

## E-health applications in the field of traumatic stress

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### ABSTRACT

E-health offers great potential in the field of traumatic stress to deliver training, assessment, prevention, and treatment of adverse outcomes after trauma worldwide. In order to encourage research on E-health applications in the field of traumatic stress, this current special issue of the *European Journal of Psychotraumatology* presents a series of papers divided into three emergent topics: I) development of digital interventions, II) the use of digital interventions to foster self-management and deliver therapy, and III) digital methods to improve prediction, assessment, and monitoring of post-trauma outcomes. These studies show acceptance of the tools by various end-user groups and improvements of current research and clinical practices, but also areas for improvement regarding the development process and making even better use of technological capabilities of E-Health. We propose three general themes to accelerate the quality of e-Health interventions and studies in this area in the coming years: optimizing user engagement and adherence, conducting more (innovative) research, and increasing implementation and dissemination activities. This issue appears in the midst of the COVID-19 pandemic. It is exactly at times like these that we need effective online interventions and we see an enormous increase in the use of e-Health. We hope this issue will contribute to help those affected and to serve the community worldwide.

### Aplicaciones De E-Salud en el campo del estrés traumático

La salud electrónica (E-salud) ofrece un gran potencial en el campo del estrés traumático para brindar capacitación, evaluación, prevención y tratamiento de resultados adversos luego de un trauma en todo el mundo. Con el fin de fomentar la investigación sobre aplicaciones de E-salud en el campo del estrés traumático, este número especial de la Revista Europea de Psicotraumatología presenta una serie de artículos divididos en tres temas emergentes: I) desarrollo de intervenciones digitales, II) el uso de intervenciones digitales para fomentar la autogestión y administrar terapia, y III) métodos digitales para mejorar la predicción, evaluación y monitoreo de resultados posteriores a un trauma. Estos estudios muestran aceptación de las herramientas por parte de varios grupos de usuarios finales y mejoras en la investigación actual y prácticas clínicas, pero también áreas para mejorar el proceso de desarrollo y hacer un mejor uso aún de las posibilidades tecnológicas de E-salud. Proponemos tres temas generales para acelerar la calidad de las intervenciones y estudios de E-salud en esta área en los próximos años: optimizar el compromiso y la adherencia del usuario, conducir más investigaciones (innovadoras) y aumentar las actividades de implementación y diseminación. Esta publicación aparece en medio de la pandemia de COVID-19. Es exactamente en tiempos como este que necesitamos intervenciones efectivas en línea y vemos un enorme aumento en el uso de E-salud. Esperamos que esta publicación contribuya a ayudar a los afectados y servir a la comunidad en todo el mundo.

### 在创伤应激领域中的电子卫生 (E-health) 应用

电子卫生 (E-health) 应用有巨大的潜力可以在全世界范围内提供培训, 评估, 预防和治疗创伤后不良后果。为了鼓励研究在创伤应激领域中的电子卫生应用, 《欧洲心理创伤学期刊》的本期特刊纳入了一系列论文, 分为三个新主题: I) 数字干预的发展, II) 数字干预的应用促进自我管理 and 提供治疗的数字干预, 以及 III) 改善对创伤后结果的预测, 评估和监测的数字方法。这些研究说明各种终端用户团体对工具的接受程度以及对当前研究和临床实践, 以及在开发过程以及甚至更好地利用 E-Health 的技术能力方面还有待改进的地方。我们提出了三个总体主题, 以加速电子卫生干预和研究质量在未来几年内提高: 优化用户参与度和依从性, 开展更多 (创新) 研究以及增加实现和传播活动。此问题出现在 COVID-19 大流行中。正是在这样的时刻, 我们需要有效的在线干预。并且我们看到电子卫生的使用大大增加。我们希望这个问题将有助于帮助那些受影响的人并为世界各地的社区服务。

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### 关键字

电子卫生; 数字干预; 实施; 创伤应激

### HIGHLIGHTS

- E-health interventions: highly relevant in current COVID-19 pandemic to strengthen our support for trauma-exposed individuals.
- Series of articles on E-health to foster prevention, self-care, treatment, assessment, prediction, and monitoring after psychotrauma.

## 1. Introduction

E-mental health applications, referring to ‘the use of information and communication technology [...] to support and improve mental health conditions and mental health care’ (Riper et al., 2010), are indispensable in the field of traumatic stress. Since two decades, studies on internet-based interventions for trauma-exposed individuals have begun to arise, with an exponential increase in the past 10 years (Olf et al., 2019). The first controlled studies predominantly addressed internet-based cognitive behavioural therapy for the treatment of adults with PTSD with remote guidance from a therapist with good results in terms of PTSD symptom reduction (e.g. Knaevelsrud & Maercker, 2007; Lange, van de Ven, Schrieken, & Emmelkamp, 2001). From the year 2010 onwards, studies on internet-based (preventive) interventions targeting a larger population of trauma-affected individuals emerged with the aim to prevent PTSD symptoms after an acute trauma. Websites for both youth and adults appeared with psycho-education (Cox, Kenardy, & Hendrikz, 2010; Marsac, Kassam-Adams, Hildenbrand, Kohser, & Winston, 2011; Ruggiero et al., 2015) and self-guided interventions delivered through a website (Marsac et al., 2013; Mouthaan et al., 2013) or web-based games (Asselbergs et al., 2018; Kassam-Adams et al., 2016).

Nowadays, E-health includes an even broader range of technologies applied to support individuals both before (e.g. for training purposes) and after psychotrauma (e.g. for assessment, prevention, or treatment). Studies have for instance reported on web-based learning on peer support after work-related trauma (van Buschbach, van der Meer, Dijkman, Olf, & Bakker, 2020) or VR technology for pre-deployment *training* to prevent posttrauma problems in the military (Rizzo & Shilling, 2017) with the ability to control the level of exposure to potentially traumatic stimuli. Further, smartphone technology (e.g. van der Meer, Bakker, Schrieken, Hoofwijk, & Olf, 2017), teleconferencing (e.g. Litwack et al., 2014), and VR (Rizzo & Shilling, 2017) have been used for the *assessment* of trauma-related symptoms. Smartphone applications (apps) have been proposed to deliver *self-help* tools (Kuhn et al., 2014, 2017; Van der Meer, Bakker, Van Zuiden, Lok, & Olf, 2020) which may have preventive potential as well. Videoconferencing (e.g. Germain, Marchand, Bouchard, Drouin, & Guay, 2009) and VR as PTSD *treatment* modalities have been put forward as well (e.g. Reger et al., 2016; van Gelderen, Nijdam, & Vermetten, 2018). The potential of E-health seems endless with still other new technological advantages that emerge.

The great number of digital interventions for traumatic stress, especially those based on smartphone applications, is not on par with the limited number of studies that have assessed their clinical and cost-effectiveness (Olf, 2015; Price et al., 2013). It is challenging to conduct thorough and methodologically sound E-health studies, considering

the speed of technological developments (Olf, 2015) and, importantly, the difficulty of conducting research in routine care with a vulnerable target group and limited research budgets. There is an important role for trauma researchers to provide the field with evidence about the E-health applications that are and those that are not capable of safely and effectively supporting individuals before and after trauma. In order to encourage research on E-health applications in the field of traumatic stress, this current special issue of the European Journal of Psychotraumatology presents a series of papers contributing to this goal.

## 2. In this issue

The papers in this special issue have been divided into three emergent topics in the field of traumatic stress: I) development of digital interventions, II) the use of digital interventions to foster prevention, self-management, and deliver therapy, and III) digital methods to improve prediction, assessment, and monitoring of post-trauma outcomes.

First, Schellong and colleagues (Schellong, Lorenz, & Weidner, 2019) propose a methodological framework based on technical and medical norms to support clinicians and researchers to successfully develop, evaluate, and implement mobile traumatic stress applications. By following a cyclic process from origination to post-market communication and back, it is hoped that future endeavours will result in a more efficient and replicable process and more satisfying user experiences and uptake of the applications. Clinicians, researchers, software developers, and other stakeholders are encouraged to learn from the experiences of the German team outlined in this tutorial paper.

Moving to the use of E-health to foster prevention of PTSD, Freedman and colleagues (Freedman, Eitan, & Weiniger, 2020) present a randomized controlled pilot study in which a semi-immersive Virtual Reality visuospatial task, as an intervention to interrupt memory consolidation, is studied among 77 Emergency Department patients. The intervention, carried out in the first few hours following a traumatic event, was well accepted by patients, but the prevention of PTSD was not demonstrated. Several recommendations for future research, including the dose and type of the visuospatial task and type of VR, are presented.

Regarding self-management of traumatic stress symptoms, Cernvall and colleagues (Cernvall, Sveen, Bergh Johannesson, & Arnberg, 2018) present a pilot test of the Swedish version of the PTSD Coach smartphone app among 11 individuals of whom most met the criteria for (partial) PTSD. In contrast to previous findings of the founders of the app, self-reported helpfulness in this study was only modest. Specific psycho-education parts of the app and relaxation exercises were rated most helpful. The positive results

regarding PTSD symptom reduction need replication in a larger sample before conclusions can be drawn.

Ashwick and colleagues (Ashwick, Turgoose, & Murphy, 2019) explore patient acceptability of Skype-delivered Cognitive Processing Therapy to adult patients with PTSD. Thematic analyses of qualitative interviews with 16 patients who had had recently received 12 video-based sessions of CPT (all but one finished their therapy) revealed that participants found the teletherapy acceptable. Patients address both positive aspects of teletherapy, including flexibility, comfort, and reduced costs, and areas of improvement, including technical problems, timing of the sessions, and in-between session support.

Three papers in this special issue discuss digital methods to improve assessment, monitoring, and prediction of PTSD. Smith and colleagues (Smith, Thew, & Graham, 2018) studied participant experiences of online grief research among bereaved adult participants. After completing the online grief questionnaire, participants received a simple check-up email question in which they were asked whether they had any questions or wanted to express any experiences concerning their participation in the study. In their article, responses to this question were analysed using a qualitative approach. The authors suggest that a simple low-threshold online follow-up approach may be used to achieve a positive participant experience when conducting research in vulnerable populations.

Price and colleagues (Price et al., 2018) demonstrate in their study on implementing mobile assessments in the acute period after an admission to the ED that participants well accepted mobile mental health assessments early after trauma. It was furthermore reported that easily accessible tools like their mobile assessment may improve response rates to mental health monitoring devices, both in research and in clinical practice.

The future of enhancing prediction, assessment, and monitoring of PTSD through the use of technologies like web-based or mobile questionnaires, virtual reality, Ecological Momentary Assessment (EMA), and digital phenotyping (referring to the use of passive data derived from digital devices such as mobile phones) is further explored by Bourla and colleagues (Bourla, Mouchabac, El Hage, & Ferreri, 2018). Points raised by the authors about the connectedness of data, ethical considerations, data security, and adoption of the tools by clinicians and patients are relevant issues to consider in future work.

In sum, this special issue has highlighted some of the newest applications of technologies in assessment, prevention, self-help, and treatment opportunities for trauma-exposed individuals. Results of the different studies underline the potential of E-health and importantly show good acceptability of the different tools in various vulnerable populations (e.g. bereaved people, injured people, veterans).

### 3. Future perspectives: three ways to accelerate the quality of E-health interventions

Future perspectives have been proposed in the papers above to enhance the development and application of digital technologies in research and clinical practice to better utilize the potential of e-mental health in our field. Apart from the many opportunities described in this issue, the studies also point out general challenges when creating, investigating, marketing, and implementing E-health applications in real-world settings, as opposed to more laboratory settings. We propose three general themes which we believe are key if we want to accelerate the quality of e-Health interventions and studies in this area.

*Optimizing user engagement and adherence* to evidence-based digital interventions in clinical practice is a first challenge. The consistent use of a requirements development approach (Van Velsen, Wentzel, & Van Gemert-Pijnen, 2013) or other user-centred designs (Schellong et al., 2019; Torous, Nicholas, Larsen, Firth, & Christensen, 2018) is warranted to design new, or refine existing, interventions that truly match the needs of the target group. Of note, both traumatized individuals, relatives, and clinicians should be considered end-users. Considering the content of an application, taking a transdiagnostic approach instead of focusing on a single disorder, and targeting both individuals with lower and higher levels of symptoms is favourable (Bakker, Kazantzis, Rickwood, & Rickard, 2016). Next, design principles and the integration of persuasive technology into digital interventions could importantly contribute to increase user engagement and a sense of self-efficacy (Bakker et al., 2016). Examples include real-time engagement in an application (for instance, provide users with specific exercises in the moments they are experiencing distress), principles of gamification (for instance, reward users with points for their achievements in the application), or tailoring functionalities to help users decide which elements of the intervention are in particularly helpful for them under which circumstances. Other solutions such as support by a therapist via email or instant messaging (Cernvall et al., 2018) may help increase the use and adherence to the intervention. Also for research purposes, automated reminders seem to increase participant engagement with a study (Price et al., 2018; Smith et al., 2018), which may be especially valuable for longitudinal designs. Newer technologies such as digital phenotyping (Insel, 2017; Torous, Onnela, & Keshavan, 2017) and augmented reality (see, e.g., Riva, Banos, Botella, Mantovani, & Gaggioli, 2016) have not been extensively studied so far, but may tap novel

opportunities to increase user engagement. In sum, the capabilities and opportunities of technology have not yet been exhausted in currently available digital interventions and stronger multidisciplinary collaborations are needed to create rigorous E-health interventions with more impact.

The need for more research and in particular *more clinical and cost-effectiveness studies*, like for instance the research fields of depression (e.g. Karyotaki, Tordrup, Buntrock, Bertolini, & Cuijpers, 2017) or alcohol (e.g. Riper et al., 2018) have published, is a second theme of interest to help accelerate E-health in the field of traumatic stress in the coming years. Many of the studies in this special issue have small sample sizes and/or lack a controlled design, limiting the evidence for the effectiveness of the applications. In general, particularly mental health smartphone apps lack rigorous evaluations of their efficacy (Donker et al., 2013; Olf, 2015). Apart from randomized controlled designs that are needed to determine the efficacy of the final intervention, other designs that enable studying and comparing multiple components of an intervention in the same study may greatly add to achieve the most strong and rigorous interventions (Collins, Murphy, & Strecher, 2007; Price, van Stolckooke, Brier, & Legrand, 2018). With regard to data collection, future studies may more heavily use the internet to speed up participant recruitment and to conduct assessments online. Moreover, capabilities of digital interventions to conduct real-time assessments throughout its use and to log usage data can add to the collection of extensive datasets in a relatively low-intrusive and less time-consuming manner.

Finally, *implementation and dissemination* challenges of digital interventions warrant more attention in our field including a more science-based approach to implementation (Vis et al., 2018). Implementation in routine clinical practice, beyond research trials that have established the effectiveness of digital interventions, varies widely (Fleming et al., 2016). Although gathering strong scientific evidence remains a priority, more attention and collaboration with stakeholders is needed to generate both effective and sustainable digital interventions that can be used by the target group in (clinical) practice (Bakker et al., 2016; Schellong et al., 2019). Although delivering mental healthcare in times of the current COVID-19 pandemic is highly challenging, it will provide opportunities to overcome existing barriers as well (Wind, Rijkeboer, Andersson, & Riper, 2020). For one thing, barriers including negative clinician and patient attitudes towards internet interventions (Andersson & Titov, 2014), and mistrust in the technology (Venkatesh, Morris, Davis, & Davis, 2003) need to be crossed. Other challenges include technology updates, bug fixing, and hosting, as pointed out by Schellong et al. (Schellong et al., 2019). Proper business models and support of business developers could help

the field to move forward in this regard. Further, the balance between unguided and professional-assisted intervention elements remains an issue of debate. Whereas research overall has shown therapist-guided interventions are preferred over unguided interventions after trauma (Kuester, Niemeyer, & Knaevelsrud, 2016; Sijbrandij, Kunovski, & Cuijpers, 2016), the minimal dose of professional guidance for different levels of symptoms still has to be determined. This particularly applies to those interventions targeting *the prevention* of trauma-related mental health problems or the reduction of *subclinical* levels of PTSD. Given that a substantial proportion of individuals with trauma-related symptomatology will not seek professional help (Grubaugh et al., 2005; Shalev, Ankri, Peleg, Israeli-Shalev, & Freedman, 2011), E-Health could importantly contribute to self-management these problems (e.g. Olf, Van Zuiden, & Bakker, 2015). More insight in the (minimal) required involvement of professionals and how this is shaped (Mohr, Cuijpers, & Lehman, 2011) may also help promote the dissemination of digital interventions at low-cost in low- and middle-income countries. There is a great need for free and easy access to e-health applications for specific populations, such as refugees (Knaevelsrud, Stammel, & Olf, 2017). From a public health perspective on the trauma field, E-health could deliver much-needed primary, secondary, and tertiary preventive interventions on a global scale (Magruder, Kassam-Adams, Thoresen, & Olf, 2016).

The papers in this special issue show that the potential of E-Health in this field is still growing and it remains a promising and exciting avenue to strengthen our support for trauma-exposed individuals worldwide. This issue appears in the midst of the COVID-19 pandemic. A challenging time in which the need for effective online interventions is even clearer than before and we already see an enormous increase in the use of particularly videoconferencing between therapists and patients (Wind et al., 2020). Researchers, clinicians, end-users, and (software and business) developers as well as health insurers and policymakers together can capitalize even more on the potential of E-Health and serve the community worldwide in the coming decade if collaborations are intensified, resources are more wisely spent, and more attention is being paid to structural implementation of the interventions.

### Disclosure statement

No potential conflict of interest was reported by the authors.

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