Development and Testing of a Virtual Reality Intervention with Adolescents Hospitalized for Suicide-Related Crises

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Abstract. The primary objective of this study was to build and test a virtual reality (VR) intervention that teaches adolescents hospitalized for suicide-related risk therapeutic skills and provides them opportunities to practice using these skills in immersive VR scenarios. The Practice Experiences for School Reintegration (PrESR) is facilitated by a clinician to help hospitalized adolescents prepare for their return to school. Our model was informed by input from adolescents with lived experience, school professionals, and hospital professionals, and the intervention was built and iteratively refined based on feedback from a community sample of adolescents (n=6), adolescents previously or currently hospitalized for suicide-related thoughts or behaviors (n=13), and hospital professionals (n=8). This paper describes the iterative development and refinement process leading to the final PrESR intervention, which is currently being tested in a pilot optimization trial.

Keywords. Suicide, virtual reality, intervention development, adolescence, cognitive behavioral therapy

1. Introduction

Increasing rates of suicide-related thoughts and behaviors [1] and hospitalization for suicide-related crises among adolescents [2,3] necessitate innovative approaches for improving treatment and recovery. Following hospital discharge, adolescents are at heightened risk of additional attempts or re-hospitalization [4]. Limited research has addressed how to prepare adolescents during this transition for handling stressors and reacclimating to school [5,6].

Although inpatient programs use diverse treatment approaches, treatment typically focuses on stabilization and psychopharmacotherapy [7,8]. One well-suited treatment, Cognitive Behavioral Therapy (CBT) [8], includes teaching, modeling, and practicing therapeutic skills. Yet, within the confines of hospital treatment, meaningful practice opportunities that could translate to daily settings are difficult to execute because of time constraints and engagement difficulties. Consequently, we developed a Virtual Reality (VR) intervention that allows hospitalized adolescents to learn and practice CBT skills. Specifically, Practice Experiences for School Reintegration (PrESR) aims to increase skill knowledge and use, to improve school reintegration and prevent suicide [9]. Adolescent patients using PrESR can learn and practice three skills (affect regulation, cognitive restructuring, problem-solving) in an immersive school scenario. Development and testing of PrESR occurred over three phases. First, we recruited adolescents previously hospitalized for suicide-related crises and school and hospital professionals to provide input on the PrESR model. We conducted qualitative analyses on transcripts of interviews [9] to refine the model. Second, we recruited participants representative of a range of roles to review scenario scripts and/or playtest a PrESR prototype. Third, we initiated a pilot optimization trial in two psychiatric inpatient hospitals with adolescents

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hospitalized for suicide-related risk. Here we present findings from the second phase of this research, which involved feedback from a sample community of adolescents, adolescents with lived experiences, and hospital professionals.

2. Methods

Methods for the development of PrESR were informed by the Person-Based Approach to Intervention Development [10]. This approach includes four stages of research towards developing and testing digital health-related behavior change interventions, from planning to implementation and trialing [10]. We have previously shared early results from the design stage addressing model development [9] and here expand on results from this stage addressing intervention development. All procedures were reviewed and approved by an Institutional Review Board prior to participant interaction.

2.1. Participants

Participants included a community sample of adolescents (n=6), adolescents currently or previously hospitalized for suicide-related crises (n=13), and hospital professionals (n=8). Participants provided permission, assent, and/or consent (depending on age) prior to participation.

Community sample. Adolescents from the community were recruited through local social media and listservs using a snowball sampling approach. Eligibility criteria included: (1) ages 13-18; (2) attended school recently; (3) ability to speak, read, and understand English; (4) consent of a parent/legal guardian; and (5) adolescent assent. Participants identified their race as White (n=4), Mexican American (n=1), or Black or African American (n=1), and ethnicity as Hispanic (n=1) or non-Hispanic (n=5). Two identified as woman/girl and reported their sex to be female, two identified as man/boy and reported their sex to be male, one identified in some other way and reported their sex to be female, and one identified as man/boy and reported their sex to be female.

Hospitalized sample. Adolescents with current or previous suicide-related risk were identified from medical records from one child and adolescent psychiatric inpatient hospital located in the southeast. For previously hospitalized adolescents, we mailed an opt out letter to parents/guardians or adult adolescents and followed up with phone calls. For adolescents currently hospitalized, we called parents or legal guardians to seek permission before approaching hospitalized adolescents for assent. Eligibility criteria included: (1) hospitalization for suicidal thoughts or behaviors in past six months; (2) ages 13-18; (3) return (or expected return) to school following discharge; (4) ability to speak, read, and understand English; (5) consent of a parent/legal guardian; and (5) adolescent assent. Minimal risk for motion sickness was required for testing the VR specifically, and if of concern participants were able to provide feedback on components of the intervention without engaging in VR. Participants identified their race as Asian and White (n=1), White (n=8), Black or African American (n=2), and White and Hispanic (n=1), and ethnicity as Hispanic (n=3) or non-Hispanic (n=10).[1] Four identified as woman/girl and reported their sex to be female, seven identified as man/boy and reported their sex to be male, one identified in some other way and reported their sex to be female, and one identified as man/boy and reported their sex to be female.

Professional sample. Clinicians (n=8) were recruited from a child and adolescent psychiatric inpatient hospital and identified their role as occupational therapist (n=2), recreational therapist (n=1), or teacher (n=5). They identified as Black or African American (n=2) and White (n=5), and ethnicity as non-Hispanic (n=7). Five identified as female and reported their sex to be female, one identified as transgender and reported their sex to be female, and one identified as male and reported their sex to be male.[2]

[1] One adolescent selected "prefer not to answer" when asked about their race.
[2] Demographics are missing from one hospital professional.

2.2. Instrumentation

We collected demographic information and structured feedback from participants using a self-report questionnaire. We audio recorded qualitative, semi-structured interviews using a think aloud protocol, and completed a debrief following each session to identify disruptions and key takeaways from interviews for rapid analysis. An observation protocol from a previously validated rubric of decision making and social competency skills [11] was used for all sessions; it involved eight ratings of engagement, verbalizations, comprehension, emotional control, provocativeness, reaction time, affect, and reflection. Two independent raters provided a rating to each of the eight categories on a scale from 1 (very low) to 5 (very high), meeting to come to consensus.

We gave the Motion Sickness Questionnaire, which measures susceptibility to motion sickness via different modes of transportation [12], to adolescents previously or currently hospitalized and to hospital professionals as a screening method for determining appropriateness of VR. We used established norms [12] and excluded participants above the 50th percentile. We provided the Simulator Sickness Questionnaire, which measures cybersickness levels after VR, to assess nausea and oculomotor symptoms [13]. Adolescents using VR additionally completed the PROMIS Anxiety and Depression instrument, which measures levels of anxiety and depression [14].

3. Intervention Development

3.1. Procedures

We developed the intervention sequentially based on iterative feedback from participants. First, we developed scripts for difficult school scenarios and lessons about CBT based on data collected during the first phase of the study [9]. Specifically, we developed (1) scripts that taught and reinforced introduction to CBT skills (introduction to CBT, affect regulation, cognitive restructuring, and problem solving); and (2) practice scenarios involving conversations between peers and adults in the school reflecting the most important and commonly recommended situations adolescents may face when returning to school. We designed three scenarios to integrate multiple stressors and interactions, including: (1) a classroom setting in which the adolescent engages in a lesson, interacts with peers in a group activity, and discusses missed work and absences with a teacher; (2) a cafeteria setting in which the adolescent interacts with different peers about their recent absence due to their hospitalization; and (3) a meeting setting in which adults in the school discuss re-entry planning with the adolescent's parent or legal guardian. Findings from the first phase of the study informed several other ideas for the intervention (e.g., virtual incentives in the intervention, additional scenarios) [9], but, due to resource constraints, we focused on core components of the intervention.

Second, we recruited participants to provide feedback across different stages of intervention development (see Figure 1). We introduced participants to PrESR with a brief overview describing its goals and aims and then invited them to playtest (from scripts to actual VR). While playtesting, participants were invited to describe their experience with whatever came to mind. We monitored participant safety during VR testing by having participants describe their level of distress using the Subjective Units of Distress Scale (SUDS) [15]. We thoroughly cleaned all equipment before and after each use and maintained an observer to monitor physical safety.

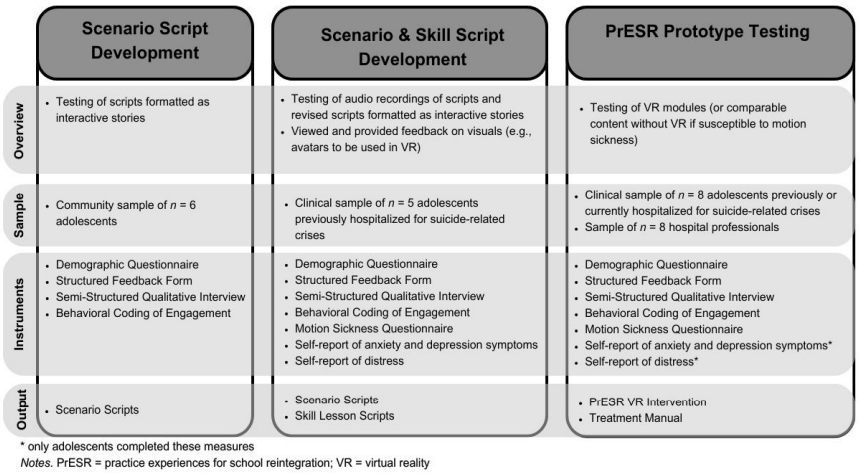

Figure 1. Stages of Intervention Development

During the first stage of intervention development, a community sample of n=6 adolescents tested the three scenarios by reading and responding to interactive stories developed in Inky [16]. We integrated findings from this feedback/playtesting and then presented to a clinical sample of n=5 previously hospitalized adolescents. These adolescents read and responded to the revised interactive stories; tested interactive audio recordings of lessons teaching affect regulation, cognitive restructuring, and problem solving; and provided feedback about their experience, as well as about some of the visuals developed for the intervention. We further refined scripts and content for inclusion in an initial computer (non-VR) prototype of the intervention. Due to resource constraints, we selected two of the scenarios and three of the skill lessons to include in the VR intervention. We prioritized the cafeteria and classroom scenes because they included a combination of supervised (classroom) and unsupervised (cafeteria) settings and reflected day-to-day experiences. (In contrast, a re-entry meeting would only occur once, if at all.) VR skill lessons focused on affect regulation, problem solving, and cognitive restructuring; the clinician would introduce CBT in-person instead of including it as a VR experience.

We internally tested and refined the initial computer build and then converted it to a VR prototype. We next recruited another clinical sample of adolescents, including adolescents previously (n=4) and currently (n=4) hospitalized for a suicide-related crises, as well as a sample of hospital professionals (n=8), to test and provide feedback about the VR scenarios and skill lessons (delivered in VR or using similar methods employed in earlier development sessions in cases of susceptibility for motion sickness).[1]

3.2. Analyses and Results

A trained researcher documented participant response choices, as well as their verbal responses to each scenario prompt. We recorded major points and impressions in debrief summaries following each session that we integrated into subsequent presentations and/or prototypes. We documented recommendations for changes to scenes and skills at all stages, as well as solutions to glitches or errors embedded in the syntax or application and also integrated these into subsequent sessions. Examples of recommendations for scenarios from community participants included toning down the way bullying was presented and adding more positive response options. Examples of recommendations from adolescents with lived experiences included identifying the best time to practice the skill in a given scenario and making the scenarios and skills more interactive.

We evaluated participant ratings from behavioral coding to gauge adolescents' willingness to engage within the scenarios and their variation. Findings supported variability in behavioral responses in our clinical samples, with scores for engagement,

[1] Technical glitches disrupted testing for one hospital professional, so a combination of VR and components of the intervention was presented in this case.

emotional control, reflection, and comprehension ratings ranging from 3 (moderate) to 5 (very high); scores for reaction time ranging from 2 (low) to 4 (high); scores for provocativeness ranging from 2 (low) to 5 (very high); and scores for verbalizations and affect ranging from the 1 (very low or positive affect) to 5 (very high or negative affect).

3.3. Final Intervention

We developed the final intervention based on the iterative feedback from participants, internal testing, and recommendations from the VR development team. PrESR is designed to be delivered by trained clinicians adhering to fidelity checklists and the PrESR treatment manual. Sessions include rapport building, goal setting, VR experience(s), and a clinical debrief. The VR experiences include up to three skill lessons and two practice scenarios. Cybersickness following the first VR experience is assessed and clinicians teach adolescents to use SUDS to gauge distress throughout the intervention. Following completion of the VR sessions, the clinician and adolescent collaborate to develop a school-focused safety planning intervention to share with schools (with permission from patients and families).

4. Conclusion and Future Directions

Findings from this study informed the development of PrESR, a novel intervention for teaching therapeutic skills to adolescents hospitalized for suicide-related crises. Our next step is to evaluate the intervention's feasibility and potential for teaching skills in an inpatient setting. A pilot optimization trial (NCT05934396) is currently underway, in which we are recruiting adolescents (ages 13-18) hospitalized for a suicide-related crisis at two child/adolescent inpatient psychiatric hospitals. Although outcomes of PrESR are still to be determined, the model aims to help adolescents increase their tolerance to difficult social experiences and change their thinking patterns, ultimately supporting a smoother transition back to school and contributing to suicide prevention among previously hospitalized adolescents [9].

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