Original Paper

Problem-Solving Treatment for Depression Using an Internet-Based Support Tool Created Through Human-Centered Design: Development and Randomized Feasibility Pilot Study

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Abstract

Background: Although problem-solving treatment (PST) for depression is an effective psychotherapy in primary care settings, it is not widely used, and clinician fidelity to key elements drops quickly following training. Human-centered design (HCD) methods may help identify and address usability barriers that limit adoption and fidelity of evidence-based psychotherapies.

Objective: This study aimed to use HCD methods to identify usability barriers in PST delivery, co-design a clinician- and patient-centered solution, and carry out a feasibility study to evaluate implementation outcomes and explore preliminary clinical outcomes of this prototype.

Methods: Using the Discover, Design, Build, and Test (DDBT) framework, we conducted observations and interviews with PST-experienced clinicians to identify usability challenges in PST delivery. Findings informed iterative co-design and development of PST Aid, a web-based clinical decision support and workflow support tool for PST. The resulting prototype underwent usability testing and was subsequently evaluated in a small pilot study incorporating clinician-level randomization to PST Aid or PST-as-Usual. Measures included feasibility, usability, acceptability, clinician certification, fidelity measures, and depression outcomes among people.

Results: The Discover phase identified multiple usability barriers affecting PST delivery, including perceived rigidity of the intervention, difficulties maintaining patient engagement and ownership of the problem-solving process, challenges with patient understanding of PST concepts, and inconsistent support for between-session activities. These findings informed rapid prototyping cycles carried out with co-design clinicians (9 undergoing PST training as usual and 9 experienced PST clinicians) and their patients (n=4), which led to a web-based application (PST Aid) that served to support and "scaffold" PST tasks as well as provide decision support for both clinicians and patients. PST Aid features included interactive guidance prompts, structured problem tracking, and enhanced action planning tools. In pilot testing, clinicians rated PST Aid as having above-average usability (System Usability Scale score of 75.5), while patients rated usability as okay or marginal (score of 66.3). Acceptability, feasibility, and appropriateness ratings were high among both clinicians and patients. Pilot findings provided preliminary feasibility signals regarding usability, acceptability, appropriateness, clinician certification, and patient follow-up. Given the small sample and clinician-level clustering, quantitative findings were descriptive and were not intended to estimate comparative effectiveness.

Conclusions: This study demonstrates the feasibility of applying HCD methods to identify implementation barriers and develop usability-focused supports for PST in primary care settings. The resulting prototype showed favorable usability,

acceptability, and preliminary implementation signals in a small pilot study. These findings support further evaluation of HCD-informed implementation supports for evidence-based psychotherapies in larger, fully powered trials.

Trial Registration: ClinicalTrials.gov NCT03516513; https://clinicaltrials.gov/study/NCT03516513

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Introduction

Depression remains a formidable public health challenge, affecting millions globally and contributing significantly to the global burden of disease [1-3]. Among the various psychotherapeutic interventions for depression in primary care settings, problem-solving treatment (PST) has been validated as an effective approach [4-9]. PST empowers individuals to manage their depressive symptoms by teaching systematic problem-solving skills that can be applied to everyday life challenges. PST training procedures improve clinician skills in this treatment in primary care settings [4, 9] as well as in community implementation projects [10]. Despite its demonstrated efficacy, PST is underused, and clinician fidelity to its core strategies tends to diminish swiftly after the initial training phase in both research and real-world contexts, potentially reducing its effectiveness [11, 12]. For example, in surveys of PST-trained clinicians, many reported modifying PST in substantial ways, and only 68% continued to use key elements of PST such as homework forms [12]. Moreover, 24% to 36% of PST sessions following expert certification in a randomized controlled trial fell below acceptable fidelity criteria ratings [11,13]. This gap between potential effectiveness and practical application suggests a critical need for innovative strategies to enhance the delivery and sustainability of such evidence-based treatments in real-world clinical contexts.

These fidelity challenges likely reflect, at least in part, usability barriers: materials, workflows, and tools that were not designed with the needs and contexts of frontline clinicians and their patients in mind [14]. Human-centered design (HCD) offers a systematic framework for identifying and addressing these kinds of barriers by directly involving end users in the design and iterative refinement of tools and processes. HCD has been applied to support implementation of evidence-based practices in clinical settings [14-16], and its emphasis on usability, fit, and engagement makes it well-suited to address the gap between PST's demonstrated efficacy and its real-world adoption.

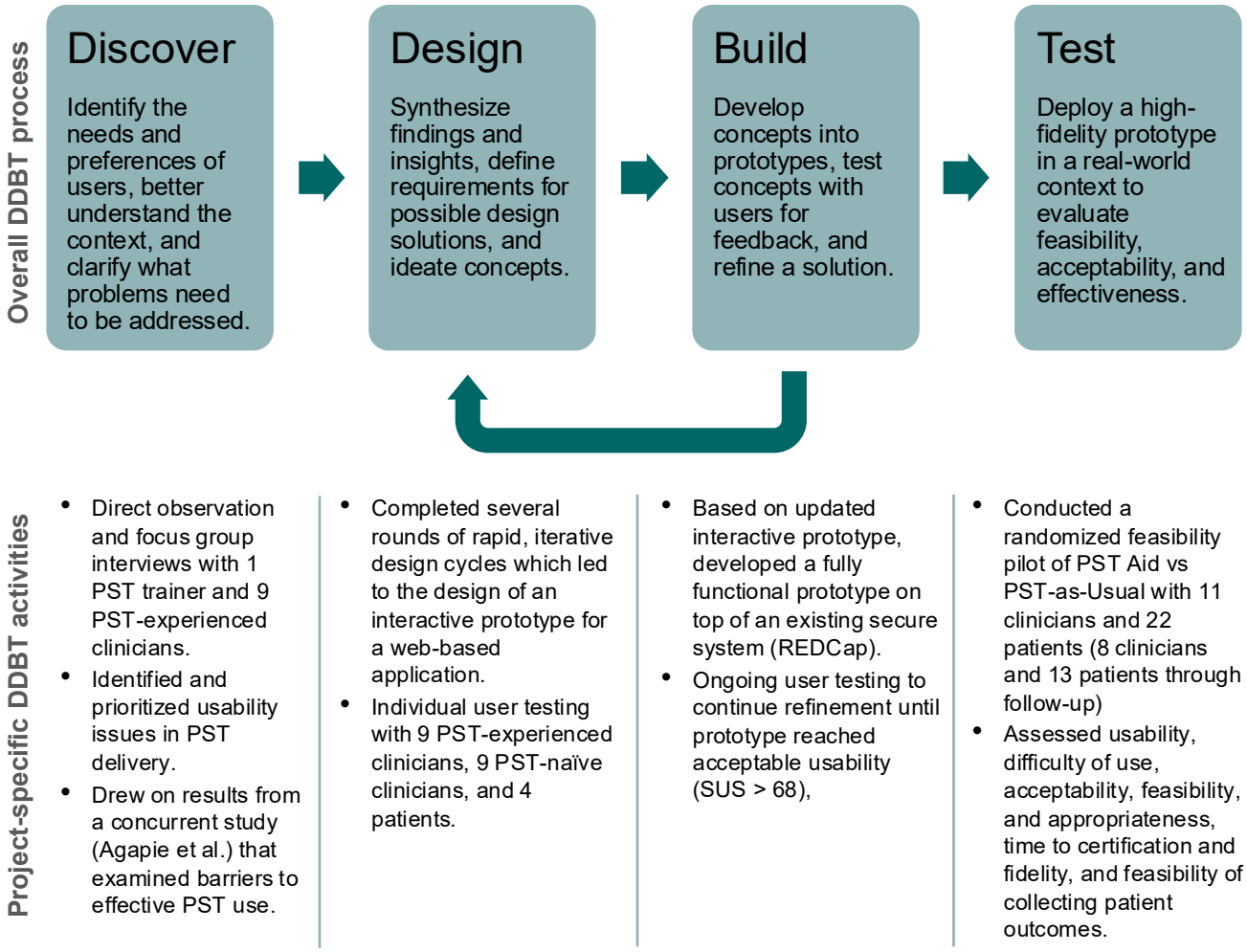
In this study, we used HCD methods to identify key usability obstacles and develop implementation strategies for primary care clinicians aspiring to deliver PST effectively. Through this process, we identified usability barriers and sought to develop, iteratively co-design, and pilot a clinician- and patient-centered solution that enhances the usability and fidelity of PST. This paper describes the integration of HCD methods with PST, the usability barriers identified, the iterative development of PST Aid, and findings from a pilot feasibility study. The study collected preliminary information regarding usability, acceptability, fidelity, clinician training, and patient outcomes to guide future evaluation.

Methods

Study Design

As part of the University of Washington ALACRITY Center (NIMH-P50MH115837), we applied the Discover, Design, Build, and Test (DDBT) framework (Figure 1), which combines aspects of HCD and implementation science, to the problem of limited uptake and use of evidence-based PST for depression in primary care [11,14]. We conceptualized this HCD approach as a means of identifying and building out implementation strategies for delivering PST in primary care with fidelity and effectiveness. The DDBT framework lays out concrete and distinct stages of initially defining problems to be solved (Discover) and then moves through defined procedures to identify potential solutions (Design), create a solution prototype (Build), and conduct a pilot study to assess aspects of this prototype (Test).

Figure 1. The Discover, Design, Build, and Test (DDBT) framework with project-specific activities. PST: problem-solving treatment.



Discover

Our Discover phase research included observations and interviews with 1 PST trainer and 9 clinicians who were experienced with PST. The PST trainer had a doctorate in clinical psychology. All clinician participants had a master's degree and worked in primary care settings. Seven clinicians were licensed social workers, 1 was a licensed mental health counselor, and 1 was a clinical nurse specialist. Observations were made over the course of 7 live PST supervision groups, where clinicians had the opportunity to discuss challenges that came up when using PST with their patients. The PST trainer led these hour-long sessions, with EF and AL joining to take notes. Subsequent semistructured interviews with individual clinicians, conducted by EF and AL, elicited further feedback and detail related to the challenges observed during the PST supervision groups. Specifically, the interviews probed clinicians on how PST did and did not fit into their usual workflows, aspects of PST that had been challenging for them and their patients in the past, and how a decision support tool might help to address some of these challenges. We scheduled each interview session for an hour, with interviews lasting 42 to 58 minutes.

Consistent with the goals of our project, the research team analyzed data from these sessions for usability issues in PST that we could address later in the design process. This analysis followed a structured, inductive qualitative approach. For each problem observed or described in interviews, we characterized what happened, its cause and impacts, the context in which it occurred, and the participants for whom it occurred [17]. Two investigators (EF and AL) used affinity diagramming to group and cluster related observations into usability issues [18]. The full research team discussed these preliminary issues together, a form of investigator triangulation: members contributed alternative explanations and iteratively reorganized clusters to surface underlying patterns. We then assigned each issue a severity ("has a minor effect on usability," "creates significant delay or frustration," or "prevents completion of a task"), complexity (related to both whether we believed we understood the root cause and how difficult we expected it to be to address), and scope (how widespread it was across participants and across steps in PST). Different analysts can reasonably construct different usability issues from the same data [19]. We sought a shared team understanding of issues to inform redesign. Members of our team (AL, EF, and SM) were also contributing to

a concurrent study, since published as Agapie et al [20], that interviewed clinicians and patients to understand support opportunities in action planning and other steps of PST. We integrated usability issues identified in Agapie et al [20] with our Discover phase results to prioritize issues to address in our design phase.

Design/Build

The project used a rapid, iterative design process to develop an interactive prototype of a clinical decision support tool for PST, called PST Aid. PST Aid was designed as an implementation support platform intended to assist clinicians and patients in delivering PST with greater consistency and usability. This design was then built into a front-end user interface on an existing secure system used widely by medical researchers handling sensitive information (REDCap) [21,22], with ongoing user testing to continue refinement. This process was carried out until a final functional prototype (version 1.0) was created, which had acceptable usability (System Usability Scale [SUS] score of >68) [23] in usability testing. A total of 9 PST-experienced clinicians from the Discover phase, 9 PST-naïve clinicians, and 4 patients participated in user testing of either the interactive or functional prototype. All clinician participants had a master's degree and worked in primary care settings. Patients were individuals who had previously received PST for depression. During usability testing, participants completed tasks using the prototype, followed by completing the SUS and a brief interview about their experiences in the test session. The final PST Aid prototype provided synchronous as well as asynchronous access to tools used during PST, including worksheets, for use by therapists and patients as between-session homework.

Test

Pilot Overview

Following the Discover and Design/Build phases (described in the Results section), a small randomized feasibility pilot was carried out to trial study procedures and characterize usability, acceptability, feasibility, appropriateness, training/fidelity processes, recruitment/retention, and the practicality of collecting patient outcomes. Randomization to training in PST Aid version 1.0 or PST-as-Usual (further described below) of a new set of psychotherapy clinicians (clinical social workers who were part of the University of Washington Behavioral Health Integration Program and new to PST) was carried out. Clinician time to certification and ongoing fidelity to PST were posited as the implementation outcomes, and change in patient depression (PHQ-9 [9-item Patient Health Questionnaire] scores) was explored as an effectiveness outcome of interest.

Recruitment

Clinician participants were recruited through emails from the study team to clinic directors in the University of Washington Primary Care (UWMPC) network. Clinic directors passed study information on to their clinicians, and interested clinicians were connected with the study team via email for screening. Upon initial email contact with prospective clinician participants, the study coordinator screened clinicians for eligibility and, if eligible, obtained informed consent. Clinician participants were included if they were aged 18 years or older, able to read and speak English, and were currently providing psychotherapeutic care to adult patients within the University of Washington Medicine network. Clinicians were all master's-level licensed clinical social workers working in a primary care setting. No clinicians had formal prior training in PST, but all had experience providing psychotherapy for at least 1 year, and all analyzed clinicians reported their primary theoretical orientation as cognitive-behavioral.

Patient participants were initially informed of the study by their clinicians via study flyers provided by the study team. Clinicians were enrolled in the study themselves prior to approaching any of their patients about participating. For any patients who expressed interest in the study, clinicians put them in contact with the study team via email to initiate the screening and consent process. Patient participants were included if they were aged 18 years or older, able to read and speak English, willing to receive psychotherapeutic care from a participating clinician who was also participating in the study, and had a clinician-reported unipolar depression diagnosis using *DSM-5* (*Diagnostic and Statistical Manual of Mental Disorders* [Fifth Edition]) criteria. Current depression symptoms were confirmed by the study team through administration of the PHQ-9. A PHQ-9 score of 10 or higher was used for inclusion, a commonly used cutoff score for moderate depression [24]. Patients were subsequently screened for exclusion by a trained research coordinator working under the oversight of Dr Raue, the PST trainer and study investigator. Patients were excluded if they had a history or presence of psychiatric diagnoses other than unipolar, nonpsychotic depression or anxiety disorder, such as a bipolar disorder, psychotic disorder, or substance use disorder. Through ongoing supervision checks with clinicians over the course of the study, the study team ensured that study patients had no changes in diagnosis that would warrant exclusion from the study.

Randomization

We tested randomization at the individual practitioner level prior to clinicians enrolling patients to minimize contamination between intervention conditions. In June 2021, after a PST Aid clinician withdrew during training, we moved 1 clinician from PST-as-Usual to PST Aid; we selected that clinician at random, and the study statistician (MDP) and center director approved and oversaw the change.

Randomizing clinicians rather than patients nested patients within clinicians and allowed caseloads to vary. We accepted that trade-off to protect against contamination, but it means each arm's patients came from a small number of clinicians, so patient-level comparisons between arms confound condition with clinician.

Intervention Training and Supervision

Dr Raue provided training and supervision for separate groups of practitioners in the PST Aid and PST-as-Usual conditions. The PST training protocol was developed by Dr Raue for the University of Washington AIMS Center, which disseminates Collaborative Care best practices and includes interactive online training in brief treatment skills and the PST process (4 h); webinar-based demonstration and discussion (1 h); one-on-one role plays of how to introduce PST to the patient in session 1 and illustrate PST steps and process (2-4 h); audiotape review of patient sessions and feedback for fidelity to the model; and 6-month group case consultation calls.

Across both study conditions, practitioners received the same PST training and ongoing clinical supervision as described earlier. The only difference between conditions was the use of the PST Aid platform, a web-based clinical decision support tool for PST. Practitioners assigned to the PST Aid condition were oriented to and trained in its use through role plays with the trainer. PST Aid allowed practitioners and their patients to complete PST worksheets online with the help of features such as pop-up windows with prompts to guide practitioners through the PST steps. Practitioners assigned to the PST-as-Usual condition were oriented to and role-played using standard tools consisting of suggested prompts in written format to guide practitioners in each step of PST. Patient-facing tools in PST-as-Usual included psychoeducation materials and PST worksheets in either standard paper-and-pencil format or fillable PDF versions for videoconference sessions. This approach has been used for many years and is considered the gold standard for training leading to PST certification.

Following initial training as described earlier, practitioners were encouraged to conduct PST with all eligible adult patients they diagnosed with unipolar depression. Practitioners submitted session audiotapes for ratings of treatment fidelity and corrective feedback by an expert in PST external to the research team. In line with standard procedures, practitioners must achieve global fidelity scores of ≥3 (“satisfactory”) on the PST Fidelity Scale for 2 sessions to be certified as PST practitioners. Dr Raue provided monthly group supervision calls for 6 months.

Measures

Usability was measured using the SUS [25], a 10-item measure that is considered the industry standard for measuring usability of websites, software, or devices. An SUS score of 68 or greater is a commonly used cutoff for “good” or above-average website usability [23]. We additionally used a modification of the SUS, the Intervention Usability Scale (IUS) [26]. This instrument uses the same structure as the SUS but was modified to be more applicable to structured tasks of an intervention, whether delivered through a technology platform or not. At baseline, we used the IUS with clinicians in both arms and followed up to identify and clarify any confusion related to language and intervention evaluation targets. The IUS was also administered to both clinicians and patients at the end of their participation in the Test phase to measure the usability of PST during the trial. We used the Difficulty of Use subscale of the User Burden Scale to assess difficulty in using PST [27]. The subscale consists of 4 items, each ranging from 0 (best) to 4 (worst), with the total score computed as an average of responses.

Implementation outcomes of acceptability, feasibility, and appropriateness were measured via the acceptability of intervention measure (AIM), feasibility of intervention measure (FIM), and intervention appropriateness measure (IAM), respectively [28]. The AIM, FIM, and IAM are 4-item validated measures that can be applied to either interventions or implementation strategies and have strong internal reliability, test-retest reliability, and sensitivity to change [28]. All measures were administered to both clinicians and patients at the end of the Test phase.

The PST Fidelity Scale was piloted by external raters to rate clinician fidelity to the PST model. The scale uses a Likert-type rating scale (0=very poor, 5=very good), with a global score of ≥3 corresponding to at least “satisfactory” levels of fidelity [11,12]. Dichotomizing fidelity in this way is clinically meaningful given standards for certifying clinicians as approved to provide PST [11,12]. The number of hours (1 session=1 hour) needed to achieve fidelity to patient sessions, or “time to certification,” was considered a descriptive implementation/process measure. Following certification, 1 randomly selected session per clinician-patient dyad was rated for fidelity by the external expert. The proportion of all evaluated postcertification sessions that met satisfactory or greater global fidelity was the dependent variable for this study hypothesis on “ongoing fidelity” through the course of the study.

The PHQ-9 was administered to patients at baseline and 9-week follow-up to assess feasibility of collecting a patient outcome and generating preliminary descriptive estimates. The PHQ-9 consists of 9 DSM depression symptoms and has been found to have a sensitivity of 88% and specificity of 88% for major depression [24,29]. A PHQ-9 score of 10 or higher was used for inclusion in the study, as this is a commonly used cutoff score for moderate depression [24].

Table 1 summarizes how and when these measures were administered to clinicians and patients. We additionally asked PST Aid patient participants to complete an exit survey consisting of open-ended questions about the tool to inform future design cycles; only 2 of the 9 completed the survey, and therefore, we do not report its results here.

Table 1. Clinician and patient Test phase measures.[a]

Measure	Respondent type	Purpose	Administration mode	Administration time points
System Usability Scale (SUS)	Clinicians and patients (PST[b] Aid arm only)	Measure usability of PST Aid	Online survey	Clinicians: 7-month follow-up; patients: 9-week follow-up
Difficulty of Use subscale of User Burden Scale (UBS)	Clinicians and patients	Measure difficulty of using PST	Online survey	Clinicians: baseline and 7-month follow-up; patients: 9-week follow-up
Intervention Usability Scale (IUS)	Clinicians and patients	Measure usability of PST	Online survey	Clinicians: baseline and 7-month follow-up; patients: 9-week follow-up
Acceptability of intervention measure (AIM)	Clinicians and patients	Measure acceptability of PST as supported by the assigned study tools/materials	Online survey	Clinicians: baseline and 7-month follow-up; patients: 9-week follow-up
Feasibility of intervention measure (FIM)	Clinicians and patients	Measure feasibility of PST as supported by the assigned study tools/materials	Online survey	Clinicians: baseline and 7-month follow-up; patients: 9-week follow-up
Intervention appropriateness measure (IAM)	Clinicians and patients	Measure appropriateness of PST as supported by the assigned study tools/materials	Online survey	Clinicians: baseline and 7-month follow-up; patients: 9-week follow-up
PST Fidelity Scale	External reviewer (to rate clinician fidelity)	Rate clinician fidelity to the PST model	Observation of session recordings	Two sessions at satisfactory fidelity levels during certification case, and 1 random session per patient postcertification
9-Item Patient Health Questionnaire (PHQ-9)	Patients	Assess change in depressive symptoms	Online survey	Patients: baseline and 9-week follow-up

[a]Online surveys were administered through REDCap.
[b]PST: problem-solving treatment.

Analysis

The pilot study was designed to evaluate the feasibility, usability, acceptability, and preliminary implementation characteristics of PST Aid rather than to test comparative effectiveness. Because clinicians rather than patients were randomized, patients were nested within clinicians. Given the small number of clinician clusters and the exploratory purpose of this pilot, formal multilevel analyses accounting for clustering were not performed. Accordingly, analyses are descriptive and intended to characterize preliminary feasibility and implementation signals. All study staff were required to complete training in the ethical conduct and procedures of human-centered research. The completed CONSORT-EHEALTH (Consolidated Standards of Reporting Trials of Electronic and Mobile Health Interventions and Online Telehealth) reporting checklist is provided as Checklist 1.

Ethical Considerations

The study protocol was submitted to and approved by the institutional review board (IRB) of the University of Washington prior to carrying out any research activities (IRB number: STUDY00004274). Informed consent was obtained from all study participants by a study team member prior to their participation. All study details were reviewed, participants were reminded that their participation was completely voluntary, and all participants were given the opportunity to ask questions prior to providing their consent and participation. All study data were kept confidential and deidentified using a study ID number. Additionally, this study has a Certificate of Confidentiality from the National Institutes of Mental Health, providing additional security over participant information. All participants were compensated for their time, and both patients and clinicians received up to US $175 for completing all study activities.

Results

Discover

Our Discover phase surfaced usability issues in PST use, including clinicians perceiving PST as rigid, repetitive, or frustrating and adapting the therapy to skip unstimulating steps; clinicians leading problem, goal, and solution selection when patients struggled, which risked working on irrelevant problems or reducing patient ownership; and patients not fully understanding PST concepts (problems, goals, and solutions) well enough to apply them independently between sessions. The first 2 issues overlapped with and were extended by findings from a concurrent study led by Agapie et al [20]; the third was unique to our Discover phase. When selecting issues to prioritize in our Design/Build phase, we additionally incorporated issues identified only by Agapie et al [20]: the need to build patient buy-in in the manualized process, the need to facilitate patient disclosure of key issues and clarify

which topics were appropriate for PST vs other therapy, and the need for action plans to be available to support between-session activities. Table 2 presents a summary of issues identified and prioritized for our Design phase, including exemplar quotes.

Table 2. Obstacles to effective use of problem-solving treatment (PST) identified in our Discover phase[a] as well as in related work by Agapie et al [20][b].

Category of issue (from Munson et al [30], 2022)	Example obstacles	Exemplar quotes
Incompatibility with interventionist preference or practice	• Some clinicians perceive PST[c] as rigid, repetitive, or frustrating, and sometimes adapt the therapy to skip these unstimulating steps, reducing fidelity.[a,b] • When a patient faces difficulty with a step in these manualized interventions, clinicians sometimes end up leading the selection of the problems, goals, and solutions to keep the process moving, but this can result in working on irrelevant problems or cause the patient to lose ownership of the process.[a,b]	• Clinician 2: "It's a little frustration. It's also a little boredom too. It's kind of boring that we keep doing the same thing over and over, and that's the point, but it's a little monotonous."[a] • Clinician 4: "You want to break down their giant problem into a problem that's like specific enough that they can have a solution that they can take a step on this week. But broad enough so you can brainstorm solutions to. And that's just niche and difficult."[b]
Intervention buy-in (value)	• Some patients were deterred by the manualized process for PST, reducing their engagement.[b]	• Patient 11: "I keep telling her, 'I don't really see, I don't really know how to break this down into little bitty feel-good tasks for the week.' I don't know. I feel like she's a journalist with a deadline. We have to come up with something on paper by the end of the session."[b]
Interventionist buy-in (trust)	• If patients do not trust their clinician, they may not disclose sensitive information that is necessary to effectively engage in therapy sessions.[b]	• Patient 11: "I think I do come in a little bit of feeling, 'Okay, show me something. Show me why you need to be here to do this instead of a high school student.' I still have yet to see where anybody's training comes into this."[b]
Inadequate scaffolding for patient/recipient	• PST concepts, such as problems, goals, and solutions, remained unclear to patients even after successfully navigating them (with clinician support) in sessions, which prevented them from effectively applying them between sessions or after therapy concluded.[a] • Some patients were unsure whether certain topics (relationships, divorce, and intimacy issues) were appropriate for PST, so they did not share this with clinicians, preventing them from working on the most meaningful problems.[b] • The action plans in PST were not always well documented or available to patients between sessions (which prevented follow-through) or to patients and clinicians in subsequent sessions (which prevented follow-up).[b]	• Clinician 6: "It was like negotiating with the client of what they want to write down in the context of what they're saying, and you're trying to convince them that when they're really stuck on a task or the steps. I was like, that's a step. That's not a goal. You're going to be doing that in order to reach your goal."[a] • Patient 11: "No, we don't talk about that...that I don't have a libido anymore. One of the things that I miss in my life, some degree of intimacy."[b]

[a]Obstacles to effective use of PST identified in our Discover phase.
[b]Obstacles to effective use of PST identified by Agapie et al [20].
[c]PST: problem-solving treatment.

Design/Build

The research team determined that an electronic clinical decision support system would be an appropriate approach for addressing the usability issues and design needs in PST identified in the Discover phase. Informed by our Discover phase findings and related literature, the team designed a collaborative online platform where the clinician and patient could work through PST steps and make edits together in real time.

We created an initial interactive prototype using an interface design tool called Figma. Through several rapid prototyping and user evaluation cycles, we iterated on this prototype, refining the design and adding or adjusting features. During these cycles, clinicians and patients expressed positive feedback about the overall feature set and interaction flow.

In particular, we had initially thought that carrying over the prior session's selected solution and action plan would be sufficient to support review during the next session. However, patients and clinicians wanted the system to also help track recurring and longer-term activities that had been prioritized from one session to another. Both groups valued checklists for accountability, and therapists noted that they are trained to discuss incomplete action plans. As a result, we added a new "ongoing efforts" section to the review sheet, which depicted these efforts as a checklist to support periodically revisiting them. Participants were excited about interactive task lists, both to help them focus and for it being rewarding; for example,

> *I definitely have more patients than not that like to check off tasks or reminders as they do them and I think they find it rewarding*. [Clinician 7]

and

> *I like the satisfaction of being able to check it off and being like YES, I accomplished that!* [Patient 13]

Additionally, providers noted that it could be difficult to prioritize review of worksheets across their caseload, and that this could result in manually checking many worksheets that had not changed. To address this, we added information about a "last modified" date to worksheets for both patients and providers. We also had an open question about the optimal number of pleasant-activity fields. Therapists considered three pleasant-activity fields appropriate, warning that more could overwhelm patients, and endorsed the option to add fields as patients progress. Participants also suggested features we deferred to future versions: opt-in reminders through push notifications or calendar integration, duplicating prior worksheets, a therapist notes section, a resources page, and an in-app video window for remote sessions.

We also used these sessions to examine detailed design choices, such as our selection of a symbol to indicate the supportive text that users could expand, with patients and clinicians preferring the *a* over a question mark:

> *Maybe better than the question is the small "a" for me, because it means information as opposed to question, and for me, I want to know that that is going to give me more information on how to complete the task as opposed to I have a question on what do I do now*. [Patient 14]

> *The question mark actually might be good to reserve for a chatbot or tech support. I think the "i" is a universal symbol for more information*. [Clinician 6]

By the end of the rapid prototyping process, platform features included (1) pop-up cards that provide in-the-moment prompts and checklists to guide clinicians and patients through the problem-solving steps, (2) a problem list that can be created at an initial session and easily accessed during any subsequent sessions, (3) a review section for all follow-up sessions for reviewing and evaluating the homework and activities from the prior session, and (4) a checklist format for the PST action plan so that patients have the option of checking off actions if completed, or carrying them over to the next worksheet if still ongoing. These features are not available in the traditional PST format, which uses paper and PDF worksheets and clinician resources. Table 3 links features to the obstacles they were intended to address.

Table 3. Features included in problem-solving treatment (PST) aid to address obstacles identified in the Discover phase.[a]

Obstacles	PST Aid features and capabilities to mitigate obstacle
Some clinicians perceive PST as rigid, repetitive, or frustrating, and sometimes adapt the therapy to skip these unstimulating steps, reducing fidelity. When a patient faces difficulty with a step in these manualized interventions, clinicians sometimes end up leading the selection of the problems, goals, and solutions to keep the process moving, but this can result in working on irrelevant problems or cause the patient to lose ownership of the process. PST concepts, such as problems, goals, and solutions, remained unclear to patients even after successfully navigating them (with clinician support) in sessions, which prevented them from effectively applying them between sessions or after therapy concluded.	• PST Aid presents both the clinician and patient with the sequential set of steps so that even if a clinician skims over a step, the step and related prompts remain accessible to the patient. • Ability of both the patient and clinician to have PST Aid open so that even if a clinician temporarily leads selection, the patient still can input their ideas and has full visibility—creating an opportunity to redirect. • PST Aid includes expanded prompts to clarify certain steps rather than relying on clarifications to come. • Expanded prompts in PST Aid remain available to patients between and after sessions, through the tool, so that patients can revisit them for support as they apply lessons between or after sessions.

Obstacles	PST Aid features and capabilities to mitigate obstacle
Some patients were unsure whether certain topics (relationships, divorce, and intimacy issues) were appropriate for PST, so they did not share this with clinicians, preventing them from working on the most meaningful problems.	• Shared comprehensive problem list supports identification and selection of personally relevant and high-priority problems to work on. • Expanded prompts in PST Aid to normalize and encourage discussion of a breadth of topics.
The action plans in PST were not always well documented or available to patients between sessions (which prevented follow-through) or to patients and clinicians in subsequent sessions (which prevented follow-up).	• Digitization of the action plans, as well as content from past sessions, ensures that patients can access the information so long as they have a device and their login information. • An interactive checklist in the action plan supports engagement and prioritization of remaining actions. • Digitization prevents losing worksheet copies. • Prepopulation of key fields in PST Aid with data from prior sessions supports continuity and follow-up in subsequent sessions and supports carrying forward incomplete actions to future weeks.

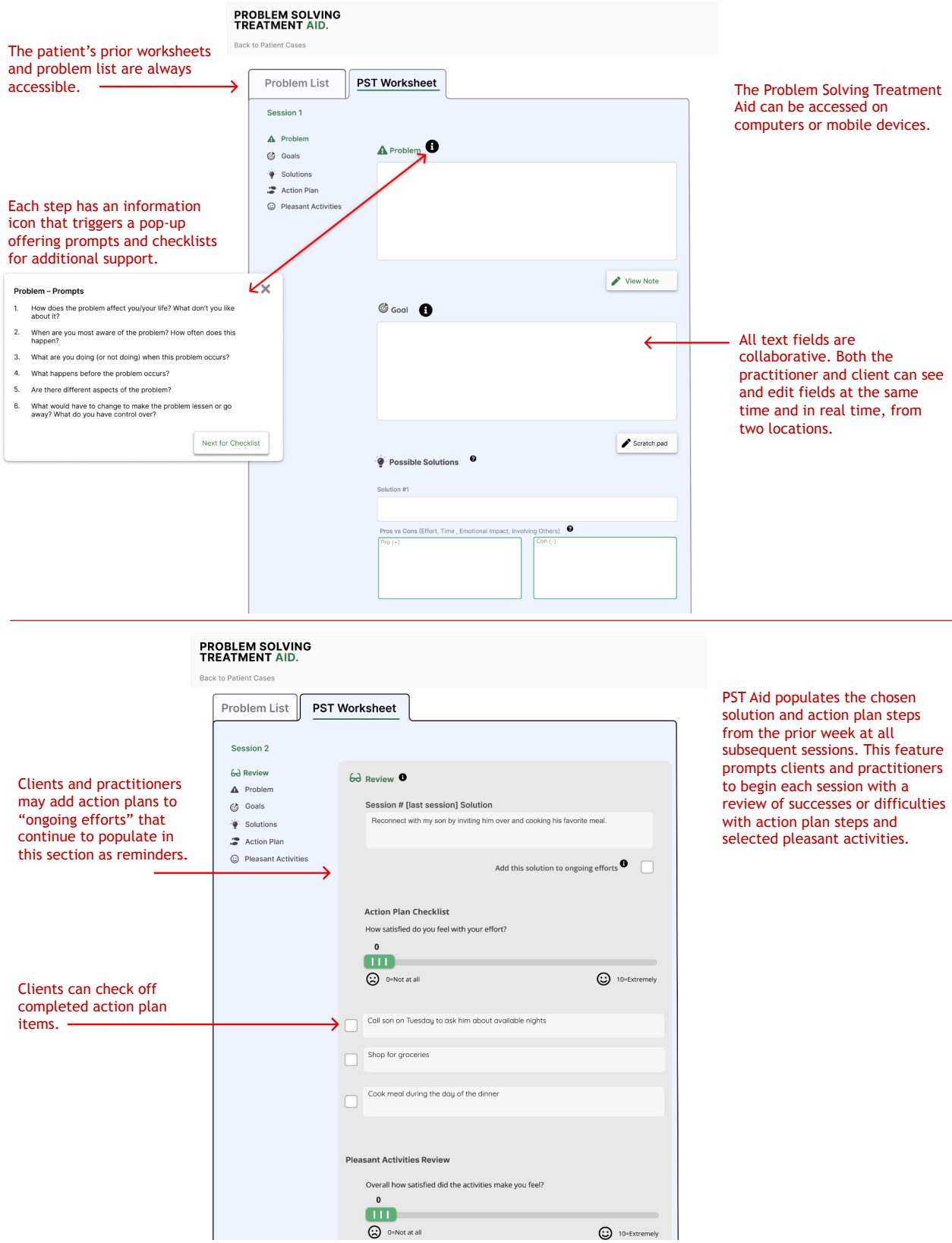
[a]In the design process for PST Aid, we did not explicitly address buy-in issues, including that some patients were deterred by the manualized process for PST, reducing their engagement, and if patients do not trust their clinician, they may not disclose sensitive information that is necessary to effectively engage in therapy sessions.

The team then built a functional prototype. This functional prototype was separate from the electronic health record (EHR), and no data from the tool was required for entry into the routine record. We recognized the potential for future integration, such as automating account setup based on an EHR order, sending action plans and reminders through an EHR's secure messaging platform, and providing clinicians with visibility into patient progress in the EHR. However, keeping PST Aid separate allowed us to focus on the core PST Aid functionality and build and pilot the system within project resources. Patients and clinicians could access PST Aid using a username and password; this was distinct from their EHR login information.

As is common when adapting a visual design to work with the technical capabilities of an existing technology platform (in this case, REDCap), this resulted in further refinements to the interface. Additionally, cognitive walkthroughs and usability testing of the functional prototype helped to identify additional usability issues with the layout of information and interface controls, which we addressed. None of these changes resulted in new or substantially changed features. We identified and fixed several technical bugs through this process as well. One technical limitation—that both the client and clinician could not edit the same text field concurrently and see changes in real time—could not be fully resolved within REDCap. We determined that training clinicians to facilitate sessions with clean handovers regarding who was editing a particular text field was sufficient to proceed to our pilot test phase.

Figure 2 depicts the final functional prototype of the electronic clinical decision support system, which we call PST Aid, and the featured text box (Textbox 1) illustrates the use of PST Aid in the clinical encounter. As illustrated, PST Aid can be accessed concurrently by participants during telehealth or in-person visits, and both can access it at any point between sessions.

Figure 2. The final functional prototype developed at the end of our Design and Build phase. Top: worksheet for specifying a problem, goal, and possible solutions. Bottom: worksheet for reviewing the prior session. PST: problem-solving treatment.



Textbox 1. Featured text box.

Clinical vignette: initial sessions using PST Aid with Mrs B

Mrs B is a composite patient. She is a 67-year-old retired woman who lives alone and chooses to have her sessions via videoconference.

Session 1: The therapist introduced Mrs B to problem-solving treatment (PST) and had Mrs B open PST Aid on her laptop. Together, they created a comprehensive problem list and finished the session by engaging her in activity scheduling for the coming week using PST Aid: a walk on three specified days, getting back to gardening on one day, and watching her online church service on Sunday.

To facilitate Mrs B's engagement with PST and ownership of the process, the therapist encouraged her to access PST Aid on her laptop at any time during the week. In particular, she emphasized that Mrs B could use PST Aid to remind herself about her action plans and to reflect on and check off what went well and note what was challenging or was not accomplished for discussion during the following session.

Session 2: Following review of current depression symptoms, the therapist reintroduced PST Aid by having Mrs B access it on her laptop. For both participants, PST Aid automatically populated the activities scheduled from the prior week on their respective laptops, serving as a reminder (or guardrail) to continue the session with *review of progress*. PST Aid prompted for successes, difficulties, and overall satisfaction level with efforts. This discussion reinforced Mrs B's successful efforts in walking and church service. She reported, however, that she was unable to garden due to a strained lower back, which demoralized her. The therapist normalized this experience and discussed the value of specifying alternate plans in the future if unforeseen obstacles arise. Mrs B rated her overall satisfaction as 9 out of 10, in that she valued and enjoyed walking and attending the church service. When prompted by PST Aid and the therapist, Mrs B reflected that she would like to continue daily walks and attending the church service, and to brainstorm other ways to enjoy her yard and nature until she recovers and is able to get back to gardening.

Next, the therapist accessed *Problem List Review* with Mrs B and asked her to *prioritize a problem area* that she would like to discuss. Mrs B selected "feeling like a bad mother and growing distant from my son."

The therapist then described the first step of PST, *problem definition*, orienting Mrs B by clicking the "i" icon to pull up the suggested prompts. Mrs B found the first 3 prompts helpful in further clarifying the nature of this problem, and she honed it down to a concrete issue she wanted to focus on this week. More specifically, the prompt "How does this problem affect you?" yielded discussion from Mrs B that "We used to be closer. Since he moved in with his partner, we're less in touch and that makes me feel even lower. I feel like a burden to him now, and I don't reach out as much as I used to either."

The prompt "When are you most aware of this problem?" yielded the response: "Mostly on the weekends when we used to get together more often, or the holidays, or even after having a phone call when I just feel like we don't talk like we used to." And a final prompt of "What are you doing or not doing?" yielded the response: "Most of our contact these days is by phone, and we just have short conversations. I feel like I don't demonstrate affection to him like I used to, or tell him that I love him." In consolidating different aspects of the problem during this process, the therapist encouraged Mrs B to articulate a focused problem statement. She then asked Mrs B whether she preferred herself or the therapist to take the lead in session in typing onto PST Aid. Mrs B chose to type in "I haven't been demonstrating affection and love to my son."

The therapist then introduced and described the second step of PST, *goal setting*, and clicked the "i" icon to pull up suggested prompts. The first prompt "What would you like to change about that, or be different in the next week?" resulted in Mrs B stating, "I want to do something to demonstrate to my son that I love him."

In the third step, initial prompts from PST Aid resulted in Mrs B brainstorming 3 possible *solutions*. She then stated that she was getting stuck in coming up with more solutions. Additional prompts around "How have you met this goal in the past?" and "What might you recommend to a friend or family member in a similar situation?" led to two more ideas from Mrs B. Following this, the therapist introduced the fourth step, *pros and cons*, and guided Mrs B in articulating and typing what made each of the 5 possible solutions good ones for her, and what made them less appealing or less feasible to accomplish within the next week.

In the fifth step, the therapist guided Mrs B toward *selecting one solution* she would like to try out in the next week. Prompts from PST Aid asked her to consider which solution had the best chance for success, and why it seemed like the best option for her. Mrs B chose to reconnect with her son by inviting him over and cooking his favorite meal, and to express her affection and love for him when they met.

The therapist then introduced the sixth step, *action planning*, and used probes such as "What will need to happen in order to make this work out?" and "What will you do and when?" Mrs B specified which day she would call her son to invite him to dinner, which day she would shop for food, and what specifically she wanted to express to her son during dinner. The PST Aid probe "What may get in the way of being able to do this?" was helpful in identifying Mrs B's apprehension around being able to express herself. This led to Mrs B adding to the action plan time for planning and practicing the main things she wanted to say to her son.

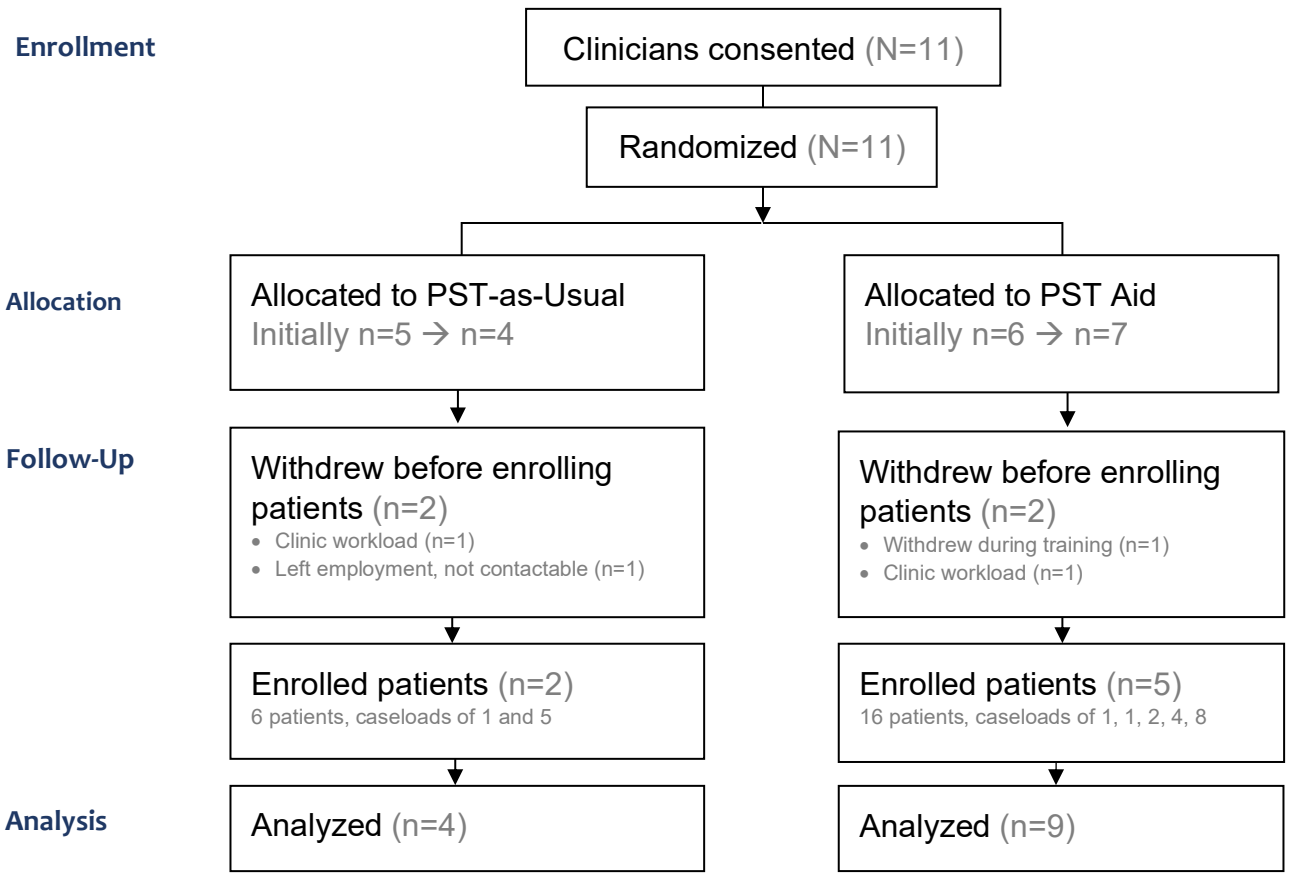
The session ended by following prompts from PST Aid to schedule ongoing *rewarding and enjoyable activities*. Mrs B decided to carry over activities that went well last week, namely taking a walk on 3 specified days and watching her online church service. She also decided to add working on her garden on 2 days.
The therapist encouraged Mrs B to continue accessing PST Aid on her laptop at any time during the week, and to practice the PST process on her own if desired by using practice worksheets within PST Aid.
Subsequent sessions: PST Aid prompts the participants in all follow-up sessions to (1) review current depression symptoms, (2) review progress with action plans from the prior week and address any barriers, and (3) guide the patient to select another problem area from the comprehensive problem list, or any emergent issue, and progress through the steps of PST on the platform.

Test

Pilot Participant Characteristics

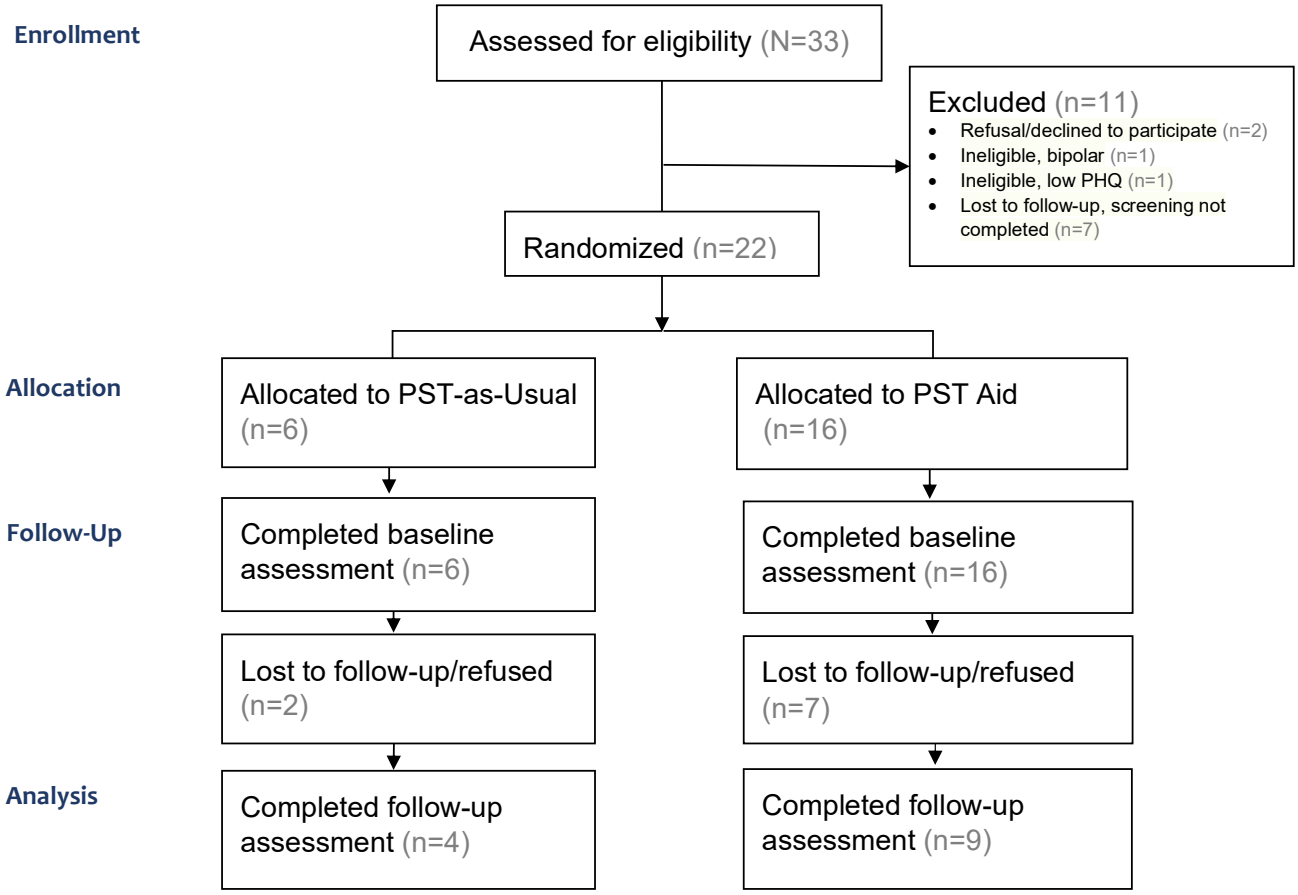
For the Test phase pilot, we randomized 11 primary care mental health clinicians; 5 to PST-as-Usual and 6 to PST Aid, and later moved 1 clinician between conditions, as described earlier. Three clinicians withdrew before completing training, citing clinic workload, leaving 3 clinicians in PST-as-Usual and 5 in PST Aid. Their mean age was 40.9 (SD 13.8) years. Of the 8 participants, 5 (62.5%) were women, 1 (12.5%) was Hispanic, and 3 (37.5%) were persons of color (Table A1 in Multimedia Appendix 1). All clinicians were master's-level licensed clinical social workers working in a primary care setting. Caseloads ranged from 1 to 8 patients. See Figure 3 for clinician CONSORT (Consolidated Standards of Reporting Trials) diagram.

Figure 3. Clinician CONSORT (Consolidated Standards of Reporting Trials) diagram. One clinician was moved from PST-as-Usual to PST Aid, after a PST clinician withdrew. The clinician was selected at random. The change was approved and overseen by the study statistician and center director. PST: problem-solving treatment.



We assessed 33 patients for eligibility and randomized 22 from the clinicians' caseloads for 9 weeks of treatment. Twelve patients ended participation early: 6 were lost to follow-up, 2 moved, 2 declined further study treatment, 1 ended treatment believing it was ineffective, and 1 withdrew after an intercurrent medical event. Thirteen patients provided 9-week follow-up measures, 4 in PST-as-Usual and 9 in PST Aid, including 3 who had ended treatment early. Their mean age was 41.2 (SD 17.7) years; 8 (61.5%) were women; and 6 (46.2%) were persons of color (Table A2 in Multimedia Appendix 1). See Figure 4 for the patient CONSORT diagram.

Figure 4. Patient CONSORT (Consolidated Standards of Reporting Trials) diagram. PST: problem-solving treatment.



Completion varied more across clinicians than across conditions. Six of the 7 clinicians who enrolled patients had at least 1 patient complete; the seventh accounted for 5 of the 12 early terminations. With patients drawn from 2 clinicians in 1 condition and 5 in the other, we cannot separate clinician from condition, and we do not interpret the difference in completion between arms.

Evaluation Outcomes

At the end of the pilot, clinicians rated the PST Aid tool as having above-average usability (SUS mean 75.5, SD 11.9; min: 65, max: 95). Patients rated it as OK or marginal in usability (SUS mean 66.3, SD 11.4; min: 50; max: 85). While means are encouraging, individual SUS scores below our target of 68—specifically 2 of the 5 clinician scores (65 and 67.5) and 4 of the 8 patient scores (50, 55, 57.5, and 67.5)—indicates further opportunities for improving PST Aid usability before moving to a larger trial.

Regarding impressions of PST overall among the PST Aid group, mean IUS scores were 63.0 for clinicians and 68.6 for patients, though benchmarks for the IUS have not yet been established, limiting interpretability. Clinicians in the PST Aid group gave high ratings of acceptability (AIM=4.3), appropriateness (IAM=4.3), and feasibility (FIM=4.1). Patients in the PST Aid group also gave high ratings of acceptability (AIM=4.3), appropriateness (IAM=4.2), and feasibility (FIM=4.5). Clinician and patient ratings for all implementation outcomes are shown in Table 4.

Table 4. Clinician and patient ratings on implementation outcome measures.[a]

Outcome measures	PST[b]-as-Usual, mean (SD)		PST Aid, mean (SD)	
	Clinician (n=2)	Patient (n=4)	Clinician (n=5)	Patient (n=9)
Acceptability of Intervention Measure (AIM)	4.1 (0.5)	3.7 (1.0)	4.3 (1.3)	4.3 (0.5)

Outcome measures	PST[b]-as-Usual, mean (SD)		PST Aid, mean (SD)	
	Clinician (n=2)	Patient (n=4)	Clinician (n=5)	Patient (n=9)
Intervention Appropriateness Measure (IAM)	4.0 (1.4)	3.9 (0.9)	4.3 (1.1)	4.2 (0.5)
Feasibility of Intervention Measure (FIM)	4.0 (1.4)	3.8 (1.1)	4.1 (1.2)	4.5 (0.6)
Intervention Usability Scale (IUS)	57.5 (17.7)	68.1 (23.0)	63.0 (28.7)	68.6 (10.8)
System Usability Scale (SUS)	—[c]	—	75.5 (11.9)	66.3 (11.4)
Difficulty of Use—subscale of User Burden Scale (UBS)	1.6 (0.18)	0.75 (0.51)	1.2 (1.14)	0.89 (0.50)

[a]AIM, IAM, FIM: mean of 4 items, 1-5, higher is better. IUS and SUS: 0-100, higher is better. Difficulty of Use: mean of 4 items, 0-4, higher indicates greater burden. SUS was administered only in the PST Aid arm. One PST Aid patient did not complete the SUS, so that cell is based on 8 respondents.
[b]PST: problem-solving treatment.
[c]Not applicable.

Time to certification outcomes were successfully obtained for participating clinicians, although the small number of clinicians precludes meaningful between-condition comparisons. Four of 5 PST Aid clinicians were certified in 2 sessions, which is the minimum number required, with a fifth clinician taking 5 sessions. All PST Aid clinicians were certified, and 1 of 3 clinicians in PST-as-Usual achieved certification, taking 3 sessions. Following certification, ongoing fidelity assessment was obtained for 2 clinicians in the PST Aid group who maintained adequate fidelity. No ongoing fidelity data were obtained for the PST-as-Usual group, as no clinicians identified additional cases for PST use postcertification.

PHQ-9 follow-up data were obtained from 13 patients (9 PST Aid, 4 PST-as-Usual). Descriptive PHQ-9 values were collected to assess the feasibility of clinical outcome measurement in a subsequent evaluation; given the small sample, attrition, and clustering of patients within clinicians, these data are not interpreted as evidence of comparative clinical effectiveness.

Discussion

Principal Results

In this HCD-based process of identifying user obstacles to an evidence-based psychotherapy in primary care, namely PST Primary Care, we identified key usability obstacles in the context of telemedicine therapy (Table 2). We then designed and built a prototype (version 1.0) of this app with acceptable usability. A subsequent pilot of an internet-based tool provided preliminary feasibility and implementation signals supporting further evaluation. The principal contribution of this work is the demonstration of a systematic HCD process for developing implementation supports for evidence-based psychotherapy. These findings support the feasibility of the implementation strategy.

Comparison With Prior Work

In the current study, we used an innovative HCD strategy to identify and address obstacles to the use of PST. Past research has called for the application of HCD approaches to support psychotherapeutic care delivery [15,31-33], though there remain limited studies on the effects of such approaches on implementation and clinical outcomes [32].

High-quality delivery of evidence-based psychosocial interventions such as PST in primary care is a function of many variables, including clinician training and the usability of the intervention. For such interventions to be delivered with sustained quality, ongoing supervision and guidance are critical [11,34-36]. Despite additional work to streamline traditional PST for primary care settings, we have observed in prior studies that—even among practitioners meeting rigorous certification criteria in PST—as many as 36% of their sessions after certification fall below fidelity standards [11,13]. Usability issues identified in our Discover phase research help explain challenges that prevent quality delivery of PST. They also highlight areas where providing additional support to both clients and clinicians may facilitate greater fidelity throughout PST.

Our findings that all PST Aid clinicians who remained enrolled achieved certification, and that 80% did so in 2 sessions, the minimum required, are promising indicators of the value of this implementation strategy. Future research will examine the ability of PST Aid to assist clinicians in maintaining that fidelity over time, as well as to assist patients in applying PST strategies independently outside of treatment sessions and following a full course of PST.

Our work helps extend a line of research arguing for the use of HCD to address EBP usability [15,31,32] and demonstrating its application to interventions and implementation strategies [30,35-39]. We have shown that formative work (interviews with patients and clinicians, training and clinical insights from investigator experience) can inform the design of an implementation strategy intended to support activities in PST. Ideation and design work was informed by both our formative research and past research on decision support tools. Automated decision support tools and feedback systems have been found to be effective in supporting sustained quality evidence-based psychosocial interventions (EBPIs) [40], but in practice have had mixed success on outcomes [41,42] such that they may actually hinder clinical care [43,44] and are often ignored by clinicians [45]. In a report by the Agency for Healthcare Research and Quality [46], a significant barrier to the use of decision support tools is that these tools have not been developed with input from

the clinician or in consideration of their work environment. Using the DDBT framework, we were successful in creating a tool to support clinician fidelity, with the goal of improving patient outcomes.

Limitations

This study has several limitations. First, this was a pilot feasibility study with a small number of clinicians and patients, limiting precision of estimates and precluding definitive conclusions regarding implementation or clinical outcomes. Second, patients were nested within a small number of clinicians, and unevenly: 2 clinicians contributed all 6 PST-as-Usual patients, and 1 PST Aid clinician contributed 8 of that arm's 16 patients. With so few clusters, formal analyses accounting for clustering were not appropriate, so patient outcomes are exploratory. Any difference between arms reflects the clinicians who delivered the treatment as much as the condition; a future Hybrid Type III trial should enroll enough clinicians per arm to separate the two. Third, participating clinicians were drawn from a single academic health system and were primarily master's-level behavioral health clinicians, limiting generalizability to other practice settings and clinician types. Fourth, although depression symptoms were confirmed using clinician diagnosis and PHQ-9 scores, we did not systematically collect information regarding concurrent psychotherapy or antidepressant treatment, which may have influenced patient outcomes. Finally, implementation of PST Aid within the REDCap platform imposed technical constraints that will inform future development of the platform.

Conclusions

A HCD approach to the development of a tool to support PST showed promise in key areas of need for implementing and disseminating this evidence-based psychotherapy in primary care. The pilot established preliminary feasibility for evaluating implementation and patient outcomes in future research. Larger hybrid implementation-effectiveness trials are warranted to determine whether these implementation supports improve clinician adoption, sustained fidelity, and patient outcomes.

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Generative AI Use

The authors did not use generative AI tools in the preparation of this manuscript (except for the table of contents image).

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Data Availability

The quantitative datasets generated and analyzed during this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

None declared.

Multimedia Appendix 1

Participant characteristics tables.
[DOCX File (Microsoft Word File), 26 KB-Multimedia Appendix 1]

Checklist 1

CONSORT-eHEALTH checklist (V 1.6.1).
[PDF File (Adobe File), 1118 KB-Checklist 1]

References

1. GBD 2019 Mental Disorders Collaborators. Global, regional, and national burden of 12 mental disorders in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Psychiatry. Feb 2022;9(2):137-150. [doi: 10.1016/S2215-0366(21)00395-3] [Medline: 35026139]
2. Chen M, Li M, Wan D, Zha J. Global, regional, and national burden of depressive disorders in older adults from 1990 to 2021, with projections of prevalence to 2050: a trend analysis for the Global Burden of Disease Study 2021. J Affect Disord. Jul 2026;405:121531. [doi: 10.1016/j.jad.2026.121531]
3. Luo Z, Zhu L, Shan S, et al. Global, regional, and national burden of five major mental disorders in working-age population, 1990-2021: a systematic analysis for the Global Burden of Disease Study 2021. J Affect Disord. Jun 15, 2026;403:121243. [doi: 10.1016/j.jad.2026.121243] [Medline: 41616861]

4. Zhang A, Park S, Sullivan JE, Jing S. The effectiveness of problem-solving therapy for primary care patients' depressive and/or anxiety disorders: a systematic review and meta-analysis. J Am Board Fam Med. 2018;31(1):139-150. [doi: 10.3122/jabfm.2018.01.170270] [Medline: 29330248]
5. Cabasag P, Sundram F, Chan A, Beyene K, Shepherd L, Harrison J. The identification and management of subthreshold depression and anxiety in primary care for people with long-term conditions. Depress Anxiety. 2025;2025:9497509. [doi: 10.1155/da/9497509] [Medline: 40225728]
6. Cuijpers P, van Straten A, Warmerdam L. Problem solving therapies for depression: a meta-analysis. Eur Psychiatry. Jan 2007;22(1):9-15. [doi: 10.1016/j.eurpsy.2006.11.001] [Medline: 17194572]
7. Simon GE, Moise N, Mohr DC. Management of depression in adults: a review. JAMA. Jul 9, 2024;332(2):141-152. [doi: 10.1001/jama.2024.5756] [Medline: 38856993]
8. Cuijpers P, Quero S, Noma H, et al. Psychotherapies for depression: a network meta-analysis covering efficacy, acceptability and long-term outcomes of all main treatment types. World Psychiatry. Jun 2021;20(2):283-293. [doi: 10.1002/wps.20860] [Medline: 34002502]
9. Unützer J, Katon W, Callahan CM, et al. Collaborative care management of late-life depression in the primary care setting: a randomized controlled trial. JAMA. Dec 11, 2002;288(22):2836-2845. [doi: 10.1001/jama.288.22.2836] [Medline: 12472325]
10. Areán PA, Raue P, Mackin RS, Kanellopoulos D, McCulloch C, Alexopoulos GS. Problem-solving therapy and supportive therapy in older adults with major depression and executive dysfunction. Am J Psychiatry. Nov 2010;167(11):1391-1398. [doi: 10.1176/appi.ajp.2010.09091327] [Medline: 20516155]
11. Alexopoulos GS, Raue PJ, Kiosses DN, Seirup JK, Banerjee S, Arean PA. Comparing engage with PST in late-life major depression: a preliminary report. Am J Geriatr Psychiatry. May 2015;23(5):506-513. [doi: 10.1016/j.jagp.2014.06.008] [Medline: 25081818]
12. Crabb RM, Areán PA, Hegel MT. Sustained adoption of an evidence-based treatment: a survey of clinicians certified in problem-solving therapy. Depress Res Treat. 2012;2012(986547):986547. [doi: 10.1155/2012/986547] [Medline: 23008764]
13. Alexopoulos GS, Raue PJ, Banerjee S, et al. Comparing the streamlined psychotherapy "Engage" with problem-solving therapy in late-life major depression. A randomized clinical trial. Mol Psychiatry. Sep 2021;26(9):5180-5189. [doi: 10.1038/s41380-020-0832-3] [Medline: 32612251]
14. Lyon AR, Munson SA, Renn BN, et al. Use of human-centered design to improve implementation of evidence-based psychotherapies in low-resource communities: protocol for studies applying a framework to assess usability. JMIR Res Protoc. Oct 9, 2019;8(10):e14990. [doi: 10.2196/14990] [Medline: 31599736]
15. Lyon AR, Brewer SK, Areán PA. Leveraging human-centered design to implement modern psychological science: return on an early investment. Am Psychol. Nov 2020;75(8):1067-1079. [doi: 10.1037/amp0000652] [Medline: 33252945]
16. Lyon AR, Aung T, Bruzios KE, Munson S. Human-centered design to enhance implementation and impact in health. Annu Rev Public Health. Apr 2025;46(1):467-485. [doi: 10.1146/annurev-publhealth-071823-122337] [Medline: 39656968]
17. Rubin J, Chisnell D. Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests. 2nd ed. John Wiley & Sons; 2008. ISBN: 9780470185483
18. Holtzblatt K, Beyer H. Contextual Design: Defining Customer-Centered Systems. 1st ed. Morgan Kaufmann; 1997. URL: https://shop.elsevier.com/books/contextual-design/holtzblatt/978-0-08-050304-2 [Accessed 2026-11-06]
19. Hertzum M, Jacobsen NE. The evaluator effect: a chilling fact about usability evaluation methods. Int J Hum Comput Interact. Feb 2003;15(1):183-204. [doi: 10.1207/S15327590IJHC1501_14]
20. Agapie E, Areán PA, Hsieh G, Munson SA. A longitudinal goal setting model for addressing complex personal problems in mental health. Proc ACM Hum Comput Interact. Nov 2022;6(CSCW2):270. [doi: 10.1145/3555160] [Medline: 38939360]
21. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. Apr 2009;42(2):377-381. [doi: 10.1016/j.jbi.2008.08.010] [Medline: 18929686]
22. Harris PA, Taylor R, Minor BL, et al. The REDCap consortium: building an international community of software platform partners. J Biomed Inform. Jul 2019;95:103208. [doi: 10.1016/j.jbi.2019.103208] [Medline: 31078660]
23. Tullis TS, Stetson JN. A comparison of questionnaires for assessing website usability. In: Proceedings of the Usability Professionals Association (UPA) 2004 Conference Usability Professionals Association (UPA). 2004:7-11. URL: https://www.researchgate.net/profile/Thomas-Tullis/publication/228609327_A_Comparison_of_Questionnaires_for_Assessing_Website_Usability/links/0912f50e4fe12066fd000000/A-Comparison-of-Questionnaires-for-Assessing-Website-Usability.pdf [Accessed 2026-11-06]

24. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. J Gen Intern Med. Sep 2001;16(9):606-613. [doi: 10.1046/j.1525-1497.2001.016009606.x] [Medline: 11556941]
25. Brooke J. SUS: a "quick and dirty" usability scale. In: Jordan PW, Thomas B, Weerdmeester BA, McClelland IL, editors. Usability Evaluation In Industry. CRC Press; 1996:189-194. ISBN: 9780429157011
26. Lyon AR, Pullmann MD, Jacobson J, et al. Assessing the usability of complex psychosocial interventions: the Intervention Usability Scale. Implement Res Pract. 2021;2:2633489520987828. [doi: 10.1177/2633489520987828] [Medline: 35601889]
27. Suh H, Shahriaree N, Hekler EB, Kientz JA. Developing and validating the User Burden Scale: a tool for assessing user burden in computing systems. In: CHI '16: Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery; 2016:3988-3999. [doi: 10.1145/2858036.2858448]
28. Weiner BJ, Lewis CC, Stanick C, et al. Psychometric assessment of three newly developed implementation outcome measures. Implement Sci. Aug 29, 2017;12(1):108. [doi: 10.1186/s13012-017-0635-3] [Medline: 28851459]
29. Löwe B, Unützer J, Callahan CM, Perkins AJ, Kroenke K. Monitoring depression treatment outcomes with the Patient Health Questionnaire-9. Med Care. Dec 2004;42(12):1194-1201. [doi: 10.1097/00005650-200412000-00006]
30. Munson SA, Friedman EC, Osterhage K, et al. Usability issues in evidence-based psychosocial interventions and implementation strategies: cross-project analysis. J Med Internet Res. Jun 14, 2022;24(6):e37585. [doi: 10.2196/37585] [Medline: 35700016]
31. Lyon AR, Koerner K. User-centered design for psychosocial intervention development and implementation. Clin Psychol Sci Pract. 2016;23(2):180-200. [doi: 10.1111/cpsp.12154]
32. Mohr DC, Lyon AR, Lattie EG, Reddy M, Schueller SM. Accelerating digital mental health research from early design and creation to successful implementation and sustainment. J Med Internet Res. May 10, 2017;19(5):e153. [doi: 10.2196/jmir.7725] [Medline: 28490417]
33. van der Meer L, Jonker T, Wadman H, et al. Targeting personal recovery of people with complex mental health needs: the development of a psychosocial intervention through user-centered design. Front Psychiatry. 2021;12:635514. [doi: 10.3389/fpsyt.2021.635514] [Medline: 33897494]
34. Pyne JM, Fortney JC, Mouden S, Lu L, Hudson TJ, Mittal D. Cost-effectiveness of on-site versus off-site collaborative care for depression in rural FQHCs. Psychiatr Serv. May 1, 2015;66(5):491-499. [doi: 10.1176/appi.ps.201400186] [Medline: 25686811]
35. Mancini AD, Moser LL, Whitley R, et al. Assertive community treatment: facilitators and barriers to implementation in routine mental health settings. Psychiatr Serv. Feb 2009;60(2):189-195. [doi: 10.1176/ps.2009.60.2.189] [Medline: 19176412]
36. Mancini MA, Linhorst DM, Menditto AA, Coleman J. Statewide implementation of recovery support groups for people with serious mental illness: a multidimensional evaluation. J Behav Health Serv Res. Oct 2013;40(4):391-403. [doi: 10.1007/s11414-013-9351-1] [Medline: 23812832]
37. Jenness JL, Bhattacharya A, Kientz JA, Munson SA, Nagar RR. Lessons learned from designing an asynchronous remote community approach for behavioral activation intervention for teens. Behav Res Ther. Apr 2022;151:104065. [doi: 10.1016/j.brat.2022.104065] [Medline: 35248749]
38. Kamp KJ, Morgan H, Yoo L, Munson SA, Heitkemper MM, Levy RL. Symptom management needs of patients with irritable bowel syndrome and concurrent anxiety and/or depression: a qualitative study. J Adv Nurs. Feb 2023;79(2):775-788. [doi: 10.1111/jan.15532] [Medline: 36511394]
39. Albright L, Le H, Meller S, et al. Co-designing m-healer: supporting lay practitioner mental health workers in Ghana. In: Stephanidis C, Antona M, Ntoa S, editors. HCI International 2021—Late Breaking Posters. Springer; 2021:115-124. [doi: 10.1007/978-3-030-90179-0_16]
40. Brown GSJ, Simon A, Cameron J, Minami T. A collaborative outcome resource network (ACORN): tools for increasing the value of psychotherapy. Psychotherapy (Chic). Dec 2015;52(4):412-421. [doi: 10.1037/pst0000033] [Medline: 26641371]
41. Moja L, Kwag KH, Lytras T, et al. Effectiveness of computerized decision support systems linked to electronic health records: a systematic review and meta-analysis. Am J Public Health. Dec 2014;104(12):e12-e22. [doi: 10.2105/AJPH.2014.302164] [Medline: 25322302]
42. Lurio J, Morrison FP, Pichardo M, et al. Using electronic health record alerts to provide public health situational awareness to clinicians. J Am Med Inform Assoc. 2010;17(2):217-219. [doi: 10.1136/jamia.2009.000539] [Medline: 20190067]
43. Genco EK, Forster JE, Flaten H, et al. Clinically inconsequential alerts: the characteristics of opioid drug alerts and their utility in preventing adverse drug events in the emergency department. Ann Emerg Med. Feb 2016;67(2):240-248. [doi: 10.1016/j.annemergmed.2015.09.020] [Medline: 26553282]

44. Singh H, Spitzmueller C, Petersen NJ, Sawhney MK, Sittig DF. Information overload and missed test results in electronic health record-based settings. JAMA Intern Med. Apr 22, 2013;173(8):702-704. [doi: 10.1001/2013.jamainternmed.61] [Medline: 23460235]
45. Singh H, Spitzmueller C, Petersen NJ, et al. Primary care practitioners' views on test result management in EHR-enabled health systems: a national survey. J Am Med Inform Assoc. 2013;20(4):727-735. [doi: 10.1136/amiajnl-2012-001267] [Medline: 23268489]
46. Eichner J, Das M. Challenges and barriers to clinical decision support (CDS) design and implementation experienced in the Agency for Healthcare Research and Quality CDS demonstrations. Agency for Healthcare Research and Quality (AHRQ); 2010. URL: https://digital.ahrq.gov/sites/default/files/docs/page/CDS_challenges_and_barriers.pdf [Accessed 2026-11-06]

Abbreviations

AIM: acceptability of intervention measure
CONSORT: Consolidated Standards of Reporting Trials
CONSORT-EHEALTH: Consolidated Standards of Reporting Trials of Electronic and Mobile Health Interventions and Online Telehealth
DDBT: discover, design, build, and test
***DSM-5*:** *Diagnostic and Statistical Manual of Mental Disorders* (Fifth Edition)
EBPI: evidence-based psychosocial intervention
EHR: electronic health record
FIM: feasibility of intervention measure
HCD: human-centered design
IAM: intervention appropriateness measure
IRB: institutional review board
IUS: Intervention Usability Scale
PHQ-9: 9-Item Patient Health Questionnaire
PST: problem-solving treatment
SUS: System Usability Scale
UWMPC: University of Washington Primary Care

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