Study Protocol

Official Title: Technology and Emotion Study "TECH-E": Randomized Controlled Trial ofMoodRing compared to Usual Care: Mobile Monitoring of Adolescent DepressionPhase II

ClinicalTrials.gov ID (NCT number): NCT05376358

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Scientific Background

Adolescent depression is increasing and limited numbers access treatment. Almost 12% of adolescents have major depression or dysthymia. A third experience suicidality and 11% attempt suicide; resulting in $12 billion in hospital costs, but only one-third receive treatment, and initial treatment delays average 10 years.
Screening may identify adolescents at risk for depression, who do not address their symptoms until they are in crisis. To increase detection of depressive symptoms, the US Preventive Service Task Force recommends routine screening for major depressive disorder in adolescents aged 12 to 18 years. For those who are at risk for worsening depression, close follow-up with the primary care provider (PCP) is recommended. Most adolescents will wait to seek medical attention only when symptoms are severe or they are in crisis . Although multiple studies show the benefit of addressing depressive symptoms before they worsen, this is not done in practice due to difficulty and burden in requiring patients to self-report and lack of scheduling and attending frequent follow-up visits.
Frequent, passive symptom monitoring which detects depression could help adolescents monitor their symptoms by employing early self-management interventions and make parents and clinicians aware of symptom worsening to avoid worsened outcomes or a crisis situation.
Preliminary studies. In the MONARCA project, Frost, Doryab, et al. developed a smartphone app to provide disease insights by collecting passive data relevant to behavioral trends of bipolar disorder in adults. They found patient mood correlated with physical activity, levels of stress, sleep, and phone use, and that phone call duration, speech analysis, and movement data from smartphones could identify manic and depressive states. Their system recognized bipolar states and transitions between those states with 76% accuracy based on 12 weeks of data with 10 patients. Dr. Doryab led two rounds of data collection at CMU where cohorts of 180 (Spring 2017) and 270 (Spring 2018) freshmen students were recruited to use AWARE for a semester. Baseline, post surveys, and ecological momentary assessment data were

collected to support and validate the outcome of machine learning models. An analysis of first round data detected post-semester depression among freshmen with accuracy of ~86% and change in severity levels with accuracy of 78.6%. A machine learning pipeline was developed to process data on a sensor by sensor basis to identify the best set of sensors that provide the highest accuracy and the minimal set of features required for accurate inferences above the majority class baselines.
We adapted this data to adolescents and used their data to replicate the analysis, rederiving the algorithms.
We will use the data collected from the first phase to create an application, MoodRing, to provide feedback to adolescents, parents, and clinicians on symptom severity using passive sensing technology, to understand whether this application improves the quality of depression management through increasing the application of self-management activities and utilization of timely engagement with healthcare
as well as exchange of passively monitored mood information between adolescents, parents, and providers.

Study Objectives

Evaluate the efficacy of MoodRing in a randomized trial.

PRIMARY: 1) Does MoodRing compared to usual care improve the self-management of depression (i.e. active involvement of adolescent patient in managing their depression)? AT 3 MONTHS

EXPLORATORY:
2) Does MoodRing compared to usual care improve the quality of depression management as measured by:
    a) depression symptom reassessment
    b) medication adherence in those on medication
    c) therapy adherence in those in therapy
3) Does MoodRing compared to usual care result in:

a) less healthcare utilization
b) decreased depressive symptoms
c) improved sleep quality
d) increased application of self-management activities

3) Is improvement in self-management of depression mediated by perceived severity, social support, self-management knowledge and skills, and self-efficacy?
4) Do healthcare providers, adolescents, parents report satisfaction with MoodRing?

Study Design & Methods

Randomized trial. Study procedures: We will recruit adolescents with a history of depression using similar mechanisms as in the Phase 1 study (IRB protocol #18120176). This will include recruitment through clinical sites at CAYAH (4 clinical sites) and the University of Pittsburgh Research Registry, Pitt+Me, run by the Clinical and Translational Science Institute as well as from the STAR center. Most participants for the Phase 1 study were successfully recruited through the STAR center. We will also recruit using social media advertisements. The research assistant (RA) will screen interested adolescents for meeting inclusion/exclusion criteria – have a prior or present history of depression per self- report and/or clinician diagnosis - and enroll those with a score of at least 5 or higher on the PHQ-9 who do not have active suicidality. Most adolescents recruited from the STAR center will have completed their acute phase of treatment in intensive outpatient treatment and will be receiving outpatient psychotherapy and/or antidepressant management. Adolescents age 12-18 and their parent will be consented for the study and be sent an online survey for baseline measures. Those who complete the baseline measures will then be randomized to receive the MoodRing intervention or treatment as usual and asked to complete data collection at 3 months and 6 months by online survey. Additionally, data will be collected via the electronic health record and from patients' healthcare providers who consent to participate in the study. Randomization: Adolescents will be

randomized at a 1:1 ratio (using randomized block sizes) to MoodRing with feedback to adolescent, parent, and healthcare provider team or to usual care with collection of passive sensing and survey data without the use of the MoodRing app. The randomization tables will be generated by the study statistician.

Eligibility Criteria

Included if
- age 12 -18
- prior or present history of depression per self-report and/or clinician diagnosis
- scores between 5 or higher on PHQ-9 consistent with at least mild symptoms
- read and understand English
- has an Android or iOS smartphone compatible with AWARE APP and access to a
smartphone data plan
- currently in United States

Excluded if
- currently actively suicidal (have suicidal thoughts and plan with an intent to act on
it)
- plans to travel to countries belonging to the European Union (Austria, Belgium,
Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France,
Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The
Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden), the

United Kingdom (England, Scotland, Wales, and Northern Ireland), Norway, Iceland,
or Lichtenstein in the next 6 months for more than 2 weeks at a time

Parent/Guardian
Included if:
- adolescent qualifies for study and assents to enroll
- understands English
- currently in United States
- has a smartphone device that can download the intervention application

Excluded if:
- If their adolescent child is excluded

Statistical Considerations

The primary outcome is self-management using the Partners in Health Scale which is a continuous scale of self-management knowledge and behavior. https://www.publish.csiro.au/PY/PY03022 Our planned sample would give us the power to detect a small effect size. For the full sample (N=200): 80% power (alpha=0.05) to detect cohens d = .40. Complete data with 10% dropout (N=180): 80% power (alpha=0.05) to detect cohens d = .42."

Data Analysis: Baseline summary statistics will be displayed. The CONSORT diagram will be completed to ensure reporting transparency. The main outcome for Phase II is self-management of depression. To assess intervention efficacy, the primary approach will be an intent to treat analysis with a mixed model with a random intercept treatment as the effect of interest. Predictors will be treatment, time, and treatment*time interaction. Covariates will be age, history of therapy, and phq9 total score.