
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
The 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.\(^{(12)}\) 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\(^{(36)}\) and ICU–survivorship specifically,\(^{(39,40)}\) could not identify optimal timing of preventative interventions. Moreover, none of the reviewed studies investigated a protocolised, trauma–focused 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. The study was conducted according to Medical Research Council (MRC) guidance on developing complex interventions and is reported according to Consolidated Standards of Reporting Trials (CONSORT) extension to randomised pilot and feasibility trials. 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 \(\geq 8\)\(^{(52)}\) 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, and previously-reported ICU recovery feasibility studies of complex interventions. 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–Wilks test.

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.

Table 1. Demographic and clinical characteristics at Baseline

<table>
<thead>
<tr>
<th>Variables</th>
<th>All (N=26)</th>
<th>Control (N=13)</th>
<th>EMDR (N=13)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD), years</td>
<td>58.0 (15.3)</td>
<td>58.3 (16.5)</td>
<td>57.7 (14.8)</td>
<td>0.923</td>
</tr>
<tr>
<td>Gender, male n (%)</td>
<td>16 (61.5)</td>
<td>8 (61.5)</td>
<td>8 (61.5)</td>
<td>1.00</td>
</tr>
<tr>
<td>BMI</td>
<td>32.7 (6.82)</td>
<td>32.5 (6.70)</td>
<td>32.9 (7.21)</td>
<td>0.885</td>
</tr>
<tr>
<td>Ethnicity n (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.593</td>
</tr>
<tr>
<td>White (British)</td>
<td>23 (88.5)</td>
<td>11 (84.6)</td>
<td>12 (92.3)</td>
<td></td>
</tr>
<tr>
<td>White (Other)</td>
<td>2 (7.7)</td>
<td>1 (7.7)</td>
<td>1 (7.7)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>1 (3.8)</td>
<td>1 (7.7)</td>
<td>0 (0.0)</td>
<td></td>
</tr>
</tbody>
</table>
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 the 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 –0.33,0.17) 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

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

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 participants per month, during a period of unprecedented clinical pressure. We were able to recruit 51% of eligible patients approached, exceeding 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 participation. 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 participants 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 recruitment 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. Eligible patients most frequently cited lack of psychological distress as the main reason for trial decline. Moreover, of the 12 participants 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 clinical 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 acceptable, 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 clinical 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, including 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 clinical 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 clinical outcomes up to a minimum of 12-months post-discharge, preferably longer. Our study was undertaken during a period of unprecedented clinical 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. 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.

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**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:

### Hospital admission history

**APACHE II – Acute physiology and chronic health evaluation**

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.

**ICU 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
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:

