

# The influence of mobile application technology on the treatment of posttraumatic stress disorder : a literature review

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The influence of mobile application technology on the treatment  
of posttraumatic stress disorder: A literature review

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The University of Toledo

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## **Dedication**

To my future husband, Travis Weirich, as gratitude for his service in the Marines and ability to support me no matter how many miles lie between us.

To my parents, David and Pat, as appreciation for their boundless guidance and love. Without you, I would not be where I am today.

### **Acknowledgements**

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## Introduction

The lifetime prevalence of post-traumatic stress disorder (PTSD) is 7 – 8% in the general population (Kuhn et al., 2014b). However, higher rates are found among occupations with an increased risk of traumatic exposure, such as military, police, firefighters, and emergency medical personnel. For instance, about 11 – 20% of veterans who fought in Operations Iraqi Freedom and Enduring Freedom, the wars in Iraq and Afghanistan respectively, experienced PTSD in a given year (United States Department of Veteran Affairs, 2016).

PTSD is a mental health condition triggered by experiencing or witnessing a traumatic event and usually occurs within three months of the event, lasting from months to years. A traumatic event is defined as an exposure to threatened or actual death, sexual violence, or serious injury. Exposure can include directly experiencing the event, witnessing or learning of the event occurring to others, and experiencing repeated exposure to details of a traumatic event (e.g., working every day in the environment where the trauma occurred; American Psychiatric Association, 2013).

The symptoms of PTSD are diverse, but fall under one of the four symptom types: re-experiencing, avoiding, negative changes in feelings and beliefs, or hyperarousal. Re-experiencing symptoms include nightmares, flashbacks, and intrusive reminders of the event set off by a trigger. A patient experiences avoiding symptoms when he/she avoids people, conversations, and situations that remind him/her of the event. Traumatic events can also lead to negative changes in cognition where the sufferer develops a pessimistic outlook on life and may not be able to experience positive and loving emotions. The last symptom type, hyperarousal, is characterized by feeling jittery, irritable, always on alert, and being constantly on the outlook for danger making it difficult to concentrate or sleep (American Psychiatric Association, 2013).

These symptoms frequently cause dysfunction in social, occupation, physical, and economic areas of a person's life.

The variability in exposure type, onset, duration, symptom presentation, and provider knowledge of PTSD make diagnosing and treating it a challenge for medical providers. Results from the National Comorbidity Survey examining those diagnosed with PTSD (with DSM-IV/WMH CIDI criteria) show only 40% receive minimally adequate care when looking at both mental health and medicine sectors. Only 13% of individuals receiving treatment for PTSD in general medicine receive minimally adequate care (Wang et al., 2005). Among veterans, a targeted group for PTSD treatment, only 33% diagnosed with PTSD receive the minimum adequate treatment (Spoont, Murdoch, Hodges, & Nugent, 2010). The high prevalence of PTSD has stretched the resources of both public and military sectors and so there has been a recent turn to delivering evidenced based care to patients by smartphone.

Smartphones are mobile telephones containing computer functionality that allows users to connect to the Internet and run software applications (Luxton, McCann, Bush, Mishkind, & Reger, 2011). This technology first became available in the 1990's and its use has only grown since its inception. Since 2014, almost half of the global population, over seven billion people, uses mobile communication (World Health Organization, 2015). The ubiquitous use of smart phones across the world creates exciting opportunities for the medical field and its utilization for mobile health.

Almost immediately after the development of the smartphone, medical professionals were utilizing them for health research, education, reference, communication, and patient care (Luxton et al., 2011). As of 2015, 500 million smartphone users utilized mobile applications for healthcare purposes. Mobile health has been created for a myraid of uses including resources for

clinicians, monitors for patients between medical appointments, and self-help materials (Olf, 2015). Applications range from *Epocrates*, a pharmaceutical guide for providers, to *Diabetes Logbook*, a virtual journal for patients to track their diabetes management with charts and graphs that can be shared with the patient's provider (Luxton et al., 2011). Many self-help materials are also available such as *Luminosity*, a daily training program to exercise the mind and improve problem solving, memory, and attention through use of various interactive games/tasks (Lumos Labs Inc., 2016). The serviceability of mobile application technology is versatile and can be beneficial in all aspects of healthcare.

The increasing popularity of mobile application in medicine led to the development of a new health field focused on accessible healthcare via technology termed mobile health (mHealth). The omnipresence of smart phones allows mobile health to be accessible to everyone. According to a 2013 study, the ownership and usability of smart phones covers people from all parts of society, including rich, young, old, healthy, functionally or mentally impaired, and homeless individuals. Additionally, mHealth can be implemented in any geographical or clinical setting (Ben-Zeev, Davis, Kaiser, Krzsos, & Drake, 2013). This vast availability and diverse ownership makes mHealth the perfect platform to increase education and adequate treatment in all fields of medicine.

Utilizing mobile applications in behavioral health is a novel but exponentially expanding concept. Of the 9,000 health apps available, approximately 6% are focused on mental health (East & Havard, 2015). Applying mHealth to this field has changed the mental health dynamic by creating consumer empowerment, reducing the stigma of seeking treatment, creating organized self-monitoring, improving patient/provider communication, and enhancing the quality of psychological services (Luxton et al., 2011).

In an effort to empower patients and provide on-demand treatment, the National Institute of Mental Health developed the mobile app, *Mobilyze*, for the treatment of depression. *Mobilyze* offers an intervention based on principles of behavioral activation, which aims to decrease depressive symptoms by increasing engagement in activities that provide a sense of accomplishment or are pleasurable. Users receive educational information, reminders, and tools to plan and track positive activities. It also contains a context sensing system that learns to identify user emotions based on location, activity, mood, and social context in order to reach out to the user when in a situation that threatens treatment progress. (Ben-Zeev et al., 2013). This mobile app delivers an evidence-based intervention discretely and in an efficient and continuous manner that would not be possible with in-person therapy sessions.

The first line treatment for PTSD is psychotherapy with the two most recommended evidence-based therapies being cognitive behavioral therapy (CBT) and prolonged exposure (PE). In CBT, the therapist helps the patient understand and change the negative behaviors and thoughts that develop after a trauma (United States Department of Veteran Affairs, 2016). In PE, the therapist exposes a patient to memories of the trauma in a safe environment in order to instill control over feelings related to the trauma. Presently, there are mobile Apps available that offer these brief evidence-based PTSD interventions virtually, and because of the mobility can be used in diverse settings, including rural and urban locations (Possemato, 2011).

Although CBT and PE are effective therapies, there are conceptual and practical barriers that decrease treatment initiation and adherence. The number one barrier to receiving adequate PTSD treatment is stigma. Among active duty military recruits, only 23 – 40% of those who screened positive for PTSD sought treatment, stating that “I would be seen as weak” and “it would harm my career”. mHealth technology might reduce the stigma surrounding a PTSD

diagnosis because it is available 24/7 and is a discrete, accessible way to continue treatment outside of a specialist's office (Possemato, 2011). In a 2014 study of a Latino man diagnosed with PTSD after experiencing an armed robbery, cultural beliefs were also identified as a major treatment barrier. Mobile applications can be developed to be sensitive to cultural and language concerns making them more effective across cultures (López, Shealy, & Rheingold, 2014). Furthermore, there is a shortage of licensed mental health providers who are specially trained in PTSD evidence-based treatment (Possemato, 2011). Mobile App technology can be a good adjunctive therapy when a specialist referral is resisted or when a specialist is not available. Understanding the usefulness of mHealth is important to practicing Physician Assistants (PA) because they will come across patients suspected to have PTSD and be unable to properly treat them.

This literature review aims to determine the current state of mobile app technology in the treatment of Posttraumatic Stress Disorder, if it is a feasible treatment, and if its utilization positively affects the efficacy and adherence to conventional treatment. I hypothesize that mHealth will serve as a beneficial supplement to established treatment and will increase the utilization and efficacy of PTSD treatment.

## Methods

A systematic qualitative review of studies examining use of mobile applications for treatment/management of PTSD was conducted using the following databases: PubMed, CINAHL, PsycINFO, and EBSCOHost. Search terms such as “treating PTSD”, “mobile apps”, “Clinical Trial”, “PTSD Coach” (PubMed MeSH terms), “Efficacy and adherence”, “efficacy or effectiveness”, “PTSD or posttraumatic stress disorder”, “smart phone”, “mHealth or m-Health or mobile health”, “PE Coach”, and “PTSD Coach” were utilized to find relevant articles. The reference sections of relevant articles were also examined to locate additional articles. The search resulted in over 11,000 article hits.

Articles were further narrowed down based on certain inclusion and exclusion criteria. Inclusion criteria included articles published in or after the year 2000 and from journals in English or translated to English. All study designs are included such as descriptive, correlational, quasi-experimental, and experimental, due to the paucity of information currently available in this field. Exclusion criterion included articles not specifically stating mobile application technology and its use in PTSD treatment. The population under study was people diagnosed with PTSD worldwide; however, much of the current literature is focused on the military veteran population.

The search found seventeen articles meeting the above criteria. Six articles are descriptive in design, three articles are review, one is correlational, four are quasi-experimental, and three are experimental. Due to the novelty of mHealth interventions, research on this specific topic is sparse.

## Literature Review

### Feasibility

Examining whether an app is being downloaded and used is the initial step in determining if that app might be an effective treatment tool. In a survey, 42% of consumers did not download a health app and of those who did some 46% stopped using it (Krebs & Duncan, 2015). In a report examining the reach of PTSD Coach (mobile app developed to treat PTSD alone or as adjuvant therapy – see Table 1), over half of first-time users abandoned the app before visiting its primary content. This use pattern (downloading an app and quickly scanning its contents for personal relevance) is a common obstacle that application developers deal with. In order to establish familiarity with an app, users need to return to it several times to appreciate what it has to offer, however, for users who only enter an app once, there is only a brief opportunity to engage that person in what the app has to offer. Identifying and understanding factors associated with increased app engagement, such as how easy it is to access the app, how clinicians perceive the app's value in treatment, and overall user interest, could increase initiation and promote long-term, appropriate use of PTSD mobile apps. (Owen et al, 2015).

**Accessibility.** In 2014, a survey study conducted by Erbes et al. using 188 veterans receiving treatment in a VA PTSD outpatient clinic found that 76% reported access to a smartphone with mobile application capability. It also reported that age had an affect on smartphone ownership where younger respondents were more likely to own a smartphone compared to older respondents (50.31 years, SD = 15.13 vs. 59.94 years, SD = 11.28;  $t = 400$ ,  $df = 57.53$ ,  $p < 0.001$ ; Erbes et al., 2014)

A similar study, tailored to veterans with serious mental illnesses, administered to 210 veterans showed 57% used the internet, 80% owned a cellphone, 30% owned a computer, and 13% owned a smartphone (Klee, Stacy, Rosenheck, Harkness, & Tsai, 2016).

A retrospective study (a study that uses pre-existing data to relate to an established outcome) using a mixed-methods approach (research that includes quantitative and qualitative data) to determine the dissemination of PTSD Coach found the mobile app was reaching both veterans and civilians - 73% of users identified as being a current service member and 27% of users identified themselves as civilians (Owen et al., 2015).

Together, these three studies suggest that PTSD treatment apps are used more by military personnel, with veterans having serious mental illness having less access to smartphone technology (13%) while veterans receiving treatment in PTSD clinics having greater access (76%).

**Clinician perception.** Since clinical providers can be instrumental to the dissemination and utilization of mobile application technology as part of a patient's treatment plan, determining their views on patient use of mobile apps is essential.

Before the launch of the PTSD app, PE Coach (Prolonged Exposure Coach; see Table 1), a survey was sent to 163 PE-trained VA clinicians to determine clinical opinions of the app. Results showed that 76% indicated an intent to use, 61% would recommend PE Coach to colleagues, and 33% already utilized mobile app usage in patient care (Kuhn et al., 2014a). After the launch of PE Coach, the same research team surveyed 271 PE-trained VA clinicians and found that 50% practicing PE in the past year utilized PE Coach with 93.6% reporting intent to continue use. Of the 50% of clinicians who did not currently use the app, 77.6% reported a future intent to use. Between the pre and post- launch surveys, mobile app utilization among PE-trained

clinicians increased from 33% to 50%. Clinician perspectives were generally favorable among those surveyed but younger clinicians (< 40 years old) showed more positive perceptions than older clinicians (>40 years old). Kuhn et al., 2015)

In a randomized controlled trial (RCT) of 20 veterans diagnosed with PTSD but not currently seeking treatment, half used PTSD Coach as self-management (SM) while the other half used the app as clinician-supported (CS). The SM group received one 10- minute session that provided handout-guided instructions with images on how to use PTSD Coach. After the session, participants were not directed to use the app on any particular schedule or in any particular way. Conversely, the CS group received four 20-minute sessions over an 8-week period with a clinician who provided app use instructions, utilized the app in sessions, set treatment goals, and assigned activities for completion between sessions. Throughout the study, clinicians rated their opinions of PTSD Coach on a five-point scale. For the clinician-supported group, providers reported high satisfaction (4.5/5), ease of treatment delivery (4.6/5), and desirable veteran engagement (4.0/5; Possemato et al., 2016).

A proof-of-concept study (small study with the sole purpose of verifying that an intervention has the potential of being used) determining feedback of the T2 Mood Tracker (mobile app developed to treat PTSD alone or as adjuvant therapy – see Table 1) demonstrated unanimous enthusiasm of the mobile app among clinical providers with one clinician stating, “I could definitely see myself having soldiers use this app in between appointments and download their records for review together” (Bush, Ouellette, & Kinn, 2014).

In a quasi-experimental (an experimental design that lacks random assignment) research report, 497 soldiers receiving treatment voluntarily at warrior transition units (WTU) across the East Coast used the app mCare (mobile app developed to treat PTSD as adjuvant therapy – see

Table 1) to facilitate treatment. A WTU is defined as a treatment facility for wounded, ill, and injured soldiers who require at least six months of rehabilitative care before transitioning out of military service or back into active duty. Over the course of twenty-one months, 85% of the clinician respondents reported that they would refer patients to mCare and case managers reported more efficient coordination of care, faster intervention implementation, and increased communication with patients (Poropatich, Pavliscsak, Tong, Little, & McVeigh, 2014).

These studies suggest high provider acceptance of utilizing PTSD Coach, PE Coach, T2 Mood Tracker, and mCare as an adjunct to conventional therapy.

**User interest.** The target population's interest in using mobile app technology to treat their illness has a direct effect on the initiation and ongoing use of mobile applications in the treatment of PTSD. Since the advent of mobile apps, studies have been conducted to determine qualitative and quantitative measurements of user interest. Interest has been reported as a component of efficacy studies or as a study on its own in feasibility trials, where a study is conducted on a novel intervention to determine participant interest and practicality of further research.

In the Erbes et al (2014) study, 85% of patients reported high interest in the use of mHealth as part of their treatment regimen. Even though age was a factor in participant accessibility of mobile application technology, it was not a statistically significant factor of app interest among the group of mHealth capable device owners. Older individuals were just as interested in mobile apps as their younger counterparts. (Erbes et al., 2014)

Throughout numerous studies, quantitative data, characterized by app downloads, has demonstrated user interest in mHealth for PTSD treatment. In a 4-year period, T2 Mood Tracker was downloaded more than 134,000 times (Bush et al., 2014). In the same time period, PTSD

Coach had 153,843 downloads (Owen et al., 2015). The reaction to PTSD Coach's U.S. release was so positive that, in 2013, Australia launched their own PTSD Coach, which was downloaded roughly 4,000 times in the first three months (Connolly, Derriman, & Connor, 2013). Reports also depict that PE Coach was installed more than 5,000 times in the first four months following its public debut (Reger et al., 2013).

In a feasibility RCT trial, a sample of community trauma survivors demonstrated that PTSD Coach was used an average of 2.65 times per week with the greatest utilization being in the evenings at home when traditional methods of treatment are less accessible (Miner et al., 2016). This illustrates how user interest may peak in the "life space" between conventional treatment sessions.

In a proof-of-concept study, eight WTU residents, who would subsequently be returned to active duty, utilized T2 Mood Tracker in addition to treatment as usual. 88% described the app as "very useful and beneficial" and 75% said they would share their recorded mood information with providers. Qualitative feedback demonstrated high usability especially when one user reported that the app's multimedia capability was useful because he "used the voice function for documenting because of my tremor". The positive reactions to the eight WTU soldiers demonstrates that T2 Mood Tracker is a feasible intervention especially for patients who may be vulnerable in their cognitive and motor functioning. (Bush et al., 2014)

Another qualitative study of PTSD Coach consisting of a 45-patient focus group was conducted in two VA PTSD residential treatment programs. Although the respondents only utilized the app for four days, they provided highly positive perceptions, almost 90%, in the focus groups describing what they loved about PTSD Coach and how it was useful. For instance, a 35-year old female veteran reported "I used it [the app] at night when I had nightmares. The

relaxation exercise was really helpful”. Additionally, a 46-year old male veteran stated, “I liked the relaxation stuff. I liked it because I didn’t have to go see a psychiatrist. It was very helpful because it was like a self-help thing”. These ratings were unaffected by age. (Kuhn et al., 2014b)

In summary, this data suggests a high interest (85%) in utilizing mobile apps for mental health purposes, with the most popular PTSD app, PTSD Coach, having an average of 3,205 downloads per month with individuals using the app on average, 2.65 times per day.

### **Efficacy**

To determine the effectiveness of mHealth in PTSD treatment, one must examine the apps ability to decrease PTSD symptoms post-treatment. PTSD Coach is the most studied app associated with the treatment of PTSD. Qualitative results from the retrospective study on PTSD Coach showed strong satisfaction ratings for first-time and return-visit users. For example, 58.3% referred to PTSD Coach as having a positive valence and numerous app reviews displayed positive feedback like the following:

- “[It was] great to be able to carry all this around in my pocket. When I can’t sleep or I feel like I’m going to lose it, I can’t always wait to see a counselor”
- “It helps me get through those rough patches, and when you’re really messed up it will advise you to call someone in your support line.” (Owen et al., 2015)

PTSD Coach utilizes the PTSD Checklist (PCL) to assess distress levels before and after app use and then converts it to a 10-point distress thermometer. The PCL is a 17-item self-report checklist measuring how bothersome DSM-IV PTSD symptoms have been to the respondent in the past month. In traditional practice, it has shown to have good psychometric properties and is useful in diagnosing PTSD and its severity. According to a study conducted by Price et al. (2014), the PCL remains a valid measure of PTSD symptoms when administered through mobile

applications. In this study, 153 trauma-exposed individuals completed the PCL on a mobile device and also with pen and paper. Results demonstrated that reported PCL results did not differ between the two assessment administration modalities. (Morland, Ruzek, & Rosen, 2015) The Owen et al. (2015) study demonstrated that PTSD Coach was used most during moments of need and effectively reduced distress by 2.6 points on the distress thermometer.

The RCT of community trauma survivors conducted by Miner utilized a control group, who was waitlisted for app use, and an experimental group that used PTSD Coach. After the first post-condition assessment, the waitlisted group was able to use the mobile app as well. Both groups reported that PTSD Coach helped them learn new tools to cope with symptoms (Control: 63% v. Experimental: 83%) and found the self-management component of the app the most useful (C: 60% v. E: 47.8%). At the first post-condition assessment, the experimental group had been using PTSD Coach for a month while the control group had not. The assessment showed that 39% of the experimental group experienced a 10-point decrease in PCL score while 19% of the control group experienced this decrease. At the second post-condition assessment, the control group, who had now been using PTSD Coach for a month, showed that 47.4% experienced a statistically significant decrease in PTSD symptoms (PCL score  $\geq$  10 point decrease). This shows a significant improvement in PTSD symptoms from pre- to post-treatment and was comparable to the improvement witnessed in the experimental group, basically replicating its findings. (Miner et al., 2016)

Additionally, in the pilot RCT of patients using PTSD Coach with and without clinician support, the CS group showed a greater decrease (70%) in PTSD symptoms than the SM group. However, 30% of the SM participants experienced significant reductions in their symptoms and 40% sought further mental health treatment after using the application (Possemato et al., 2016).

These statistics highlight that; even when used alone, PTSD Coach is useful and should garner future research.

From these three studies, the efficacy of mHealth in PTSD treatment was characterized as having a positive valence, supportive user feedback, significant decrease of PCL score when comparing no treatment (19%) to treatment (47%) of the same group, and decrease in symptoms with (70%) and without (30%) clinician support.

### **Adherence**

In order for a treatment to be successful, there needs to be adherence to the components of treatment. However, the two aspects of adherence, attendance at treatment sessions and completion of homework (activities designed to initiate self-treatment between professional sessions) are often low in PTSD treatment due to avoidance symptoms characteristic of PTSD. With the use of mHealth, professionals are trying to mitigate avoidance and increase adherence to traditional treatment.

A case study of two active duty soldiers undergoing PE therapy with and without utilizing PE Coach was conducted in 2015. The soldiers completed eight sessions of PE therapy but only used PE Coach for four of the eight sessions. It showed that PE Coach produced higher homework adherence compared to traditional PE pen and paper workbooks. Additionally, both soldiers stated that it was easier to remember, record, and complete assignments when using PE Coach. (Reger, Skopp, Edwards-Stewart, & Lemus, 2015)

In the RCT of self-managed or clinician-supported PTSD Coach utilization, 70% of participants from the CS group continued to seek further mental health treatment as clinician managed and/or self-managed. Possemato and his colleagues conclude that CS PTSD Coach could serve as an introduction to mental health treatment, particularly in the primary care setting,

because if an introduction to PTSD evidence-based therapy is favorable, like the reviews of PTSD Coach, patients may be more likely to continue treatment. This would be beneficial since previous research has shown that veterans diagnosed with PTSD in primary care are less likely to seek further treatment compared to those diagnosed in mental health clinics. However, further studies need to be implemented to support this theory. (Possemato et al., 2016)

The mobile app, mCare, was designed to improve contact rates, defined as communication between patient and provider via phone calls or messaging, and efficacy of PTSD treatment among geographically dispersed military patients. In the pilot study determining adherence, the contact rates (phone calls and mCare messaging) improved by 176% and 50% of case management teams reported an improvement in appointment attendance. Additionally, 48% of participants utilized mCare for more than a year, which is 6 months longer than the estimated average time a consumer normally spends on a mobile health application. (Poropatich et al., 2014)

Following the pilot study of mCare, there was a two-armed prospective RCT conducted at WTUs over 9 months. In this study, 87 patients received the standard of care (SOC) while 95 participants received SOC plus the mCare mobile app. Results showed an increase in utilization and adherence to mental health care that lead to an increase in both attendance and homework completion. There were 1042.98 contacts (phone calls between care team and patient plus mCare messages; 28.97/wk.) for the experimental group, which are six times more contacts than the control group (phone calls between care team and patient only; 173.58 contacts or 4.8/wk.). Additionally, mCare provides a patient an activation component where the patient can initiate appointments and create appointment reminders for therapy sessions. During the 9-month study, the experimental group entered over 900 appointments. (Pavliscsak, 2013)

Mobile apps like PE Coach, PTSD Coach, and mCare promote treatment adherence. Numerous studies reported increased homework adherence when mobile apps were used in conjunction with traditional therapy. Treatment adherence was demonstrated by seeking additional treatment (70%), improving contact rates (176%), and utilizing these mobile apps six months longer than the average consumer. Additionally, mCare promoted patient control and accountability with its patient activation component, which recorded 100 new appointments per month (Pavliscsak, 2013).

## Discussion

The studies examined suggest that mobile application technology has a positive influence on traditional PTSD treatment. Overall, preliminary trials displayed promising results that warrant further research into mHealth as an adjunctive PTSD therapy. The results included high user and clinician interest, improved adherence to treatment and clinician user communication and -most importantly- improved treatment outcome characterized by a reduction in symptoms. From a patient's point of view, a large advantage of mobile app utilization is its private nature. The anonymity provided by mHealth smartphone applications may be advantageous to patients with PTSD because it diminishes the stigma or shame often accompanied with receiving mental health care (Kuhn et al., 2014b).

The results of clinician perceptions are worth mentioning in detail. In order for mHealth to popularize, there needs to be high clinician support since they are a primary factor in the dissemination and utilization of this technology. In addition to encouraging the delivery of evidence-based interventions, positive clinician perception may allow practitioners to assist more patients and address a broader range of needs. It is increasingly recognized that conventional modes of small group and individual treatment fails to implement widespread dissemination of evidence-based interventions. Use of technology, like mHealth, can potentially decrease costs of treatment while improving patient engagement and extending services to successfully meet patient needs. (Kuhn et al., 2014a)

Findings suggest that mobile apps are best utilized in the "life space" between traditional appointments when professional help is not readily available. They were utilized more for times of need rather than maintenance, and these times of need occurred most outside clinical business hours (Owen et al., 2015). Mobile app technology makes evidence based care more accessible

and can provide quick interventions in situations causing acute stress. This, in turn, can increase patient control over their disorder and treatment in a way that traditional treatment cannot (Pavlisacsak, 2013).

A principal reason why mobile app technology is beneficial in PTSD treatment is because the leading psychological treatment, cognitive behavioral therapy (CBT), lends itself to be translated onto a technology platform. As previously stated, CBT consists of educational and instructional content on reactions to trauma, and providing helpful coping mechanisms to these reactions. In order for treatment to be successful, patients need to practice these coping skills on their own. CBT capable mobile apps, like PTSD Coach, allow patients to practice these skills and are beneficial in situations where acute symptoms may arise. (Kuhn et al., 2014b)

PTSD symptoms often occur unexpectedly causing physical and psychological reactions that are difficult to control. For example, PTSD re-experiencing symptoms can be randomly triggered and cause shortness of breath, anxiety attacks, or other intolerable symptoms. Additionally, avoidance symptoms can precipitate seclusion and isolation in hopes of deterring flashbacks. If these symptoms are not dealt with, they can maintain or exacerbate PTSD. By utilizing mHealth, patients are instantly provided with coping tools (calming self-talk, relaxation exercises) that can alleviate these symptoms in any situation. Having readily available, evidence based treatment could give a patient the confidence to deal with unexpected symptoms and continue a productive lifestyle after a traumatic event. (Kuhn et al., 2014b)

**Limitations of mHealth.** However, mHealth lacks human contact and in-person support that is necessary for those recovering from trauma. With mobile app technology being a novel intervention, studies show that the main reason for nonuse of PTSD Coach and similar apps is the lack of awareness and opportunity for use, defined as patients not having mobile app capable

phones (Kuhn et al., 2015). Results from a PTSD Coach RCT reports an increase in adherence with app use when combined with clinician support. These findings are consistent with the Supportive Accountability Model, a theoretical model created for mHealth interventions, which argues that clinician supported treatment is the best way to increase adherence because patients have to be accountable to a professional (Mohr, Cuijpers, & Lehman, 2011). This is especially true in instances where the provider is viewed as experienced, trustworthy, and helpful (Possemato et al., 2016). Therefore, mobile app technology would be best utilized as an adjunct to clinician supported treatment rather than as a treatment on it's own (Olf, 2015).

**Recommendation.** As an adjunctive treatment there are many uses for mobile apps in treatment for PTSD. For example, it can be utilized as a first-line treatment following primary screening and diagnosis of PTSD in the primary care setting and for patients waiting to enter specialty treatment. It can also be utilized with minimal assistance with distant, telephone coaching for those in rural locations who are unable to travel to institutions with conventional treatment. Most importantly, it can be used to improve traditional care and increase engagement for patients receiving pharmacotherapy or psychotherapy. As an adjunct to clinical treatment, mHealth can complement sessions by providing timely and relevant information for the patient to review at home. (Miner et al., 2016)

The majority of studies in this report pertain to mobile app use in military populations. However, there is evidence that civilians experience violence; specifically 50% of women and 60% of men will experience at least one traumatic event in their lives. Additionally, about 10% of women and 4% of men who have experienced trauma will develop PTSD sometime in their life. In the civilian setting PTSD can be precipitated by violence (rape, assault, gun shots), accident/disaster related trauma (motor vehicle accidents, house fires, terrorist attacks,) and

medical trauma (medical errors, near death; United States Department of Veteran Affairs, 2016).

These instances often go unrecognized where, if caught early, treatment by mobile app may be something PAs and other health professionals can use to initiate treatment in this population.

More research is needed in this non-military population.

Overall, the high penetration of mobile-app capable smartphones combined with strong patient interest in mHealth interventions suggests that mental health clinicians have yet another modality to provide psychoeducational information, self-managed interventions, and therapy materials to patients (Erbes et al., 2014).

## Conclusion

Mobile application technology for the treatment of Posttraumatic Stress Disorder is in its infancy. Most current published work on this topic discusses the potential benefits of mHealth rather than proving its value. There are quasi-experimental and experimental reports but they are limited, on a small-scale, and with a short time period. However, preliminary results do support mHealth as a feasible, adjunctive intervention for PTSD and characterize mobile app technology to have a positive effect on the efficacy and adherence to conventional treatment. Based on the research in this literature review, I believe it would be prudent to put money and resources into large-scale randomized trials to reproduce preliminary results. It is hypothesized that mHealth will become standard tools for practitioners and patients who are very mobile or have limited access to healthcare (Bush et al., 2014). With society becoming mobile and networked, it is crucial for medicine to use these novel avenues to treat currently under-diagnosed, misdiagnosed, and undertreated conditions like PTSD.

Physician assistants (PAs) are highly skilled healthcare professionals who work on a healthcare team with physicians and other providers. The foundation of the PA education is in primary care but PAs can practice in any specialty. Because of job flexibility, PAs garner a vast medical experience and are able to effectively meet the changing needs of patients. It is crucial for this profession to stay current with novel medical research. Understanding mHealth and its application to medicine is especially important to PAs. Mobile app technology will be highly beneficial for providers in primary care because they are the first providers who may come in contact with a patient with PTSD. With a solid primary care background, PAs can utilize mobile apps to properly address PTSD and ultimately enhance coordination of care, improve patient outcomes, and increase patient satisfaction (American Academy of Physician Assistants, 2016).

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## Appendix

Table A1

### *Description of Mobile Applications for PTSD Treatment*

<u>Name</u>	<u>Platform</u>	<u>Description</u>	<u>Features</u>
<b>PTSD Coach</b>	Android, iPhone	Developed by VA's National Center for PTSD Dissemination and Training Division Can be used on its own or as adjunct therapy	<u>Learn</u> : provides psychoeducation about trauma, PTSD, and specialized treatment options <u>Manage Symptoms</u> : offers CBT-based self-management tools for PTSD symptoms (Interactive relaxation tools, stress inoculation training, and grounding) <u>Self Assessment</u> : ability to take, schedule, and view assessments of their symptoms using PCL <u>Find Support</u> : stores personal contacts, crisis lines, and emergency service contacts for convenient use Ability to personalize with music, photos, and contacts stored on the smartphone to be used in tools (eg. soothing pictures and songs in relaxation tools)
<b>PE Coach</b>	Android, iPhone	Developed by VA National Center for PTSD Only used as adjunct therapy Designed to use during and between traditional PE therapy sessions, content appears sequentially in line with the session number of traditional PE therapy	Audio recording for playback after therapy sessions Assessment and tracking of treatment outcomes using PCL Tools to encourage tasks and provide support between sessions (breathing-retraining tool, homework assignments, psychoeducation, and therapist contact information) Appointment reminders that are connected to the smartphone's calendar
<b>T2 Mood Tracker</b>	Android, iPhone	Developed by Defense Department's National Center for Telehealth and Technology (T2) Can be used on its own or as adjunct therapy	Contains moveable points on scales to rate moods, graphs to self-monitor across time, and ability to display reports to healthcare providers Has ability to customize rating categories (eg. pain, sleep, substance use, etc.)
<b>mCare</b>	Android, iPhone, Blackberry, regional pay-as-you-go phones	Developed by the Telemedicine and Advanced Technology Research Center Only used as adjunct therapy Utilized by providers and patients	Schedule and set appointment reminders personalize relevant health & wellness tips Display unit announcements (eg. timesheet reminders, job fairs, reintegration information, and civilian employment opportunities) Communicate with care team (eg. personal messages, questionnaires) Measure treatment efficacy by creating trend graphs that display pattern behaviors over time

Information adapted from the following journals: Bush et al., 2014; Erbes et al., 2014; E. Kuhn, Greene, et al., 2014; Pavliscsak, 2013; Poropatich et al., 2014; Reger et al., 2013; Shore et al., 2014

### Abstract

**Objective:** To determine how mobile application technology has affected Posttraumatic Stress Disorder (PTSD) treatment by measuring its influence on treatment initiation, efficacy, and adherence. **Method:** A qualitative literature search was conducted on the following databases: PubMed, CINAHL, PsycINFO, and EBSCOHost. **Results:** Seventeen articles met proper criteria. Six were descriptive in design, three were review, one was correlational, four were quasi-experimental, and three were experimental. They were examined to assess the influence of mobile health (mHealth) on PTSD treatment. Primary trials exhibited promise that mobile application technology will increase initiation, efficacy, and adherence to traditional treatment. **Conclusion:** mHealth is a beneficial adjunct to conventional PTSD treatment, especially in medical settings where evidence-based psychotherapy is limited or unavailable. Additional large-scale, long-term studies need to be conducted to support preliminary findings. By understanding and utilizing up-to-date, hi-tech PTSD treatments, Physician Assistants can enhance coordination of care, improve patient outcomes, and increase patient satisfaction by properly addressing this undertreated condition.

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