:g1687.

Supplementary file: Table S1: Detailed outcome measure description

Hospital admission history	
APACHE II – Acute physiology and chronic health evaluation(1)	APACHE II is a severity of disease classification, applied within 24 hours of ICU admission. Points are ascribed according to arterial pressure of oxygen, body temperature, mean arterial pressure, arterial blood pH, heart rate, respiratory rate, serum sodium, serum potassium, creatinine, haematocrit, white blood cell count, and Glasgow coma scale. Additional points are added for age and chronic (pre-existing) health problems,
Intensive care unit (ICU) length of stay (LOS)	ICU LOS is the number of calendar days from ICU admission (day one) to ICU discharge.
Total ventilation days	Recorded as the number of calendar days during which the patient received invasive positive pressure ventilation (IPPV). Duration of IPPV is reported to be associated with post-ICU psychopathology(2).
Benzodiazepine use	We report the total number of patients who received benzodiazepines at any point during their ICU admission, as use of this class of drug is associated with post-ICU psychopathology(2).
Hospital length of stay	Number of calendar days from hospital admission (day one) to hospital discharge.
Feasibility outcomes	
Recruitment	Calculated from patients who consented for trial participation as a proportion of patients approached.
Intervention adherence	Calculated from EMDR intervention sessions completed as a proportion of sessions offered.
Protocol adherence	Calculated from number of participants who completed the trial with no protocol deviations or violations as a proportion of participants enrolled.
Trial completion	Calculated from number of participants who completed all trial outcome assessments as a proportion of participants enrolled.
Clinical outcomes	
Post-traumatic stress disorder Civilian checklist (PCL-C)	A patient-reported outcome measure comprising 17 questions related to key symptoms of PTSD. Participants were asked to report how much they have been bothered by symptoms in the last month, ranging from not at all (1 point), a little bit (2 points), moderately (3 points), quite a bit (4 points), extremely (5 points). Scores range from 17-85. The PCL-C has been validated(3) used in studies of post-ICU psychopathology(4).
Hospital anxiety and Depression Scale (HADS)(5)	A patient-reported outcome measure comprising 2 subscales – one subscale consists of 7 questions assessing anxiety symptoms (HADS-A). The other subscale consists of 7 questions assessing symptoms of depression (HAD-D). Scores form the sub-scales can be reported separately or combined. Each subscale can record a maximum score of 21, with higher scores representing increased symptomology. HADS has been demonstrated good internal

	consistency with alternative mental health scoring systems in ICU survivor populations(6)
EuroQol Five Dimension-Five level scale (EQ-5D-5L)(7)	A patient reported outcome measuring health-related quality of life, through five dimensions of health: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Participants also rate their perception of health on a visual analogue scale numbered from 0-100, with a higher score relating to better quality of health.
Brief Resilience Scale (BRS)(8)	Patient-reported outcome measure of ability to bounce back following exposure to health-related stressors. Participants are asked to respond to six statements, relating 'the extent to which you agree with the following statements'. Participants respond with strongly disagree (1 point) through to strongly agree (5 points), and a mean score is calculated. BRS is correlated with anxiety, depression and physical symptoms(8)
Council of Nutrition Appetite Questionnaire (CNAQ)(9)	Patient-reported outcome measure that is predictive of weight loss, known to complicate health recovery and predict mortality across a range of participant groups(10). CNAQ is an eight item Likert scale questionnaire, with a range of total scores from 8-40, with higher score predicting higher weight loss.

References:

1. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. Crit Care Med. 1985 Oct;13(10):818-29.
2. Wade DM, Howell DC, Weinman JA, Hardy RJ, Mythen MG, Brewin CR, et al. Investigating risk factors for psychological morbidity three months after intensive care: a prospective cohort study. Crit Care. 2012 Oct 15;16(5):R192.
3. Karstoft KI, Andersen SB, Bertelsen M, Madsen T. Diagnostic accuracy of the Posttraumatic Stress Disorder Checklist-Civilian Version in a representative military sample. Psychol Assess. 2013 Mar;26(1):321.
4. Hatch R, Young D, Barber V, Griffiths J, Harrison DA, Watkinson P. Anxiety, Depression and Post Traumatic Stress Disorder after critical illness: a UK-wide prospective cohort study. Crit Care. 2018;22(1):310.
5. Zigmond AS, Snaith RP. The Hospital Anxiety and Depression Scale. Acta Psychiatr Scand. 1983, Jun;67(6):361-70.
6. Jutte JE, Needham DM, Pfoh ER, Bienvenu OJ. Psychometric evaluation of the Hospital Anxiety and Depression Scale 3 months after acute lung injury. J Crit Care. 2015 Aug;30(4):793-8.
7. Herdman M, Gudex · C, Lloyd · A, Janssen MF, Kind · P, Parkin · D, et al. Development and preliminary testing of the new five-level version of EQ-5D (EQ-5D-5L). Qual Life Res. 2011 Dec;20(10):1727-36
8. Smith BW, Dalen J, Wiggins K, Tooley E, Christopher P, Bernard J. The brief resilience scale:

Assessing the ability to bounce back. Int J Behav Med. 2008 Sep;15(3):194–200.

9. Wilson M-MG, Thomas DR, Rubenstein LZ, Chibnall JT, Anderson S, Baxi A, et al. Appetite assessment: simple appetite questionnaire predicts weight loss in community-dwelling adults and nursing home residents. Am J Clin Nutr. 2005 Nov 1;82(5):1074–81.

10. Losonczy KG, Harris TB, Cornoni-Huntley J, Simonsick EM, Wallace RB, Cook NR, et al. Does weight loss from middle age to old age explain the inverse weight mortality relation in old age? Am J Epidemiol. 1995 Feb 15;141(4):312–21.