Collaborative Management of PTSD Treatment through Smartphone Apps Validated through Patient-Centered Design

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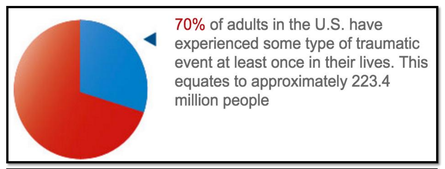
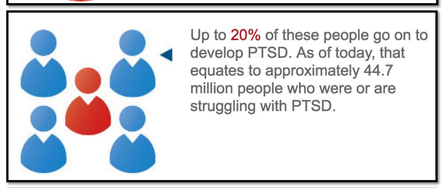
1. Background

Post-traumatic stress disorder (PTSD) is a mental health disorder that an estimated 8% of Americans – 24.4 million people – experience at any given time.





Smartphone apps can complement PTSD treatment in a variety of ways.

- e.g. Homework tools, psychoeducation

Recent research has shown that apps are a feasible method for enhancing standard treatment for PTSD.

- 76% of Veterans receiving outpatient treatment for PTSD reported owning a smartphone
- 85% reported interest in at least one potential use of an app as part of therapy
- VA clinicians trained in evidence-based treatment for PTSD generally find treatment integration of smartphone apps to be favorable

Systematic review of more than 113 publicly-available PTSD smartphone apps showed:

- Only 2 (CPT Coach and PE Coach) were designed explicitly for integration with standard treatment.
- Most apps are standalone and do not have remote monitoring capabilities.

Critical Need: to determine how to best integrate information from these apps into on-going treatment and validate the efficacy

2. Research Aims

Aim 1: *Derive functional and information requirements to inform the design of a usable, efficient, and interactive PTSD information system that meets the needs of clinicians and patients.*

Aim 2: *Develop and verify the efficacy of a sensor-enabled smartwatch app in predicting stress state changes*

3. Methods & Results

3.1 Systematic Review of Peer-Reviewed Literature

- Inclusion criteria:
  1) The article reviewed or validated an existing PTSD app
  2) The article detailed the development of a new app for the detection or treatment of PTSD
  3) the article was a case study using PTSD apps
- A total of **28 papers** met the inclusion criteria.
- Only **SIX** documented original studies evaluating the design or usage of a PTSD smartphone app.
- Only **TWO** PTSD apps were studied: PE Coach and PTSD Coach.
- None of the reviewed papers documented the design methodologies

	Reference	Application	Method	Study Objective	Findings
1	Kuhn, Greene, et al., 214	PTSD Coach	Evaluation	Validate PTSD Coach	The mobile application could potentially be used as an effective self-management tool for PTSD
2	Reger et al., 213	PE Coach	Evaluation	Validate PE Coach	Application may improve patient compliance with treatment, as well as convenience.
3	Owen et al., 215	PTSD Coach	Usage	Analyze PTSD Coach analytics	PTSD Coach has reach a large population, and based on reviews is well-received
4	Possemato et al., 216	PTSD Coach	Usage	Analyze PTSD Coach with and without clinician support	Clinician support for PTSD Coach increases effectiveness of the mobile application.
5	Kuhn et al., 215	PE Coach	Usage	Clinicians' perceptions of PE Coach	Clinicians are keen to use a PE mobile application for therapy.
6	Reger et al., 215	PE Coach	Usage	Compare treatment with and without PE Coach	PE Coach can enhance the treatment engagement of the clinician and patient.

3.2 Systematic Review of Smartphone App Information

- Inclusion criteria:
  1) Web search for relevant apps: Search Engines, Online Forums and Communities, App Rating Sites, Government Mobile App Sites
  2) Search terms included either "App" or "Apps" and the following words related to PTSD (e.g., Trauma), Symptoms of PTSD (e.g., Anger). Treatments specific to PTSD (e.g., Cognitive Processing Therapy), or Social support for PTSD
  3) Mental health or treatment apps had to be relevant to PTSD
- A total of **113 apps** were found and reviewed.
- Only **TWO** apps (PE Coach and CPT Coach) were designed explicitly for integration with standard treatment.

	App Theme by Characteristics of Apps	Treatment Integration	Education	Exercises	Symptom & Progress Tracking	Outside Professional Support	Outside Peer Support
1	PTSD		4	7	2	1	1
2	Mental Health (including PTSD)		2	2	5		1
3	PTSD Treatment	2	4	9	4		
4	Mindfulness and Relaxation		5	21	5	2	1
5	Anger		3	6	1		
6	Insomnia		3	1	3		1
7	Peer Support		2			1	5
	Total	2	23	55	2	4	9

3.3 Patient-Centered Design for an Active Smartwatch App

- A user-centered design approach was used to implement a PTSD smartwatch application
- The design was informed by hierarchical task analysis and a heuristic analysis (Nielsen's Heuristics)

Subject Matter Expert (SME) Interviews

- 10 interviews were conducted with the VA Psychiatrists & Psychologists
- SMEs were asked to validate a descriptive model of the current PTSD treatment process
- SMEs interviews were also used to derive functional and informational requirements for the PTSD smartphone app.

Usability Testing

- 8 Texas A&M University graduate students were asked to explore PTSD Coach (the most widely used PTSD mobile health application.
- Major interaction, technical and usability issues were identified and documented.
- While subjects found the tool to be easy to use, the functionality did not meet their expectation

Intervention: The device alerts the patient when "hyper arousal" is detected by the heart rate sensor. Other activities are de-noised using other sensors

Therapy: The tool provides variety of interactive activities, facilitates connection to peers, and clinicians, and patient's social networks.

On Demand Access: Patients can use the tool to use the interactive features of the tool whenever they feel stressed.

Self-Assessment: Patients can use the tool to complete periodical self-assessments, review their progress, and share the results with clinicians.

4. Implications

While remote monitoring using sensor-based technologies offer many capabilities that can be implemented in mHealth apps, there are still many limitations and challenges that prevent the existing and future apps from reaching their full potential including treatment adherence, compliance, and convenience. A careful selection of human factors engineering (HFE) methods tailored to the information system will unveil user requirements focusing on usability, security and privacy, as well as safety and reliability.

5. Future Work

Subject Matter Expert (SME) Interviews

- Veterans with PTSD will be recruited to expand the descriptive model of care

Laboratory Study

- 40 veterans will participate in a user study to (1) identify the optimal sensor configuration (e.g., reporting interval, sensitivity, etc.) required for heart rate values to prompt the user, (2) develop an analytical model that will predict the patient's mental state based on heart rate data and automatically adjust for environmental factors, perspiration, and watch movements, and (3) determine human factors and usability issues that need to be considered in the enhanced design.

Iterative Formative Usability Testing

- The initial tests would include concurrent gathering of signals from EEG (i.e., electrical activity of the brain) and physiological and voice metrics from a wearable device under the high stress test conditions to validate the sensor data.
- This would be followed by tests with the wearable device(s) under various at home conditions and covariate specifications to test the usability and reliability of data provided.

Summative Usability Testing

- PTSD patients will be recruited to use the device in a usability laboratory to collect subjective data on usability and overall experience, followed by in-home trials to gather additional data.
- For longitudinal user experience data collection, a diary study will be conducted where patients are asked to document thoughts, evaluate experiences, and provide other contextual information such as events that precipitated the hyperarousal.

For more information about this work, please contact Dr. Farzan Sasangohar: sasangohar@tamu.edu ; (979) 458-2337