European Psychiatry 41 (2017) 140–152

Contents lists available at ScienceDirect

European Psychiatry

journal homepage: http://www.europsy-journal.com

Original article

EPA guidance on eMental health interventions in the treatment of posttraumatic stress disorder (PTSD)

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ARTICLE INFO

Article history:
Received 20 October 2016
Received in revised form 4 January 2017
Accepted 9 January 2017
Available online 27 January 2017

Keywords:
eMental Health
E-mental health
Mobile health
Posttraumatic stress disorder
PTSD
Mental healthcare

ABSTRACT

The aim of this EPA guidance was to develop recommendations on eMental health interventions in the treatment of posttraumatic stress disorder (PTSD). A systematic literature search was performed and 40 articles were retrieved and assessed with regard to study characteristics, applied technologies, therapeutic approaches, diagnostic ascertainment, efficacy, sustainability of clinical effects, practicability and acceptance, attrition rates, safety, clinician-supported vs. non-supported interventions and active vs. waiting-list controls. The reviewed studies showed a great heterogeneity concerning study type, study samples, interventions and outcome measures. Based on these findings, five graded recommendations dealing with symptom reduction, acceptability, type of administration, clinician support, self-efficacy and coping were developed.

1. Introduction

In the last decades, the field of eHealth, i.e. the use of information and communication technologies for health [1], has grown substantially and is getting increasingly important in the diagnosis and treatment of diseases in general [2]. However, there is no common consensus on how eMental health is defined as a subtype of eHealth [3]. The focus of an eMental health intervention may vary from the inclusion of administrative mechanisms of healthcare systems (e.g. electronic prescribing, electronic health records) to targeting prevention, mental health literacy, education and treatment using specific information technologies and devices [4]. For the purpose of this guidance eMental health is defined as "mental health services and information delivered or enhanced through the Internet and related technologies" [5].

E-mental health approaches may contribute to closing the treatment gap in mental healthcare as they are relatively inexpensive and easily accessible [6]. Another advantage of eMental health interventions is that they can provide anonymity to the user. This may be particularly important in mental healthcare which is associated with high levels of stigmatization and resulting access barriers to mental healthcare. E-mental health interventions are under development for a range of mental disorders [6,7] and the focus of this guidance is on eMental health interventions for the treatment of posttraumatic stress disorder (PTSD). According to DSM-5, PTSD is triggered by exposure to actual or threatened death, serious injury or sexual violation. The exposure must result from direct experience of the traumatic event, witnessing the traumatic event in person, learning that the traumatic event occurred to a close family member or close friend or experiencing first-hand repeated or extreme exposure to aversive details of the traumatic event [8]. Furthermore, diagnostic criteria include intrusion symptoms, persistent avoidance of trauma-associated stimuli, negative alterations in cognition and mood, and increased arousal and reactivity associated with the traumatic event. PTSD is treated effectively by trauma-focused psychotherapies (e.g. cognitive behavioural therapy or cognitive processing) and eMental health interventions for PTSD are often based on these evidence-based treatment approaches [2]. The aim of this EPA Guidance is to systematically identify eMental health

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http://dx.doi.org/10.1016/j.eurpsy.2017.01.001
0924-9338/

Table 1
Systematic search strategies.

Database	Search syntax[a]	Number of retrieved documents	Date of search
Medline (PubMed)	(intervention[a] OR applicat[a] OR guideline[a]) AND (effect[a] OR effic[a] OR eviden[a] OR outcome) AND (mhealth OR "m health" OR m-health OR ehealth OR "e health" OR e-health OR mobile OR "e-mental health" OR "e mental health" OR "emental health") AND ("Stress Disorders, Post-Traumatic"[MeSH] OR PTSD) Filters: Publication date from 2000/01/01 to 2016/05/04; Languages: English; German Search in [Title/Abstract]	18	04.05.2016
Scopus	(mhealth OR m-health OR "m health" OR ehealth e-health OR mobile OR "emental health" OR "emental health" OR "e-mental health") AND (PTSD OR "posttraumatic stress disorder" OR "post-traumatic stress disorder") AND (intervention[a] OR applicat[a] OR guideline) AND (effect[a] OR effic[a] OR eviden[a] OR outcome) Filters: Publication date from 2000/01/01 to 2016/05/04; Languages: English; German Search in [Title/Abstract/Keywords]	23	11.05.2016
PsychINFO	(mhealth OR m-health OR "m health" OR ehealth OR e-health OR "e health" OR mobile OR "emental health" OR "e-mental health" OR "e mental health") AND (posttraumatic stress disorder [Index Term] OR "posttraumatic stress disorder" OR PTSD OR "post-traumatic stress disorder") AND (effect[a] OR effic[a] OR eviden[a] OR outcome) AND (intervention OR applicat[a] OR guideline) Filters: Publication date from 2000/01/01 to 2016/05/04; Languages: English; German Search in [Title/Abstract]	14	12.05.2016

[a] The detailed search syntax is available on request from the authors.

interventions in the treatment of posttraumatic stress disorder, to assess their efficacy and to provide evidence-based recommendations for their application in clinical practice.

2. Methods

The development of EPA Guidance documents is standardized and has been described in detail in previous EPA Guidance papers [9–11]. In brief, systematic literature searches were performed (Table 1). Studies were selected according to predefined inclusion and exclusion criteria. Discrepancies in the selection were resolved via discussions (by the authors IG, AK, JZ). Study quality was appraised using quality checklists that were adapted from the Scottish Intercollegiate Guidelines Network (SIGN) quality checklists for different study types (http://www.sign.ac.uk/methodology/checklists.html). These checklists included information on study quality (research question, methodology, statistical methods, potential confounders, reported conflicts of interest), study characteristics (sample sizes, sample characteristics, study design, follow-up duration, main results, effect sizes (Cohen's *d*) and source of study funding) and an overall assessment (appraisal of bias; representative size and selection of study group; results measured in standard, valid and reliable way; information about drop-outs, results applicable to target group of guidance; overall appraisal of strengths and weaknesses of the study). Details of the selection process are shown in Fig. 1.

The following inclusion and exclusion criteria were used in order to identify studies on the efficacy of eMental health interventions for PTSD.

2.1. Inclusion criteria

Inclusion criteria are as follows:

- studies about the use of eMental health applications (i.e. computer-based, Internet-based, smartphone or tablet-based applications) as interventions in the treatment of PTSD;
- papers addressing quality assurance methods for assessing the efficacy of eMental health applications for PTSD;
- publications addressing the ethical or legislative aspects of eMental health applications for PTSD;
- manuals about eMental health applications for PTSD.

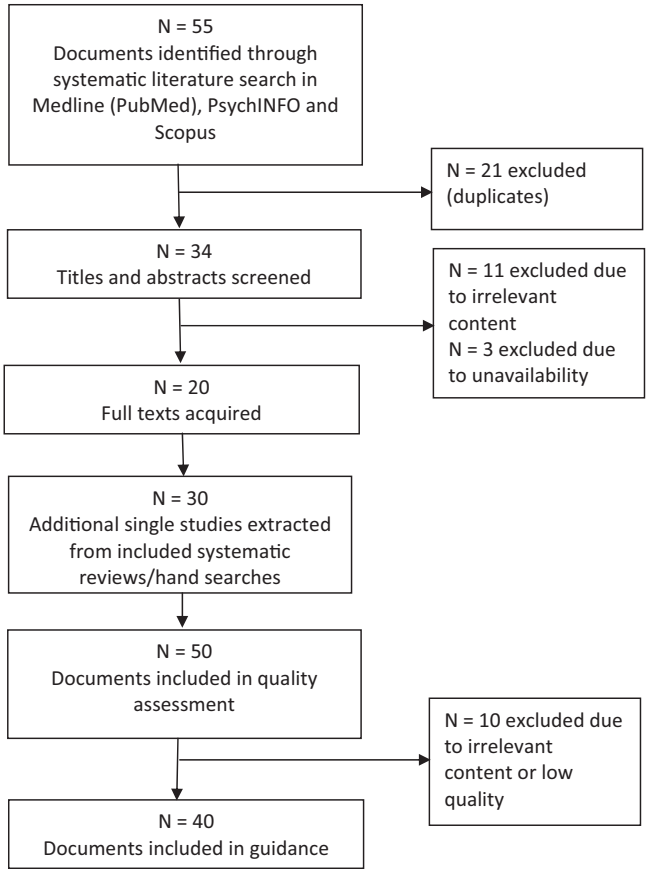

Fig. 1. Flowchart of evidence retrieval and assessment.

2.2. Exclusion criteria

Exclusion criteria are as follows:

- studies not including posttraumatic stress symptoms as (primary or secondary) outcome measure;
- conference abstracts, editorials, pure opinion papers and papers addressing general mental healthcare questions without empirical data;

Table 2
Grading of evidence from quantitative studies, qualitative studies and reviews ([1,51,52]2).

Study type	Features of qualitative research	Features of quantitative studies	Features of reviews
Level I Generalizable studies	Sampling focused by theory and the literature, extended as a result of analysis to capture diversity of experience. Analytic procedures comprehensive and clear. Results can be generalized to settings or stakeholder groups other than those reported in the study	Randomized controlled trials. Surveys sampling a large and representative group of persons from the general population or from a large range of service settings. Analytic procedures comprehensive and clear usually including multivariate analyses or statistical modeling. Results can be generalized to settings or stakeholder groups other than those reported in the study	Systematic reviews or meta-analyses
Level II Conceptual studies	Theoretical concepts guide sample selection, based on analysis of literature. May be limited to one group about which little is known or a number of important subgroups. Conceptual analysis recognizes diversity in participants' views	Uncontrolled, blinded clinical trials. Surveys sampling a restricted group of persons or a limited number of service providers or settings. May be limited to one group about which little is known or a number of important subgroups. Analytic procedures comprehensive and clear. Results have limited generalizability	Unsystematic reviews with a low degree of selection bias employing clearly defined search strategies
Level III Descriptive studies	Sample selected to illustrate practical rather than theoretical issues. Record a range of illustrative quotes including themes from the accounts of "many", "most", or "some" study participants	Open, uncontrolled clinical trials. Description of treatment as usual. Survey sampling not representative since it was selected from a single specialized setting or a small group of persons. Mainly records experiences and uses only a limited range of analytical procedures, like descriptive statistics. Results have limited generalizability	Unsystematic reviews with a high degree of selection bias due to undefined or poorly defined search strategies
Level IV Single case study	Provides rich data on the views or experiences of one person. Can provide insight in unexplored contexts	Case studies. Provides survey data on the views or experiences of a few individuals in a single setting. Can provide insight in unexplored contexts. Results cannot be generalized	Editorials

- computer-aided systems, i.e. systems which use computer- or Internet-based technologies to address study participants or retrieve and/or collect information from study participants, but which have no clear focus on eMental health applications (like the use of a computerized version of a depression test without any further eMental health aspect of the study);
- studies dealing with television, radio, telephone, videoconferencing, video telephone services and print materials;
- studies dealing with the prevention of or diagnostic processes of PTSD;
- descriptions and evaluations of computer- or Internet-based systems exclusively used to collect or analyze routine healthcare data (like hospital information systems or descriptions of algorithms used to analyze mental health datasets) or solely used as a communication tool between patients and healthcare providers;
- technical descriptions of eMental health systems without evaluation of their efficacy (like descriptions of the design stages of eMental health product developments or conceptual papers about the potential uses of e mental health applications);
- studies about information retrieval systems (like analyses about the use of computers to store medical information or analyses of database use, but studies were included if they analyzed the use of eMental health applications);
- general electronic information applications provided by healthcare providers, patient organizations or medical specialty societies;
- applications not dealing with PTSD;
- internet/computer use and addiction: studies on computer use (for example its relation to sleep problems) and on the concept of Internet addiction, epidemiology, diagnosis and classification, and non-eMental health based interventions for Internet or computer use and addiction were not included;
- radiologic studies without eMental health aspects (like clinical studies on the use of "computer tomography");
- virtual reality studies, unless these used Internet-based presentations of virtual reality applications in the framework of an eMental health application.

Included studies were summarized in evidence tables (Table 4 adapted from the Scottish Intercollegiate Guidelines Network (SIGN) (http://www.sign.ac.uk/methodology/checklists.html). Each study was graded as described in Table 2.

Based on the evidence table that summarizes information on all included studies (Table 4), recommendations were developed by four authors (WG, IG, AK and JZ) and reviewed by the co-authors (AM and DM). We consented on relevant recommendation topics by discussion. The topics emerged from the currently available evidence in the selected studies. We formulated each recommendation based on the framed evidence outlined in the results section. They were graded according to the criteria described in Table 3 [12].

The "body of evidence", as described in Table 3, was defined as the availability of three or more studies on one recommendation

Table 3
Grading of recommendations ([1,51,52]2).

Recommendation grade	Description
A	At least one study or review rated as I and directly applicable to the target population; or A body of evidence consisting principally of studies and/or reviews rated as I, directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including studies and/or reviews rated as II, directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies and/or reviews rated as I or II
C	A body of evidence including studies and/or reviews rated as II–III, directly applicable to the target population and demonstrating overall consistency of results; or extrapolated evidence from studies and/or reviews rated as II–III
D	Evidence level III or IV; or Extrapolated evidence from studies and/or rated as III or IV; or Expert consensus

Table 4
Evidence table of included studies.

References (alphabetical order)	Type of study	Methods, main results and limitations	Evidence level
Askins et al., 2009 [53]	Randomized controlled trial	Randomized comparison of an 8-week problem-solving skills training of eight 1-h individual sessions either with or without additional support by a personal digital assistant (PDA). In person training $n = 104$, additional PDA $n = 93$. PDA provided brief reviews of the problem-solving process, practice of the training elements, prompts to use problem-solving skills and periodic logs to record problems and solutions experienced by the user. The follow-up duration was 3 months Study did not show superior effects of PDA compared to a treatment-as-usual group Limitations: specific sample (mothers of children with newly diagnosed cancer), no clinician-administered clinical PTSD diagnosis	I
Beyer et al., 2014 [54]	Randomized controlled trial	This trial compared two novel therapist guided forms of written emotional disclosure (WED) ($n = 41$) — advance guidance (before sessions)($n = 41$) or real-time guidance ($n = 41$) (during sessions, through instant messaging)—to both standard WED and control writing ($n = 40$) in 163 students; it also tested "Big 5" personality traits as moderators of guided WED. The follow-up duration was 6 weeks The study showed lack of differential efficacy of three different types of expressive writing approaches, although beneficial effects were observed in all three study arms Limitations: specific sample (student participants with previous trauma experiences), no clinician-administered clinical PTSD diagnosis, no information on power calculation, no follow-up after post-treatment measurement at 6 weeks	I
Bolton and Dorstyn, 2015 ([34])	Systematic review	Evaluation of the effectiveness of psychological services provided remotely for the management of PTSD. Eleven studies ($n = 472$ participants) were identified from electronic database searches Short-term treatment gains were reported for Internet based interventions. This included significant medium to large improvements in symptoms of depression, generalized anxiety and posttraumatic stress. Both, treatment gains and deterioration were noted 1 to 6 months following treatment cessation Limitations: several included studies were characterized by small and underpowered samples and limited follow-up data. Studies with participants without clinician-administered clinical PTSD diagnosis were included	I
Böttche et al., 2014 [45]	Non-randomized uncontrolled trial	Investigation of the effectiveness of integrative writing therapy in 51 openly recruited participants aged 65–85 with war-associated trauma. Data were collected over 2 years with an intervention period of 6 weeks. Therapeutic texts were analyzed using quantitative content analysis Promising approach in identifying and distinguishing components of writing therapy on the affective vocabulary level. No therapeutic effects could be described Limitations: specific sample (mostly participants of older age), no clinician-administered clinical PTSD diagnosis	III
Böttche et al., 2016 [41]	Randomized controlled trial	Evaluation of the role of resource-oriented variables in predicting treatment response in older adults with post-traumatic stress. A sample of 58 adults with subsyndromal or greater severity of war-associated PTSD symptoms completed a randomized controlled Internet-based CBT with immediate (n = 30) and delayed treatment ($n = 28$) groups. Assessments of PTSD severity and resource-oriented variables of self-efficacy, Locus of control (LOC) and post-traumatic growth (PTG) were conducted at baseline, post-treatment and at a 6-month follow-up Findings suggested that greater locus of control and post-traumatic growth were associated with greater improvement in PTSD symptoms following Internet-based CBT Limitations: waiting-list control condition	I
Carpenter et al., 2014 [29]	Randomized controlled trial	Evaluation of an online CBT stress management manual for breast cancer patients. Randomized to intervention were $n = 71$, control $n = 61$. Completer numbers were $n = 57$ in the intervention group and $n = 59$ in the control group At 10 weeks, intervention participants showed improved self-efficacy for coping with their cancer and for regulating negative mood, and lower levels of cancer-related post-traumatic symptoms as compared to the control group. The follow-up duration was 20 weeks Limitations: relatively high drop-out rate, it was unclear, if participants had diagnosis of PTSD or only symptoms, post-traumatic stress symptoms were assessed as secondary outcome measure only, waiting-list control condition	I
Hirai and Clum, 2005 [37]	Randomized controlled trial	This study compared the efficacy of an Internet-based, 8-week self-help program for traumatic event-related consequences ($n = 13$) to a waiting-list (WL) condition ($n = 14$) Significant differential improvements for depression, state anxiety and the frequency of intrusive thoughts were found. Clinically significant improvement 50–60% of cases in the SHTC group and 15–35% in the waiting-list groups Limitations: clinician-administered sub-clinical PTSD diagnosis, waiting-list control condition. No follow-up after post-treatment measurement at 8 weeks	I
Hirai et al., 2012 [30]	Randomized controlled trial	This study compared the efficacy of 2 online expressive writing protocols for a traumatic/stressful life event in a Hispanic student sample with a follow-up of 5 weeks Both groups (emotion-focused expressive writing ($n = 54$) vs. fact-focused control writing ($n = 50$) statistically significantly reduced trauma symptoms over time with the emotion-focused group, demonstrating statistically significantly greater trauma symptom reductions than the fact-focused group Limitations: specific sample, no clinician-administered clinical PTSD diagnosis, high drop-out rate ($n = 29$), no follow-up after post-treatment measurement at 5 weeks, no information on power calculation	I
Kassam-Adams et al., 2015 [55]	Mixed methods (model development and survey)	Assessment of content validity of the app "coping coach" by an expert group ($n = 15$) of psychiatrists and psychologists with quantitative and qualitative methods in a 5-step evaluation approach The study demonstrated that assessment of content validity was straightforward and feasible to implement and that results of this assessment can provide useful information for ongoing development and iterations of new eHealth interventions Limitations: small scale study, incomplete ratings of experts and non-validated evaluation approach	III

Table 4 (*Continued*)

References (alphabetical order)	Type of study	Methods, main results and limitations	Evidence level
Kersting et al., 2013 [26]	Randomized controlled trial	This is an Internet-based intervention using exposure techniques and cognitive restructuring with 228 participants (treatment group $n = 115$, control group = 113) and a 12-month follow-up comparing posttraumatic stress symptoms, prolonged grief, general psychopathology and depression The Internet-based intervention was effective for parents after pregnancy loss. It was feasible, lead to reduced symptoms of posttraumatic stress, grief, depression, anxiety and general mental health after pregnancy loss Limitations: specific sample (mostly female, well participants), no clinician-administered clinical PTSD diagnosis, waiting- list control condition	I
Kersting et al., 2011[40]	Randomized controlled trial	Delivery of Internet-based CBT in the form of an online stress management programme ($n = 45$) vs. waiting-list control condition ($n = 33$) This Internet-based CBT program was an effective treatment approach with stable effects (3 months follow-up) for women after pregnancy loss. There were significant improvements in posttraumatic stress symptoms, grief, depression, and overall mental health, but not in anxiety or somatization Limitations: specific sample (only females included), no clinician-administered clinical PTSD diagnosis, waiting-list control condition	I
Klein et al., 2010 [36]	Uncontrolled open trial	Open trial evaluation of a 10-week therapist-assisted cognitive behavior therapy Internet intervention (PTSD Online) undertaken with 22 persons with a primary clinical diagnosis of posttraumatic stress disorder with 3-month follow-up Significant improvements on PTSD severity ratings and related PTSD symptomatology were observed at post-assessment and maintained at 3-month follow-up Limitations: PTSD group was underpowered compared to online group, no control group	II
Klein et al., 2011 [42]	Naturalistic participant choice, quasi-experimental design	Open access participant choice evaluation pilot trial including people both with subclinical and clinical diagnoses in five anxiety disorder areas (General Anxiety Disorder, $n = 88$; Social Anxiety Disorder, $n = 50$), Panic Disorder with or without Agoraphobia, $n = 40$; PTSD, $n = 30$; Obsessive Compulsive Disorder, $n = 17$). Follow-up duration was 12 weeks Study indicates efficacy of online PTSD CBT-based treatment Limitations: part of the sample with no clinician-administered clinical PTSD diagnosis, no follow-up after post-treatment measurement at 12 weeks, no control group, PTSD group was underpowered	III
Knaevelsrud and Maercker, 2006 [13]	Randomized, controlled trial	Comparative study on the therapeutic relationship (working alliance) in Internet-based PTSD treatment (INTERAPY) with $n = 48$ participants in the intervention group, receiving working alliance assessment at 4th session treatment, and $n = 43$ participants in the waiting-list control group. The follow-up duration was 5 weeks Positive correlations were identified between the patients' ratings of the working alliance and therapeutic outcome, but these were not statistically significant. Working alliance perceptions did not seem to play a major role in determining treatment success in online intervention Limitations: no clinician-administered clinical PTSD diagnosis, no follow-up after post-treatment measurement at 5 weeks, waiting-list control condition, small sample size limited power	I
Knaevelsrud and Maercker, 2007 [14]	Randomized controlled trial	Evaluation of the "INTERAPY" approach with an intervention condition ($n = 49$) vs. waiting-list control condition ($n = 47$). The intervention consisted of two weekly 45-minute writing assignments over a five-week period (10 essays in total). The therapy consisted of three treatment phases: 1) self-confrontation, 2) cognitive reconstruction, and 3) social sharing. The follow-up duration was 3 months INTERAPY lead to a significantly improved primary outcome (PTSD severity as measured for intrusions, avoidance, hyperarousal, depression and anxiety). The effects were sustained during the 3-month follow-up period Limitations: no clinician administered clinical PTSD diagnosis, waiting- list control condition, no information on power calculation	I
Knaevelsrud and Maercker, 2010 [15]	Naturalistic follow-up study	18-month follow-up of an Internet-based cognitive behavioral therapy intervention (INTERAPY) for $n = 30$ persons with PTSD Sustained improvements after INTERAPY with regard to PTSD symptom severity, depression, anxiety, mental and physical health and healthcare utilization Limitations: specific sample (mostly female, highly educated participants), no clinician-administered clinical PTSD-diagnosis, waiting-list control condition, no information on power calculation	II
Knaevelsrud et al., 2015 [16]	Randomized controlled trial	Evaluation of the "INTERAPY" approach with an intervention condition ($n = 49$) vs. waiting-list control condition ($n = 47$) in war-traumatized Arab patients in Iraq. The intervention consisted of two weekly 45-minute writing assignments over a five-week period (10 essays in total). The therapy consisted of three treatment phases: 1) self-confrontation, 2) cognitive reconstruction, and 3) social sharing INTERAPY lead to a significantly improved primary outcome (PTSD severity as measured for intrusions, avoidance, hyperarousal, depression and anxiety). The effects were sustained during the 3-month follow-up period Limitations: specific sample (well educated, mostly female participants), no clinician-administered clinical PTSD diagnosis, waiting-list control condition, no information on power calculation	I
Kuhn et al., 2015 [24]	Survey	This survey sought to identify the rate of PE Coach use among 271 clinicians and to characterize their perceptions of the app's relative advantage, compatibility, complexity, trialability, and observability Findings suggest that clinicians are using PE Coach and have favorable perceptions of it, but enhanced dissemination efforts may be needed to increase adoption for certain clinician groups Limitations: survey, no validation of self developed scale, no information on power calculation	II
Kuhn, 2014 [21]	Descriptive study	A sample ($n = 45$) of veterans with a self-assessed level of PTSD symptoms were provided with instructions on how to use the app (PTSD Coach) and test it within 3 days followed by a focus group discussion on feasibility and acceptability Participants were very satisfied with PTSD Coach and perceived it as being moderately to very helpful for their PTSD symptoms. Analysis of focus group data resulted in several categories of app use: to manage acute distress and PTSD symptoms, at scheduled times, and to help with sleep. These findings offer preliminary support for the acceptability and perceived helpfulness of PTSD Coach and suggest that it has potential to be an effective self-management tool for PTSD Limitations: specific, mostly male (76%) sample, no clinician-administered clinical PTSD diagnosis, no data on long-term utilization and acceptability	III

Table 4 (*Continued*)

References (alphabetical order)	Type of study	Methods, main results and limitations	Evidence level
Kuester et al., 2016 [43]	Systematic review	Meta-analysis of 20 randomized controlled studies, including 21 comparisons to assess the efficacy of Internet-based interventions for the treatment of PTSD and to identify moderator variables CBT-internet based interventions were more efficacious than passive controls, but were not superior to active controls. The maximum follow-up duration in the included studies was 24 weeks Limitations: studies with participants without clinician-administered clinical PTSD diagnosis were included, number of includable studies for subgroup analyses was low, which limited statistical power, several included studies were characterised by small and underpowered samples	I
Kryspin-Exner et al., 2009 [44]	Narrative review	Unsystematic review focusing on the elderly gives information about studies conducted with a PTSD online treatment program and an international guideline Study shows that Internet-based treatment of PTSD was effective Limitations: non-systematic identification of relevant studies	III
Lange et al., 2003 [17]	Randomized controlled trial	Evaluation of the "INTERAPY" approach in a sample of $n = 184$ ($n = 122$ treatment group, $n = 62$ waiting-list control group) with a high attrition rate The intervention consisted of two weekly 45-minute writing assignments over a five-week period (10 essays in total). The therapy consisted of three treatment phases: 1) self-confrontation, 2) cognitive reconstruction, and 3) sharing and farewell ritual The participants in the treatment condition received treatment immediately after the screening procedure. Follow-up tests were completed 6 weeks after treatment ($n = 57$) Participants in the treatment condition ($n = 69$) improved significantly more than participants in the waiting-list control condition ($n = 32$) on trauma-related symptoms and general psychopathology with large effect sizes Limitations: no clinician-administered clinical PTSD diagnosis, waiting-list control condition, high drop-out rate	I
Lange et al., 2001 [18]	Randomized controlled trial	Evaluation of the "INTERAPY" approach in a very small sample ($n = 13$ in intervention group, $n = 12$ in waiting-list control group) of students who had experienced a traumatic event at least 3 months ago. Treatment lasted 5 weeks. The follow-up assessment took place 6 weeks after treatment ($n = 8$) Decreased symptoms of PTSD were observed in both groups over time, but significantly larger decrease in the INTERAPY group Limitations: specific sample (only students), no clinician-administered clinical PTSD diagnosis, no information on power calculation	I
Nieminen et al., 2016 [31]	Randomized controlled trial	Analysis of the effects of an 8-weeks trauma-focused guided Internet-based CBT intervention for relieving PTSD symptoms following childbirth in a sample of 56 traumatized women ($n = 28$ in intervention group and $n = 28$ in waiting-list control group) Decreased posttraumatic stress symptoms were found in both groups but with larger effects in the treatment group. In both groups, treatment had positive effects on comorbid depression and anxiety. In the treatment group there were also positive effects on QoL Limitations: specific sample (PTSD after childbirth), waiting-list control condition, no follow-up after post-treatment measurement at 8 weeks, small sample size limited power	I
Olff, 2015 [2]	Narrative review	The study gives an overview about the status and application of mobile health interventions for PTSD. It provides preliminary evidence on the effectiveness of treatment with mHealth interventions for PTSD, but most studies thus far have a low methodological quality There is no method description in this review Limitations: non-systematic approach, no methodology or systematic search criteria provided	III
Owen et al., 2005 [56]	Randomized controlled trial	Randomized controlled pilot study assessing the effects of a self-guided, Internet-based coping-skills training group on quality of life in 62 women with clinical stage 1 or 2 breast cancer ($n = 30$ in waiting-list control condition, $n = 32$ in Internet-based discussion group). Post-treatment measurement at12 weeks Results showed no main effects on quality of life Limitations: waiting-list control condition, no clinician-administered clinical PTSD diagnosis, only measurement of distress, no follow-up after post-treatment measurement at 12 weeks, small sample size limited power	I
Owen et al., 2015 [22]	Descriptive study (with mixed-methods analyses)	Analysis of $n = 153.834$ downloads of PTSD Coach app with regard to utilization pattern (e.g., pathways of using its functions, time spent using the app) and qualitative analysis of $n = 156$ user reviews and ratings of the PTSD Coach app in the Apple store and Google Play stores in order to characterize reach, use and impact of PTSD Coach Over 60% of users engaged with PTSD Coach on multiple occasions. Users rated availability of the app during moments of need positively. A certain attrition level was identified, with only 80% of first-time users opening the home screen of the app and 37% opening at least one content area The main conclusion was that the PTSD coach app was used as intended and had been favorably received Limitations: only app store ratings were included in qualitative analysis	III
Parish et al., 2014 [57]	Not applicable (short project description)	Evaluation of the efficacy of several innovative online engagement and assessment methods in 86 veterans with half of them having combat-related PTSD and the other half having no PTSD. After 1 year follow-up the latter were substantially more difficult to engage than veterans without PTSD Authors stated that engagement difficulty was at least in part due to the trauma-avoidance features of PTSD. Findings suggest that the nature of PTSD may reduce the likelihood of engagement in and effectiveness of online programs Limitations: short description of recent project outcomes	IV
Possemato et al., 2014 [58]	Narrative review (book chapter)	Review of research findings on how technology-based methodologies can be applied to the assessment and treatment of substance use and PTSD Chapter concludes that a variety of technology-based assessments for PTSD and substance abuse are valid Limitations: non-systematic approach, no methodology or systematic search criteria provided	III

Table 4 (*Continued*)

References (alphabetical order)	Type of study	Methods, main results and limitations	Evidence level
Possemato et al., 2016 [23]	Randomized controlled trial	Evaluation of the utilization of PTSD Coach in a self-administered group ($n = 10$) vs. a clinician-supported group ($n = 10$) in a sample of veterans Both treatments resulted in clinically significant improvements of PTSD symptoms. Clinician-supported PTSD Coach resulted in more specialty PTSD care use after the intervention and possibly greater reductions in PTSD symptoms. Post-treatment measurement at 8 weeks. Follow-up measurements at 12 and 16 weeks Limitations: no clinician-administered clinical PTSD diagnosis, small sample size limited power	I
Possemato et al., 2010 [39]	Randomized controlled trial	This pilot study examined an Internet-based expressive writing (EW) intervention adapted for kidney transplant recipients with the goal of improving PTSD symptoms, general quality of life and health-related quality of life. 48 participants ($n = 22$ expressive writing; $N = 26$ medical fact writing) were randomly assigned to EW or medical fact writing conditions Both writing groups showed a decrease in PTSD severity, with the expressive writers demonstrating a trend toward significantly less PTSD arousal symptoms. General QOL did not improve. Post-treatment measurement at 12 weeks Limitations: specific sample (only kidney-transplant recipients), no clinician-administered clinical PTSD diagnosis, no follow-up after post-treatment measurement at 12 weeks sample size underpowered for the PTSD outcome	I
Reger et al., 2015 [25]	Case study	The present study examined PE (prolonged exposure) Coach with 2 soldiers to assess usability and satisfaction with the app. Soldiers completed 8 sessions of PE and used PE Coach during 4 of those sessions Participants rated the PE Coach positively and reported higher levels of satisfaction during PE with PE Coach as compared with PE alone Limitations: case study design with 2 participants only	IV
Spence et al., 2014 [32]	Randomized controlled trial	Study on the comparison of the efficacy and safety of an Internet-based cognitive behavioral intervention (iCBT) for PTSD–related symptoms comprised of psychoeducation, stress management, cognitive restructuring and exposure components ($n = 59$) with the equivalent protocol without the exposure components ($n = 66$), using a randomized controlled trial design. Post-treatment measurement was at 8 weeks and follow-up at 12 weeks Both groups achieved improvements in symptoms with no differences between groups on any primary or secondary outcome measures, diagnostic remission rates or adverse events Limitations: small sample size due to drop-out rate limited power	I
Spence et al., 2011 [33]	Randomized controlled trial	Study on an Internet-based cognitive behavioral intervention (iCBT) ($n = 23$) vs. waiting-list control group ($n = 21$) with participants with a clinical diagnosis of PTSD obtained via DSM-5 criteria (telephone assessment). Post-measurement was at 12 weeks Large pre- to post-treatment effect sizes (ESs) were found for the treatment group on measures of PTSD symptoms, depression, anxiety, and disability. A small between-group ES was found for PTSD symptoms and moderate between-group ESs were found for depression, anxiety, and disability. This study provides preliminary support for the efficacy of the PTSD program in reducing PTSD symptoms Limitations: waiting-list control condition, small sample size limited power, no follow-up after post-treatment measurement at 12 weeks	I
Steinmetz et al., 2012 [46]	Randomized, controlled trial	This pilot study tested the efficacy of the My Disaster Recovery (MDR) website to decrease negative affect and increase coping self-efficacy in 56 survivors of a hurricane. Restricted randomization was used to allocate the population to MDR website condition ($n = 18$), information-only website condition ($n = 19$) or usual care condition ($n = 19$) MDR reduced participant worry more than the other conditions. No significant effects were found for PTSD symptoms, perceived stress, or coping self-efficacy Limitations Limited information on study procedures, no clinician-administered clinical PTSD diagnosis, no information on power calculation	I
Stockton et al., 2014 [59]	Randomized controlled trial	Examination of the effects of Internet-based expressive writing on posttraumatic growth. Expressive ($n = 14$) and control writing ($n = 10$) with 8-week follow-up Posttraumatic growth (self-reported psychological wellbeing) significantly increased only in the expressive writing group. Intrusive and avoidant cognitions did not differ between writing groups. Analyses of language use showed that greater use of insight words was associated with an increase in posttraumatic growth. Post-treatment measurement at 2 weeks and follow-up measurement at 8 weeks Limitations: specific sample (1 male, 23 female participants), no clinician-administered clinical PTSD diagnosis	I
Wagner et al., 2012 [20]	Randomized controlled trial	5-week Internet-based CBT-writing tasks program (INTERAPY), therapist-guided with 42 patients randomized to the intervention group and 13 to the waiting-list control group. After midterm, for ethical reasons, waiting-list control patients were crossed over to the therapy arm. Post-treatment measurement at 5 weeks A positive therapeutic relationship early in the therapeutic process was associated with better outcomes Limitations: specific sample (Arabic-speaking, mostly female participants), no clinician-administered clinical PTSD diagnosis, waiting-list control condition, no follow-up after post-treatment measurement at 5 weeks, no information on power calculation	I
Wagner et al., 2012 [19]	Non-randomized, uncontrolled trial	Study on the clinical efficacy of an Arabic translation of an Internet-based intervention for PTSD (INTERAPY) Participants? PTSD scores decreased significantly over the course of treatment, 67% reached clinically significant change (post-treatment PDS score < 20). The treatment took 12 weeks on average Limitations: specific sample (Arabic-speaking, mostly female participants), high attrition rate (only 15 finished the program). Small scale pilot trial providing limited and preliminary evidence for the efficacy of the Arabic version of the program	II

Table 4 (*Continued*)

References (alphabetical order)	Type of study	Methods, main results and limitations	Evidence level
Wang et al., 2013 [38]	Randomized controlled trial	This study investigated the efficacy of the Chinese version of the My Trauma Recovery (CMTR) website 90 survivors of different trauma types in urban context and 93 survivors of different trauma types in rural context ($n = 183$) were allocated to two parallel samples of a randomized controlled trial (RCT) with a waiting-list control condition. The follow-up duration was 12 weeks The findings give support for the short-term efficacy of CMTR in the two Chinese populations and contribute to the literature that self-help Web-based programs can be used to provide mental health help for traumatized persons Limitations: no clinician-administered clinical PTSD diagnosis, waiting-list control condition, no information on power calculation	I
Winzelberg et al., 2003 [35]	Randomized controlled trial	Web-based social support group for breast cancer patients (therapist-moderated) vs. waiting-list control group. 151 respondents to public service announcement, $n = 72$ met eligibility requirements ($n = 36$ intervention group, $n = 36$ control group) Significant group differences were found after 12 weeks for PTSD symptoms, depression and perceived stress Limitations: specific sample (only breast cancer patients), no clinician-administered clinical PTSD diagnosis, waiting-list control condition, no follow-up after post-treatment measurement at 12 weeks, no information on power calculation	I

topic. This cut-off was chosen because, besides studies' quality, quantity of evidence was also considered important in judging the strength of the evidence base. Evidence from three studies was considered to provide a strong evidence base in contrast to having just two or less studies supporting a recommendation. When a recommendation was based on less than three studies, the recommendation grade was lowered one level (see recommendation 3). In addition, when evidence in studies with equal evidence grades was conflicting (some studies showed significant effects while others showed non-significant effects; or the direction of effects was opposite to each other in different studies), the recommendation grade was also lowered one level (see recommendation 5). The recommendations were reviewed by the EPA Board and the co-authors of this manuscript.

3. Results

3.1. Characteristics of included studies

Overall, 40 documents were identified. A summary of the relevant information from all retrieved documents, including their methods, results and limitations, can be found in Table 4). For all documents, evidence grades were assigned according to the procedures outlined in Table 2. Many studies were conducted by the same author groups and dealt with the evaluation of the same eMental health interventions applied to different populations. We identified eight studies on the web-based intervention "INTERAPY" [13–20], three studies on the mobile-phone application (app) "PTSD Coach" [21–23] and two studies on the mobile-phone app "PE Coach" [24,25]. Included study designs varied from randomized controlled trials (RCTs) to case studies and descriptive studies analyzing data of app usage. Moreover, several studies focused on specific populations, such as war veterans, persons with pregnancy loss, breast cancer patients and kidney transplant recipients (Table 4). The follow-up period in the studies varied from no follow-up after post-treatment measurement to a few weeks or months with a maximum follow-up time of 1.5 years [15]. Sample sizes in RCTs ranged from 20 [23] to 228 [26] study participants (Table 4). Moreover, to illustrate the content of eMental health interventions, an example of a protocol of an Internet-based intervention is given in Box 1.

3.2. Technologies and therapeutic approaches

The technologies in the reviewed studies were based on a variety of therapeutic approaches: i.e. expressive writing, cognitive behavioral therapy, symptom and stress management, self-help, social support and cognitive restructuring. The interventions focused on various outcome measures, such as PTSD symptoms, problem-solving skills, self-efficacy, "post-traumatic growth" (self-reported wellbeing), stress management skills and coping skills.

3.3. Diagnostic ascertainment

In most studies, posttraumatic stress symptoms were diagnosed using self-rating scales, such as the Posttraumatic Diagnostic Scale (PDS) [27] and the Impact of Events Scale (IES) [28]; [e.g. 8,19,21,27,29,34,42]. In contrast, a clinical diagnosis via a clinician-administered assessment according to systematic criteria such as ICD or DSM was made less frequently [31–33].

3.4. Evaluation and outcome measures

The retrieved studies used a variety of outcome measures. Interventions were evaluated with regard to feasibility, safety, efficacy and users' engagement, perceptions, acceptance and satisfaction.

Box 1. Example of an Internet-based CBT intervention: the INTERAPY Treatment Protocol [17]

During a period of 5 weeks participants engaged in ten 45-min writing sessions (2 per week). There were three treatment phases:

- first phase: self-confrontation. Participants received on-screen psychoeducation about the rationale of self-confrontation (exposure). The therapists instructed the participants to describe their traumatic event in detail and to write about their intimate fears and thoughts concerning the traumatic events. This was the theme of the first four writing sessions.
- second phase: cognitive reappraisal. Participants received on-screen psychoeducation about the principles of cognitive reappraisal. The therapists intended to instill new views in the participants related to the traumatic event and to help them regain a sense of control. Participants were instructed to formulate encouraging advice for a hypothetical friend who had experienced a similar traumatic event.
- third phase: sharing and farewell ritual. Participants received on-screen psychoeducation about the positive effects of sharing. They took symbolic leave of their traumatic experience by writing a letter to themselves or to significant others who had been involved in the traumatic event.

3.5. Clinical efficacy

Studies have shown that both, web-based interventions and mobile-phone apps can have a significant effect on reducing posttraumatic stress symptoms, anxiety and depression symptoms. In their review, Bolton and Dorstyn ([34]) reported a decline in cognitive and behavioral symptoms of PTSD (Cohen's $d = 1.05$) and depression ($d = 1.01$) among those who accessed Internet programs.

Kersting et al. [26] conducted the study with the biggest sample size ($n = 228$). They compared an Internet-based five-week cognitive behavioral intervention, including self-confrontation, cognitive restructuring, and social sharing for parents after pregnancy loss with a waiting-list control condition and measured levels of posttraumatic stress symptoms (assessed by the IES-R), prolonged grief, general psychopathology and depression. The intervention group showed significantly reduced symptoms of posttraumatic stress, prolonged grief, depression, and anxiety relative to the waiting-list control group. Statistical analyses revealed treatment effect sizes between $d = 0.84$ and $d = 1.02$ for posttraumatic stress and prolonged grief comparing pre- to post-treatment time points. More significant improvement in all symptoms of PTSD and prolonged grief was found at the twelve-month follow-up measurement compared to the post-treatment evaluation ($d = 1.5$).

Spence et al. [32] found clinically significant improvements on measures of PTSD, anxiety and depression in the short and medium term with between-group effect sizes of $d = 0.21$ on the IES Scale and $d = 0.22$ on the PTSD Symptom Scale-Interview (PSS-I) for Internet-based trauma-focused cognitive behavioral therapy.

Moreover, Knaevelsrud et al. [14] tested the efficacy of the Internet-based INTERAPY intervention and found effect sizes of $d = 1.00–1.60$ for the primary outcome (PTSD severity as measured for intrusions, avoidance, hyperarousal, depression and anxiety) after three months. In another INTERAPY study by Wagner et al. [20] participants, clinical scores decreased significantly over the course of a twelve-week intervention with effect sizes of $d = 1.17$-1.57 for PDS score, depression and anxiety scores (Hopkins Symptom List-25) and EUROHIS (Quality of Life, QoL assessment).

Winzelberg et al. [35] found significant group differences for PTSD symptoms ($d = 0.45$) measured on the PCL-Checklist as well as depression and perceived stress for women with breast cancer who joined an Internet support group intervention.

Significant improvements of PTSD severity (assessed by a clinician) were also found by Klein et al. [36] who tested an online CBT intervention. At post-intervention and at three months follow-up, anxiety ($d = 0.92$), depression ($d = 1.18$) and the frequency of intrusion ($d = 0.72$) were reduced. Nieminen et al. [31] tested a clinician guided online CBT intervention and found positive effects on PTSD symptoms at follow-up post-treatment with a between-group effect size of $d = 0.82$ measured on the IES-R scale.

Hirai and Clum [37] found significant differential improvements for depression ($d = 1.18$), state anxiety ($d = 0.92$) and the frequency of intrusive thoughts ($d = 0.72$) for a self-help program for traumatic event related consequences. Wang et al. [38] tested the efficacy of a web-based intervention for traumatized persons and found reduced posttraumatic symptoms with effect sizes between $d = 0.81$ and $d = 1.34$.

Hirai et al. [30] investigated online expressive writing and found significantly reduced trauma symptoms over time for depression, anxiety, stress, avoidance, intrusion and hyperarousal ($d = 0.28–0.55$). Expressive writing was also shown to decrease PTSD severity in a study by Possemato et al. [39].

In another study, Possemato et al. [23] investigated the feasibility of delivering two approaches (with and without clinical support) to using PTSD Coach in primary care and found that both resulted in reductions of PTSD symptoms from pre-treatment to post-treatment ($d = 0.41$). Clinician-supported PTSD Coach resulted in more specialty PTSD care use post-intervention.

3.6. Sustainability of clinical effects

Beneficial clinical effects have mostly been shown in studies with short follow-up periods. Only one naturalistic 1.5 years follow-up study with 34 participants by Knaevelsrud and Maercker [15] indicated that there may be sustained longer term improvements with regard to symptom severity. It showed preliminary evidence for sustainable efficacy of the Internet-based cognitive behavioral therapy INTERAPY for intrusion ($d = 1.9$), avoidance ($d = 1.4$), hyperarousal ($d = 1.8$), depression ($d = 1.3$), anxiety ($d = 1.4$), and general psychological functioning ($d = 1.2$) [15].

3.7. Practicability and acceptance, attrition rates

The majority of studies gave no information about practicability issues of the applied technologies. Possemato et al. [23] identified technical problems in the PTSD Coach app, which reduced practicability. However, those problems only applied to the research version of the app that was used in the study and not the publicly available version of the app. Few studies showed that mobile-based interventions were well accepted by users [21] (Table 4). Higher usage rates were found in participants who used a mobile app for the first time in comparison to second-time users [22]. One study on the efficacy of a guided online CBT intervention showed that most of the participants found the modules easy to read and to understand but laborious to work with [31]. Concerning web-based interventions, no studies were identified that measured acceptability as primary or secondary outcomes.

Furthermore, many studies reported high drop-out rates during follow-up in the range of 14 [26] to 62% [19]. Wagner et al. [20], for instance, tested the clinical efficacy of an Arabic translation of the Internet-based cognitive behavioral therapy INTERAPY in Iraq and reported a high attrition rate of 62%. A possible reason for this could have been the insecure situation in Iraq which posted particular challenges for this intervention, including the ongoing violence and economic insecurity leading to a hyper-alertness of participants. Some individuals also doubted the neutrality of the treatment [19]. Kersting et al. [26] reported an attrition rate of 14%. In this study, the individual reasons for dropping out were either not given or participants could simply no longer be reached by the research team. Other dropped out participants stated that writing was not the right approach for them or that they were no longer interested in the treatment program. Finally, one participant stopped treatment due to a death in the family. In a study by Spence et al. [33] five out of 44 included participants did not complete the program either for unknown reasons, because of competing time commitments or because of a relapse of depressive symptoms. In a study by Nieminen et al. [31] eight women could not continue to participate in the study as they got pregnant. Other reasons for high drop-out rates included technical problems, preferred face-to-face contact, and the burden caused by writing about experiences of stressful events [17].

3.8. Cost-effectiveness

The reviewed studies provided no details on cost-effectiveness.

3.9. Safety

Only one study assessed the safety of two different Internet-based cognitive behavioural therapy (CBT) interventions in terms of the occurrence of adverse events [32]. Adverse events were

defined as an increase in symptoms from pre- to post-treatment. Serious adverse events were defined as "self-reported hospitalisations, suicide attempts and self-harm that required medical attention or the onset of substance abuse due to treatment" [32]. In this study, trauma-based cognitive behavioural therapy (TB-CBT) comprising psychoeducation, stress management and cognitive restructuring and exposure elements were compared to an active control group employing the same treatment protocol without exposure elements. There were no differences between groups related to symptom increase at post-treatment assessment ($P > 0.05$). Serious adverse events were reported for two participants in each treatment group.

3.10. Clinician-supported vs. non-supported interventions

Three studies investigated the impact of clinician-support in eMental health interventions on treatment outcomes and therapeutic working alliance between clinician and patient [20,23,31]. Possemato and colleagues [23] conducted a pilot randomized controlled trial to investigate if clinician-supported use of the PTSD Coach app in primary care improved the severity of posttraumatic stress symptoms and the utilization of specialty mental healthcare in comparison to self-managed PTSD Coach use. While both interventions resulted in significant improvement of PTSD symptoms ($d = 0.41$, $P = 0.02$ in self-managed group; $d = 1.4$, $P \leq 0.01$ in clinician-supported group), the clinician-supported group showed increased post-intervention specialty PTSD mental healthcare use (70% in clinician-supported group vs. 10% in self-managed group). Wagner et al. [20] assessed to which extent the working alliance between the study participants and the therapist influenced the therapeutic outcome in an Internet-based cognitive behavioural therapy. They found that a positive working alliance established early in the treatment process was associated with better treatment outcomes at post-treatment measurement ($\beta = 0.37$, $t = 2.81$, $P = 0.007$). Nieminen et al. [31] investigated a clinician-supported online CBT intervention and reported that three participants of their sample expressed their wish to have met a therapist in person.

3.11. Active vs. waiting-list controls

Many of the reviewed RCTs used a waiting-list control condition and were able to show reductions in posttraumatic stress symptoms [18,31,35,37,40]. However, studies showed that the beneficial effects of web-based interventions for trauma-associated symptoms were diminished when an active control group was used instead of awaiting-list control group [30,32]. In studies with active controls, PTSD symptoms were reduced in both the treatment group and the active control group. Spence et al. [32] tested the efficacy of an online treatment for PTSD with and without an exposure component. For PTSD symptom improvement, they found effect sizes of $d = 1.29$ in the intervention group versus $d = 1.59$ in the active control group.

Finally, Hirai et al. [30] compared the efficacy of two online expressive writing protocols. One protocol focused on emotions and feelings and the other protocol on facts associated with the traumatic life event. They found that both groups significantly reduced trauma symptoms over time (at five weeks $d = 0.28$-0.55 for depression, anxiety, stress, avoidance, intrusion and hyperarousal).

4. Recommendations

Recommendations were graded following the classification detailed in Table 3 and described in the methods section.

4.1. Recommendation 1

The European Psychiatric Association considers (grade of recommendation: A) that evidence shows that web-based eMental health interventions, such as Internet-based cognitive behavioral therapy, and mobile-based eMental health interventions, such as apps for symptom management or prolonged exposure, lead to reduced posttraumatic stress symptoms, depressive symptoms, anxiety symptoms, grief symptoms and increased subjective well-being in people with symptoms of post-traumatic stress (evidence level I–III) ([34]; [2,14,16–19,29–33,35–44]). Due to the low number of clinical long-term studies, no definite recommendation is currently possible regarding the long-term efficacy of eMental health interventions for persons with those symptoms ([34]; [15]).

4.2. Recommendation 2

The European Psychiatric Association considers (grade of recommendation: C) that mobile-based eMental health interventions, such as apps for symptom management or prolonged exposure, are acceptable for persons with posttraumatic symptoms (evidence level III–IV) [21,22,25]. However, technical difficulties may decrease user acceptance (evidence level I–III) [22].

4.3. Recommendation 3

The European Psychiatric Association considers (grade of recommendation: B) that both self-administered as well as clinician-supported mobile-based eMental health interventions result in clinically significant reductions in posttraumatic stress symptoms. However, clinician-supported mobile-based interventions can lead to increased use of specialty PTSD mental healthcare (evidence level I) [23]. One web-based intervention showed that in a therapist-guided intervention, a positive therapeutic relationship was associated with a better mental health outcome (evidence level I) [20].

4.4. Recommendation 4

The European Psychiatric Association considers (grade of recommendation: A) that Internet-based cognitive behavioral therapy (CBT) has beneficial short-term effects on posttraumatic stress symptoms in senior adults with war-associated trauma [45] and in the area of PTSD symptoms and prolonged grief in women after pregnancy loss or following childbirth [31,40] and women with breast-cancer [29] (evidence level I).

4.5. Recommendation 5

The European Psychiatric Association considers (grade of recommendation: B) that eMental health interventions, such as online CBT stress management manuals or self-help websites, have the potential to improve self-efficacy and coping with posttraumatic stress symptoms [29,38] (evidence level I). However, one study showed no significant effect on coping self-efficacy of a web-based intervention [46] (evidence level I).

5. Discussion

In this EPA Guidance we developed recommendations on the efficacy of eMental health interventions for PTSD in a systematic evidence- and consensus-based process. The scope of this guidance was rather broad because eMental health is a relatively new field.

The focus of the recommendations was not predefined, but emerged during the development process. Therefore, the recommendations only cover a selection of aspects related to eMental health interventions for PTSD that we extracted from the included studies. Moreover, we found a variety of therapeutic approaches, technologies and clinical statuses of the study population which may impair inter-study comparability.

While the grading of the included studies and the grading of the recommendations followed a systematic process, the weighing of the body of evidence for a recommendation was based on a consensus of the authors. We considered three or more studies as a strong evidence base for a recommendation. Therefore, the grading may be considered as rather conservative.

In general, the current evidence on the efficacy of eMental health interventions for posttraumatic symptoms is promising. Moreover, these interventions may also be effective in the treatment of grief as pointed out in a study by Kersting et al. [40]. However, studies were mostly conducted in study-populations with self-reported stress- and trauma-associated symptoms, but only rarely in participants with clinically confirmed PTSD. This may be due to the fact that clinician-administered interviews are more time consuming and expensive in research projects. However, self-reported symptoms may lead to biased results in outcome measurements. While many pilot studies have been conducted, results need to be replicated in larger scale clinical trials with more representative samples. This is needed in order to increase the generalizability of the results and provide confirmation of the efficacy in persons with confirmed clinical diagnoses of PTSD. Besides clinical efficacy, the cost-effectiveness of eMental Health interventions for PTSD patients is unclear, as is the sustainability of clinical effects. In an observational study, Ruwaard et al. [47] showed that one-year results of online treatment for patients with depression, panic and burnout in routine clinical practice were similar to clinical trial situations. However, this study did not include the assessment of posttraumatic stress symptoms [47].

Furthermore, studies should aim at identifying whether an eMental health intervention (stand-alone or as an add-on to regular care) is efficacious, acceptable and safe in comparison with regular face-to-face mental healthcare [2]. None of the present studies included regular face-to-face mental healthcare controls, but mostly waiting-list control conditions. Therefore, the efficacy of eMental health interventions cannot be evaluated in comparison to regular care provision. The reviewed studies showed that effect sizes were higher when a waiting-list control group was used compared to an active control group. Thus, active control conditions instead of waiting-list control groups are necessary to provide conclusive evidence about the clinical efficacy of eMental health interventions for PTSD patients [43]. Another disadvantage of waiting-list control conditions is that they do not allow for the identification of long-term effects, because due to ethical reasons individuals in the waiting-list control group receive the treatment after a certain waiting period.

Moreover, due to the high attrition rates (up to 62%) in clinical studies on eMental health interventions for people with posttraumatic stress symptoms, future studies need to further examine the reasons for the high attrition rates with the aim to develop recommendations to improve patient adherence and clinical efficacy. Reasons for high attrition rates mentioned in the reviewed studies include technical problems, preferred face-to-face contact, and the burden caused by writing about experiences of stressful events [17]. The authors of one study pointed out that low adherence and a high attrition rate may be explained by participants struggling with a delayed start of the intervention due to the allocation to the waiting-list group. Participants of the waiting-list control condition reported that the mental work to complete the online CBT treatment was hard for them. The authors concluded that the disappointment of the participants of being included in the waiting-list control group may have led to a reduced motivation to adhere to the intervention. Another reason was that avoidance is a main coping strategy of PTSD [31]. Furthermore, it is still unclear if therapist guidance for eMental health interventions is necessary and useful [2]. On the one hand, the anonymity that eMental health interventions provide may be useful in reducing the barriers to care (e.g. stigmatization). On the other hand, these interventions may lack human interaction and in-person support, which is known to be beneficial in prevention and recovery from trauma [2]. The doctor-patient relationship in mental healthcare plays an important role in the therapeutic process [48]. Therefore, the high attrition rates could also be explained through missing contact to a therapist. In a study of Nieminen et al. [31] participants expressed their wish to meet a therapist. Wagner et al. [20] found that a positive working-alliance between the patient and the therapist in a clinician-supported Internet-based CBT intervention led to better treatment outcomes.

The supportive role of relatives and family members may also influence the effectiveness of mental healthcare interventions and should be taken into account in future studies. The reviewed studies provided no information about risks and benefits of family support when eMental health interventions were applied.

As has been shown in a previous EPA Guidance on eMental health interventions in psychotic disorders [4], no quality standards, standards for data protection, ethical guidelines and legal frameworks to regulate the provision and safety of eMental health interventions could be identified.

Kuhn et al. [21] stated that most clinicians are willing to use eMental health interventions. However, there is still insufficient dissemination and awareness about such interventions. Possible reasons may be a lack of information about how to access and use the intervention, as well as technical limitations. In the future, comprehensive quality assessment standards need to be developed with the aim to provide quality-proven Internet-based interventions for people with mental disorders.

Although the selected studies only provided interventions to native speakers or study participants who spoke the language of the respective intervention fluently, the aspect of language translation and trans-cultural communication needs to be taken into account [49]. This is especially important when the wider provision of eMental health interventions to at-risk populations, like migrants and refugees, is considered.

In summary, in the field of PTSD treatment, there are studies showing short-term clinical efficacy of web-based and mobile-based interventions for people suffering from trauma-associated mental symptoms. No conclusive results are available regarding the sustainability of the beneficial effects, the efficacy compared to regular care control groups, and the efficacy in patients with clinically diagnosed PTSD. Major challenges are to reduce the high attrition rates, to demonstrate cost-effectiveness and to develop quality assessment procedures for eMental health interventions.

Disclosure of interest

The authors declare that they have no competing interest.

Acknowledgements

The authors thank A. Hinsche-Böckenholt for her support in performing the systematic literature search and retrieving full texts.

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